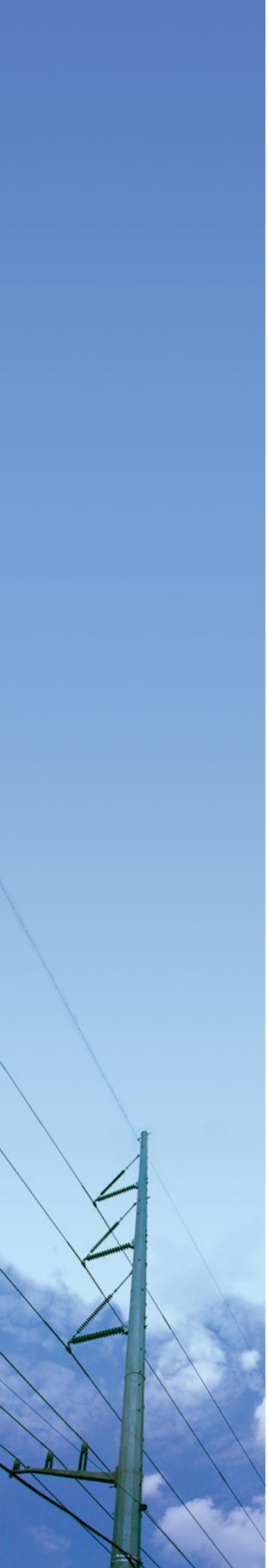

2009 SPP TransCanada Pipeline Study Report

SPP Engineering Department, Planning Section

PUBLISHED: 7/9/2009
LATEST REVISION: 7/9/2009

SPP Southwest Power Pool

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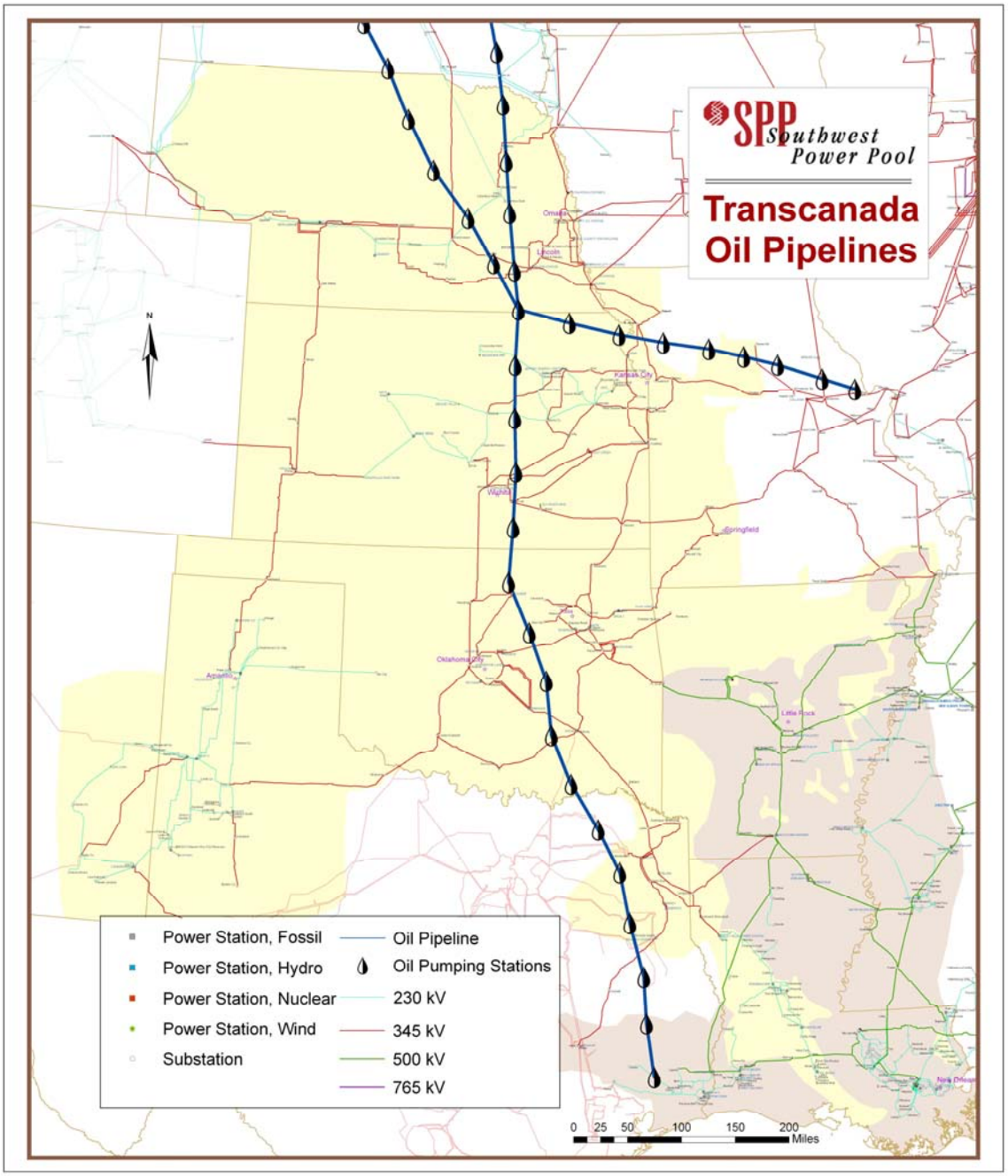
Executive Summary

The objective of this study is to determine the effects within the entire SPP footprint due to the additional loads being served for the new TransCanada Keystone and Keystone XL pipelines. There will be a total of 510 MW of load added to the SPP footprint.

The general area studied is shown in the map below. The two crude oil pipelines are shown as the two dark blue lines generally running from North to South. The electrically driven pumping stations are shown at 50-mile intervals along the pipelines.



The 2008 4th Quarter Models, with the all of the 2008 SPP Transmission Expansion Plan (STEP) projects added to them, were used in this study. A second set of models was created that was the same as the first but had all the Pumping Station loads and topology changes added to the models. AC Contingency Analysis was performed on each set of models and then the results were compared. New voltage and thermal issues that were a result of the TransCanada projects were reviewed by the Transmission Owners and SPP Staff. A second AC Contingency Analysis was performed after adding all of the upgrade projects necessary to relieve the overloads and voltage issues associated with the new TransCanada loads. Voltage and thermal issues that were new and those that remained after the addition of the upgrade projects were reviewed by the Transmission Owners and SPP Staff. The results show that there were a number of projects required due to the addition of the TransCanada Pumping Station loads.

Introduction

History and Background

TransCanada intends to build 29 new pumping stations within the SPP footprint. Each of the **Keystone** pipeline pumping stations will be built with either three or four 5000 H.P. motors for a total load of 12 - 16 MW. Each of the **Keystone XL** pipeline pumping stations have five 6500 H.P. motors for a total load of between 20 - 23 MW.

The pipelines run through Nebraska, Kansas, Oklahoma, Missouri and Texas. The facilities of the following transmission operators are affected:

Nebraska Public Power District, Westar Energy, Kansas City Power and Light, Missouri Public Service Co., Associated Electric Coop., Grand River Dam Authority, Midwest Energy, Oklahoma Gas & Electric Cooperative, American Electric Power, Western Farmers Electric Coop., Oklahoma Municipal Power Authority, and Entergy.

Study Methodology

Scope

This study was performed according to the Study Scope as shown below. The Study Scope outlined the methods for creating the load flow models and for performing the reliability analysis.

TransCanada Pipeline Load Study 2009 Scope

- OBJECTIVE: To determine the effects within the SPP footprint due to the additional load being served for the TransCanada Keystone and Keystone XL pipelines. The scheduled pipeline completion dates are as follows:
  - Keystone--------Hardisty to Steele City---------- Q4 2009
  - Keystone--------Steele City to Patoka---------- Q4 2009
  - Keystone XL—Steele City to Cushing Ext.---------- Q4 2010
  - Keystone XL—Cushing Ext. to Houston---Proposed Q4 2011
  - Keystone XL—Hardisty to Steele City------Proposed Q4 2012

STUDY PROCESS

- Model Assumptions
  - Use 2008 SPP Transmission Expansion Plan (STEP) models
    - Version “Q4” with applicable upgrades proposed in 2008 STEP
    - All seasons (2009 April Minimum – 2018 Summer Peak)
    - All base and transactional scenarios (0-5)
    - Total of 66 models
  - Add the anticipated loads for TransCanada Keystone Pipeline inside/nearby the SPP footprint including Nebraska
  - All dispatch adjustments will follow SPP tariff studies merit order protocols

- Reliability Analysis
  - Assumptions
    - AC contingency analysis (N-1) on all load flow models using PSS/E
    - Contingencies
      - Single element (N-1) outages of:
        - SPP facilities 69kV and above
        - SPP generators
        - Entergy and AECI facilities 100kV and above
        - First tier companies 230kV and above
        - NPPD and OPPD at 69 kV and above
      - Multi-terminal outages as provided for the 2008 STEP by SPP members and first tier companies

    - Monitored Elements
        - SPP facilities 69kV and above (overload & voltage)
        - Entergy and AECI facilities 100kV and above (overload)
        - First tier companies 230kV and above (overload)
        - In NPPD and OPPD areas 69 kV and above
    - Apply SPP and NERC reliability standards

- Study Timeline
    - Finalize scope – January 16, 2009
    - Build models – February 6, 2009
    - Contingency results – March 6, 2009
    - Summarized results – April 3, 2009
    - Draft report – April 24, 2009
    - Final report – May 15, 2009

Summary of Modeling Methods and Analysis

The models included the most up to date information available to SPP Staff at the time that the ACCC runs were initiated. Because of the fluidity of pumping station location, loading and point of service, as well as the timing for project completion, some necessary model topology changes were needed.

The reliability analysis was performed on the load flow models using PSS/E's AC contingency analysis (N-1) software. All contingencies 69kV and above were taken in SPP (including NPPD, OPPD, and LES), AECI, LAGN, EES, and AMRN. All overload and voltage violations were then reported for SPP (including NPPD, OPPD, and LES) and EES. The violations that occurred before the TransCanada Pipeline loads were compared to the violations that occurred after the new loads were added. This information was shared with the stakeholders and solutions were determined for the violations that were a result of the new loads.

The cost estimates included in the study are for the listed network upgrades only. The load serving upgrades and additions are beyond the scope of this study. This includes radial transmission lines, pumping station substations, step down transformers, and power factor correction capacitor banks.

Results of Analysis

Area Results

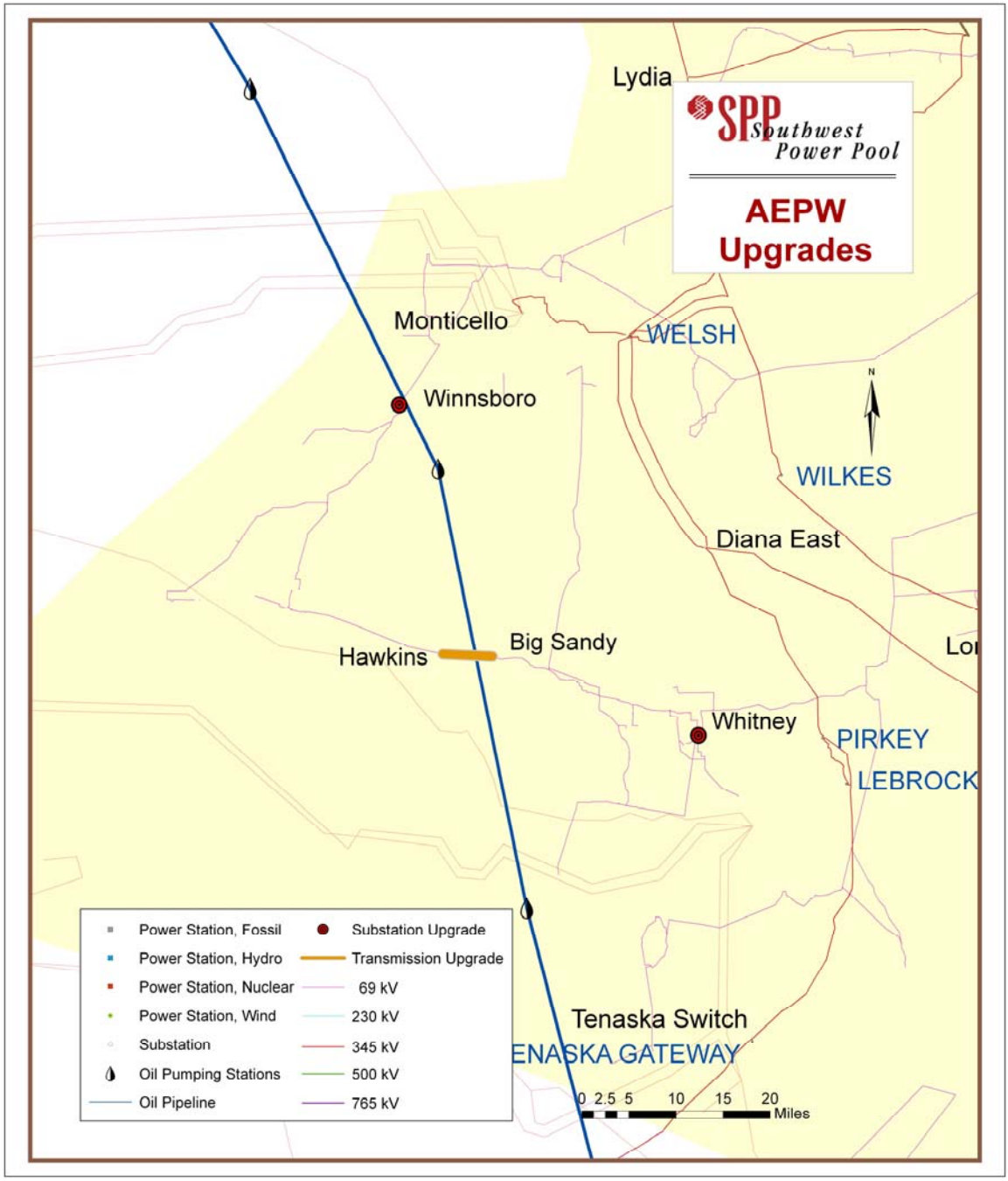
The results of the contingency analysis showed that the addition of the TransCanada Pumping Station loads had only zonal effects. However, some of the local exceptions are listed as follows:

AEPW:

2010 – Four switches and one breaker overload in the Whitney 138/69 kV substation for the contingency of either of the two Whitney 138/69/12.47 kV transformers. This is an advancement of the project identified in the 2008 SPP Transmission Expansion Plan for the year 2011 with a Project ID 452, Upgrade ID 10586, and Notification to Construct ID 20027. This upgrade costs $350,000.

2018 – The Big Sandy - Hawkins 69 kV line is overloaded for the contingency of the North Mineola 138/69/12.47 kV transformer. That overload can be relieved by rebuilding 5.5 miles of line, replacing 477 ACSR with 1272 ACSR by 2018 summer. AEP estimates the cost to be $6,000,000.

2018 – A new 28.8 MVAR capacitor bank at Winnsboro on the 138 kV bus, 508317, can relieve contingency driven voltage violations in the 2018 summer. SPP staff estimates the cost to be $1,166,400.



EES:

Entergy has not provided comments about the contingency results.

NPPD:

TransCanada will be building five pumping stations in NPPD for the **Keystone** pipeline. Service is needed in 2009. For the TransCanada **Keystone XL** pipeline, five additional pumping plants are planned for the 2012 in service date. NPPD had previously inserted topology changes as solutions for the Keystone pipeline pumping stations into the 2008 STEP models.

In NPPD, the Keystone XL results listed line overloads and voltage problems during some contingencies. Upon investigation it was determined that several projects listed in the Nebraska Subregional Transmission Plan (2008-2017) were not included by SPP in the models. This includes ten transmission lines that were re-rated for 100 degrees Celsius operation and other network upgrades.

The following is a list of Keystone XL load driven projects that were developed by NPPD to resolve the remaining violations:

2013 – Capacitor banks at the following locations can relieve contingency driven voltage violations in the 2013 summer:

A new 15 MVAR capacitor bank at Petersburg on the 115 kV bus, 640318. SPP staff estimates the cost to be $607,500.

An additional 18 MVAR capacitor bank at O'Neil on the 115 kV bus, 640305. SPP staff estimates the cost to be $729,000.

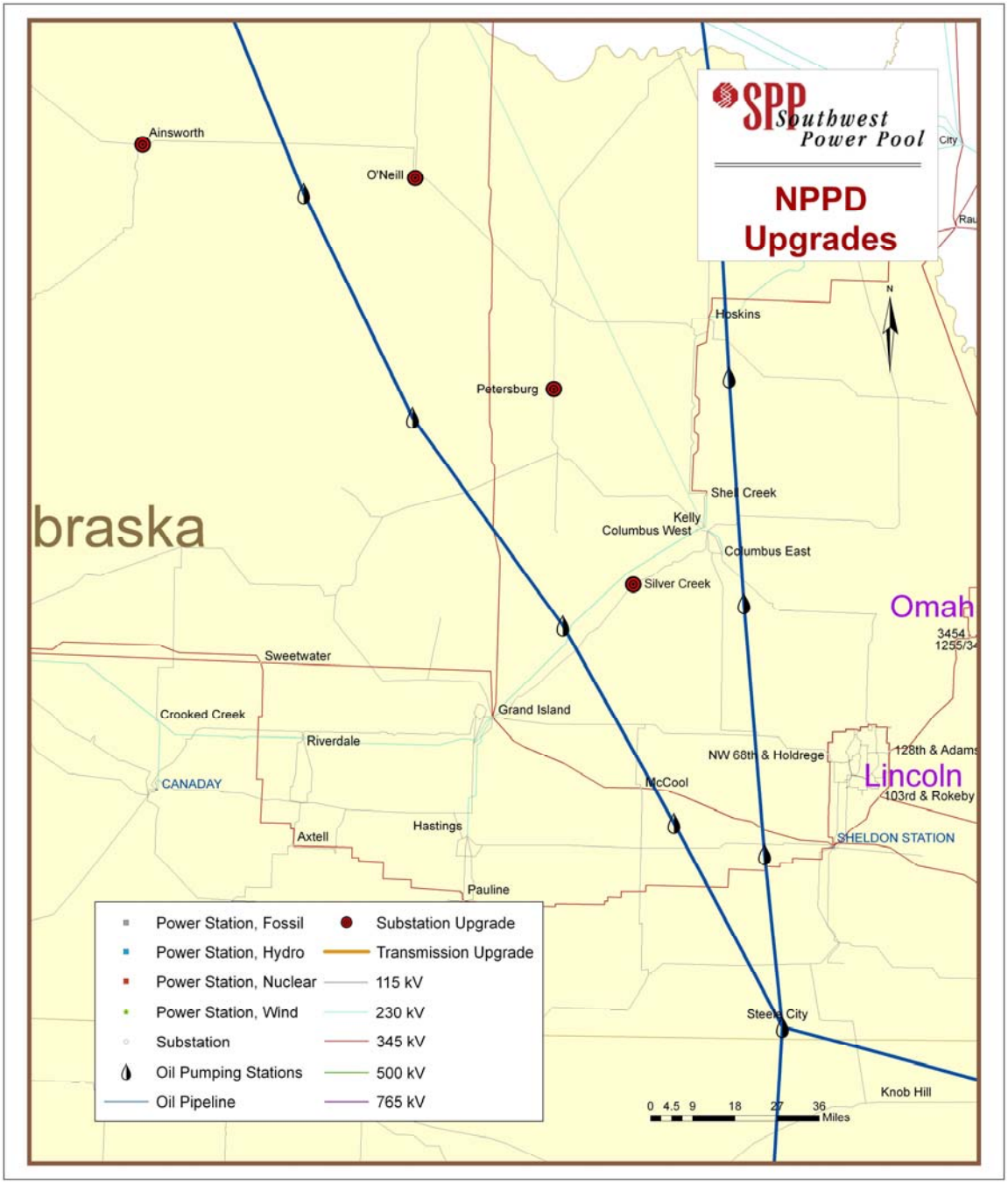
A new 9 MVAR capacitor bank at O'Neil on the 69 kV bus, 640306. SPP staff estimates the cost to be $364,500.

A new 18 MVAR capacitor bank at Silver Creek on the 115 kV bus, 640345. SPP staff estimates the cost to be $729,000.

An expansion of the existing 9 MVAR capacitor bank at Ainsworth to 18 MVAR, on the 115 kV bus, 640051. SPP staff estimates the cost to be $364,500.

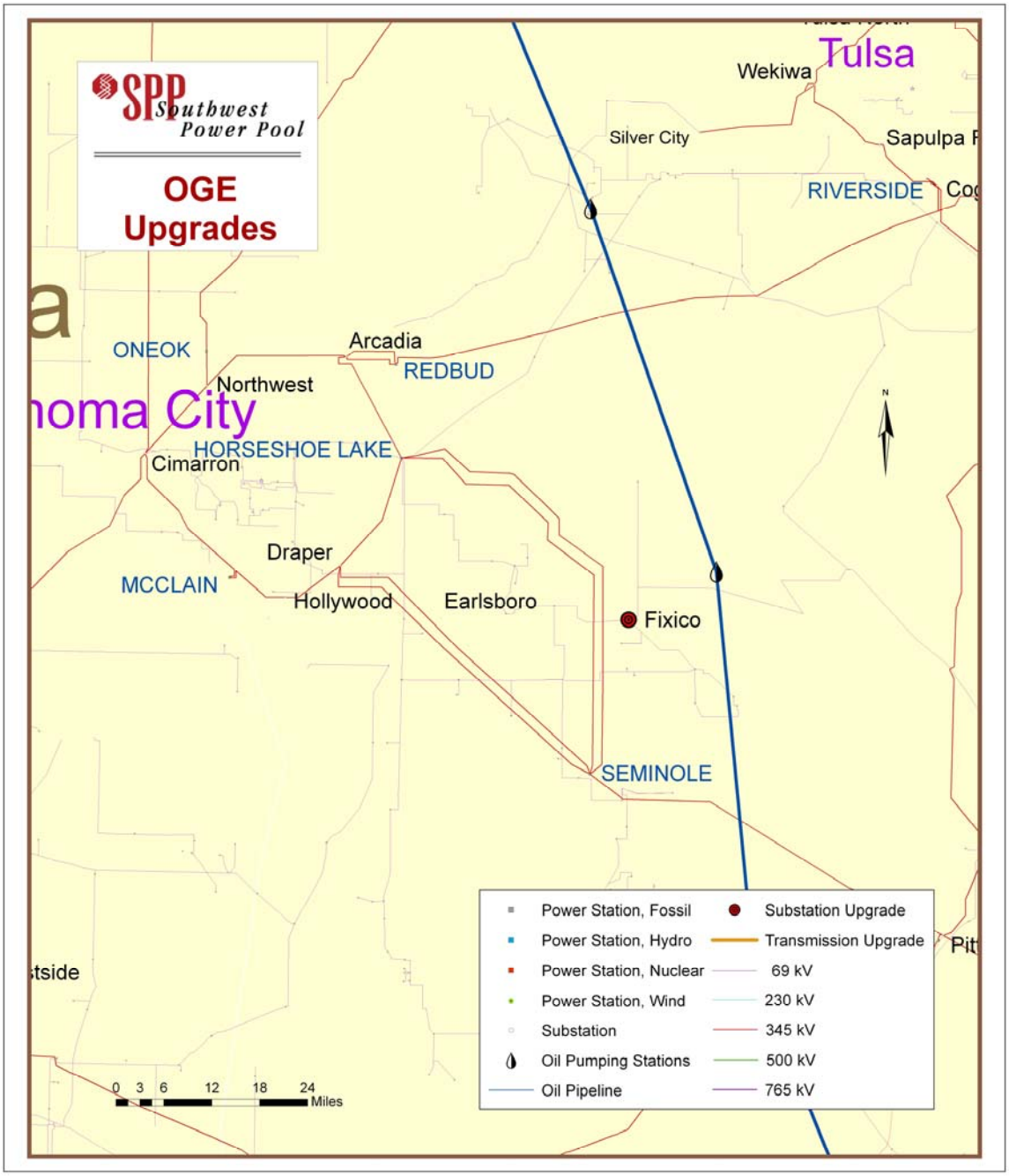
The combination of the above listed NPPD model changes and projects were seen to correct the identified voltage and overload violations.

NPPD has also been working on a coordinated study effort with WAPA and Basin Electric to address joint planning issues with the Keystone XL load additions in South Dakota and Nebraska. WAPA has published a study report on its OASIS documenting its facility plans and staged approach to reliably serve the Keystone XL load additions.


SPP Southwest Power Pool
NPPD Upgrades
Ainsworth
O'Neill
Petersburg
Hoskins
Shell Creek
Kelly
Columbus West
Columbus East
Silver Creek
Omaha
3454
1255/3
Sweetwater
Crooked Creek
Grand Island
Riverdale
NW 68th & Holdrege
128th & Adams
Lincoln
103rd & Rokeby
CANADAY
McCool
SHELDON STATION
Axtell
Hastings
Pauline
Steele City
Knob Hill
Power Station, Fossil
Power Station, Hydro
Power Station, Nuclear
Power Station, Wind
Substation
Oil Pumping Stations
Oil Pipeline
Substation Upgrade
Transmission Upgrade
115 kV
230 kV
345 kV
500 kV
765 kV
0 4.5 9 18 27 36
Miles

OGE:

2013 – The current transformer and wave trap at the Fixico end of the Earlsboro – Fixico 69 kV line is overloaded for the contingency of the Fixico Tap bus, 510877. This is an advancement of the project identified in the 2008 SPP Transmission Expansion Plan for the year 2015 with a Project ID 459 and Upgrade ID 10595. This upgrade costs $150,000.

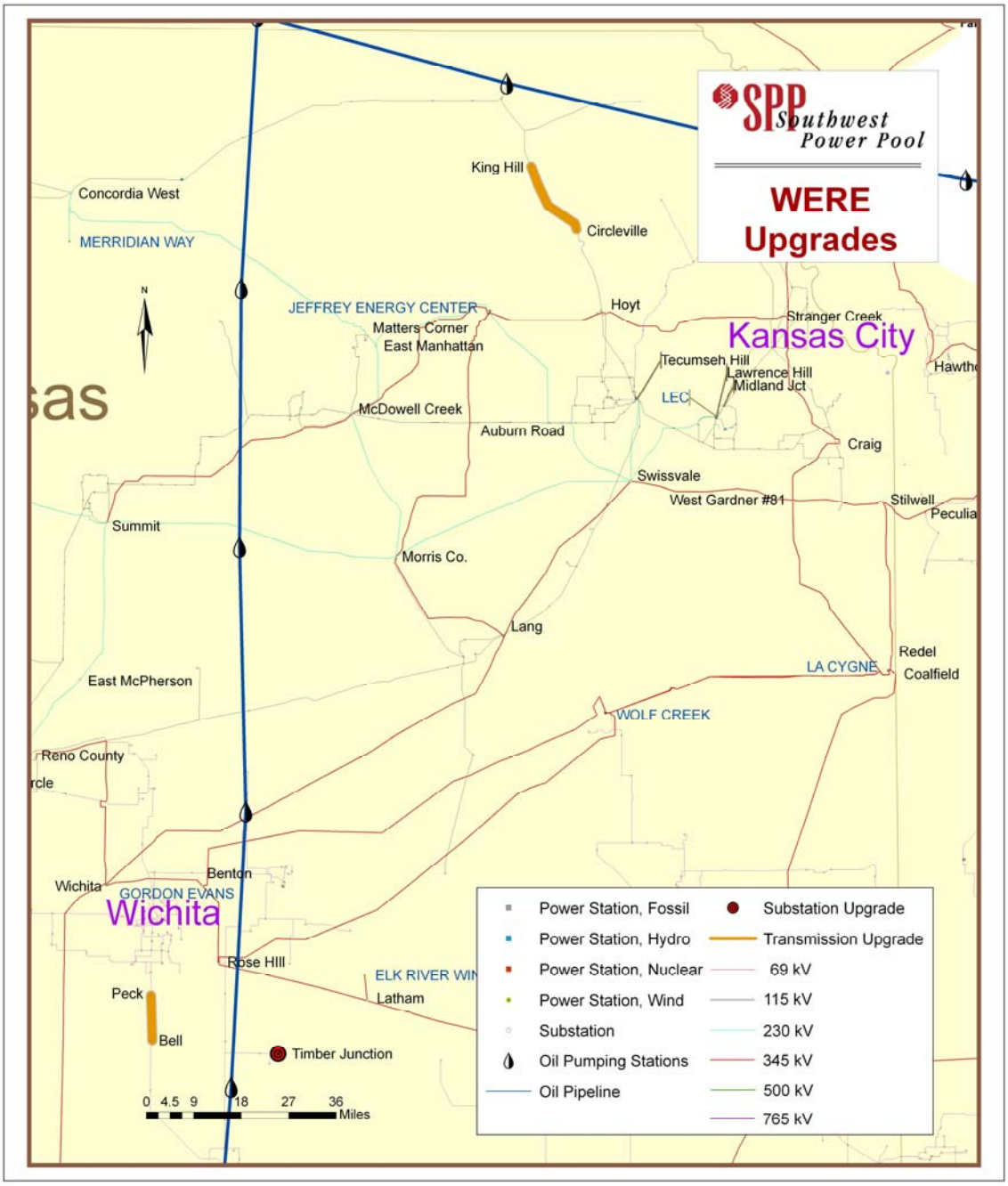


WERE:

2013 – The Bell-Peck 69 kV line overloads for the contingency of the El Paso – Farber 138kV line. That overload can be relieved by tearing down/rebuilding the 8.23 mile line by 2013 summer. This upgrade will increase the summer normal/emergency rating from 37/37 MVA to 59/59 MVA. SPP staff estimates the cost to be $3,703,500.

2018 – The Circleville-King Hill 115 kV line overloads for the contingency of the Kelly 161/115/13.8 kV transformer. That overload can be relieved by rebuilding the 15.15 mile line with 1192.5 kcmil ACSR and replacing the current transformers by 2018 summer. This upgrade will increase the summer normal/emergency rating of that line from 92/92 MVA to 223/240 MVA. SPP staff estimates the cost to be $6,391,406.

2018 – Two new capacitor banks (30 MVAR total) at the Timber Junction buses can relieve contingency driven voltage violations in the 2018 summer. SPP staff estimates the cost to be $1,215,000.



Slightly affected areas

The results of the contingency analysis showed no violations or operationally corrected violations for the following:

GRDA, KCPL, MIPU, MIDW, MKEC, OMPA, OPPD, WFEC

Conclusions and Recommendations

When the twenty-nine new TransCanada Keystone and the Keystone XL Pipeline pump station loads were analyzed on the SPP system, a number of voltage and thermal problems occur in multiple areas in SPP. To relieve these violations, twelve reliability projects will need to be completed. This information will be incorporated into the 2009 SPP Transmission Expansion Plan as needed.

The project costs for the following owners are:

Transmission Owner	2009	2010	2013	2018	Total
AEPW	$0	$350,000	$0	$7,166,400	$7,516,400
EES					Unknown
NPPD	$0	$0	$2,794,500	$0	$2,794,500
OGE	$0	$0	$150,000	$0	$150,000
WERE	$0	$0	$3,703,500	$7,606,406	$11,309,906
Total	$0	$350,000	$6,648,000	$14,772,806	**$21,770,806**