



AEPSC Sinton – Beeville – Kenedy Load Area Improvements Project

Version 1.0

Document Revisions

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1. Introduction

Eagle Ford Shale oil and natural gas exploration located in multiple counties in South Texas, stretches from the Laredo area, bounded by Maverick and Webb counties, northeast to Gonzalez and DeWitt counties, and beyond. Electric load related to oil and gas exploration is developing in and around this area. American Electric Power Service Corporation (AEPSC) projects a load increase in the Bee and Goliad Counties area of approximately 94 MW which will be served through the ERCOT Region transmission system by the end of 2016.

The existing 69 kV transmission system in the area is composed of 4/0 ACSR conductor having a rating (circuit Rate B) as low as 34 MVA. Most of the system has almost reached its capacity limit and thus cannot support the proposed load additions without transmission system improvements.

AEPSC, on behalf of AEP-TCC proposed the following transmission improvements to support the load addition:

- Construct a new approximately 56 mile, 138/69-kV double circuit transmission line from Coleto Creek to Big Oak to Pettus to Kenedy. A significant portion of this new transmission line should be able to use or parallel the existing rights-of-Way (ROW) on Fannin – Goliad – Berclair, STEC Big Oak – Beeville and Beeville – Normanna – Pettus 69 kV transmission lines. The ability to use existing easements will need further research and it may be necessary to acquire new easements or supplement existing easements to construct the new transmission line. It is likely that a certificate of convenience and necessity (CCN) will be required
- Rebuild Sinton – Skidmore –Beeville 69 kV transmission line on double-circuit capable structures
- Install a 69 kV, 120 MVA phase shifting transformer (PST) at Sinton on the Sinton – Skidmore 69 kV transmission line
- Install a 15 ohm series reactor at Edroy on the Edroy – Mathis 69 kV transmission line
- Rebuild the Orange Grove- Casa Blanca 69 kV transmission line

The total cost for these projects is estimated to be \$89.2 million and it is anticipated that the projects can be completed by May, 2016.

Figure I below shows the existing 69 kV transmission serving the load in Bee and Goliad Counties, TX

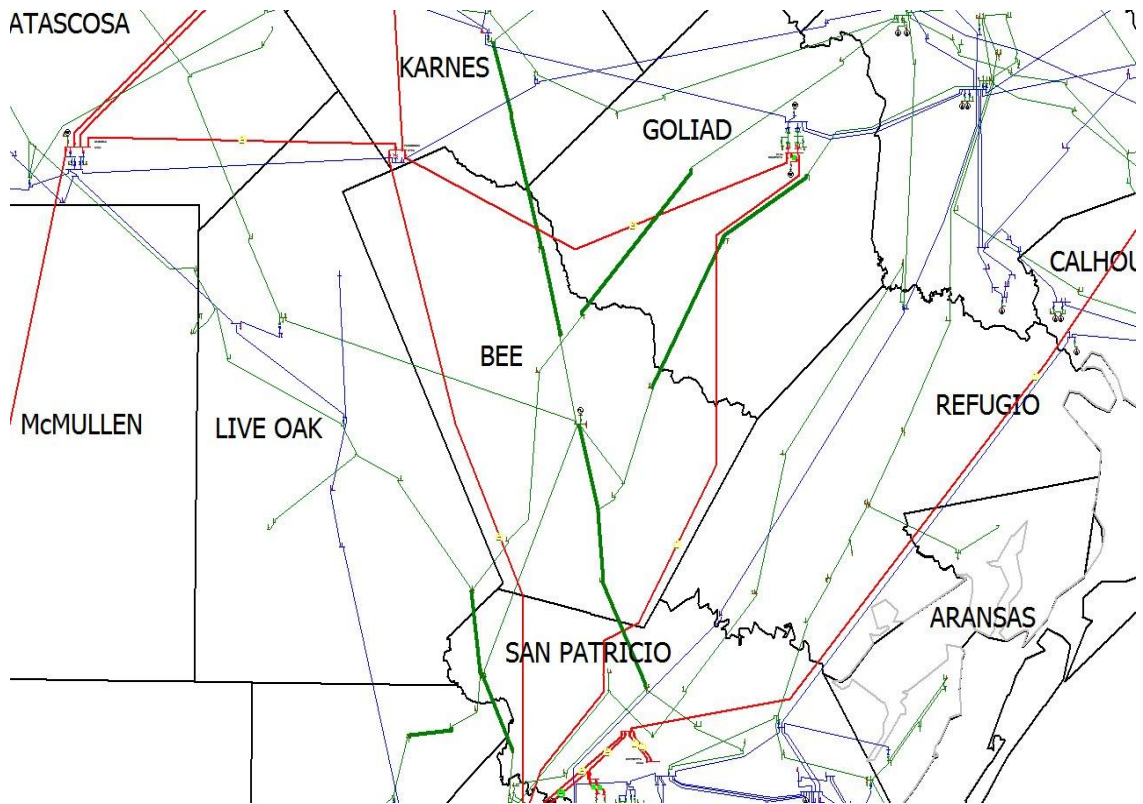


Figure I: Approximate Location of the area of concern

2. Study Approach

The analysis of the system needs primarily focused on steady-state reliability (thermal and voltage) of the ERCOT transmission system upon interconnecting the new load.

The latest 2012 Five-Year Transmission Plan model for the year 2017 served as the benchmark for the analysis. The following changes were based on the most recent information received by ERCOT at the time of study:

Load Changes:

- Approx. 73 MVA Load was added to the 69 kV Pettus substation
- Approx. 21 MVA Load was added to the 69 kV Big Oak substation (new station on STEC's Beeville – Goliad 69 kV line)

Transmission system Changes:

- Removed the Orange Grove – Casa Blanca 69 kV line upgrade so that the original rating (Rate B = 45 MVA) was restored
- Removed the Edroy – Smith - Mathis 69 kV line upgrade so that the original rating (Rate B = 61 MVA) was restored
- Removed the Mathis – Mathis sub 69 kV line upgrade so that the original rating (Rate B = 45 MVA) was restored
- Removed the Sinton – Skidmore - Beeville 69 kV line upgrade so that the original rating (Rate B = 38 MVA) was restored
- Build a new 138 kV Tuleta substation near Pettus 69 kV switching station
- Rebuild the existing 69 kV line (approximately 16 miles) between Kenedy and Pettus as a double circuit 69 kV and 138 kV line with 180 MVA and 463 MVA (emergency rating), respectively. The 138 kV line should terminate at the new 138 kV Tuleta substation

It should be noted that rebuilding Kenedy to Pettus/Tuleta lines are neutral projects and these projects are already under construction.

3. Reliability Analysis

The reliability analysis was performed using TARA. N-1 (AC Contingency) analysis was performed on the study cases (2017) with the addition of the load. Table I summarizes the highest loaded elements on the northern and southern portions of the area of concern; respectively.

Highest Loaded Element	Contingencies	Post contingency Loading in 2017
Kenedy Switch – Kenedy 69 kV line	Beeville – Chase Tap 69 kV line Beeville – Normana 69 kV line	258 %
Edroy – Smith 69 kV line	Lon Hill – Orange Grove 138 kV line Lon Hill – Nedin 345 kV line	142 %
Normana – Pettus 69 kV line	Kenedy Switch – Kenedy 69 kV line	227%
Sinton – Skidmore 69 kV line	Lon Hill – Orange Grove 138 kV line Lon Hill – Nedin 345 kV line	138%

Table I: Loading on the existing 69 kV system in 2017 due to new loads

The results show that the existing 69 kV transmission system is heavily constrained and cannot support the new load addition without additional transmission improvements. The addition of new loads also caused low voltage issues on the 69 kV transmission system. The results of the full AC Contingency analysis are presented in Appendix A.

It should be noted that the analysis revealed other post-contingency loaded elements that are regional problems. These elements were discarded from the analysis since these are either not related to the new load addition, are very far from the area under study, or will be addressed in subsequent projects. These elements are shaded gray in the attached spreadsheets in the appendices.

4. Project Options

ERCOT studied three different alternatives to identify the most reliable solution to serve the load. These alternatives are listed as follows:

Option 1:

- Install a 69 kV, 120 MVA phase shifting transformer (PST) at Sinton on the Skidmore 69 kV transmission line
- Build a new 138 kV Big Oak substation near 69 kV Big Oak switching station (Big Oak 69 kV will be built on STEC Beeville – Goliad 69 kV line)
- Rebuild the existing 69 kV line (approximately 6.20 miles) from Pettus to Normana and from Normana to STEC Beeville to Big Oak (approximately 16 miles) as a double circuit 69 kV and 138 kV line with 180 MVA and 463 MVA (emergency rating), respectively. The 138 kV line from Tuleta should terminate at the new 138 kV Big Oak substation
- Rebuild the existing 69 kV line (approximately 29 miles) from Coletto Creek to Fannin to Berclair as a double circuit 69 kV and 138 kV line with 180 MVA and 463 MVA (emergency rating), respectively. The 138 kV line from Coletto Creek should terminate at the new 138 kV Big Oak substation
- Rebuild Sinton – Skidmore – Beeville 69 kV transmission line (approx. 29.5 miles) on double-circuit capable structures such that the circuit Rate B is 180 MVA
- Move the loads from Pettus (73 MVA) and Big Oak (21 MVA) 69 kV substations to Tuleta and Big Oak 138 kV substations; respectively
- Install a 15 ohm series reactor at Edroy on the Mathis 69 kV transmission line
- Upgrade the Orange Grove - Casa Blanca 69 kV line (approx. 6.7 miles) such that the circuit Rate B is at least 180 MVA
- Install 9.6 Mvar capacitor bank at STEC Beeville Prison 69 kV substation
- Upgrade the STEC's Mathis – Mathis sub 69 kV line so that the circuit Rate B is at least 180 MVA

It should be noted that the upgrades listed in last two bullets under Option 1 are in addition to what AEPSC proposed initially in order to serve the load reliably. The total cost estimate is approximately \$93.15 million for these improvements.

The n-1 (AC contingency) analysis showed no overloads with option 1. Full AC Contingency results are provided in the Appendix B.

Figure II below shows the transmission topology related to Option 1 upgrades:

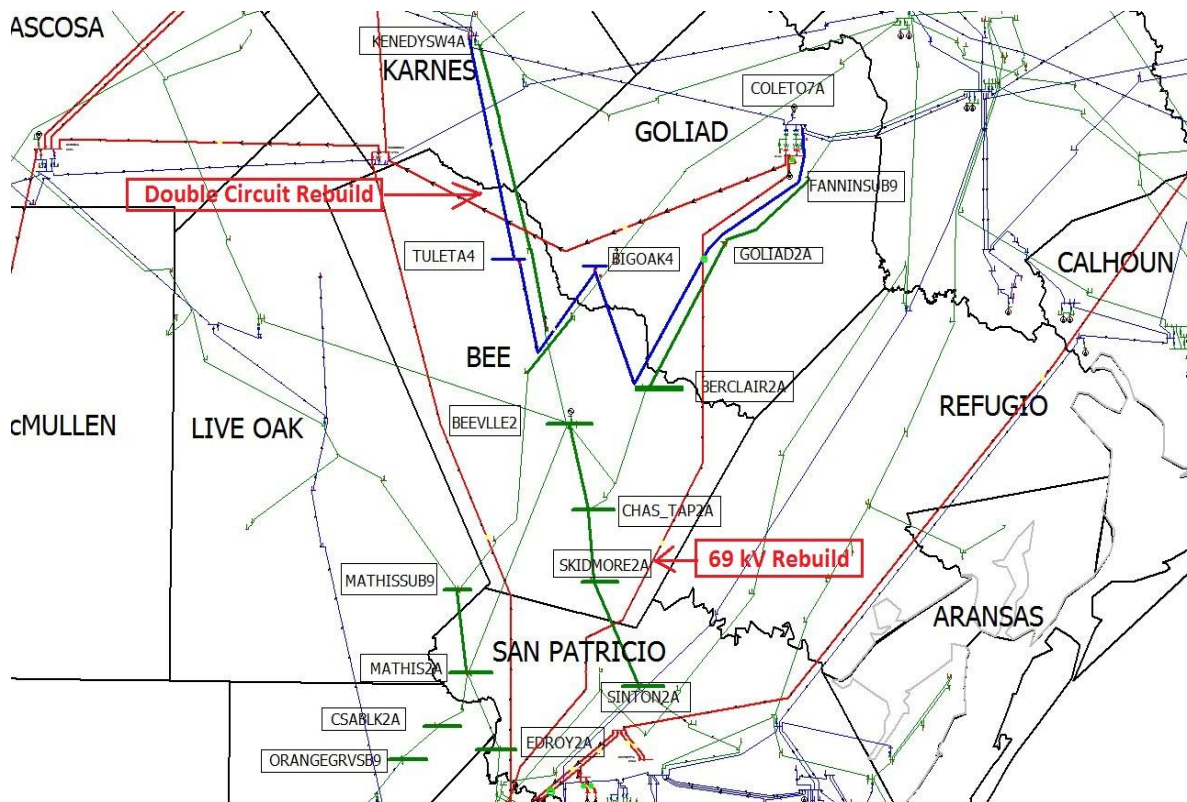


Figure II: Approximate Location of Upgrades

Option 2:

- Build a new 138 kV Big Oak substation near 69 kV Big Oak switching station (Big Oak 69 kV will be built on STEC Beeville – Goliad 69 kV line)
- Rebuild the existing 69 kV line (approximately 6.20 miles) from Pettus to Normana and from Normana to STEC Beeville to Big Oak (approximately 16 miles) as a double circuit 69 kV and 138 kV line with 180 MVA and 463 MVA (emergency rating), respectively. The 138 kV line from Tuleta should terminate at the new 138 kV Big Oak substation
- Rebuild the existing 69 kV line (approximately 29 miles) from Coletto Creek to Fannin to Berclair as a double circuit 69 kV and 138 kV line with 180 MVA and 463 MVA (emergency rating), respectively. The 138 kV line from Coletto Creek should terminate at the new 138 kV Big Oak substation
- Rebuild Sinton – Skidmore – Beeville 69 kV transmission line (approx. 29.5 miles) on double-circuit capable structures such that the circuit Rate B is 180 MVA

- Move the loads from Pettus (73 MVA) and Big Oak (21 MVA) 69 kV substations to Tuleta and Big Oak 138 kV substations; respectively
- Install a 15 ohm series reactor at Edroy on the Mathis 69 kV transmission line
- Upgrade the Orange Grove - Casa Blanca 69 kV line (approx. 6.7 miles) such that the circuit Rate B is at least 180 MVA
- Install 9.6 Mvar capacitor bank at STEC Beeville Prison 69 kV substation
- Upgrade the STEC's Mathis – Mathis sub 69 kV line so that the circuit Rate B is at least 180 MVA

The total cost estimate for Option 2 is approximately \$85.15 million.

It should be noted that the upgrades discussed in Option 2 are similar to the upgrades discussed in Option 1 except the installation of phase shifting transformer (PST) at Sinton has been omitted.

The n-1 (AC contingency) analysis showed no overloads with option 2. Full AC Contingency results are provided in the Appendix C.

Figure II (page 6) shows the transmission topology related to Option 2 upgrades.

Option 3:

- Build a new 138 kV Big Oak substation near 69 kV Big Oak switching station (Big Oak 69 kV will be built on STEC Beeville – Goliad 69 kV line)
- Rebuild the existing 69 kV line (approximately 6.20 miles) from Pettus to Normana and from Normana to STEC Beeville to Big Oak (approximately 16 miles) as a double circuit 69 kV and 138 kV line with 180 MVA and 463 MVA (emergency rating), respectively. The 138 kV line should terminate at the new 138 kV Big Oak substation
- Rebuild the existing 69 kV line (approximately 29 miles) from Coletto Creek to Fannin to Berclair as a double circuit 69 kV and 138 kV line with 180 MVA and 463 MVA (emergency rating), respectively. The 138 kV line should terminate at the new 138 kV Big Oak substation
- Rebuild Sinton – Skidmore – Beeville 69 kV transmission line (approx. 29.5 miles) on double-circuit capable structures such that the circuit Rate B is 180 MVA
- Move the loads from Pettus (73 MVA) and Big Oak (21 MVA) 69 kV substations to Tuleta and Big Oak 138 kV substations; respectively
- Upgrade the Orange Grove - Casa Blanca 69 kV line (approx. 6.7 miles) such that the circuit Rate B is at least 180 MVA
- Install 9.6 Mvar capacitor bank at STEC Beeville Prison 69 kV substation
- Upgrade the STEC's Mathis – Mathis sub 69 kV line so that the circuit Rate B is at least 180 MVA
- Upgrade the Edroy – Smith - Mathis 69 kV line (approx. 22.4 miles) such that the circuit Rate B is at least 180 MVA

The total cost estimate for Option 3 is approximately \$99.25 million.

It should be noted that the upgrades discussed in Option 3 are similar to the upgrades discussed in Option 2 except that the Edroy – Smith – Mathis 69 kV line was upgraded instead of installing a 15 Ohm series reactor at Edroy.

The n-1 (AC contingency) analysis showed no overloads with Option 3. Full AC Contingency results are provided in the Appendix D.

Figure II (page 6) shows the transmission topology related to Option 3 upgrades.

All three options studied resolved the identified reliability issues. Based on the cost estimates, Option 2 was preferred over Options 1 and 3. Upgrades discussed under Option 2 were studied for additional sensitivities.

5. G-1 and N-1 Analysis

In accordance with the ERCOT Planning Criteria, a G-1 + N-1 analysis was also performed by turning off nearby generation units in the study area and AC contingency analysis was performed. A sensitivity analysis (with 10 percent additional loading on 69 kV substations in the area of concern) was performed by turning off a single unit at Pearsall (25 MW). It was found that the outage of these units did not cause any transmission violations. Full AC Contingency results, with the Pearsall units out may be found in Appendix E.

6. Load Growth Scenario

A sensitivity analysis was performed to study the impact of additional load growth in the area. The loads on the existing 69 kV substations were increased by 10 percent. The 2017 base case load + 10 percent additional loading in the study area was studied for Option 2 upgrades. The AC contingency analysis revealed no violations.

Full AC Contingency results may be found in Appendix F.

7. Conclusion

Based on the reliability analysis it was determined that the following transmission upgrades studied as Option 2 would constitute the most effective and least cost solution to serve the projected load addition:







- Build a new 138 kV Big Oak substation near 69 kV Big Oak switching station (Big Oak 69 kV will be built on STEC Beeville – Goliad 69 kV line)
- Rebuild the existing 69 kV line (approximately 6.20 miles) from Pettus to Normana and from Normana to STEC Beeville to Big Oak (approximately 16 miles) as a double circuit 69 kV and 138 kV line with 180 MVA and 463 MVA (emergency rating), respectively. The 138 kV line from Tuleta should terminate at the new 138 kV Big Oak substation

- Rebuild the existing 69 kV line (approximately 29 miles) from Coletto Creek to Fannin to Berclair as a double circuit 69 kV and 138 kV line with 180 MVA and 463 MVA (emergency rating), respectively. The 138 kV line from Coletto Creek should terminate at the new 138 kV Big Oak substation
- Rebuild Sinton – Skidmore – Beeville 69 kV transmission line (approx. 29.5 miles) on double-circuit capable structures such that the circuit Rate B is 180 MVA
- Move the loads from Pettus (73 MVA) and Big Oak (21 MVA) 69 kV substations to Tuleta and Big Oak 138 kV substations; respectively
- Install a 15 ohm series reactor at Edroy on the Mathis 69 kV transmission line
- Upgrade the Orange Grove - Casa Blanca 69 kV line (approx. 6.7 miles) such that the circuit Rate B is at least 180 MVA
- Install 9.6 Mvar capacitor bank at STEC Beeville Prison 69 kV substation
- Upgrade the STEC's Mathis – Mathis sub 69 kV line so that the circuit Rate B is at least 180 MVA

8. Designated Providers of Transmission Facilities

In accordance with ERCOT Protocol Section 3.11.4.8, ERCOT staff is to designate transmission providers for projects reviewed in the RPG. These providers can agree to provide or delegate the new facilities or inform ERCOT if they do not elect to provide them. For the project scope recommended in this report AEP TCC and STEC are the designated providers of all transmission facilities.

9. APPENDICES

Appendix A	 2017_startCASE_Petus_Bigoak_LOADS.xl
Appendix B	 2017_startCASE_AEP.xlsx
Appendix C	 2017_startCASE_Option2.xlsx
Appendix D	 2017_startCASE_Option3.xlsx
Appendix E	 10percent_reactor_PearsalOUT_MathisUpd
Appendix F	 10percent_MATHIS_UPGRADE.xlsx