Interconnection of Navajo-Gallup Water Supply Project
Electrical Transmission Facilities

Non-Tariff
System Impact Study

March 2014

Prepared by:
Utility System Efficiencies, Inc. (USE)

Under Contract with:
Public Service Company of New Mexico
Foreword
This technical report is prepared for customer(s) as an affected system study to Public Service Company of New Mexico (“PNM”). The customer through Western Area Power Administration (“WAPA”) has submitted two different plans of action. This study was performed by Utility System Efficiencies, Inc. (USE) pursuant to a consulting contract with PNM Transmission/Distribution Planning and Contracts Department.

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Executive Summary

The Navajo-Gallup Water Supply Project (“NGWSP”) is a planned infrastructure project aimed at providing reliable water supply to the eastern portion of the Navajo Nation, southwestern portions of the Jicarilla Apache Nation, and the City of Gallup, New Mexico.

The customer requested, through WAPA, the construction of new electrical transmission facilities to serve approximately 20 MW of pump load. Two alternative plans were proposed for the transmission facilities. The City of Gallup 69 kV plan will feed the new pump load on a 69 kV system stretching from Cudei 69 kV (Navajo Tribal Utility Authority (“NTUA”)) to a tap point on the Yah-ta-hey-Ambrosia 115 kV line (PNM). Under this plan a 3 breaker ring will be required to be constructed to connect to the Yah-ta-hey – Ambrosia 115 kV line (See Figure 1). The other alternative plan is the NTUA 115 kV option which proposes to build a 115 kV system from Cudei 115 kV (NTUA) to Window Rock 115 kV (NTUA). Window Rock is currently a radial feed from the Yah-ta-hey 115 kV bus (See Figure 2).

The project plans to operate with a normally open point to eliminate any parallel path flows that could impact Path 48. The scope is therefore limited to looking at other possible impacts.

The purpose of this study was to determine the impacts of the two different plans on PNM and surrounding systems. For each plan, the following scenarios were studied:

- **Gallup 69 kV plan**
  - Normal configuration where the open point is between plant 4 and plant 5
  - Load served from the North where the open point is between Tohlakai and AY Tap
  - Load served from the South where the open point is between Cudei and plant 2

- **NTUA 115 kV plan**
  - Normal configuration (all load served from the North) where the open point is between Window Rock and Tohatchi
  - Load served from the South where the open point is between Cudei and Newcomb
Figure 1 — City of Gallup 69 kV Plan Illustration

Figure 2 — NTUA 115 kV Plan Illustration
The findings of this SIS are summarized as follows:

**Steady-State Performance**

**City of Gallup 69 kV plan**
The results showed low base case and contingency voltage under all three scenarios indicating the project will require voltage support along the project line. There was one thermal violation for the loss of the Yah-ta-hey-AY Tap 115 kV line. Performance was re-evaluated assuming capacitors will be installed at key locations to eliminate the pre-contingency low voltages. The addition of the capacitors eliminated most of the post-contingency low voltages. However, under conditions where the entire pump load was fed only from the south, there were still post-contingency voltage deviations exceeding 10% for loss of the Yah-ta-hey-AY Tap 115 kV Line 115 kV line.

**NTUA 115 kV plan**
The results showed that there were no violations under the normal configuration. There were voltage and thermal violations when the entire pump load was fed only from the south. The Window Rock (Window Rock)-Yah-ta-hey 115 kV line exhibited overloads and the Window Rock, Tohatchi, and Newcomb 115 kV buses had low pre-contingency voltages. A capacitor was inserted to eliminate the pre-contingency voltage violations. The addition of the capacitor reduced the thermal overload but did not eliminate it.

Under this plan, if the entire load is to be fed from Window Rock, then Yah-Ta-Hey – Window Rock 115 kV line would have to be re-built with a larger conductor.

**Transient Stability Performance**
The transient stability analysis had acceptable system performance for all single (n-1) contingencies.

**Conclusion**

**City of Gallup 69 kV plan**
The project should add capacitors along the project line to boost the voltage for normal and contingency conditions. If there is a plan to operate with the entire pump load fed from the south, then other mitigation will need to be considered for voltage drop violations.

Construction and cost estimate for this plan implementation is listed below. All cost estimates will be verified in a facilities study.

<table>
<thead>
<tr>
<th>Network upgrades required</th>
<th>Cost M$</th>
<th>Construction Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three Breaker ring at the Point of interconnection approximately 5 miles east of Yah-ta-hey 115 kV station. Assumes Interconnecting customer provides the land.</td>
<td>5.0</td>
<td>18 months</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5.0</strong></td>
<td><strong>18 months</strong></td>
</tr>
</tbody>
</table>
NTUA 115 kV plan
Under the proposed plan there are no violations.

If there is a plan to operate with the entire pump load fed from the south, then a capacitor should be added for voltage support and the Yah-Ta-Hey – Window Rock 115 kV line would have to be re-built with a larger conductor.

All cost estimates will be verified in a facilities study.

<table>
<thead>
<tr>
<th>Network upgrades required for the entire load served from Window Rock 115 kV Station</th>
<th>Cost M$</th>
<th>Construction Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.3 miles of line to be re-built with a larger conductor</td>
<td>3.7</td>
<td>18 months</td>
</tr>
<tr>
<td>Total</td>
<td>3.7</td>
<td>18 months</td>
</tr>
</tbody>
</table>
Introduction

This SIS determines the physical and electrical impacts to PNM’s transmission system of the NGWSP. It identifies any potential upgrades to both transmission options. The results of this study are based on power flow (thermal and voltage) and transient stability (dynamic simulation).

The SIS reviewed two separate transmission options for the pump load interconnection. Option 1 was provided by the City of Gallup and consisted of a 69 kV system from Cudei (NTUA) in the north to a new bus on the Yah-ta-hey-Ambrosia 115 kV line (PNM) in the south. Option 2 was provided by NTUA and consisted of a 115 kV system from Cudei (NTUA) in the north to Window Rock aka Coalmine (PNM/NTUA) in the south.

Study Criteria

A system reliability evaluation consists of power flow analysis for identifying thermal overloads or voltages outside criteria (too high or low) under normal and contingency conditions. Transient stability analysis is performed to ensure all machines remain in synchronism, all voltage swings are damped, and all frequency dips are within acceptable limits. Each evaluation is conducted for credible contingencies that the system might sustain, such as the loss of a single or double circuit line, a transformer, a generator or a combination of these facilities. Planning analysis is conducted sufficiently in advance of potential interconnection so that network upgrades or modifications can take place in time to prevent a reliability criteria violation.

Performance of the transmission system is measured against the following planning criteria: the Western Electricity Coordinating Council (“WECC”) Reliability Criteria, and the North American Electric Reliability Council (“NERC”) Planning Standards. If system reliability problems resulting from the interconnection of a project are discovered, the study will identify the system facilities or operational measure that will be necessary to mitigate reliability criteria violations. Addition of these new facilities would maintain the reliability to the transmission network.

The SIS investigated whether the addition of the project resulted in:

- Equipment overloads on transmission lines, transformers, series compensation or other devices.
- Voltage criteria violations.
- Machines lose synchronism.
- Voltage and frequency swings exceed acceptable limits.
Power Flow Criteria

All power flow analysis was conducted with version 18.1_02 of General Electric’s PSLF/PSDS/SCSC software. Traditional power flow analysis was used to evaluate thermal and voltage performance of the system under Category A (all elements in service), Category B (N-1) and Category C (N-2) conditions. The power flow performance criteria utilized to assess the impact of the project throughout the SIS are shown in the table below. The criteria are WECC/NERC performance requirements with applicable additions and/or exceptions for the New Mexico transmission system.

Table 1 — Power Flow Disturbance/Performance Criteria

<table>
<thead>
<tr>
<th>Area</th>
<th>Conditions</th>
<th>Loading Limits</th>
<th>Voltage (p.u.)</th>
<th>Voltage Drop</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNM (Area 10)</td>
<td>Normal ALIS</td>
<td>&lt; Normal Rating</td>
<td>0.95-1.05</td>
<td></td>
<td>46 kV and above*</td>
</tr>
<tr>
<td></td>
<td>Contingency N-1</td>
<td>&lt; Emergency Rating</td>
<td>0.925-1.08^</td>
<td>6 %**</td>
<td>46 kV to 115 kV</td>
</tr>
<tr>
<td></td>
<td>Contingency N-2</td>
<td>&lt; Emergency Rating</td>
<td>0.90-1.08^</td>
<td>6 %**</td>
<td>230 kV and above</td>
</tr>
<tr>
<td></td>
<td>Normal ALIS</td>
<td>&lt; Normal Rating</td>
<td>0.95-1.05</td>
<td></td>
<td>All buses</td>
</tr>
<tr>
<td></td>
<td>Contingency N-1</td>
<td>&lt; Emergency Rating</td>
<td>0.90-1.1</td>
<td>6 %</td>
<td>69 kV and above except Northeastern NM and Southern NM</td>
</tr>
<tr>
<td></td>
<td>Contingency N-2</td>
<td>&lt; Emergency Rating</td>
<td>0.90-1.1</td>
<td>7 %</td>
<td>69 kV and above in Northeastern NM and Southern NM</td>
</tr>
<tr>
<td>Tri-State (zones 120-123)</td>
<td>Contingency N-1</td>
<td>&lt; Emergency Rating</td>
<td>0.90-1.1</td>
<td>10%</td>
<td>All buses</td>
</tr>
<tr>
<td>TEP (zones 160, 166)</td>
<td>Normal ALIS</td>
<td>&lt; Normal Rating</td>
<td>1.03-1.04</td>
<td></td>
<td>TEP EHV, Maintain inbound flow at the Vail, South and Tortolita EHV/138kV tie stations; Outbound Mvar flow at Tortolita EHV/138 kV</td>
</tr>
<tr>
<td></td>
<td>Contingency N-1</td>
<td>&lt; Emergency Rating</td>
<td>0.98-1.05</td>
<td>5%</td>
<td>All buses</td>
</tr>
<tr>
<td></td>
<td>Contingency N-2</td>
<td>&lt; Emergency Rating</td>
<td>0.98-1.05</td>
<td>10%</td>
<td>All buses</td>
</tr>
<tr>
<td>WAPA (zones 191, 199)</td>
<td>Normal ALIS</td>
<td>&lt; Normal Rating</td>
<td>0.95-1.05</td>
<td>5%</td>
<td>66 – 499 kV</td>
</tr>
<tr>
<td></td>
<td>Contingency N-1</td>
<td>&lt; Emergency Rating</td>
<td>0.90-1.10</td>
<td>5%</td>
<td>66 – 499 kV</td>
</tr>
<tr>
<td></td>
<td>Contingency N-2</td>
<td>&lt; Emergency Rating</td>
<td>0.90-1.10</td>
<td>10%</td>
<td>66 – 499 kV</td>
</tr>
<tr>
<td>NTUA (zones)</td>
<td>Normal ALIS</td>
<td>&lt; Normal Rating</td>
<td>0.95-1.05</td>
<td></td>
<td>Same as for WAPA &amp; PNM connections</td>
</tr>
<tr>
<td></td>
<td>Contingency N-1</td>
<td>&lt; Emergency Rating</td>
<td>Same as for WAPA &amp; PNM connections</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contingency N-2</td>
<td>&lt; Emergency Rating</td>
<td>Same as for WAPA &amp; PNM connections</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Taiban Mesa and Guadalupe 345 kV voltage 0.95 and 1.1 p.u. under normal and contingency conditions.
**For PNM buses in southern New Mexico (Zones 104,130, 131, and 132), the allowable N-1 voltage drop is 7%.
^ Provided operator action can be utilized to adjust voltages back down to 1.05 p.u.

1 For TPL-001-0.1, TPL-002-0a, TPL-002-0b, TPL-003-0a, TPL-004-0 see NERC website http://www.nerc.com
3 For PNM exceptions to WECC criteria see http://www.oatioasis.com/PNM/PNMdocs/PNM_Study_Criteria_and_Guidelines_03-04-08.pdf
Transient Stability Criteria

The NERC/WECC transient stability performance requirements for transmission contingencies are as follows:

- All machines will remain in synchronism.
- All voltage swings are well damped.
- Following fault clearing for single contingencies, voltage on load buses may not dip more than 25% of the pre-fault voltage or dip more than 20% of the pre-fault voltage for more than 20 cycles. For N-2 and breaker failure contingencies, voltage on load buses may not dip more than 30% of the pre-fault voltage or dip more than 20% of the pre-fault voltage for more than 40 cycles.
- All frequency dips are well damped.
- Following fault clearing for single contingencies, frequency on load buses may not dip below 59.6 Hz for more than 6 cycles. For N-2 and breaker failure contingencies, frequency on load buses may not dip below 59.0 Hz for more than 6 cycles.

Fault clearing times used in the SIS are shown in Table 2.

Table 2 — PNM Fault Clearing Times

<table>
<thead>
<tr>
<th>Fault Type</th>
<th>Voltage (kV)</th>
<th>Clearing Time (near-far end breakers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Phase Normally Cleared</td>
<td>345</td>
<td>4–4 Cycles</td>
</tr>
<tr>
<td></td>
<td>230</td>
<td>4–4 Cycles</td>
</tr>
<tr>
<td></td>
<td>115</td>
<td>4–4 Cycles</td>
</tr>
<tr>
<td>1 Phase Stuck Breaker</td>
<td>345</td>
<td>4-12 Cycles</td>
</tr>
<tr>
<td></td>
<td>230</td>
<td></td>
</tr>
<tr>
<td></td>
<td>115</td>
<td>4-15 Cycles</td>
</tr>
</tbody>
</table>

Power Flow Base Case Development

The approved WECC 2023 heavy summer case was used to develop the PNM 2023 summer peak power flow base case, while the WECC 2022-23 heavy winter case was used to develop the PNM 2023 off-peak power flow base case. The corresponding dynamic data files were used for each seasonal case. Details of the generation dispatch and resulting path/transmission element flows, and bus voltages of interest are discussed in the "Power Flow Case Attributes" section of this report.
Project Model

Specific modeling parameters for each scenario were provided by the customer in the interconnection request. Those parameters were used to construct the power flow models. The specific dynamic modeling data for the pump loads was not provided. Typical modeling data was used to construct the dynamic models.

The City of Gallup 69 kV plan was designed with five new 69 kV buses representing load take off points and two new 115 kV buses, one of which loops the Yah-ta-hay-Ambrosia 115 kV transmission line. Five new 69 kV lines, one new 115 kV line and one 115/69 kV transformer complete the system. The Plant 4 to Plant 5 69 kV line was normally open. For the purpose of this study the loads were modeled on the 69 kV buses.

Figure 3 — City of Gallup 69 kV plan Power Flow Model
The NTUA 115 kV plan was designed with one new 115 kV bus and three new 115 kV lines. Existing NTUA buses at Window Rock and Tohatchi were used to complete the new configuration. The new Tohatchi-Window Rock 115 kV line was normally open. For the purpose of this study the loads were modeled on the 115 kV buses.

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**Figure 4 — NTUA 115 kV plan Power Flow Model**
Generation Dispatch

Generation dispatch of the existing and planned facilities for each case that was used for the SIS are itemized in the table below.

Table 3 — Heavy Summer Generation Dispatch (MW)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>San Juan 1</td>
<td>370</td>
<td>360</td>
<td>360</td>
<td>360</td>
<td>360</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>San Juan 2</td>
<td>370</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>San Juan 3</td>
<td>544</td>
<td>544</td>
<td>544</td>
<td>544</td>
<td>544</td>
<td>544</td>
<td>544</td>
</tr>
<tr>
<td>San Juan 4 (Area Swing)</td>
<td>544</td>
<td>527.5</td>
<td>527.5</td>
<td>527.5</td>
<td>527.5</td>
<td>527.5</td>
<td>529.3</td>
</tr>
<tr>
<td>Four Corners 1</td>
<td>192</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Four Corners 2</td>
<td>192</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Four Corners 3</td>
<td>256</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Four Corners 4</td>
<td>798.1</td>
<td>798.1</td>
<td>798.1</td>
<td>798.1</td>
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<td>798.1</td>
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<tr>
<td>Four Corners 5</td>
<td>798.1</td>
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<td>798.1</td>
<td>798.1</td>
<td>798.1</td>
<td>798.1</td>
<td>798.1</td>
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<tr>
<td>Reeves 1</td>
<td>43</td>
<td>44</td>
<td>44</td>
<td>44</td>
<td>44</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Reeves 2</td>
<td>44</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td>Reeves 3</td>
<td>66</td>
<td>66</td>
<td>66</td>
<td>66</td>
<td>66</td>
<td>66</td>
<td>66</td>
</tr>
<tr>
<td>Delta-Person</td>
<td>132</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
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<td>80</td>
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<tr>
<td>Luna Energy Facility</td>
<td>570</td>
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<td>570</td>
<td>570</td>
<td>570</td>
<td>570</td>
<td>570</td>
</tr>
<tr>
<td>Lordsburg</td>
<td>80</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Afton</td>
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<td>235</td>
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<td>235</td>
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<td>235</td>
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<tr>
<td>Valencia Energy Facility</td>
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<td>95</td>
<td>95</td>
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<tr>
<td>Taiban Mesa Wind Project</td>
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<td>0</td>
<td>0</td>
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<td>0</td>
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<td>Aragonne Mesa Wind Project</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High Lonesome Mesa Project</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 4 — Heavy Winter Generation Dispatch (MW)

<table>
<thead>
<tr>
<th>UNIT</th>
<th>NAMEPLATE RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Juan 1</td>
<td>370</td>
</tr>
<tr>
<td>San Juan 2</td>
<td>370</td>
</tr>
<tr>
<td>San Juan 3</td>
<td>544</td>
</tr>
<tr>
<td>San Juan 4 (Area Swing)</td>
<td>544</td>
</tr>
<tr>
<td>Four Corners 1</td>
<td>192</td>
</tr>
<tr>
<td>Four Corners 2</td>
<td>192</td>
</tr>
<tr>
<td>Four Corners 3</td>
<td>256</td>
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<td>798.1</td>
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<td>Reeves 2</td>
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<tr>
<td>Reeves 3</td>
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<tr>
<td>Delta-Person</td>
<td>132</td>
</tr>
<tr>
<td>Luna Energy Facility</td>
<td>570</td>
</tr>
<tr>
<td>Lordsburg</td>
<td>80</td>
</tr>
<tr>
<td>Afton</td>
<td>235</td>
</tr>
<tr>
<td>Valencia Energy Facility</td>
<td>173</td>
</tr>
<tr>
<td>Taiban Mesa Wind Project</td>
<td>200</td>
</tr>
<tr>
<td>Aragone Mesa Wind Project</td>
<td>90</td>
</tr>
<tr>
<td>Red Mesa Wind Project</td>
<td>102</td>
</tr>
<tr>
<td>High Lonesome Mesa Project</td>
<td>100</td>
</tr>
</tbody>
</table>

Power Flow Case Attributes
Table 5 provides an overview of the power flow cases after loading the project and the generation pattern into the heavy summer and heavy winter cases.

Table 5 — Heavy Summer Power Flow Case Attributes

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Path 47: Southern New</td>
<td>155.4</td>
<td>155.4</td>
<td>155.4</td>
<td>155.4</td>
<td>155.4</td>
<td>155.4</td>
</tr>
<tr>
<td><strong>Transmission Voltages (kV)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yah-ta-hay 115 kV</td>
<td>117.9</td>
<td>117.8</td>
<td>117.9</td>
<td>117.5</td>
<td>117.9</td>
<td>117.9</td>
</tr>
<tr>
<td>AY Tap 115 kV</td>
<td>117.1</td>
<td>116.8</td>
<td>117.1</td>
<td>116.1</td>
<td>117.1</td>
<td>117.1</td>
</tr>
<tr>
<td>Ambrosia 115 kV</td>
<td>120.2</td>
<td>120.2</td>
<td>120.2</td>
<td>120.1</td>
<td>120.2</td>
<td>120.2</td>
</tr>
<tr>
<td>Shiprock 115 kV</td>
<td>118.1</td>
<td>117.7</td>
<td>117.4</td>
<td>117.9</td>
<td>117.5</td>
<td>117.9</td>
</tr>
<tr>
<td>Window Rock 115 kV</td>
<td>112</td>
<td>111.9</td>
<td>112</td>
<td>111.6</td>
<td>112</td>
<td>108.8*</td>
</tr>
</tbody>
</table>

* Voltage in this scenario does not reflect required mitigation to bring this voltage back into criteria
Navajo-Gallup Water Supply Project System Impact Study

Table 6 — Heavy Winter Power Flow Case Attributes

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power Flows (MW)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Path 47: Southern New</td>
<td>210.2</td>
<td>211.2</td>
<td>211.1</td>
<td>211.3</td>
<td>211.1</td>
<td>211.5</td>
</tr>
<tr>
<td>Path 48: Northern New</td>
<td>1753.1</td>
<td>1760.2</td>
<td>1753.2</td>
<td>1773.9</td>
<td>1753.2</td>
<td>1780.8</td>
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<tr>
<td><strong>Transmission Voltages (kV)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yah-ta-hey 115 kV</td>
<td>117.8</td>
<td>117.7</td>
<td>117.8</td>
<td>117.4</td>
<td>117.8</td>
<td>117.7</td>
</tr>
<tr>
<td>YATAP 115 kV</td>
<td>117</td>
<td>116.7</td>
<td>117</td>
<td>116</td>
<td>117</td>
<td>116.9</td>
</tr>
<tr>
<td>Ambrosia 115 kV</td>
<td>119.9</td>
<td>119.9</td>
<td>119.9</td>
<td>119.9</td>
<td>119.9</td>
<td>119.9</td>
</tr>
<tr>
<td>Shiprock 115 kV</td>
<td>117.2</td>
<td>116.8</td>
<td>116.5</td>
<td>117.1</td>
<td>116.6</td>
<td>117.1</td>
</tr>
<tr>
<td>Window Rock 115 kV</td>
<td>110.3</td>
<td>110.2</td>
<td>110.4</td>
<td>109.9</td>
<td>110.4</td>
<td>106.8*</td>
</tr>
</tbody>
</table>

*Voltage in this scenario does not reflect required mitigation to bring this voltage back into criteria

Arizona generation was used to offset the addition of the load.

List of Contingencies

The contingencies evaluated for power flow (thermal & voltage) in this SIS are listed below.

Table 7 — Power Flow Contingencies

<table>
<thead>
<tr>
<th>NO.</th>
<th>CATEGORY</th>
<th>CONTINGENCY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B</td>
<td>San Juan-Rio Puerco 345 kV (WW)</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>Four Corners-West Mesa 345 kV (FW)</td>
</tr>
<tr>
<td>3</td>
<td>B</td>
<td>San Juan-McKinley 345 kV #1</td>
</tr>
<tr>
<td>4</td>
<td>B</td>
<td>San Juan-McKinley 345 kV #2</td>
</tr>
<tr>
<td>5</td>
<td>B</td>
<td>Yah-ta-hey-Ambrosia 115 kV (AY)</td>
</tr>
<tr>
<td>6</td>
<td>B</td>
<td>Yah-ta-hey-PEGS 115 kV</td>
</tr>
<tr>
<td>7</td>
<td>B</td>
<td>West Mesa-Arroyo 345 kV (EP)</td>
</tr>
<tr>
<td>8</td>
<td>B</td>
<td>McKinley/Yah-ta-hey 345/115 kV transformer</td>
</tr>
<tr>
<td>9</td>
<td>B</td>
<td>Yah-ta-hey-YATAP 115 kV (69 kV Plan Post-Project)</td>
</tr>
<tr>
<td>10</td>
<td>B</td>
<td>YATAP-Ambrosia 115 kV (69 kV Plan Post-Project)</td>
</tr>
<tr>
<td>11</td>
<td>B</td>
<td>YATAP-Tohlakai 115 kV (69 kV Plan Post-Project)</td>
</tr>
<tr>
<td>12</td>
<td>B</td>
<td>Tohlakai-Cudei 69 kV (69 kV Plan Post-Project)</td>
</tr>
<tr>
<td>13</td>
<td>B</td>
<td>Cudei-Window Rock 115 kV (115 kV Plan Post-Project)</td>
</tr>
<tr>
<td>14</td>
<td>B</td>
<td>Yah-ta-hey-Window Rock 115 kV</td>
</tr>
<tr>
<td>15</td>
<td>C</td>
<td>San Juan-McKinley 345 kV #1 &amp; 2</td>
</tr>
<tr>
<td>16</td>
<td>C</td>
<td>McKinley-Springerville 345 kV #1 &amp; 2</td>
</tr>
<tr>
<td>17</td>
<td>C</td>
<td>McKinley/Yah-ta-hey 345/115 kV transformer and Yah-ta-hey 115 kV Cap</td>
</tr>
</tbody>
</table>

The contingencies evaluated for transient stability in the SIS are listed below.
Table 8 — Transient Stability Contingencies

<table>
<thead>
<tr>
<th>NO.</th>
<th>CATEGORY</th>
<th>CONTINGENCY DESCRIPTION</th>
<th>AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B</td>
<td>Four Corners-West Mesa 345 kV</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>McKinley/Yah-ta-hey 345/115 kV</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>B</td>
<td>Yah-ta-hey-Ambrosia 115 kV</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>B</td>
<td>Yah-ta-hey-AY Tap 115 kV (69 kV Plan Post-Project)</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>B</td>
<td>AY Tap-Ambrosia 115 kV (69 kV Plan Post-Project)</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>B</td>
<td>AY Tap-Tohlakai 115 kV (69 kV Plan Post-Project)</td>
<td>10</td>
</tr>
</tbody>
</table>

Power Flow Analysis

After review of both suggested options there were low voltages seen at the extreme ends of each line (closest point to the normally open line). It is suggested that both projects consider adding additional capacitors to help with the voltage support. Additional capacitors also helped with post-contingency voltage deviations.

For the City of Gallup 69 kV plan, a 7.5 MVAR cap at Plant 3 69 kV and a 5 MVAR cap at Plant 5 69 kV were added.

For the NTUA 115 kV plan, a 20 MVAR cap was added at Newcomb 115 kV.

However, it must be noted that even with capacitor upgrades on the City of Gallup 69 kV plan the scenario with the entire pump load fed from the south still had voltage deviations greater than 5%, as high at 9.2% in the summer and as high as 10.1% in the winter. In the Heavy Winter case violations still occurred on the PNM buses closest to the project. If this option is selected and there are plans to operate with the entire pump load fed from the south, then additional upgrades will be required.

Power Flow Results

After updating the cases with the suggested capacitors, the power flow violations on the Yah-ta-hey-Window Rock 115 kV lines still existed with entire pump load fed from Window Rock Station.

The line loading was 105.7% of normal. The line is currently limited by 18.3 miles of 266.8 ACSR. If the NTUA 115 kV plan is selected and there is a plan to operate with the entire pump load fed from the south, then additional upgrades will be required.

Table 9 — Summer Peak Flow Thermal Results – NTUA 115kV Plan (South)

<table>
<thead>
<tr>
<th>NO.</th>
<th>CONTINGENCY DESCRIPTION</th>
<th>OVERLOADED ELEMENT</th>
<th>AREA</th>
<th>PRE-Project (% rating)</th>
<th>PST-Project (% rating)</th>
<th>DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Base Case</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>79.8</td>
<td>110.7</td>
<td>30.9</td>
</tr>
<tr>
<td>1</td>
<td>San Juan-Rio Puerco 345 kV Line</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>80.1</td>
<td>111.1</td>
<td>31.0</td>
</tr>
<tr>
<td>2</td>
<td>Four Corners-West Mesa 345</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>79.8</td>
<td>110.8</td>
<td>31.0</td>
</tr>
</tbody>
</table>
### Table 10 — Winter Peak Flow Thermal Results – NTUA 115kV Plan (South)

<table>
<thead>
<tr>
<th>NO.</th>
<th>CONTINGENCY DESCRIPTION</th>
<th>OVERLOADED ELEMENT</th>
<th>AREA</th>
<th>PRE-Project (% rating)</th>
<th>PST-Project (% rating)</th>
<th>DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Base Case</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>98.3</td>
<td>131.7</td>
<td>33.4</td>
</tr>
<tr>
<td>1</td>
<td>San Juan-Rio Puerco 345 kV Line</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>98.3</td>
<td>131.7</td>
<td>33.4</td>
</tr>
<tr>
<td>2</td>
<td>Four Corners-West Mesa 345 kV Line</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>98.3</td>
<td>131.6</td>
<td>33.3</td>
</tr>
<tr>
<td>3</td>
<td>San Juan-Mckinley 345 kV Line #1</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>98.5</td>
<td>132.1</td>
<td>33.6</td>
</tr>
<tr>
<td>4</td>
<td>San Juan-Mckinley 345 kV Line #2</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>98.5</td>
<td>132.1</td>
<td>33.6</td>
</tr>
<tr>
<td>5</td>
<td>Yah-ta-hey-Ambrosia 115 kV (AY) Line</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>97.9</td>
<td>131.0</td>
<td>33.1</td>
</tr>
<tr>
<td>6</td>
<td>Yah-ta-hey-PEGS 115 kV Line</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>97.9</td>
<td>131.0</td>
<td>33.1</td>
</tr>
<tr>
<td>7</td>
<td>West Mesa-Arroyo 345 kV (EP) Line</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>98.6</td>
<td>132.0</td>
<td>33.4</td>
</tr>
<tr>
<td>8</td>
<td>McKinley/Yah-ta-hey 345/115 kV Transformer</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>98.2</td>
<td>132.4</td>
<td>34.2</td>
</tr>
<tr>
<td>15</td>
<td>San Juan-Mckinley 345 kV Line #1 and #2</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>98.8</td>
<td>133.0</td>
<td>34.2</td>
</tr>
<tr>
<td>16</td>
<td>McKinley-Springerville 345 kV Line #1 and #2</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>98.1</td>
<td>131.6</td>
<td>33.5</td>
</tr>
<tr>
<td>17</td>
<td>Yah-ta-hey Xfmr and Yah-ta-hey 115 kV Cap</td>
<td>WNDWROCK - YAH-TA-HEY 115 kV Line #1</td>
<td>10</td>
<td>100.1</td>
<td>135.3</td>
<td>35.2</td>
</tr>
</tbody>
</table>
Voltage Results
After updating the cases with the suggested capacitors the majority of the voltage violations were eliminated. Only the City of Gallup 69 kV Plan with the entire pump load fed from the south still had violations. If this option is selected for service additional upgrades will be required to maintain voltage criteria.
Table 11 — Summer Peak Voltage Results w/Caps – City of Gallup 69 kV Plan (South)

<table>
<thead>
<tr>
<th>NO.</th>
<th>CONTINGENCY DESCRIPTION</th>
<th>BUS VOLTAGE</th>
<th>AREA</th>
<th>PRE-Contingency (PU)</th>
<th>PST-Contingency (PU)</th>
<th>DEV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>PLANT 2 69</td>
<td>14</td>
<td>1.026</td>
<td>0.931</td>
<td>-9.24</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>PLANT 3 69</td>
<td>14</td>
<td>1.031</td>
<td>0.937</td>
<td>-9.13</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>PLANT 4 69</td>
<td>14</td>
<td>1.025</td>
<td>0.936</td>
<td>-8.65</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>PLANT 5 69</td>
<td>14</td>
<td>1.035</td>
<td>0.957</td>
<td>-7.51</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>TOHLAKAI 69</td>
<td>14</td>
<td>1.037</td>
<td>0.963</td>
<td>-7.09</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>TOHLAKAI 115</td>
<td>14</td>
<td>1.014</td>
<td>0.952</td>
<td>-6.09</td>
</tr>
</tbody>
</table>

Table 12 — Winter Peak Voltage Results w/Caps – City of Gallup 69 kV Plan (South)

<table>
<thead>
<tr>
<th>NO.</th>
<th>CONTINGENCY DESCRIPTION</th>
<th>BUS VOLTAGE</th>
<th>AREA</th>
<th>PRE-Contingency (PU)</th>
<th>PST-Contingency (PU)</th>
<th>DEV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>AY TAP 115</td>
<td>10</td>
<td>1.018</td>
<td>0.951</td>
<td>-6.57</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>NOE 115</td>
<td>10</td>
<td>1.011</td>
<td>0.946</td>
<td>-6.43</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>NOE_TAP 115</td>
<td>10</td>
<td>1.013</td>
<td>0.948</td>
<td>-6.40</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>SUNSHIN# 115</td>
<td>10</td>
<td>1.012</td>
<td>0.948</td>
<td>-6.41</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>SUNSHN_T 115</td>
<td>10</td>
<td>1.016</td>
<td>0.952</td>
<td>-6.35</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>PLANT 2 69</td>
<td>14</td>
<td>1.032</td>
<td>0.928</td>
<td>-10.11</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>PLANT 3 69</td>
<td>14</td>
<td>1.038</td>
<td>0.934</td>
<td>-9.99</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>PLANT 4 69</td>
<td>14</td>
<td>1.031</td>
<td>0.934</td>
<td>-9.47</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>PLANT 5 69</td>
<td>14</td>
<td>1.041</td>
<td>0.955</td>
<td>-8.22</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>TOHLAKAI 69</td>
<td>14</td>
<td>1.042</td>
<td>0.961</td>
<td>-7.77</td>
</tr>
<tr>
<td>9</td>
<td>Yah-ta-hey-AY Tap 115 kV Line</td>
<td>TOHLAKAI 115</td>
<td>14</td>
<td>1.018</td>
<td>0.950</td>
<td>-6.68</td>
</tr>
</tbody>
</table>

Transient Stability Analysis Results

All six (6) transient stability contingencies were simulated under each load serving scenario in the Heavy Summer and Heavy Winter seasonal cases. Review of the results for all dynamic simulations did not identify any criteria violations.

Conclusion

City of Gallup 69 kV plan
Capacitors should be added to the plan to boost the voltage along the transmission path. If there is a plan to operate with the entire pump load fed from the south, then other mitigation will need to be considered for voltage drop violations.

Construction and cost estimate for this plan implementation is listed below. All cost and construction estimates will be verified in a facilities study.
**Table 13 — City of Gallup Plan required upgrades**

<table>
<thead>
<tr>
<th>System upgrade</th>
<th>Cost M$</th>
<th>Construction Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three Breaker ring at the Point of interconnection approximately 5 miles east of Yah-ta-hhey 115 kV station. Assumes Interconnecting customer provides the land.</td>
<td>5.0</td>
<td>18 months</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5.0</strong></td>
<td><strong>18 months</strong></td>
</tr>
</tbody>
</table>

**NTUA 115 kV plan**
Under the proposed plan there are no violations.

If there is a plan to operate with the entire pump load fed from the south, then a capacitor should be added for voltage support and the Yah-Ta-Hey – Window Rock 115 kV line would have to be re-built with a larger conductor.

All cost and construction estimates will be verified in a facilities study.

**Table 14 — NTUA 115 kV Plan required upgrades for entire load served from Window Rock 115 kV Station**

<table>
<thead>
<tr>
<th>System upgrade</th>
<th>Cost M$</th>
<th>Construction Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.3 miles of line to be re-built with a larger conductor</td>
<td>3.7</td>
<td>18 months</td>
</tr>
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Appendix A

POWER FLOW PLOTS
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<td>2023 Heavy Summer: 69 kV Plan Normal Conditions - North (MW/MVAR)</td>
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City of Gallup 69kV Plan

General Electric International, Inc. PSLF Program Sat Jan 25 13:30:01 2014 04_23HS_PST_69_S.sav
City of Gallup 69kV Plan

NTUA 115kV plan


NTUA 115kV plan

To McKinley 345kV

To Ambrosia

To PEGS

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CUDEI115 1.013

NEWCOMB 0.893

TOHATCHI 0.908

WNDWROCK 0.929

YAHTAHEY 1.023

MVA/rate

Rating = 1
City of Gallup 69kV Plan

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NTUA 115kV plan
NTUA 115kV plan

General Electric International, Inc.  PSLF Program   Sat Jan 25 13:30:09 2014   16_23HS_PST_115_m.sav

To McKinley 345kV

To Ambrosia

To PEGS

To Pitt-Midway
NTUA 115kV plan

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CUDEI115 1.020

NEWCOMB 1.007

CUDEI69 1.013

TOHATCHI 0.979

WNDWROCK 0.968

YAHTAHEY 1.021

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City of Gallup 69kV Plan
City of Gallup 69kV Plan

City of Gallup 69kV Plan


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PLANT 4 0.987

NOE 1.010

SUNSHIN# 1.012

TOHLAKAI 0.982

ALLISON# 1.016

AY TAP 1.017

SMITHLAK 1.030

CHURCH_R 1.021

SUNSHN_T 1.015

NOE_TAP 1.012

BY TAP 6 1.021

PWN Ten Year Plan
Built: March 2013
WECC Base Case: 2021-22 HW1 APPROVED BASE CASE

WVA/rate
Rating = 1
City of Gallup 69kV Plan
NTUA 115kV plan

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\textbf{NTUA 115kV plan}
Appendix B

Transient Stability Plots
NGWSP Transient Stability Plots

115 kV Bus Voltages

69 kV Bus Voltages

115 kV Bus Frequencies

69 kV Bus Frequencies

PNM Ten Year Plan

2023 Summer Peak Case with Proposed Fixes

Built: May 2013

WECC Base Case: 2023 HS1 BASE CASE
NGWSP Transient Stability Plots

115 kV Bus Voltages

69 kV Bus Voltages

115 kV Bus Frequencies

69 kV Bus Frequencies

PNM Ten Year Plan
2023 Summer Peak Case with Proposed Fixes
Built: May 2013
WECC Base Case: 2023 HS1 BASE CASE

Fri Jan 24 22:02:35 2014
NGWSP Transient Stability Plots

115 kV Bus Voltages

69 kV Bus Voltages

115 kV Bus Frequencies

69 kV Bus Frequencies

PNM Ten Year Plan
2023 Summer Peak Case with Proposed Fixes
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115 kV Bus Voltages

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PNM Ten Year Plan
2023 Summer Peak Case with Proposed Fixes
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115 kV Bus Voltages

115 kV Bus Frequencies

PNM Ten Year Plan
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115 kV Bus Voltages

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PNM Ten Year Plan
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115 kV Bus Voltages

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115 kV Bus Frequencies

69 kV Bus Frequencies

PNM Ten Year Plan
2023 Winter Peak with Proposed Fixes
Built: March 2013
WECC Base Case: 2021-22 HW1 APPROVED BASE CASE

PNM Ten Year Plan
2023 Winter Peak with Proposed Fixes
Built: March 2013
WECC Base Case: 2021-22 HW1 APPROVED BASE CASE

![Graph of 115 kV Bus Voltages](image)

![Graph of 69 kV Bus Voltages](image)

![Graph of 115 kV Bus Frequencies](image)

![Graph of 69 kV Bus Frequencies](image)
NGWSP Transient Stability Plots

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115 kV Bus Frequencies

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PNM Ten Year Plan
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115 kV Bus Frequencies

69 kV Bus Frequencies

PNM Ten Year Plan
2023 Winter Peak with Proposed Fixes
Built: March 2013
WECC Base Case: 2021-22 HW1 APPROVED BASE CASE

Fri Jan 24 22:04:26 2014
NGWSP Transient Stability Plots

115 kV Bus Voltages

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69 kV Bus Voltages

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115 kV Bus Frequencies

Time (sec) 0.0 20.0 1.8 3.7 5.5 7.3 9.1 10.9 12.7 14.6 16.4 18.2

69 kV Bus Frequencies

Time (sec) 0.0 20.0 1.8 3.7 5.5 7.3 9.1 10.9 12.7 14.6 16.4 18.2

PNM Ten Year Plan
2023 Winter Peak with Proposed Fixes
Built: March 2013
WECC Base Case: 2021-22 HW1 APPROVED BASE CASE

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NGWSP Transient Stability Plots

115 kV Bus Voltages

69 kV Bus Voltages

115 kV Bus Frequencies

69 kV Bus Frequencies

PNM Ten Year Plan
2023 Winter Peak with Proposed Fixes
Built: March 2013
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69 kV Bus Voltages

115 kV Bus Frequencies

69 kV Bus Frequencies

PNM Ten Year Plan
2023 Winter Peak with Proposed Fixes
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NGWSP Transient Stability Plots

115 kV Bus Voltages

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PNM Ten Year Plan
2023 Winter Peak with Proposed Fixes
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115 kV Bus Frequencies

PNM Ten Year Plan
2023 Winter Peak with Proposed Fixes
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115 kV Bus Voltages

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115 kV Bus Frequencies

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NGWSP Transient Stability Plots

115 kV Bus Voltages

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115 kV Bus Frequencies

Time (sec)

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PNM Ten Year Plan
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NGWSP Transient Stability Plots

115 kV Bus Voltages

Time (sec)

69 kV Bus Voltages

Time (sec)

115 kV Bus Frequencies

Time (sec)

69 kV Bus Frequencies

Time (sec)

PNM Ten Year Plan
2023 Summer Peak Case with Proposed Fixes
Built: May 2013
WECC Base Case: 2023 HS1 BASE CASE

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NGWSP Transient Stability Plots

115 kV Bus Voltages

69 kV Bus Voltages

115 kV Bus Frequencies

69 kV Bus Frequencies

PNM Ten Year Plan
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115 kV Bus Frequencies

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PNM Ten Year Plan
2023 Summer Peak Case with Proposed Fixes
Built: May 2013
WECC Base Case: 2023 HS1 BASE CASE
115 kV Bus Voltages

115 kV Bus Frequencies

PNM Ten Year Plan
2023 Summer Peak Case with Proposed Fixes
Built: May 2013
WECC Base Case: 2023 HS1 BASE CASE
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115 kV Bus Frequencies

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PNM Ten Year Plan
2023 Summer Peak Case with Proposed Fixes
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NGWSP Transient Stability Plots

115 kV Bus Voltages

115 kV Bus Frequencies

PNM Ten Year Plan
2023 Summer Peak Case with Proposed Fixes
Built: May 2013
WECC Base Case: 2023 HS1 BASE CASE
NGWSP Transient Stability Plots

115 kV Bus Voltages

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115 kV Bus Frequencies

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PNM Ten Year Plan
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115 kV Bus Voltages

115 kV Bus Frequencies

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PNM Ten Year Plan
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PNM Ten Year Plan
2023 Winter Peak with Proposed Fixes
Built: March 2013
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19_23HW_PST_69_N_m_005_AYT-AM_1.chf

Fri Jan 24 22:09:18 2014
115 kV Bus Voltages

69 kV Bus Voltages

115 kV Bus Frequencies

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PNM Ten Year Plan
2023 Winter Peak with Proposed Fixes
Built: March 2013
WECC Base Case: 2021-22 HW1 APPROVED BASE CASE
NGWSP Transient Stability Plots

115 kV Bus Voltages

Time (sec)
0.0 20.0 1.8 3.7 5.5 7.3 9.1 10.9 12.7 14.6 16.4 18.2 20.0

0.2000 vbus 10382 YAHTAHEY 115.0 0 0.0 1 1 1.2000
0.2000 vbul 10072 WNDWROCK 115.0 0 0.0 1 1 1.2000
0.2000 vbul 98989 TOHATCHI 115.0 0 0.0 1 1 1.2000
0.2000 vbul 98999 NEWCOMB 115.0 0 0.0 1 1 1.2000
0.2000 vbul 98990 CUDEI115 115.0 0 0.0 1 1 1.2000
0.2000 vbul 79062 SHIPROCK 115.0 0 0.0 1 1 1.2000

115 kV Bus Frequencies

Time (sec)
0.0 20.0 1.8 3.7 5.5 7.3 9.1 10.9 12.7 14.6 16.4 18.2 20.0

59.4000 fbus 10382 YAHTAHEY 115.0 0 0.0 1 1 60.6000
59.4000 fbul 10072 WNDWROCK 115.0 0 0.0 1 1 60.6000
59.4000 fbul 98989 TOHATCHI 115.0 0 0.0 1 1 60.6000
59.4000 fbul 98999 NEWCOMB 115.0 0 0.0 1 1 60.6000
59.4000 fbul 98990 CUDEI115 115.0 0 0.0 1 1 60.6000
59.4000 fbul 79062 SHIPROCK 115.0 0 0.0 1 1 60.6000

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Time (sec)

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0

1.20
1.11
1.02
0.93
0.84
0.75
0.66
0.57
0.48
0.39
0.30
0.21
0.12
0.03
0.12
0.21
0.30
0.39
0.48
0.57
0.66
0.75
0.84
0.93
1.02
1.11
1.20

115 kV Bus Frequencies

Time (sec)

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0

59.40
59.51
59.62
59.73
59.84
59.95
60.06
60.17
60.28
60.39
60.50
60.61
60.72
60.83
60.94

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<tbody>
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</tr>
<tr>
<td>20.01</td>
<td>0.75</td>
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<tr>
<td>20.01</td>
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