



ERCOT Independent Review of the AEPSC Live Oak County Transmission Project

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1. Introduction

Live Oak County Texas is served by three 138 kV lines. Two of the three 138 kV lines terminate at the AEP Sigmor 138 kV Station. The two 138 kV lines are San Miguel – Sigmor 138 kV and Lon Hill – Orange Grove – George West – Sigmor 138 kV. The Sigmor 138 kV Station then serves as a source to the underlying 69 kV system through a nearby AEP Three Rivers 138 kV Station. Figure 1 shows the map of the existing transmission system in the Live Oak County area.

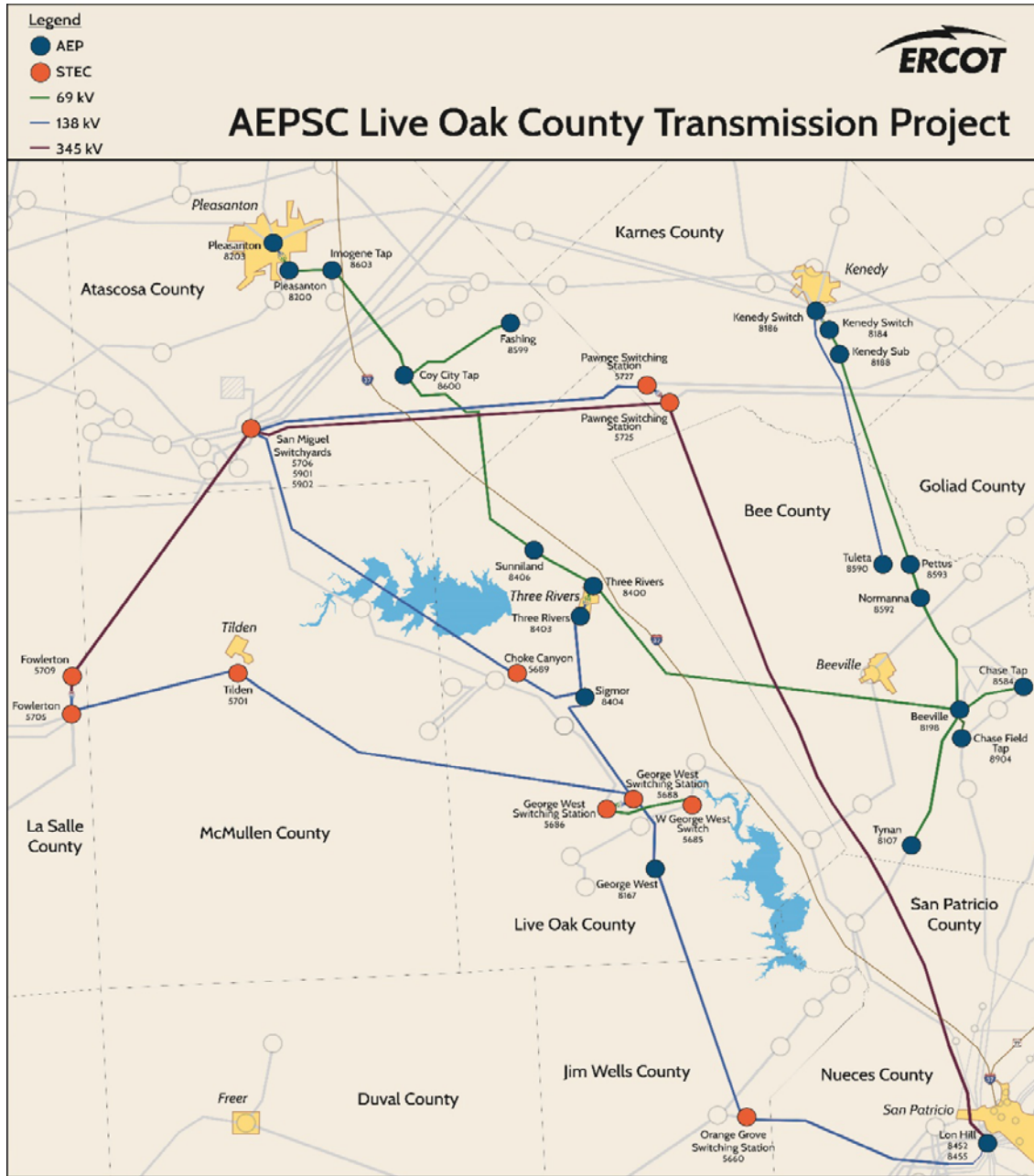


Figure 1: Transmission System map of Live Oak County Area

The load growth in Live Oak County and Bee County has recently created the need for transmission improvements in this area. In addition, with the present transmission system it is difficult to schedule the maintenance for either of the above two 138 kV lines even during off-peak seasonal conditions. In October 2013, during the maintenance outage of the San Miguel – Sigmor 138 kV line, the static shield wire of the Lon Hill – Orange Grove 138 kV line failed and faulted one of the phase conductors, causing the Orange Grove – Sigmor 138 kV line to trip and lock open. Approximately 80 MW of load loss resulted from this forced outage that included a large industrial customer and seventeen substations with load connected. Tables 1 – 3 show the reliability issues in the study area.

Table 1: Thermal overloads in 2018 and 2021 summer peak cases under G-1+N-1

Branch	Contingency	Loading in 2018	Loading in 2021
San Miguel – Choke Canyon 138 kV	Fowlerton – Miguel 345 kV; Duke Combined Cycle Train	107%	113%
Choke Canyon – Sigmor 138 kV	Fowlerton – Miguel 345 kV; Duke Combined Cycle Train	103%	109%
Normanna - Pettus 69 kV	Fowlerton – Miguel 345 kV; Duke Combined Cycle Train	100%	103%
Normanna - Beeville 69 kV	Fowlerton – Miguel 345 kV; Duke Combined Cycle Train	99%	103%

Table 2: Thermal overloads in 2017 minimum load case under N-1-1

Branch	Contingency	Loading
Pleasant – Imogene Tap 69 kV	George West – Sigmor 138 kV; Choke Canyon – San Miguel 138 kV	102%
Coy City – Imogene Tap 69 kV	George West – Sigmor 138 kV; Choke Canyon – San Miguel 138 kV	102%

Table 3: Low voltages in 2017 minimum load case under N-1-1

Bus Name	Contingency	Bus Voltage
Choke Canyon 138 kV	George West – Sigmor 138 kV; Choke Canyon – San Miguel 138 kV	0.88
Three Rivers 138 kV	George West – Sigmor 138 kV; Choke Canyon – San Miguel 138 kV	0.88
Sigmor 138 kV	George West – Sigmor 138 kV; Choke Canyon – San Miguel 138 kV	0.88

To improve the reliability of the Live Oak County and surrounding electric system, American Electric Power Service Corporation Company (AEPSC) proposed the following project:

- Construct approximately 24 miles of new 138 kV transmission line from the existing Tuleta Station to the existing Three Rivers Station with an emergency rating of 534 MVA

The total cost for this proposed project is estimated to be approximately \$33 million. ERCOT analyzed the system needs and reviewed the proposed project along with several other alternative projects.

2. Study Cases

To perform the independent review, ERCOT used the 2015 Regional Transmission Plan (RTP) G-1+N-1 and X-1+N-1 secure start cases for years 2018 and 2021, posted on July 21, 2015. The 2015 RTP secure cases included a placeholder project in the study area. Initially, the project related to this RPG proposal was removed from the 2015 RTP secure case in order to create a study base case. Later, each of the project alternatives was modeled into the study base case to evaluate the performance. ERCOT also used the 2017 minimum load case built for the 2014 RTP to study the maintenance outage conditions.

The reliability criteria used in this independent review is consistent with the RTP study. NERC TPL-001-4 contingency events (P0, P1, P2-1, P3, P6 and P7) were analyzed for the summer peak cases in this study. N-1-1 contingency analysis was performed for the minimum load case to study the system maintenance outage conditions.

PowerWorld version 18 with SCOPF was used for AC power flow analysis. TARA version 801 was used for N-1-1 contingency analysis to study the system maintenance outage conditions.

3. Description of Project Alternatives and Reliability Analysis

Five project alternatives studied for consideration are discussed below.

3.1 Description of studied project alternatives

Option 1: New 345/138 kV Substation on the Lon Hill – Pawnee 345 kV Line with New 138 kV Line to Three Rivers 138 kV Station

- Construct a new three breaker ring bus, 345/138 kV Substation on the existing 345 kV line from Pawnee to Lon Hill
- Install an autotransformer at the new 345/138 kV Substation with an emergency rating of approximately 540 MVA
- Construct approximately 15 miles of new 138 kV transmission line from the new Substation to the existing Three Rivers Station with an emergency rating of approximately 534 MVA
- Rebuild the Pettus - Normanna – Beeville 69 kV line on a double circuit capable structure with an emergency rating of approximately 180 MVA
- Upgrade the Sigmor – George West 138 kV line with an emergency rating of approximately 486 MVA

The estimated cost for Option 1 is \$76.6 million.

Option 2: New Pawnee – Three Rivers 138 kV Line

- Construct approximately 22 miles of new 138 kV transmission line from the existing Pawnee Station to the existing Three Rivers Station with an emergency rating of approximately 534 MVA
- Rebuild the Pettus - Normanna – Beeville 69 kV line on a double circuit capable structure with an emergency rating of approximately 180 MVA
- Upgrade the Sigmor – George West 138 kV line with an emergency rating of approximately 486 MVA

The estimated cost for Option 2 is \$63.5 million.

Option 3: New Tuleta – Three Rivers 138 kV Line (AEP proposed option to address the maintenance outage issue)

- Construct approximately 24 miles of new 138 kV transmission line from the existing Tuleta Station to the existing Three Rivers Station with an emergency rating of approximately 534 MVA.

The estimated cost for Option 3 is \$32.9 million.

Option 3-1: New Tuleta – Three Rivers 138 kV Line and Pettus – Normanna – Beeville 69 kV line rebuild

- Construct approximately 24 miles of new 138 kV transmission line from the existing Tuleta Station to the existing Three Rivers Station with an emergency rating of approximately 534 MVA
- Rebuild the Pettus - Normanna – Beeville 69 kV line on a double circuit capable structure with an emergency rating of approximately 180 MVA
- Upgrade the Sigmor – George West 138 kV line with an emergency rating of approximately 486 MVA

The estimated cost for Option 3 is \$65.2 million.

Option 4: New 138 kV Beeville Substation with New Tuleta – Beeville 138 kV Line and Beeville – Three Rivers 69 kV line rebuild and conversion to 138 kV

- Construct a new 138 kV Beeville Substation near the existing Beeville 69 kV Station
- Install a new 138/69 kV autotransformer at the new Beeville 138 kV Station with an emergency rating of approximately 143MVA
- Construct a new 138/69 kV double circuit transmission line from Tuleta to Beeville with emergency ratings approximately 360/180 MVA. Attempt to utilize existing Right of Way of the Pettus – Normanna – Beeville 69 kV transmission line where possible
- Using existing Right of Way where possible, rebuild and convert the existing Beeville – Three Rivers 69 kV transmission line to 138 kV with an emergency rating of approximately 360 MVA.

The estimated cost for Option 4 is \$74.5 million.

3.2 Reliability Analysis Results

All five of the options described above will provide another 138 kV source to the Three Rivers 138 kV Station and may facilitate future maintenance to be performed and improve transmission reliability to the area. All five of the options resolve the N-1-1 reliability issues identified in 2017 minimum load case. No X-1+N-1 issues were observed for each of the five options.

Option 1, Option 3-1 and Option 4 effectively resolve all the reliability issues identified in 2018 and 2021 summer peak cases. For Option 2, the Pawnee 345/138 kV auto transformer exceeds its emergency rating under N-1 and G-1+N-1 conditions in both 2018 and 2021. For Option 3, Sigmor – George West 138 kV line exceeds the emergence rating and Pettus – Normanna – Beeville 69 kV is close to the emergency rating under G-1+N-1 condition in 2021. Table 4 and Table 5 show the reliability study results of the summer peak cases under N-1 and G-1+N-1 conditions (the loss of the Duke Combined Cycle Train is the most limiting G-1 contingency condition in the study area). The full contingency analysis results for 2018 and 2021 are provided in Appendix A.

Table 4: Thermal loadings in 2018 and 2021 summer peak cases for all options under N-1

Element	Contingency	Option 1		Option 2		Option 3		Option 3-1		Option 4	
		2018	2021	2018	2021	2018	2021	2018	2021	2018	2021
Pawnee 345/138 kV transformer	Fowlerton – Miguel 345 kV	-	-	101%	102%	-	-	-	-	-	-

Table 5: Thermal loadings in 2018 and 2021 summer peak cases for all options under G-1+N-1

Element	Contingency	Option 1		Option 2		Option 3		Option 3-1		Option 4	
		2018	2021	2018	2021	2018	2021	2018	2021	2018	2021
Pawnee 345/138 kV transformer	Fowlerton – Miguel 345 kV; Duke CC Train	-	-	101%	105%	-	-	-	-	-	-
Sigmor – George West 138 kV	Fowlerton – Miguel 345 kV; Duke CC Train	-	-	-	-	100%	107%	-	-	-	-
Normanna – Pettus 69 kV	Fannin – Goliad 69 kV & Coletto – NorthHill 345 kV; Duke CC Train	-	-	-	-	93%	98%	-	-	-	-
Normanna – Beeville 69 kV	Fannin – Goliad 69 kV & Coletto – NorthHill 345 kV; Duke CC Train	-	-	-	-	92%	97%	-	-	-	-

4. Conclusion and Recommendation

Among the three options which resolved all the reliability issues, Option 1 has the highest cost estimate (\$76.6 million) followed by Option 4 (\$74.5 million) and Option 3-1 (\$65.2 million). Although Option 4 is not the lowest cost project, it provides more benefit when compared to the other two options, for example:

- Option 4 could utilize existing Right of Way compared to Option 3-1 which would require ~24 miles of new ROW.
- Option 4 would be an improvement to the weak 69 kV system in that area. Currently, the loads in Bee County are all served by the 69 kV transmission system. The Beeville 69 kV Station is a hub connecting five 69 kV lines. Adding a 138 kV Beeville Substation will provide a new source and improve the voltage in that area.

Based on the review, ERCOT recommends Option 4 as the preferred option to meet the reliability need in the area. The following facilities constitute the preferred option:

- Construct a new 138 kV Beeville Substation near the existing Beeville 69 kV Station
- Install a new 138/69 kV autotransformer at the new Beeville 138 kV Station with an emergency rating of approximately 143MVA
- Construct a new 138/69 kV double circuit transmission line from Tuleta to Beeville with emergency ratings approximately 360/180 MVA. Attempt to utilize existing Right of Way of the Pettus – Normanna – Beeville 69 kV transmission line where possible
- Using existing Right of Way where possible, rebuild and convert the existing Beeville – Three Rivers 69 kV transmission line to 138 kV with an emergency rating of approximately 360 MVA

5. Designated Provider of Transmission Facilities

In accordance with ERCOT Nodal Protocols Section 3.11.4.8, ERCOT staff is to designate transmission providers for projects reviewed in the RPG. The default providers will be those that own the end points of the new projects. These providers can agree to provide or delegate the new facilities or inform ERCOT if they do not elect to provide them. If different providers own the two ends of the recommended projects, ERCOT will designate them as co-providers and they can decide between themselves what parts of the recommended projects they will each provide.

Since American Electric Power Texas Central Company (AEP TCC) owns the substations of Tuleta, Beeville and Three Rivers, ERCOT designates AEP TCC as the provider for the project scope recommended in this report.

6. Appendix A

Appendix A: AC Contingency Analysis Result of 2018 and 2021 Cases (N-1 and G-1+N-1 analyses)



Appendix A - N-1
and G-1+N-1 Result