



*Texas Panhandle – Western Oklahoma
Load Growth Study*

**SPP ENGINEERING DEPARTMENT,
PLANNING SECTION**

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1. EXECUTIVE SUMMARY

The objective of the Study is to develop a transmission expansion plan for the region comprised of the Texas Panhandle and Western Oklahoma border area.



A meeting was held with representatives from Western Farmers Electric Cooperative (WFEC), Golden Spread Electric Cooperative (GSEC), Southwestern Public Service (SPS) and American Electric Power (AEP) on March 3, 2006 to discuss transmission expansion alternatives in the Texas Panhandle – Western Oklahoma border area that would address the high load growth in the region brought about by the boom in oil drilling.

SPP staff, through stakeholder collaboration, developed a Scope Document and performed a full AC N-1 contingency analysis to evaluate the impact of proposed transmission reinforcements in the area. Study results indicate that the following projects are needed to reliably operate the power system within the scope area. The timing of these projects is based on the 2007 STEP models.

- Conversion of the Morewood SW – Durham 69 kV loop to 138 kV (WFEC) – June 2008 (Expected to be completed by the end of 2008)
- New Stateline Substation (SPS) – June 2009
 - Install one 230/115 kV transformer
 - Build new 115 kV line to Grave
- Existing Grave Substation (SPS) – June 2009
 - Install one 115/69 kV, 40 MVA transformer
- Reconductor Hamon Butler – Morewood 69 kV line (WFEC) – June 2007
- Installation of 9 Mvar capacitor at Sweetwater (WFEC) – June 2007
- New 115 kV line (55 miles) from Gray County to Grave (SPS) – Not Needed in the 2007-2017 Expansion Planning Horizon.
- Second 115/69 kV transformer at Grave – Not Needed in the 2007-2017 Expansion Planning Horizon

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The Gray County – Grave 115 kV line was identified, under the heavy load scenarios, to be needed by June 2013. In addition a second 115/69 kV transformer at Grave is also needed by June 2014. Both of these projects are out of the planning horizon based on the 2007 STEP models.

This study provides a long range transmission expansion plan for the Texas Panhandle – Western Oklahoma region. The upgrades evaluated in this study are intended to provide guidance for future reinforcements to the transmission system in this area. This study did not consider economic issues such as transfer capability but focused on meeting N-1 reliability criteria. It must be noted that the results are subject to change as other upgrades or load additions are added to the area.

2. INTRODUCTION

Increased oil drilling in the Texas Panhandle – Western Oklahoma border area prompted the need for a study to assess the reliability of the transmission grid in serving the load growth. Stakeholders from WFEC, AEP, GSEC, SPS and SPP staff met in Dallas to discuss the need for short-term and long-term transmission expansion alternatives in the region.

SPP staff was asked to conduct a study to address the load growth in the region. The study was to analyze medium- and heavy-load scenarios for the purpose of identifying transmission constraints. Staff would then look at the proposed alternatives and any other possible projects that would enhance the reliability of the system in serving the load growth.

The study uses two cases, a 2011 and a 2016 case. These cases incorporate the entire 2006-2016 SPP Transmission Expansion Plan (STEP) upgrades of which two projects are of particular interest:

New Stateline & Existing Grave Substations (Stateline Project)

- 115/69 kV transformer at the existing Grave Substation
- 230/115 kV transformer at the new Stateline Substation
- New 115 kV line from Stateline to Grave

Sayre – Morewood 138 kV conversion (Sayre-Morewood Project)

- New Sayre – Erick 138 kV line
- Conversion of the Erick-Sweetwater-Durham-Brantley-Morewood 69 kV loop to 138 kV
- PSO interconnect at 138 kV

The study analyzed three different alternatives all of which included the two projects listed above.

Alternative 1: 138 kV Expansion

- Stateline Project
- Sayre-Morewood Project
- 230/138 kV auto @Stateline
- Stateline – Shamrock 138 kV line
- Stateline – Erick 138 kV line

Alternative 2: 115 kV Expansion

- Stateline Project
- Sayre-Morewood Project
- Additional 115/69 kV auto at Stateline
- Grave – Shamrock 115 kV line
- Sweetwater 9 Mvar capacitor

Alternative 3: 115 kV Expansion

- Stateline Project
- Sayre-Morewood Project
- Gray County – Grave 115 kV line
- Additional 115/69 kV auto at Stateline
- Sweetwater 9 Mvar capacitor

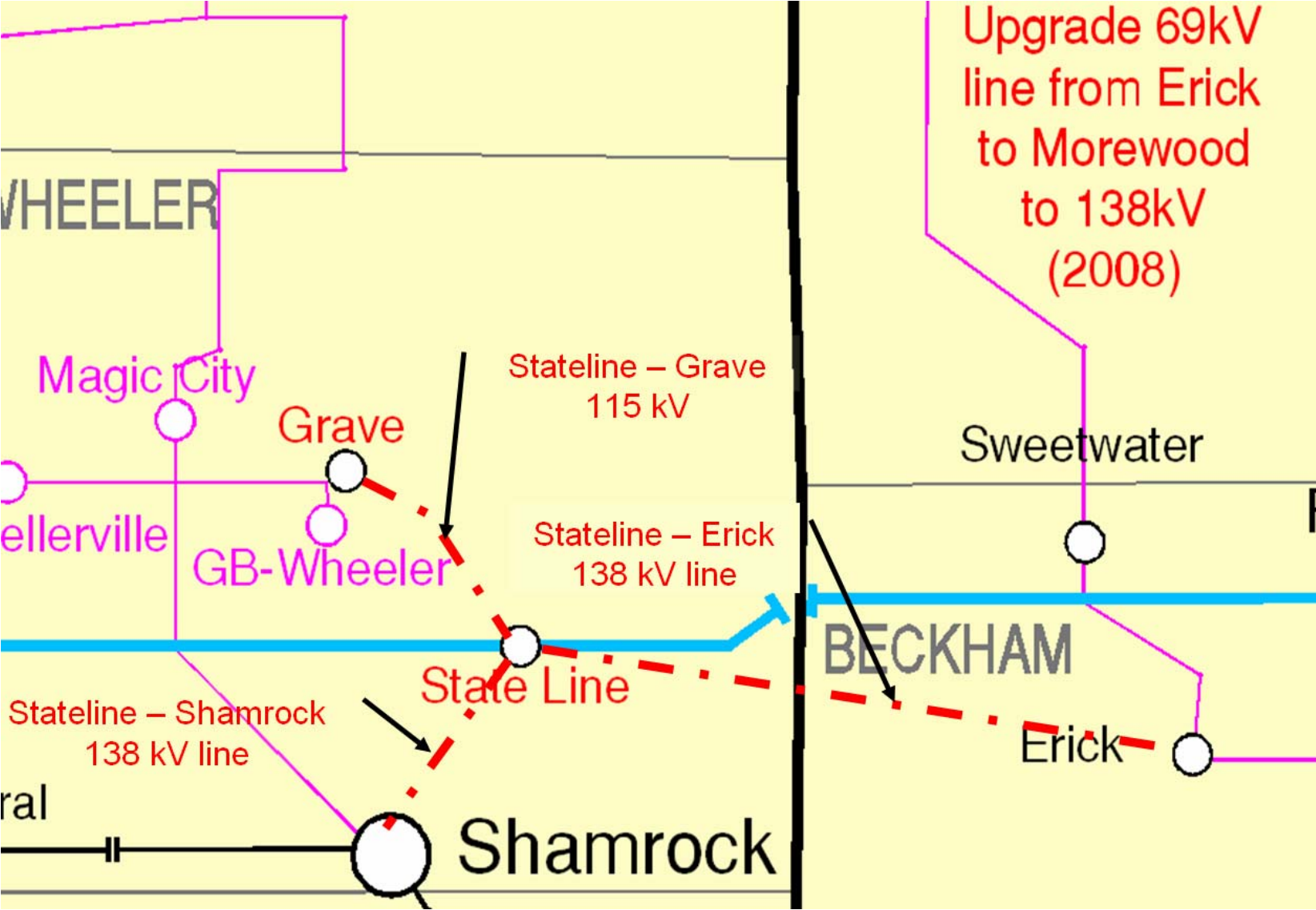


Figure 1 Alternative 1: 138 kV Expansion

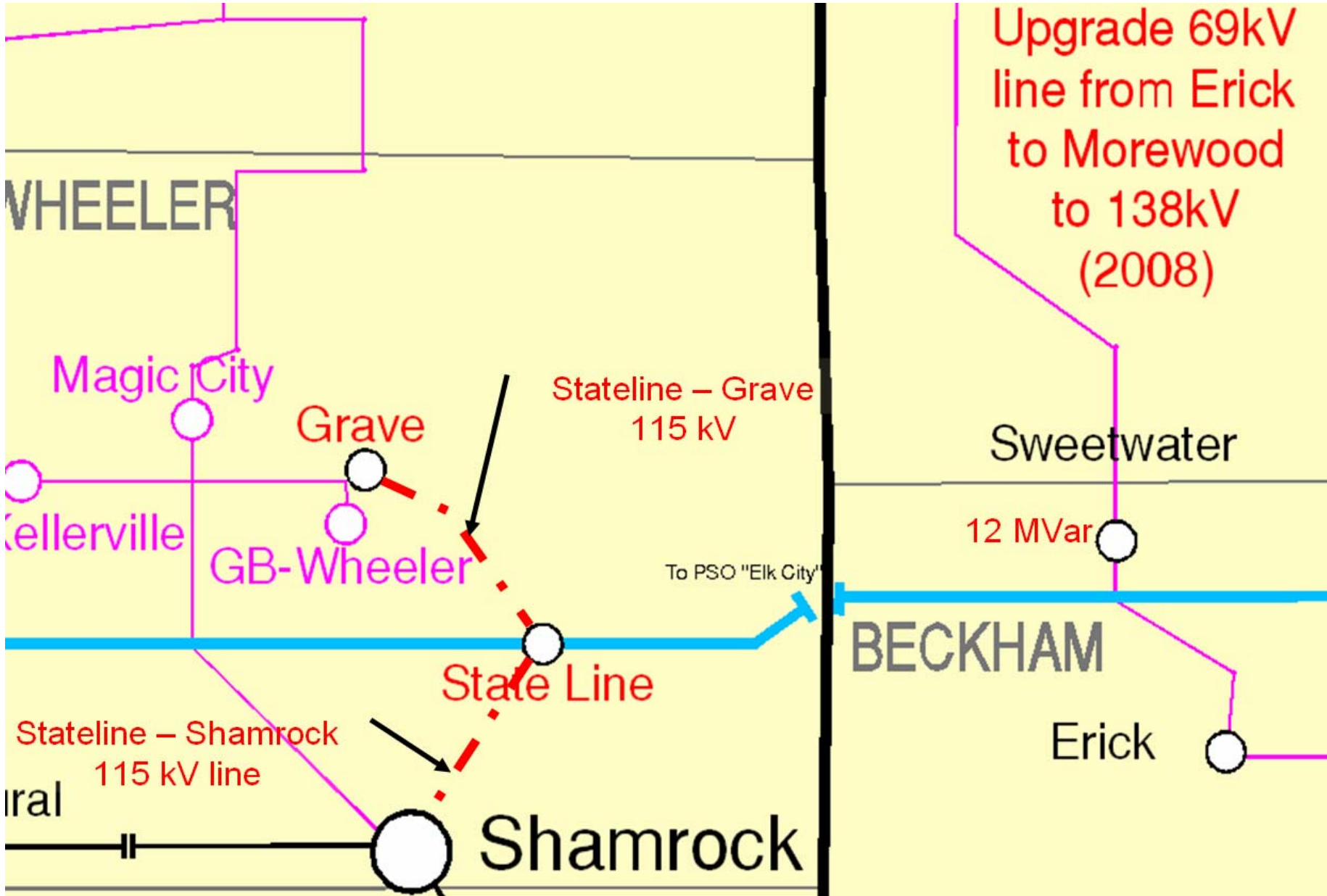


Figure 2 Option 2: 115 kV Expansion

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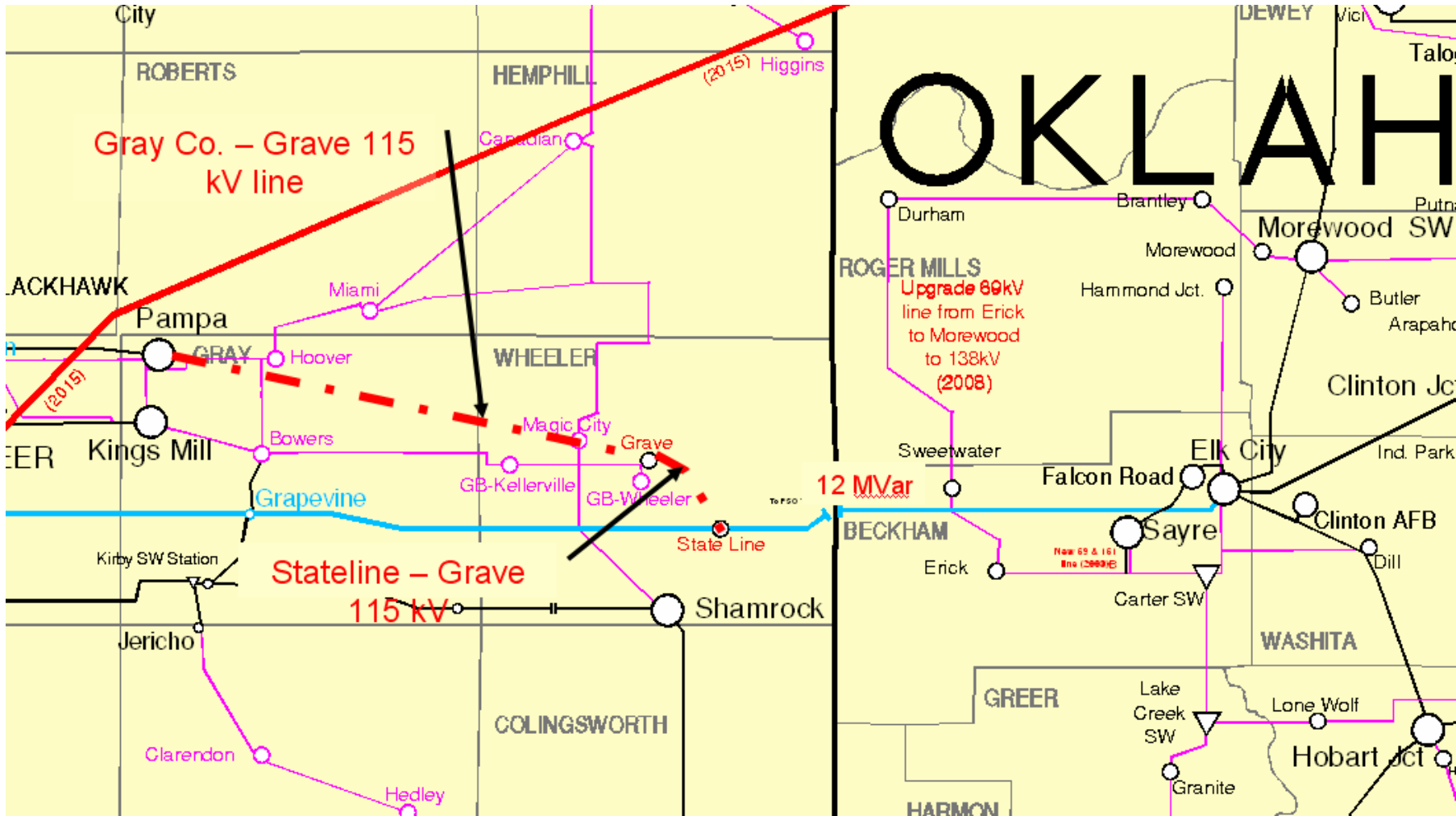


Figure 3 Option 3: 115 kV Expansion

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3. STUDY METHODOLOGY

The models used in the study were based on the 2011 and 2016 Expansion Plan summer peak models. This model set includes all reinforcements identified in the 2006 STEP. The model set also includes a base case and four transaction scenario cases. The transaction scenarios are:

1. West to East, SPS Exporting, ERCOT_S_N, Lamar_W_E
2. East to West, SPS Importing, ERCOT_N_S, Lamar_E_W
3. South to North, SPS Exporting, ERCOT_S_N, Lamar_E_W
4. North to South, SPS Importing, ERCOT_N_S, Lamar_W_E

SPP staff created models representing medium and heavy loading in the area using the stakeholder provided load forecasts. Figure 4 provides a visual comparison of the loads in the medium/high load scenarios (2011 & 2016) used in the study to the actual load as modeled in the 2012 & 2017 base case loads of the 2007 series models.

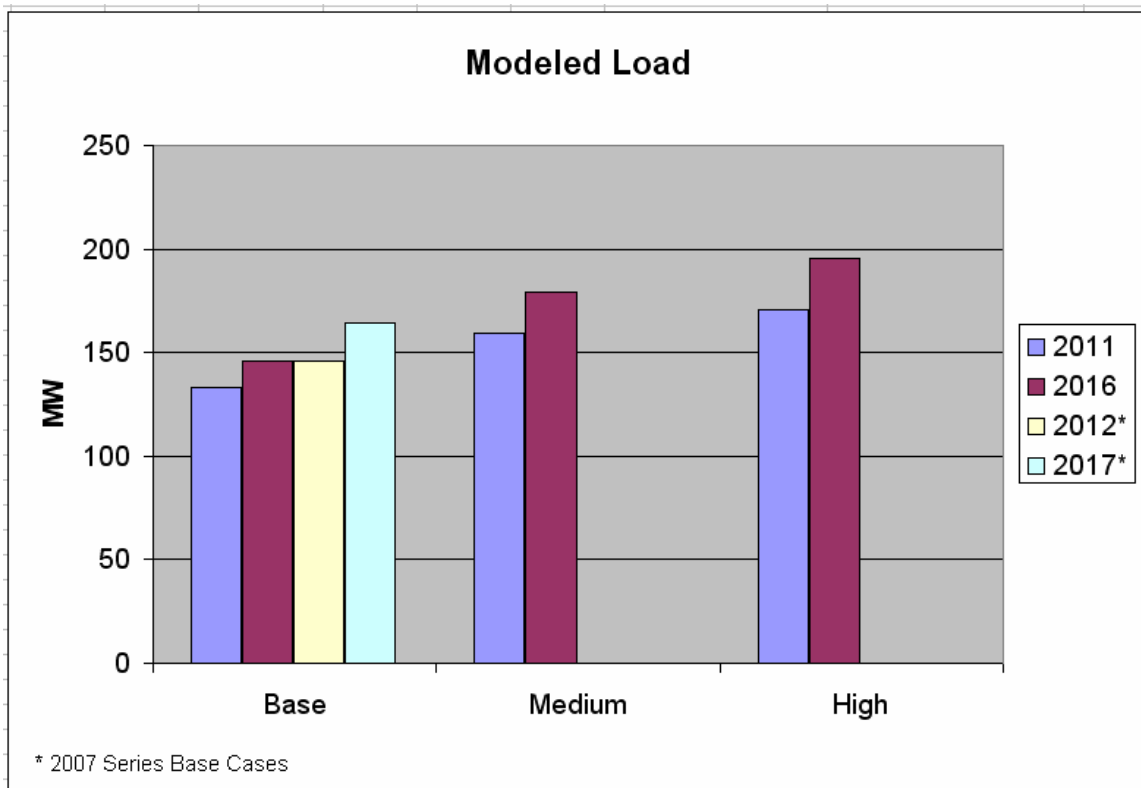


Figure 4 Modeled Loads Compared to Loads in the 2007 Series Models

A contingency analysis using PSS/E was performed on the base case and each transactional scenario to determine new potential transmission constraints in the area. The analysis monitored all facilities (69 kV and above) using the contingency lists used in the 2006-2016 SPP Transmission Expansion Plan. All overloads and voltage violations were screened to identify those falling outside the scope area. The analysis focused on reliability and not on commercial or market benefits.

4. RESULTS OF ANALYSIS

As noted earlier, two of the projects (Stateline Project and the Sayre-Morewood Project) identified by the 2006 STEP are common to the alternatives analyzed. The initial run was performed with these projects in place. Initial results from the contingency analysis showed the following facilities exceeding their emergency ratings:

Summer 2011

Limiting Element	Contingency	MVA % Loading
Hamon Butler – Morwood 69 kV line	Mooreland – Morewood 138 kV line	105.9
Kingsmill 115/69 kV Transformer	Hutchinson – Gray County 115 kV line	104.6

Summer 2016

Limiting Element	Contingency	MVA % Loading
Grave 115/69 kV Transformer	Base Case	103.2
Kingsmill 115/69 kV Transformer	Hutchinson – Gray County 115 kV line	106
Bowers 115/69 kV Transformer	Hutchinson – Gray County 115 kV line	102.4
Grapevine 230/115 kV Transformer	Hutchinson – Gray County 115 kV line	117.6

In addition to the overloads above, the initial results showed that the following facilities were not meeting voltage criteria.

Summer 2011

Bus Voltage Violation	Contingency	Post-Cont Voltage
Sayre 138 kV	Elk City – Falcon Rd 138 kV line	0.89
Falcon Rd 138 kV	Elk City – Falcon Rd 138 kV line	0.89

Summer 2016

Bus Voltage Violation	Contingency	Post-Cont Voltage
Canadian 69 kV	Bowers 115/69 kV Transformer	0.89
Erick 138 kV	Sayre – Falcon Rd 138 kV	0.85
Falcon Rd 138 kV	Elk City – Falcon Rd 138 kV line	0.86
Sayre 138 kV	Sayre – Falcon Rd 138 kV	0.85
Sweetwater 138 kV	Sayre – Falcon Rd 138 kV	0.86

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SPP staff evaluated the following alternatives that would address the load-serving capability issues in the study area.

Alternative 1: 138 kV Expansion

Alternative 1 called for the following projects:

- reconductoring the Sayre-Morewood line
- building the Stateline Substation
- installing a 230/138 kV transformer at the Stateline substation
- building a 138 kV line from Stateline (SPS) to Shamrock (AEPW) and a 138 kV line from Stateline to Erick (WFEC).
- reconductoring the Hamon Butler – Morewood 69 kV line (WFEC)

While this alternative provided some relief to the overloaded facilities it did not fully address all of the voltage violations in the SPS area (Buffalo, Canadian, Spring Creek, Briscoe on the 69 kV system). To address these additional voltage violations the option to utilize switching schemes was suggested. Although the switching schemes did provide relief, some of the proposed schemes required manual operation and were meant more for restoration.

Additionally, the need for the new 138 kV lines could not be justified. The analysis revealed that all of the violations in the Shamrock and Erick vicinity that the 138 kV alternatives addressed could be adequately addressed with existing facilities.

Alternative 2: 115 kV Expansion

Alternative 2 consisted of the following:

- reconductoring the Sayre-Morewood line
- building the Stateline Substation
- installing a second 115/69 kV transformer at Grave
- building a 115 kV line from Grave (SPS) to Shamrock (AEPW)
- installing a 9 Mvar capacitor at Sweetwater.
- reconductoring the Hamon Butler – Morewood 69 kV line (WFEC)

Alternative 2 did not address all of the limiting facilities. Under voltage problems at Canadian on the 69 kV-system were still an issue.

Under this alternative, additional 115 kV facilities (McClellan-McLean, McClellan-Kirby, and McLean-Shamrock) exceeded their emergency ratings. The results indicated that the Grave and Bowers 115/69 kV transformers also exceeded their emergency ratings.

Alternative 3: 115 kV Expansion

Alternative 3 included the following projects

- reconductoring the Sayre-Morewood line
- building the Stateline Substation
- installing a second 115/69 kV transformer at Grave
- building a 115 kV line from Gray County (SPS) to Grave (SPS)
- installing a 9 Mvar capacitor bank at Sweetwater (WFEC)

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- reconductoring the Hamon Butler – Morewood 69 kV line (WFEC)

Alternative 3 is the only alternative that solved all N-1 violations for the heavy load scenario. This alternative solves all of the voltage violations. It is recommended that the Grave 115/69 transformers to be installed have a higher rating (46 MVA) than what was proposed to address any overload created when one of the two units is taken offline.

5. RECOMMENDATIONS AND CONCLUSIONS

As the study progressed, it became evident that most of the limiting facilities were in the SPS area. Some of the facilities exceeding their emergency ratings in almost every modeled scenario were the Bowers 115/69 kV transformer, the Kingsmill 115/69 kV transformer and the Grave 115/69 kV transformer. Similarly, there were several facilities with voltage violations that were persistently showing up in all scenarios (see appendix for complete violation list).

After ruling out Alternatives 1 and 2, Alternative 3 was determined to be the most effective option that would significantly lessen the constraints in the study area. Therefore it is recommended that as part of Alternative 3 the following projects be pursued to ensure that the new loads in the study area are served while maintaining the reliability of the system:

Project	Study Needed Date	STEP Needed Date
Stateline (SPS)	June 2009	June 2009
• Stateline Substation	June 2009	June 2009
• 115/69 kV Transformer at Grave	June 2009	June 2009
• 230/115 kV Transformer at Stateline	June 2009	June 2009
• 115 kV line Stateline – Grave	June 2009	June 2009
138 kV conversion Sayre - Morewood loop (WFEC)	June 2008 [†]	Not Modeled
Reconductor Hamon Butler–Morewood 69 kV line (WFEC)	June 2011	June 2007
Install second 115/69 kV transformer at Grave (SPS)	June 2014	N/A
Build Gray County – Grave 115 kV line (SPS)	June 2013	N/A
Install new 9 Mvar Sweetwater Capacitor (WFEC)	June 2012	June 2007

[†] Project expected to be completed by the end of 2008.

The study identified those projects that are needed to adequately serve the forecasted load. As the table on page 10 showed, the forecasted levels are considerably higher than those currently being modeled in the 2007 STEP cases. With this in mind, and in an effort to coordinate projects with those identified by the 2007 STEP, the projects identified in this study were timed using both sets of models. The following observations must be made:

1. Stateline Project – this project is identified as needed in 2009. In both instances, this project is needed to address the overloads of the Kingsmill and the Gray County 115/69 kV transformers for the loss of the Hutchinson-Gray County 115 kV line or the Bowers 115/69 kV transformer.
2. The Sayre-Morewood – although this project was identified in the study as needed by June 2008, the 2007 STEP did not identify this project. Instead, it called for a new 9 Mvar capacitor at Sweetwater by June 2007. Under the forecasted load levels, the capacitor is not sufficient to meet voltage criteria.
3. Second 115/69 kV transformer at Grave – this project is not needed during the 2007-2017 Planning Horizon. It will be needed under the heavy load scenarios under study.
4. Gray County to Grave 115 kV line – this project is not needed during the 2007-2017 Planning Horizon. It will be needed under the heavy load scenarios under study.

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This study provides a long range transmission expansion plan for the Texas Panhandle – Western Oklahoma region. The upgrades evaluated in this study are intended to provide guidance for future reinforcements to the transmission system in this area to reliably serve the forecasted load. It must be noted that the analysis results are subject to change as other upgrades or load additions are added to the area.