ERCOT Independent Review of the Sharyland and BPUB Cross Valley Project

Version 1.0

Document Revisions

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Table of Contents

1. Introduction 2
2. Study Approach 4
3. Study Case Evaluation 5
4. Description of Project Alternatives and Reliability Analysis 11
5. Long-Term Considerations for the Lower Rio Grande Valley 19
6. Summary of Project Alternatives 21
7. Conclusion 24
8. Designated Provider of Transmission Facilities 26

1. Introduction

The Brownsville area is located at the southernmost portion of the Lower Rio Grande Valley (LRGV) area in the ERCOT system along the international border with Mexico. There are three (3) electric utilities that have service areas in Brownsville and surrounding areas. The bulk of the electrical service inside the city is supplied by Brownsville Public Utilities Board (BPUB), the city-owned, non-profit utility. The other distribution service providers are American Electric Power – Texas Central Company and Magic Valley Electric Cooperative.

Currently, the load is primarily served by four 138 kV lines and the Silas Ray natural gas and oil-fired plant owned and operated by BPUB. The total generation capability of the Silas Ray power plant is approximately 120 megawatts. One of the units is sixty (60) years old. Figure 1 shows the east LRGV area of the ERCOT system including the Brownsville area.

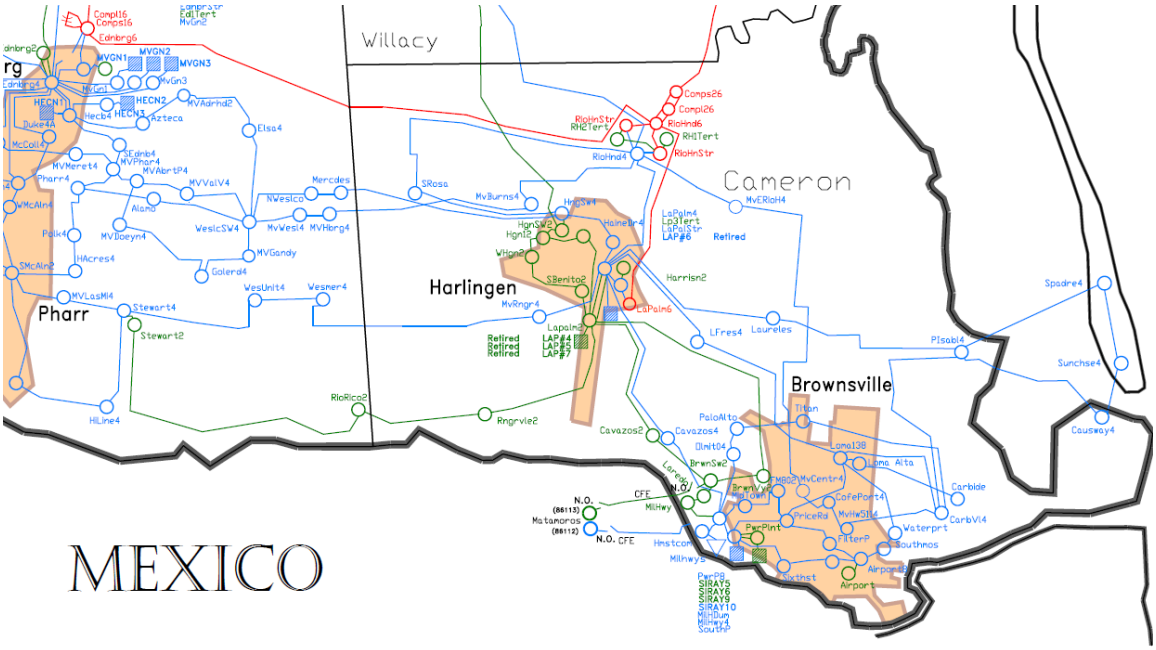

Figure 1: Map of east Lower Rio Grande Valley area

Brownsville is the 16th largest city in Texas. Due to its proximity to the Gulf of Mexico and being at the southern edge of the ERCOT system, the area has experienced multiple storm related forced outages and rolling blackouts in the past. Additionally, the transmission utilities in the area have experienced difficulty in taking lines out for maintenance due to the reliance on only one power plant and a limited number of transmission circuits to support the area.

Figure 2 depicts the historical summer and winter peak demand levels for the BPUB area over the past two decades. The Brownsville area has experienced high population and economic growth and consequently high electric load growth rates. In addition to the normal load growth, BPUB has also projected new industrial load of 250 MW in the 2014 timeframe near the Port of Brownsville. While this 250 MW does not reflect a specific end-use consumer, it reflects BPUB's estimate of the load that could be added at this location if sufficient transmission capacity was available to serve it, based on

previous economic development activity and prior industrial load interconnection requests received by BPUB. Figure 3 shows the projected BPUB summer and winter load growth with the expected industrial load assumed to start in 2014.

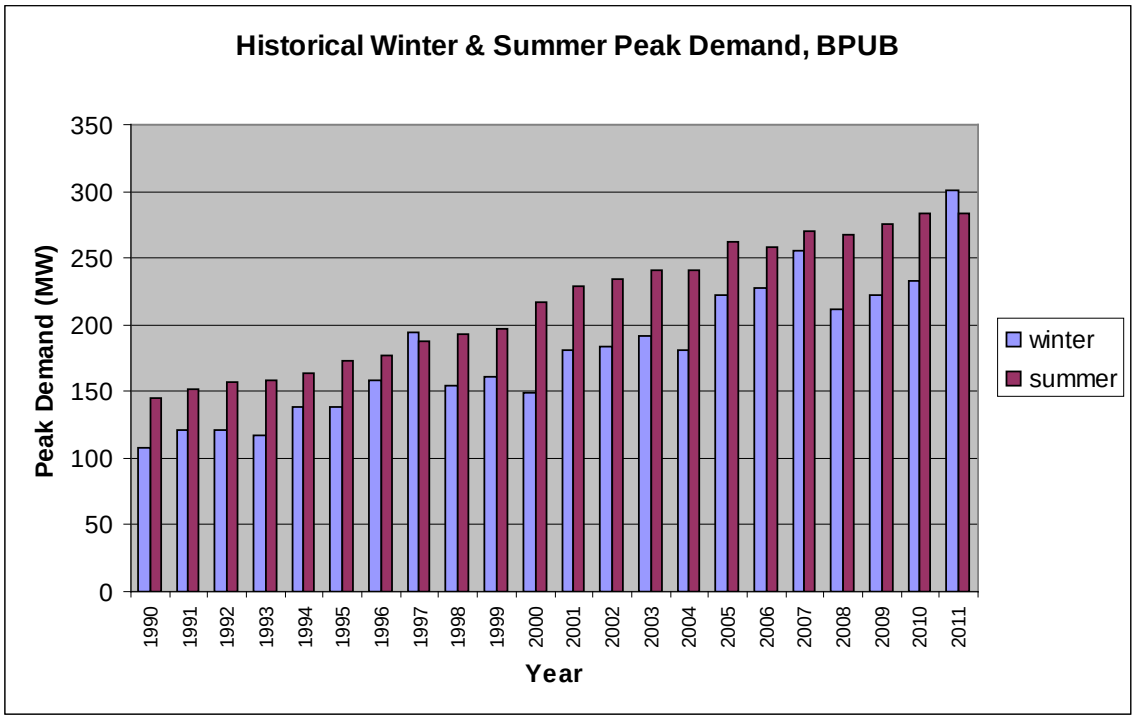

Figure 2: Historical BPUB Summer & Winter Peak Demand, 1990-2011

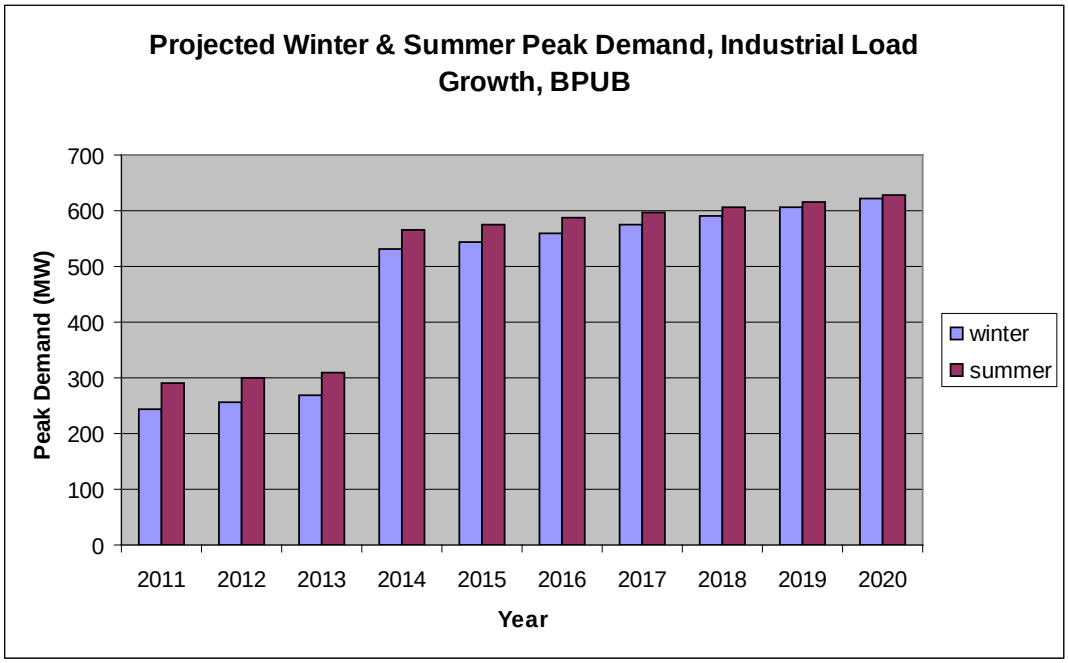

Figure 3: Projected BPUB Summer & Winter Peak Demand with the 250 MW industrial load addition in 2014

In order to provide transmission infrastructure that meets ERCOT reliability criteria and supports BPUB's projected load including industrial load additions of 250 MW, Sharyland Utilities (Sharyland) and BPUB proposed the following improvements:

- Construct a new 345 kV bus at the existing Loma Alta station with one (1) 345/138 kV autotransformer
- Construct a new 345kV transmission line from the existing 345 kV La Palma station to a new 345 kV Loma Alta bus (~14 miles)
- Construct a new 345 kV transmission line from the new 345 kV Loma Alta bus to a new 345 kV bus at the existing Frontera station across the LRGV (~ 59 miles)

ERCOT analyzed the system needs and reviewed the proposed project along with several other alternative projects.

2. Study Approach

The Steady State Working Group (SSWG) 2016 summer peak base case (updated in April 2011) was modified to reflect updated information related to the study area, and the resulting study case was evaluated to determine if there were any reliability criteria exceedances in the east LRGV and Brownsville area.

There are two existing wind plants (Penascal and Gulf Wind) and two planned wind plant additions (Magic Valley Wind Project and Los Vientos) in the study area. Based on 2010 coastal wind output data, it was decided to set the dispatch of the wind plants in the area to 10% of their capacity for the study. This value was near the 10^{th} percentile output for high load hours which, although conservative, seemed appropriate given the lack of history for Texas coastal wind plant data and the low number of plants with operational history. The Railroad DC tie was assumed to be set at zero export and import for the extent of this study.

The SSWG 2016 summer peak base case was modified with the following changes to create the 2016 study case:

- Add a new 163 mile, single circuit 345 kV line from Laredo Lobo to Rio Bravo to North Edinburg with 50% series compensation
- Reconductor the existing Lon Hill-Nelson Sharpe-Ajo-Rio Hondo 345 kV line and Lon Hill-North Edinburg 345 kV line to 1988/2426 MVA normal/emergency rating
- Upgrade the South McAllen to Las Milpas to Stewart Road 138 kV line to 395/476 MVA normal/emergency rating (identified as Reliability Project in 2011 Five-Year Transmission Plan)
- The dispatch of the Penascal, Gulf Wind, Magic Valley Wind Project and Los Vientos wind plants were set at 10% of their capacity
- Silas Ray Unit 5 (10 MW) was turned off in the model for the extent of the analysis because it was decided to not count on the availability of this unit to solve the local reliability constraints for the timeframe of this study due to its age (~60 years) and technology (small gas steam, non-reheat).

- All other generation in the LRGV was set at maximum output with the exception of the hydro powered units which were left at their base case output

During the course of the RPG review of this project, RPG members did not come to a consensus about whether it was appropriate to plan the system based on the inclusion of the potential 250 MW industrial load additions in Brownsville (modeled at the Loma Alta substation). However, based on BPUB's account of historical load interconnection requests at the Port of Brownsville that have been unfulfilled due to limited transmission capacity, ERCOT agreed to perform a sensitivity study to evaluate the system needs with and without the 250 MW load additions.

The evaluation consisted of AC contingency analysis in accordance with NERC and ERCOT criteria. Several transmission improvement options were studied in order to resolve the reliability criteria exceedances found in the 2016 study case. An additional sensitivity analysis was performed using a 2020 summer peak case to allow the longer-term needs of the area to be taken into account in the current decision.

3. Study Case Evaluation

ERCOT performed a power flow AC contingency analysis on the 2016 summer peak study case to find reliability issues that did not meet the NERC or ERCOT planning criteria. The results of the power flow analysis indicated that the worst single contingency is the loss of a 138 kV line combined with the loss of the largest generator[1] in the Brownsville area. For this contingency, there are several thermal overloads under pre-contingency and post-contingency conditions even in the case without the 250 MW load additions. Figure 4 shows the thermal overloads observed in the Brownsville area without the 250 MW load additions. The resulting overloads cannot be relieved by redispatch of the generation in the LRGV area. There were no voltage violations under base case or contingency. The results of this analysis are listed below:

2016 Summer Peak Reliability Results without the new 250 MW load:

Pre-contingency overloads:

- Rio Hondo – East Rio Hondo 138 kV line (108.9% of normal rating)

Post-contingency overloads (except overflow in base case):

- La Palma – Cavazos line 138 kV (114.8% of contingency rating)
- La Palma – Los Fresnos 138 kV line (109.3% of contingency rating)
- Military Highway – Cavazos 138 kV line (107.6% of contingency rating)

[1] The loss of generator is modeled as the loss of combined cycle train in the Silas Ray plant.

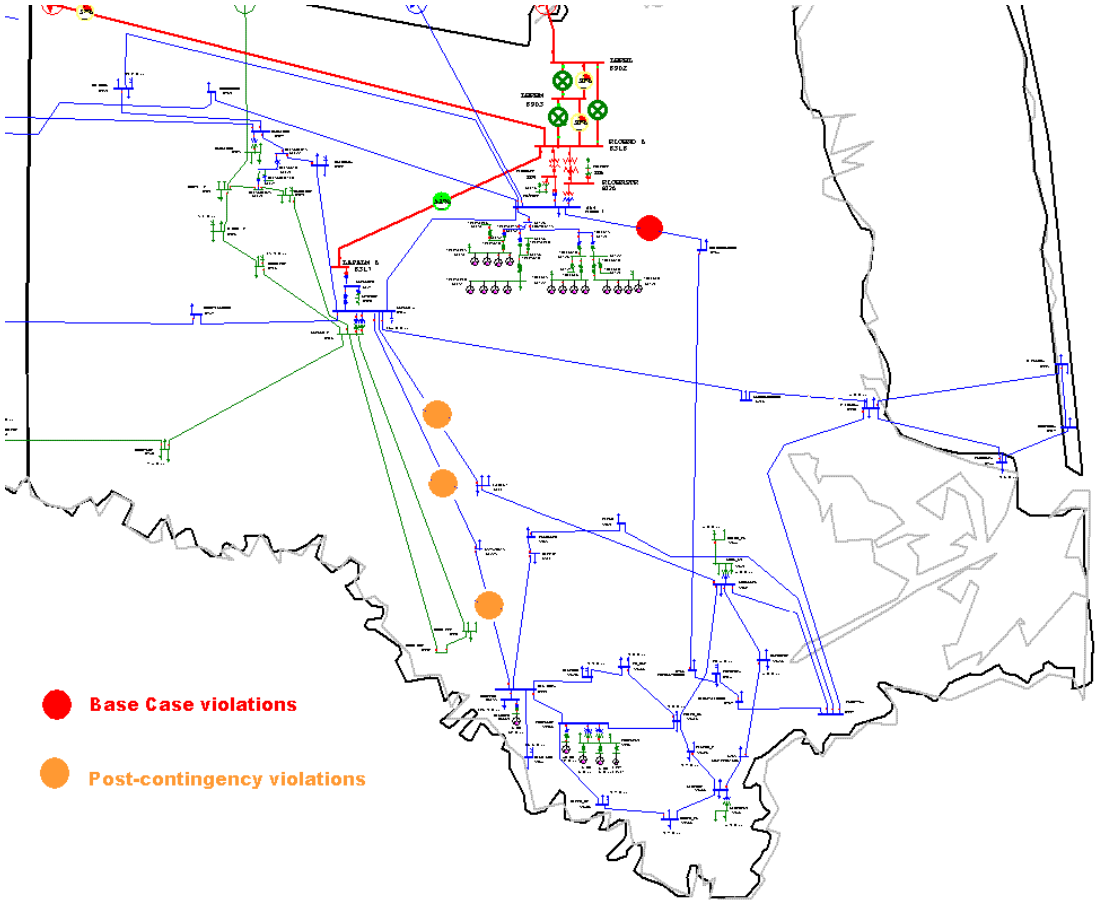

Figure 4: 2016 Thermal overloads in Brownsville area without 250 MW load

This analysis was repeated on a case that included the 250 MW load additions. Figure 5 shows the thermal overloads observed in the Brownsville area with the 250 MW load additions. There were no voltage violations under base case or contingency. The results of this analysis are listed below:

2016 Summer Peak Reliability analysis including the new 250 MW load

Pre-contingency overloads:

- Rio Hondo – East Rio Hondo 138 kV line (152.7% of normal rating)
- East Rio Hondo – Central Avenue Sub 138 kV line (141.4% of normal rating)
- La Palma – Los Fresnos 138 kV line (124.3% of normal rating)
- La Palma – Cavazos line 138 kV (115.0% of normal rating)
- Loma Alta – Los Fresnos 138 kV line (108.8% of normal rating)
- Military Highway – Cavazos 138 kV line (108.0% of normal rating)

Post-contingency overloads:

- Loma Alta – Carbide Valley line 138 kV (158.3% of contingency rating)
- La Palma – Laureles Sub 138 kV line (118.5% of contingency rating)
- Port Isabel – Laureles Sub 138 kV line (114.1% of contingency rating)
- La Palma 345/138 kV transformer (109.7% of contingency rating)
- Aderhold to Hidalgo Energy Center 138 kV line (100.5% of contingency rating)

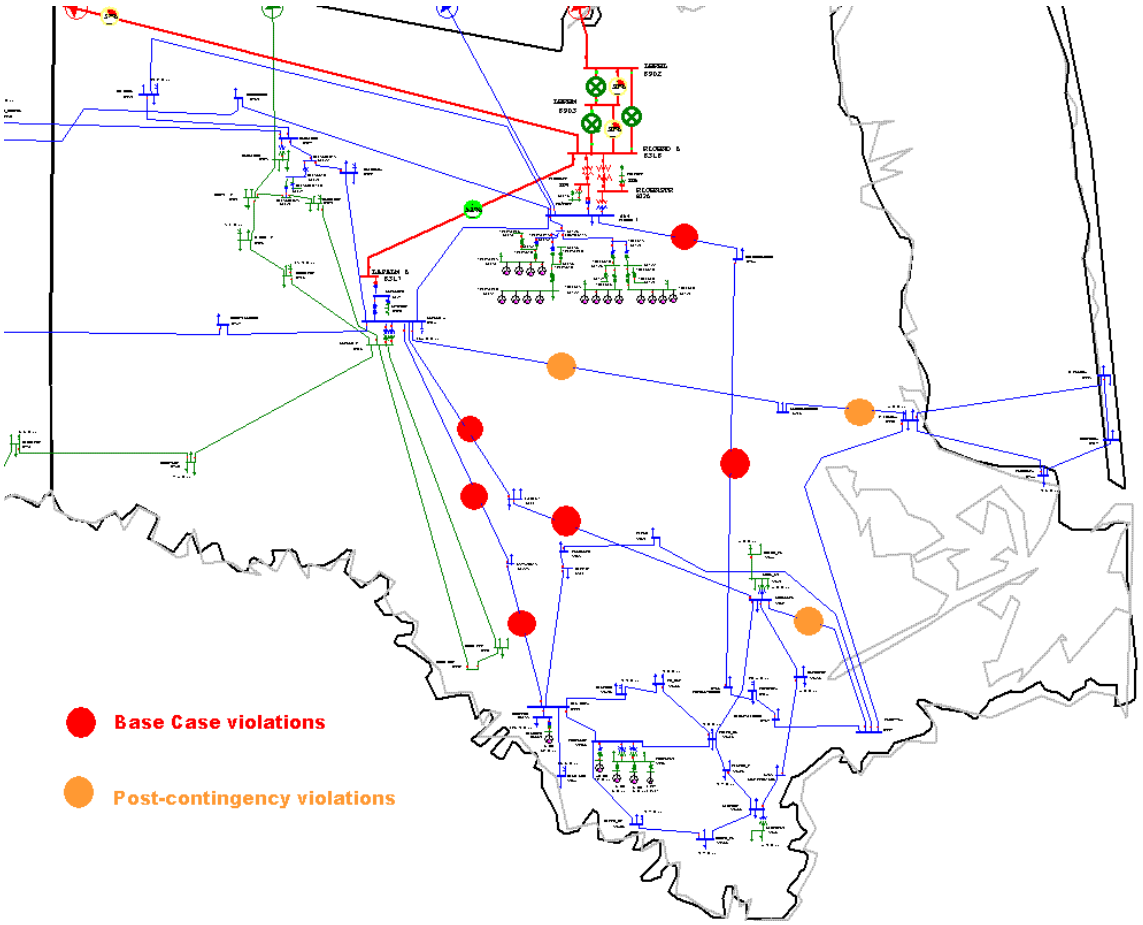

Figure 5: 2016 Thermal overloads in Brownsville Area including the 250 MW load

2016 Summer Peak N-1-1 Reliability analysis without the new 250 MW load

The Brownville system is primarily served by four (4) 138 kV lines originating from the La Palma and Rio Hondo substations. The Rio Hondo 345 kV station is supported by two 345 kV lines from Corpus Christi and North Edinburg, respectively. The N-1-1 contingency involving the loss of the two (2) 345 kV lines supporting the Rio Hondo substation would result in the Brownville area load served by only the 138 kV system from the west side of the LRGV. Without a 345 kV source, the cross Valley 138 kV lines that serve Brownsville will be significantly loaded and the only viable mitigation plan would involve significant load shed in the Brownsville area (even without the industrial load additions in

Brownsville). Similar heavy line loadings were observed for the N-1-1 contingency loss of the La Palma – Rio Hondo 345 kV line and the La Palma – Rio Hondo 138 kV line.

Some of the major post-contingency (> 120%) N-1-1 overloads:

- Weslaco Unit to Stewart Road 138 kV line (159.1 % of contingency rating)
- Weslaco Switching Station to Weslaco 138 kV line (147.9% of contingency rating)
- Aderhold to Hidalgo Energy Center 138 kV line (142.9% of contingency rating)
- Elsa to Aderhold 138 kV line (133.8% of contingency rating)
- Heidelberg to Weslaco 138 kV line (132.3% of contingency rating)
- Burns to Heidelberg 138 kV line (124.6% of contingency rating)
- Wesmer to Weslaco Unit 138 kV line (121.6% of contingency rating)

N-1-1 overloads (>120%) for prior outage of La Palma – Rio Hondo 345kV line

- Harlingen to Oleander 138 kV line (167.24% of contingency rating)
- Rio Hondo – East Rio Hondo 138 kV line (165.2% of contingency rating)
- East Rio Hondo – Central Avenue Sub 138 kV line (157.3% of contingency rating)
- Haine Dr. to Oleander 138 kV line (157% of contingency rating)
- Weslaco Unit to Stewart Road 138 kV line (127.9 % of contingency rating)
- La Palma to Haine Dr. 138 kV line (121.7% of contingency rating)

It was determined that it would require ~365 MW of load shed in the LRGV to mitigate the N-1-1 contingency (loss of the two (2) 345 kV lines supporting the Rio Hondo substation) exceedances to below 100% of the contingency rating. Approximately 290 MW of the 365 MW load shed would affect the Brownsville area which has a peak load forecast of ~627 MW (excluding the new 250 MW load) in 2016. Figure 6 shows the Brownville load area which would be affected by the 290 MW load shed.

Due to the severity of these N-1-1 overloads and the amount and multiple locations of load shed that would be needed to mitigate all the N-1-1 overloads, it is neither practical nor reliable to implement a post-contingency N-1-1 mitigation plan. Some of these N-1-1 overloads are greater than 150% of the contingency rating which could cause uncontrolled tripping and eventually lead to system cascading. In real-time if the first contingency were to occur, the system operators would have to implement mitigation plans for pre-contingency load shed in order to prepare for the next contingency. It is determined that in order to reduce the N-1-1 post contingency overloads to less than 120% of the contingency rating, it would require ~175 MW of load shed in the LRGV following the loss of the first contingency.

With the addition of the 250 MW load in Brownsville, the same N-1-1 contingency would result in a voltage collapse in the Brownsville area. Any mitigation plan to resolve this would require significant pre-contingency load shed (greater than ~175 MW) to prevent the voltage collapse in the Brownsville area.

Figure 7 shows the projected 2016 load duration curve for the Brownsville area that illustrates the load shed exposure for N-1-1 conditions.

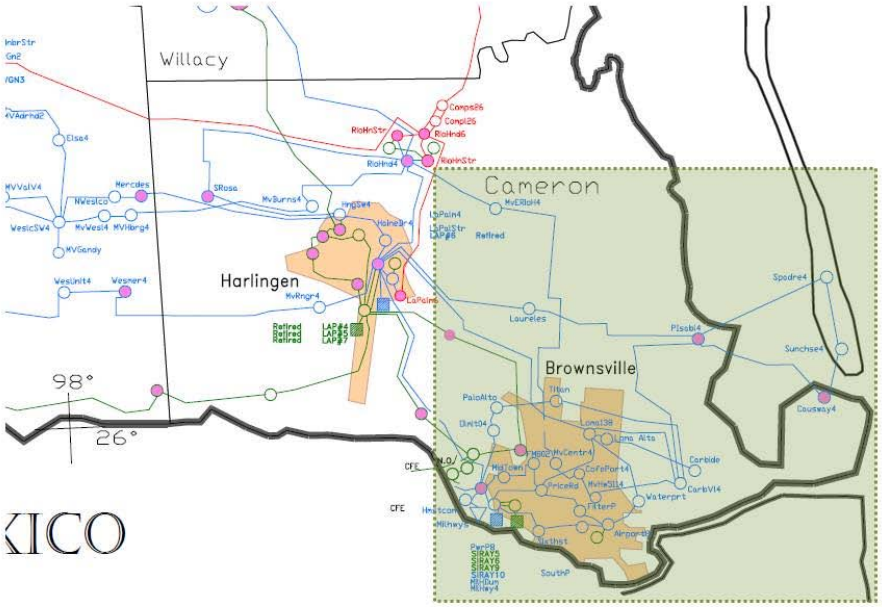

Figure 6: Map of the Brownsville N-1-1 load shed area

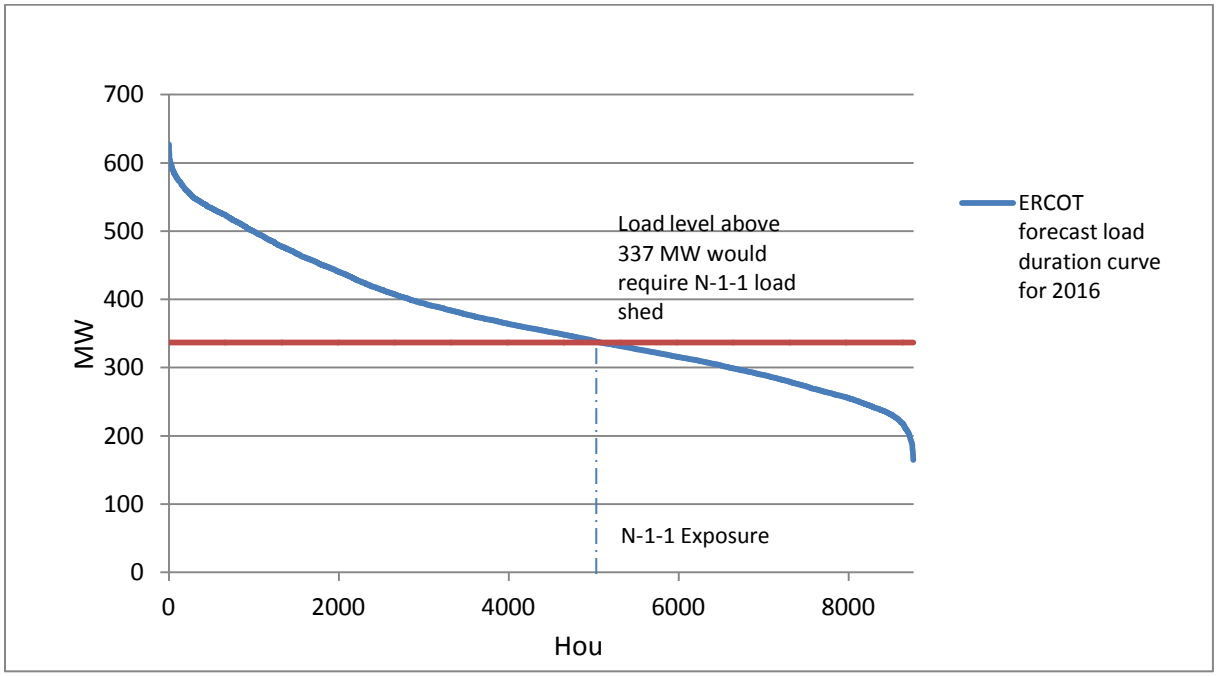

Figure 7: 2016 Load duration curve for Brownsville area (without 250 MW industrial load additions)

Also it is difficult to take a maintenance or construction related outage of one of these lines 345 kV lines at Rio Hondo because the next contingency would leave the Brownsville area exposed to load shed under moderate to high load conditions . Moreover, owners and operators of both generation resources and transmission assets must schedule maintenance and construction outages during short

windows in the spring and fall. Figure 8 shows the historical maximum daily peak for 2010-2011 timeframe with the 2012 load level that could be supported for maintenance outages based on the N-1-1 condition. It is estimated that during the 2010-2011 time frame there were ~180 days when the load was low enough to allow for these maintenance outage conditions. It should be noted that based on the 2016 load projections this maintenance outage window will be significantly smaller.

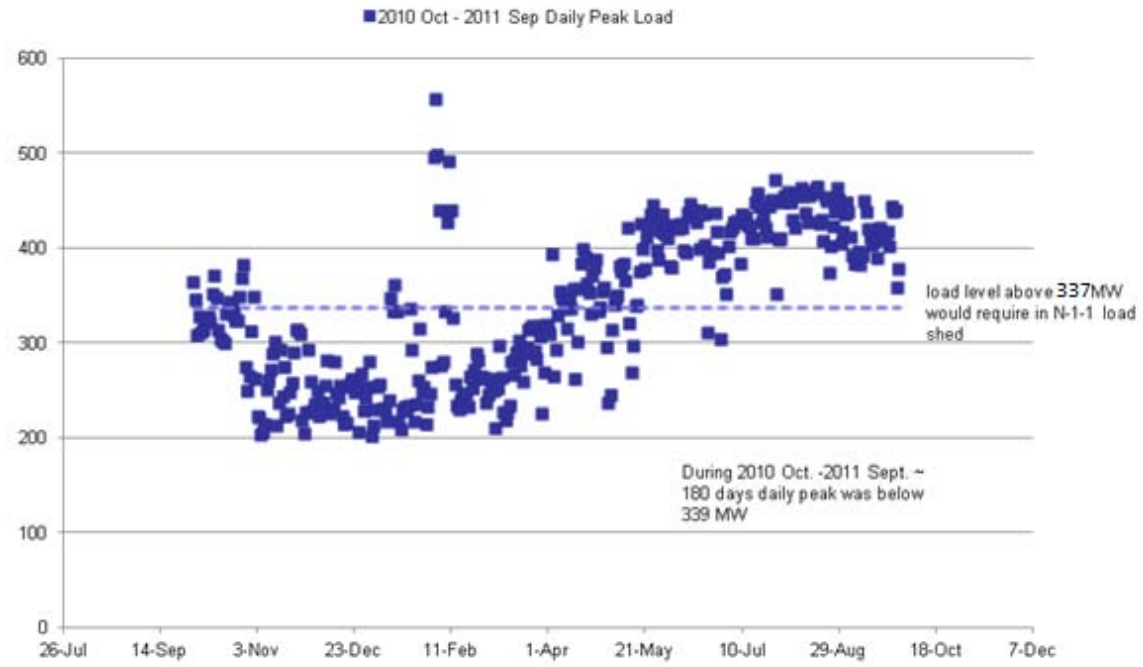

Figure 8: Historical maximum daily peak for 2010-2011for Brownsville Area

Based on the N-1-1 reliability analysis, it is determined that the east LRGV area will be exposed to significant load shed risk for the loss of one 345 kV source (N-1) to the Brownsville area. The N-1-1 risk will be worse with the 250 MW load additions at Brownsville area and cause voltage collapse in the Brownsville area under these conditions if transmission improvements are not made. NERC and ERCOT planning criteria allow for the controlled shedding of load under N-1-1 contingency conditions. The LRGV situation is unique in ERCOT due to the amount of load shed that would be required to keep facilities within their applicable ratings and the proportion of total load in an area that would need to be shed. While there may be a few places in ERCOT with similar amounts of total MW of load shed needed under N-1-1 conditions, nowhere else is the proportion of total load in a metropolitan area so high. This also corresponds to a significant amount of time that the load would be exposed to these conditions which may make it difficult to perform maintenance of the transmission and generation facilities in the area. Further, a substantial amount of load would have to be shed after the first contingency in order to prevent cascading following a second contingency. Due to the above considerations, it was decided to include this N-1-1 contingency as part of the reliability analysis for project consideration.

4. Description of Project Alternatives and Reliability Analysis

Multiple project alternatives were studied to solve the reliability criteria exceedances in two separate scenarios. The two scenarios and corresponding project alternatives are discussed below:

Scenario 1:

Scenario 1 assumed 2016 load conditions without the 250 MW load additions in Brownsville. The options studied for Scenario 1 are described as follows:

Submitted Option- Sharyland and BPUB proposal

- Construct a new 345kV bus at the Loma Alta station with two (2) 345/138kV autotransformers
- Construct a new 345kV bus at the Frontera station with one 345/138kV autotransformer
- Construct a new La Palma-Loma Alta 345kV line (~14 miles) on new ROW using double circuit capable towers with one circuit in place
- Construct a new Frontera-Loma Alta 345kV line (~59 miles) on new ROW using double circuit capable towers with one circuit in place

The cost estimate for the Submitted Option is $259.9M. It should be noted that Sharyland Utilities and BPUB reviewed and updated the cost estimate during the ERCOT Independent Review which resulted in the cost estimate stated above which is higher than what was originally submitted to the RPG. Additionally, both AEP and Sharyland Utilities provided ERCOT with cost estimates for new 345 kV line construction. AEP's estimate was approximately $2.4M per mile for double circuit capable towers with one circuit in place. The Sharyland Utilities estimate for similar construction was $2.06M per mile. In order to be consistent all estimates used in this report for new 345 kV line construction assumed the higher estimate ($2.4M per mile).

Below are the contingency analysis results with the Submitted Option implemented in the study model:

N-1-1 Post-contingency overloads: (prior outage of the Rio Hondo-Ajo 345 kV line)

- Aderhold to Hidalgo Energy Center 138 kV line (110.2% of contingency rating)
- Elsa to Aderhold 138 kV line (101.4% of contingency rating)

Approximately 48 MW of load would need to be shed in order to resolve the above overloads.

N-1-1 Post-contingency overloads: (prior outage of the La Palma-Rio Hondo 345 kV line)

- Rio Hondo – East Rio Hondo 138 kV line (116.3% of contingency rating)
- East Rio Hondo – Central Avenue Sub 138 kV line (108.7% of contingency rating)
- Harlingen to Oleander 138 kV line (102.2% of contingency rating)

Approximately 64 MW of load would need to be shed in order to resolve the above overloads.

While the above N-1-1 contingency results would still require some load shed, the amount of load shed is considered feasible to execute and the loading on the lines are low enough such that pre-contingency load shed would not be required. There were no other post-contingency overloads in the LRGV in Scenario 1 with the Submitted Option.

Several additional options were studied in order to resolve the reliability criteria exceedances. In order to reduce or eliminate the load shed for the N-1-1 contingency condition it was found that a new 345 kV source from the west side of the LRGV was required. Alternatives were analyzed for originating a 345 kV line from North Edinburg 345 kV station, Frontera 138 kV station, Railroad 138 kV station, and South McAllen 138 kV station. The Railroad and South McAllen stations were found to be less effective in reducing the N-1-1 overloads.

However, it is recommended that the line be routed near the existing South McAllen 138 kV station in order to support the long-term needs of the west side of the LRGV. This is explained further in Section 5. Also, for this reason, the option of sourcing the 345 kV line from South McAllen was kept as a project alternative in the study.

In order to support the long-term needs of the Brownsville/ Harlingen area, two termination points were considered feasible: La Palma 345 kV station and Loma Alta 138 kV station. When terminating at La Palma 345 kV station, an additional 138 kV line improvement was found to be necessary to support the load growth in the Brownsville area (excluding the 250 MW load addition). The following three 138 kV project alternatives were considered:

Option A

- Rebuild La Palma-Cavazos-Military Highway 138 kV line (~21 miles) with a rating of at least 430 MVA
- Rebuild La Palma-Los Fresnos-Loma Alta 138 kV line (~22 miles) with a rating of at least 430 MVA

The cost estimate for Option A is $87.3M.

Option B

- Construct a new La Palma-Palo Alto 138 kV line (~12 miles) on new Right of Way (ROW) with a rating of at least 215 MVA

The cost estimate for Option B is $18.5M.

Option C

- Rebuild and convert La Palma-Brownsville SS-Brownsville City 69 kV line (~22 miles) to a 138 kV line
- Add a 138 kV ring bus and new 138/69 kV autotransformer at Brownsville

The cost estimate for Option C is $54.3M.

Option D

- Rebuild a portion of the existing La Palma-Brownsville (via Cavazos) 69 kV line for 138 kV operation with a rating of at least 215 MVA and terminate the line into the existing Military Highway to Palo Alto 138 kV transmission line at a new substation or the existing Olmito or Palo Alto 138 kV substations (~18.5 miles, partial new ROW)
- Add a 69 kV bus and a 138/69 kV autotransformer at the 138 kV termination point and construct a 69 kV line out of the substation to connect to the existing 69 kV line to Brownsville

The cost estimate for Option D is $30.8M.

All four project alternatives solved the reliability criteria exceedances. Since Option B had a significantly lower capital cost when compared to the other options it was the preferred alternative even though it will require new ROW. Therefore, Option B was incorporated into all of the project alternatives that terminate at the La Palma 345 kV station (Options 1, 2 and 4).

The following project alternatives were evaluated for Scenario 1:

Option 1

- Construct a new La Palma-Palo Alto 138 kV line (~12 miles) on new ROW with a rating of at least 215 MVA
- Construct a new La Palma-Frontera 345 kV line (double circuit capable with one circuit in place) routed in proximity to the existing South McAllen Substation (~ 56.6 miles) on new ROW
- Construct a new 345kV bus at the Frontera station with one 345/138kV autotransformer

The cost estimate for Option 1 is $204.2M. Below are the contingency analysis results with Option 1 implemented in the study model:

N-1-1 Post-contingency overloads: (prior outage of the Rio Hondo-Ajo 345 kV line)

- Aderhold to Hidalgo Energy Center 138 kV line (111.4% of contingency rating)
- Azteca to Hidalgo Energy Center 138 kV line (102.8% of contingency rating)
- Elsa to Aderhold 138 kV line (102.5% of contingency rating)

Approximately 53 MW of load would need to be shed in order to resolve the above overloads.

N-1-1 Post-contingency overloads: (prior outage of the La Palma-Rio Hondo 345 kV line)

- Rio Hondo – East Rio Hondo 138 kV line (124.6% of contingency rating)
- East Rio Hondo – Central Avenue Sub 138 kV line (116.9% of contingency rating)
- Harlingen to Oleander 138 kV line (105.2% of contingency rating)
- Azteca to Hidalgo Energy Center 138 kV line (100.5% of contingency rating)

Approximately 123 MW of load would need to be shed in order to resolve the above overloads.

There were no other post-contingency overloads in the LRGV in Scenario 1 with Option 1.

Option 2

- Construct a new La Palma-Palo Alto 138 kV line (~12 miles) on new ROW with a rating of at least 215 MVA
- Construct a new La Palma-South McAllen 345 kV line (double circuit capable with one circuit in place) (~ 42.2 miles) on new ROW
- Construct a new 345kV bus at the South McAllen station with one 345/138kV autotransformer

The cost estimate for Option 2 is $168.2M. Below are the contingency analysis results with Option 2 implemented in the study model:

N-1-1 Post-contingency overloads: (prior outage of the Rio Hondo-Ajo 345 kV line)

- Aderhold to Hidalgo Energy Center 138 kV line (118.3% of contingency rating)
- Elsa to Aderhold 138 kV line (109.4% of contingency rating)
- West McAllen to North McAllen 138 kV line (107.7% of contingency rating)
- Azteca to Hidalgo Energy Center 138 kV line (106% of contingency rating)
- Azteca to SE Edinburg 138 kV line (103% of contingency rating)

Approximately 152 MW of load would need to be shed in order to resolve the above overloads.

N-1-1 Post-contingency overloads: (prior outage of the La Palma-Rio Hondo 345 kV line)

- Rio Hondo – East Rio Hondo 138 kV line (129.6% of contingency rating)
- East Rio Hondo – Central Avenue Sub 138 kV line (121.9% of contingency rating)
- Harlingen to Oleander 138 kV line (113.5% of contingency rating)
- Azteca to Hidalgo Energy Center 138 kV line (102.6% of contingency rating)
- Aderhold to Hidalgo Energy Center 138 kV line (100.2% of contingency rating)

Approximately 167 MW of load would need to be shed in order to resolve the above overloads.

There were no other post-contingency overloads in the LRGV in Scenario 1 with Option 2.

Option 3

- Construct a new North Edinburg-Loma Alta 345 kV line (double circuit capable with one circuit in place) routed in proximity to the existing South McAllen Substation(~ 106.5 miles) on new ROW
- Construct a new 345kV bus at the Loma Alta station with one 345/138kV autotransformer

The cost estimate for Option 3 is $256.2M. Below are the contingency analysis results with Option 3 implemented in the study model:

N-1-1 Post-contingency overloads: (prior outage of the Rio Hondo-Ajo 345 kV line)

- None

N-1-1 Post-contingency overloads: (prior outage of the La Palma-Rio Hondo 345 kV line)

- None

There were no other post-contingency overloads in the LRGV in Scenario 1 with Option 3.

Option 4

- Construct a new La Palma-Palo Alto 138 kV line (~12 miles) on new ROW with a rating of at least 215 MVA
- Construct a new North Edinburg-La Palma 345 kV line (double circuit capable with one circuit in place) routed in proximity to the existing South McAllen Substation(~ 89.9 miles) on new ROW

The cost estimate for Option 4 is $234.8M. Below are the contingency analysis results with Option 4 implemented in the study model:

N-1-1 Post-contingency overloads: (prior outage of the Rio Hondo-Ajo 345 kV line)

- None

N-1-1 Post-contingency overloads: (prior outage of the La Palma-Rio Hondo 345 kV line)

- Rio Hondo – East Rio Hondo 138 kV line (104.7% of contingency rating)

Approximately 24 MW of load would need to be shed in order to resolve the above overload.

The above N-1-1 contingency results would still require some load shed, but the amount of load shed is considered feasible to execute and the loading on the lines are low enough such that pre-contingency load shed would not be required. There were no other post-contingency overloads in the LRGV in Scenario 1 with Option 4.

All of the project alternatives studied solved the G-1 + N-1 post-contingency overloads. Options 1 and 2 would still require a significant amount of load shed under N-1-1 conditions and were not considered further. While Option 3 resulted in no N-1-1 post-contingency overloads, Option 4 and the Submitted Option had minimal overloads and the post-contingency load shed required for these options would be feasible. Because Option 4 had acceptable performance and a lower capital cost when compared to Options 3 and the Submitted Option ($21.4M and $25.1M, respectively) it is the preferred solution for Scenario 1.

Scenario 2:

Scenario 2 assumed 2016 load conditions with the 250 MW load additions in Brownsville. In order to reduce or eliminate the load shed for the N-1-1 contingency condition it was found that a new 345 kV source from the west side of the LRGV was required as discussed in Scenario 1. However, terminating the 345 kV line at La Palma 345 kV station was found to be deficient for supporting the load addition in Brownsville. Hence, the most reasonable termination point was the Loma Alta 138 kV station.

In addition, a 138 kV improvement was found to be necessary to solve the G-1 + N-1 contingency overloads (except for the Submitted Option). Based on the analysis discussed in Scenario 1, the La Palma-Palo Alto 138 kV line (Option B) was assumed to be the preferred 138 kV improvement in Options 5 and 6.

Three project alternatives were considered for solving the reliability criteria exceedances in Scenario 2:

Submitted Option- Sharyland and BPUB proposal

- Construct a new 345 kV bus at the Loma Alta station with two (2) 345/138kV autotransformers
- Construct a new 345 kV bus at the Frontera station with one 345/138 kV autotransformer
- Construct a new La Palma-Loma Alta 345 kV line (~14 miles) on new ROW using double circuit capable towers with one circuit in place
- Construct a new Frontera-Loma Alta 345 kV line (~59 miles) on new ROW using double circuit capable towers with one circuit in place

The cost estimate for the Submitted Option is estimated to be $259.9M. Below are the contingency analysis results with the Submitted Option implemented in the study model:

N-1-1 Post-contingency overloads: (prior outage of the Rio Hondo-Ajo 345 kV line)

- Aderhold to Hidalgo Energy Center 138 kV line (125.6% of contingency rating)
- Elsa to Aderhold 138 kV line (117.6% of contingency rating)
- Weslaco Unit to Stewart Road 138 kV line (116.7 % of contingency rating)
- Azteca to Hidalgo Energy Center 138 kV line (110.0% of contingency rating)
- Frontera 345/138 kV transformer (109.7% of contingency rating)
- Weslaco Switching Station to Stewart 2 138 kV line (108.4% of contingency rating)
- Azteca to SE Edinburg 138 kV line (107.0% of contingency rating)
- Weslaco Switching Station to Weslaco 138 kV line (102.8% of contingency rating)
- Elsa to Weslaco 138 kV line (101.9% of contingency rating)

Approximately 216 MW of load would need to be shed in order to resolve the above overloads.

N-1-1 Post-contingency overloads: (prior outage of the La Palma-Rio Hondo 345 kV line)

- Rio Hondo – East Rio Hondo 138 kV line (149.6% of contingency rating)

- East Rio Hondo – Central Avenue Sub 138 kV line (141.8% of contingency rating)
- Harlingen to Oleander 138 kV line (135.7% of contingency rating)
- Haine Dr. to Oleander 138 kV line (107.3% of contingency rating)

Approximately 314 MW of load would need to be shed in order to resolve the above overloads.

There were no other post-contingency overloads in the LRGV in Scenario 2 with the Submitted Option.

Option 5 (same as Option 3 with the addition of the La Palma-Palo Alto 138 kV line)

- Construct a new La Palma-Palo Alto 138 kV line (~12 miles) on new ROW with a rating of at least 215 MVA
- Construct a new North Edinburg-Loma Alta 345 kV line (double circuit capable with one circuit in place) routed in proximity to the existing South McAllen Substation (~106.5 miles) on new ROW
- Construct a new 345 kV bus at the Loma Alta station with one 345/138 kV autotransformer

The cost estimate for Option 5 is $274.7M. Below are the contingency analysis results with Option 5 implemented in the study model:

N-1-1 Post-contingency overloads: (prior outage of the Rio Hondo-Ajo 345 kV line)

- Aderhold to Hidalgo Energy Center 138 kV line (107.8% of contingency rating)
- Weslaco Unit to Stewart Road 138 kV line (102.8 % of contingency rating)

Approximately 61 MW of load would need to be shed in order to resolve the above overloads.

N-1-1 Post-contingency overloads: (prior outage of the La Palma-Rio Hondo 345 kV line)

- Harlingen to Oleander 138 kV line (118.38% of contingency rating)
- Rio Hondo – East Rio Hondo 138 kV line (115.5% of contingency rating)
- East Rio Hondo – Central Avenue Sub 138 kV line (107.7% of contingency rating)

Approximately 135 MW of load would need to be shed in order to resolve the above overloads.

There were no other post-contingency overloads in the LRGV in Scenario 2 with Option 5.

Option 6

- Construct a new La Palma-Palo Alto 138 kV line (~12 miles) on new ROW with a rating of at least 215 MVA
- Construct a new Frontera-Loma Alta 345 kV line (double circuit capable with one circuit in place) routed in proximity to the existing South McAllen Substation(~ 73.2 miles) on new ROW

- Construct a new 345kV bus at the Frontera station with one 345/138kV autotransformer
- Construct a new 345kV bus at the Loma Alta station with one 345/138kV autotransformer

The cost estimate for Option 6 is $245.4M. Below are the contingency analysis results with Option 6 implemented in the study model:

N-1-1 Post-contingency overloads: (prior outage of the Rio Hondo-Ajo 345 kV line)

- Aderhold to Hidalgo Energy Center 138 kV line (128.43% of contingency rating)
- Elsa to Aderhold 138 kV line (119.5% of contingency rating)
- Weslaco Unit to Stewart Road 138 kV line (114.4 % of contingency rating)
- Azteca to Hidalgo Energy Center 138 kV line (111.3% of contingency rating)
- Weslaco Switching Station to Weslaco 138 kV line (109..6% of contingency rating)
- Azteca to SE Edinburg 138 kV line (108.4% of contingency rating)
- Elsa to Weslaco 138 kV line (104.6% of contingency rating)
- West McAllen to North McAllen 138 kV line (100.3% of contingency rating)

Approximately 282 MW of load would need to be shed in order to resolve the above overloads.

N-1-1 Post-contingency overloads: (prior outage of the La Palma-Rio Hondo 345 kV line)

- Harlingen to Oleander 138 kV line (148.4% of contingency rating)
- Rio Hondo – East Rio Hondo 138 kV line (144.1% of contingency rating)
- East Rio Hondo – Central Avenue Sub 138 kV line (136.3% of contingency rating)
- Haine Dr. to Oleander 138 kV line (119.6% of contingency rating)
- Haine Dr. to La Palma 138 kV line (103.5% of contingency rating)
- Azteca to Hidalgo Energy Center 138 kV line (106.3% of contingency rating)
- Azteca to S. Edinburg 138 kV line (103.3% of contingency rating)
- Weslaco Unit to Stewart Road 138 kV line (101.1% of contingency rating)

Approximately 341 MW of load would need to be shed in order to resolve the above overloads.

There were no other post-contingency overloads in the LRGV in Scenario 2 with Option 6.

All three project alternatives solved the G-1 + N-1 post-contingency overloads. The Submitted Option and Option 6 still had a significant amount of load shed that would be required under N-1-1 conditions and may require load shed after the first contingency in order to prevent cascading following the next contingency due to the high line loadings. While Option 5 had some load shed, it is considered feasible for N-1-1 conditions and may not require load shed after the first contingency in order to prevent cascading following the next contingency. Therefore, Option 5 was considered the preferred option for Scenario 2.

5. Long-Term Considerations for the Lower Rio Grande Valley

The Long-Term Assessment 2020 summer peak base case (updated in April 2011) was evaluated to determine if there were any reliability criteria exceedances in the LRGV beyond 2016. This base case was modified with the following changes to create the 2020 study case:

- Add a new 163 mile, single circuit 345 kV line from Laredo Lobo to Rio Bravo to North Edinburg with 50% series compensation
- Reconductor the existing Lon Hill-Nelson Sharpe-Ajo-Rio Hondo 345 kV line and Lon Hill-North Edinburg 345 kV line to 1988/2426 MVA normal/emergency rating
- Upgrade the South McAllen to Las Milpas to Stewart 138 kV line to 395/476 MVA normal/emergency rating (identified as Reliability Project in 2011 Five-Year Transmission Plan)
- The dispatch of the Penascal, Gulf Wind, Magic Valley Wind Project and Los Vientos wind plants were set at 10% of their capacity
- Silas Ray Unit 5 (10 MW) was turned off
- All other generation in the LRGV was set at maximum output with the exception of the hydro powered units which were left at their base case output
- Add 250 MW load at Loma Alta (Brownsville)
- Construct a new 345kV bus at the Loma Alta station with one 345/138kV autotransformer
- Construct a new Rio Hondo-Loma Alta 345kV line (~27.4 miles) on new ROW
- Construct a new La Palma-Palo Alto 138 kV line (~12 miles) on new ROW with a rating of at least 215 MVA

The Rio Hondo-Loma Alta 345 kV line was added as a proxy to support the load addition in the Brownsville area in order to evaluate the cross-Valley reliability needs in 2020. The following are the contingency analysis results for this case for the LRGV.

G-1 + N-1 (prior outage of the largest Silas Ray unit) post-contingency overloads:

- Azteca to Hidalgo Energy Center 138 kV line (112.4% of contingency rating)
- Azteca to SE Edinburg 138 kV line (108.5% of contingency rating)
- Aderhold to Hidalgo Energy Center 138 kV line (107.2% of contingency rating)
- La Palma to Rangerville 138 kV line (102.5% of contingency rating)

<u>Other lines with post contingency flows > 90% of the contingency rating</u>

- Weslaco Unit to Stewart Road 138 kV line (97.0 % of contingency rating)
- Elsa to Aderhold 138 kV line (95.4% of contingency rating)
- S. Edinburg to Pharr Sub. 138 kV line (93.6% of contingency rating)
- North Edinburg to Rio Hondo 345 kV line (90.5% of contingency rating)

G-1 + N-1 (prior outage of the largest Frontera unit) post-contingency overloads:

- Azteca to Hidalgo Energy Center 138 kV line (116.4% of contingency rating)
- Azteca to SE Edinburg 138 kV line (112.8% of contingency rating)
- Aderhold to Hidalgo Energy Center 138 kV line (106.5% of contingency rating)
- La Palma to Rangerville 138 kV line (102.5% of contingency rating)

Other lines with post contingency flows > 90% of the contingency rating

- S. Edinburg-Pharr Sub. 138 kV line (97.9% of contingency rating)
- Edinburg- McColl 138 kV line (96.8 % of contingency rating)
- Weslaco Unit to Stewart Road 138 kV line (96.8 % of contingency rating)
- Elsa to Aderhold 138 kV line (94.8% of contingency rating)
- West McAllen to North McAllen 138 kV line (94.5% of contingency rating)
- North McAllen to Edinburg 138 kV line (92.7% of contingency rating)
- North Edinburg to Rio Hondo 345 kV line (91.4% of contingency rating)

The total cost estimate to upgrade each of the overloaded lines except the La Palma to Rangerville 138 kV line is approximately $35.4M. The total cost estimate to upgrade each of the lines loaded 92% or higher (except the La Palma to Rangerville 138 kV line and the Weslaco Unit to Stewart Road 138 kV line) is approximately $95M. An alternative solution would be to construct a North Edinburg to South McAllen 345 kV line with a new 345 kV bus and autotransformer at South McAllen. The Frontera station was considered as an alternative to South McAllen, but terminating the line at South McAllen showed a greater reduction in loading on the overloaded elements. This alternative would relieve all of the above overloaded lines except for the La Palma to Rangerville 138kV line and the Weslaco Unit to Stewart Road 138 kV line. Further, this alternative would provide for a better long-term solution because it would significantly reduce the north to south flow on other highly loaded transmission lines on the west side of the LRGV. Therefore, connecting a 345 kV source from North Edinburg into the South McAllen 138 kV substation will defer or eliminate the need to implement a significant amount of 138 kV line upgrades. Any 345 kV lines that are constructed between the west part of the LRGV and the east part of the LRGV should be constructed and routed in anticipation of a 345/138 kV connection at the existing South McAllen station.

The above analysis also showed that both the North Edinburg to Rio Hondo 345 kV line and the Weslaco Unit to Stewart Road 138 kV line were more than 90% post-contingency loaded by 2020 without an additional cross-Valley 345 kV line.

Based on this analysis it can be concluded that a 345 kV line from North Edinburg to the east side of the LRGV (with a future connection at South McAllen) will likely defer multiple line upgrades that would be needed between 2016 and 2020. Hence, Options 3, 4 and 5, which incorporate such a line, will not only meet the reliability needs identified in 2016, but will also solve the long-term reliability problems in the LRGV.

6. Summary of Project Alternatives

Below is a summary of the project alternatives considered in this study:

Project Options	Project Description	Cost Estimate ($M)	N-1-1 load shed amount
Submitted Project	• La Palma-Loma Alta 345 kV line • Frontera-Loma Alta 345 kV line • New 345/138kV autos at Loma Alta and Frontera	$259.9	64 MW
1	• La Palma-Palo Alto 138 kV line • La Palma-Frontera 345 kV line via South McAllen • New 345/138kV auto at Frontera	$204.2	123 MW
2	• La Palma-Palo Alto 138 kV line • La Palma-South McAllen 345 kV line • New 345/138kV auto at South McAllen	$168.2	167 MW
3	• North Edinburg-Loma Alta 345 kV line via South McAllen • New 345/138kV auto at Loma Alta	$256.2	0 MW
4	• La Palma-Palo Alto 138 kV line • North Edinburg-La Palma 345 kV line via South McAllen	$234.8	24 MW

Table 1: Summary of project alternatives analyzed for Scenario 1 (excluding the 250 MW load)

Project Options	Project Description	Cost Estimate ($M)	N-1-1 load shed amount
Submitted Project	• La Palma-Loma Alta 345 kV line • Frontera-Loma Alta 345 kV line • New 345/138kV autos at Loma Alta and Frontera	$259.9	314 MW
5	• La Palma-Palo Alto 138 kV line • North Edinburg-Loma Alta 345 kV line via South McAllen • New 345/138kV auto at Loma Alta	$274.7	135 MW
6	• La Palma-Palo Alto 138 kV line • Frontera-Loma Alta 345 kV line via South McAllen • New 345/138kV autos at Frontera and Loma Alta	$245.4	341 MW

Table 2: Summary of project alternatives analyzed for Scenario 2 (including the 250 MW load)

Figures 9 through 15 show the location of each of the project alternatives.

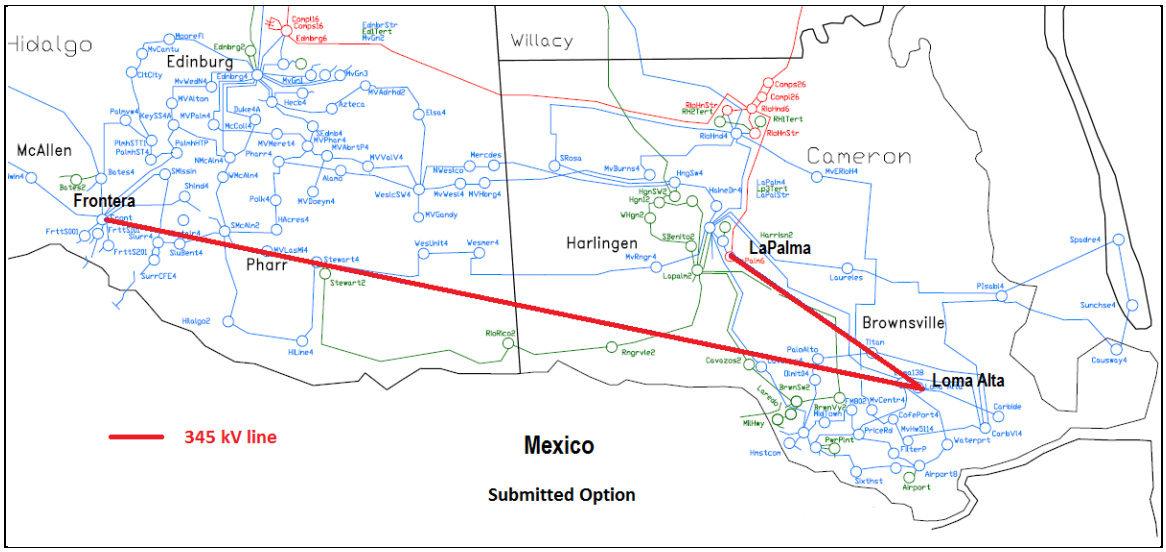

Figure 9: Submitted Option

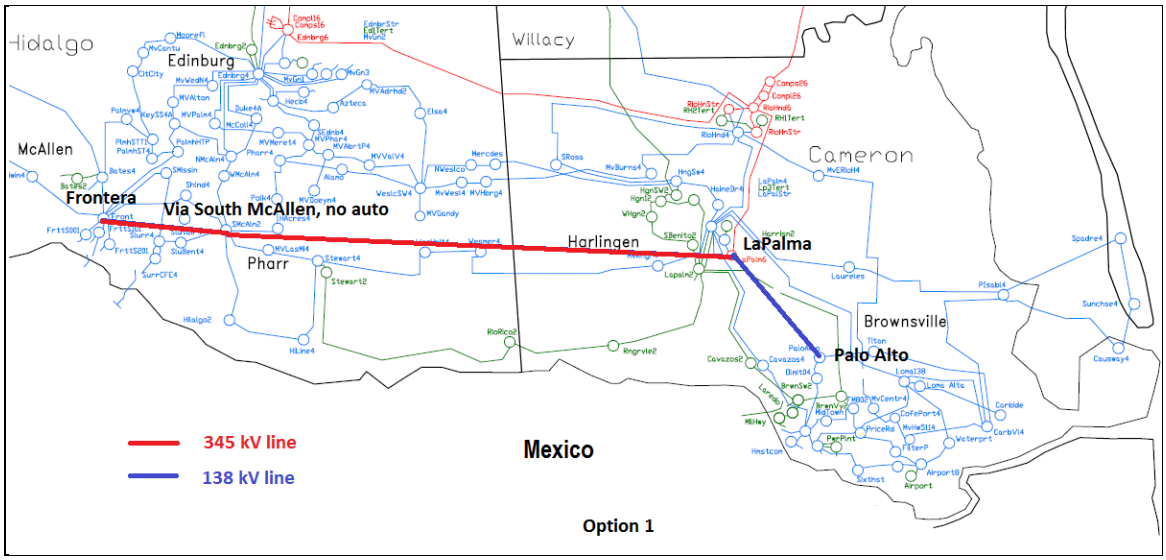

Figure 10: Option 1

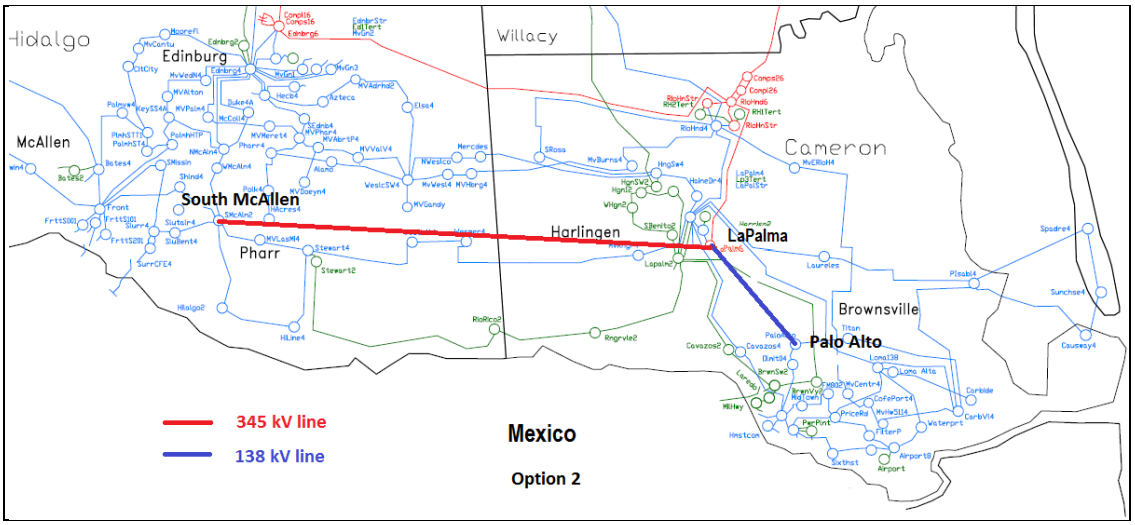

Figure 11: Option 2

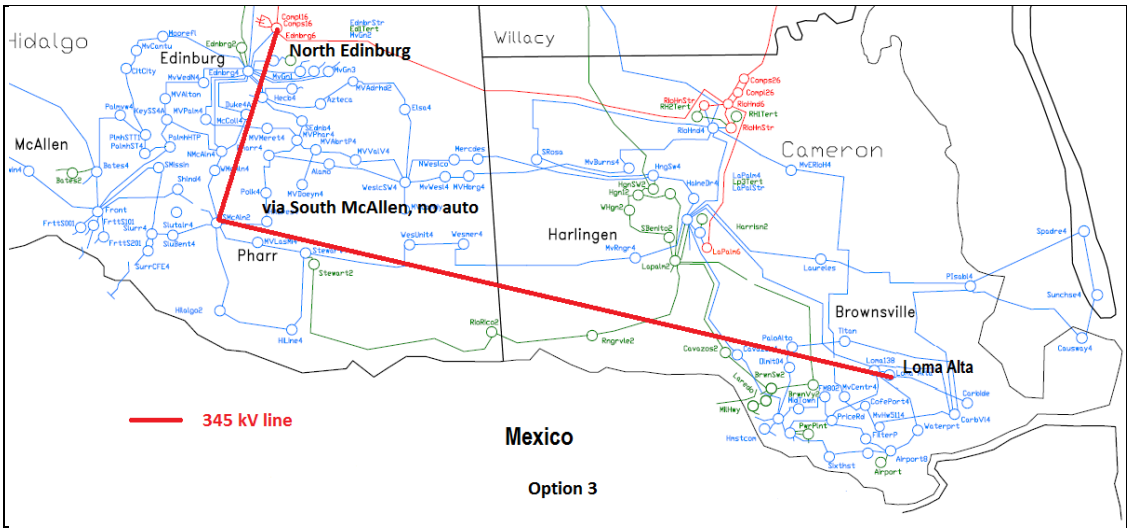

Figure 12: Option 3

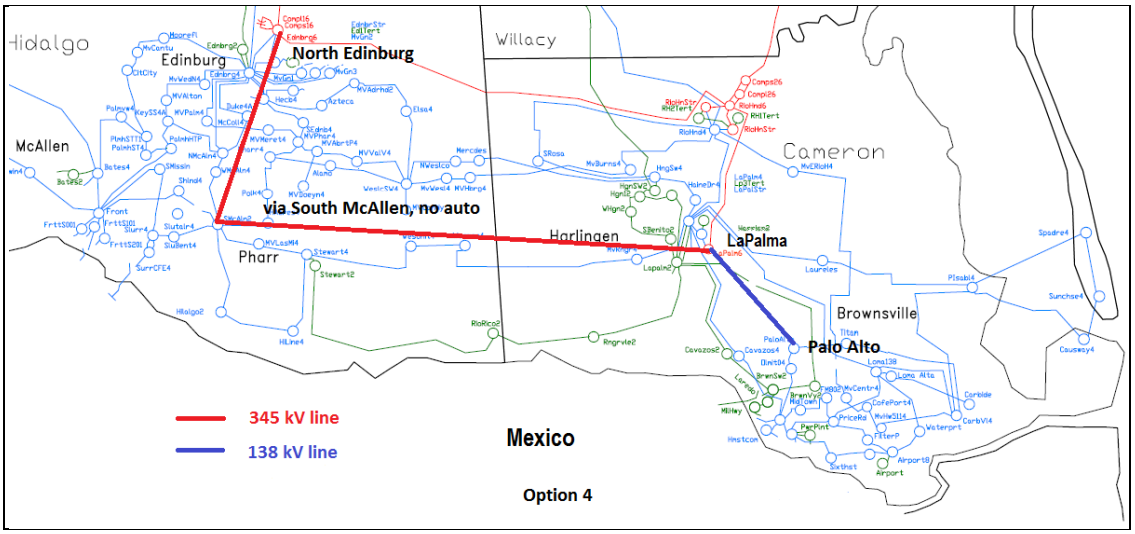

Figure 13: Option 4

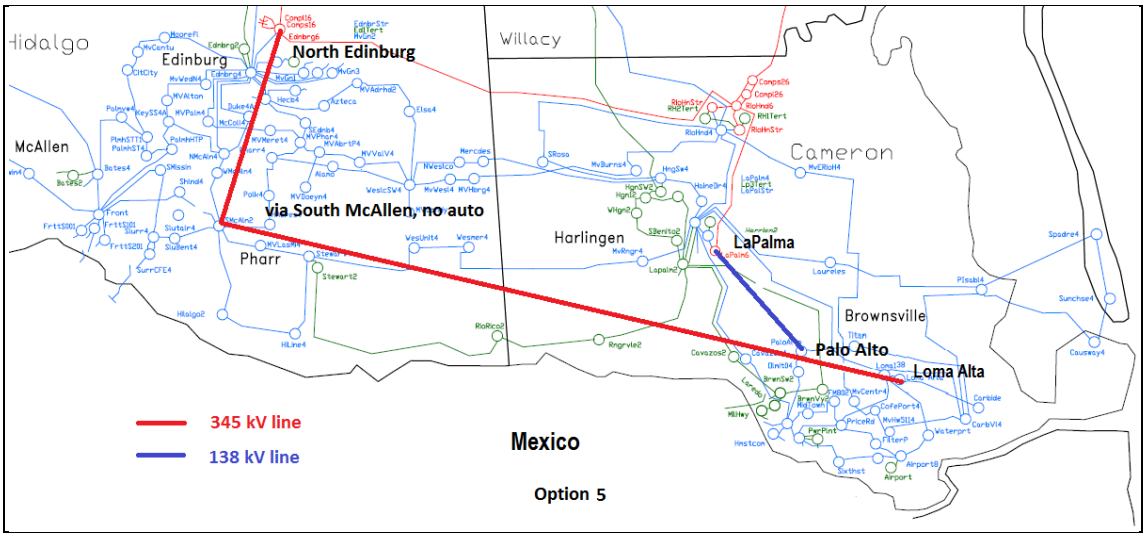

Figure 14: Option 5

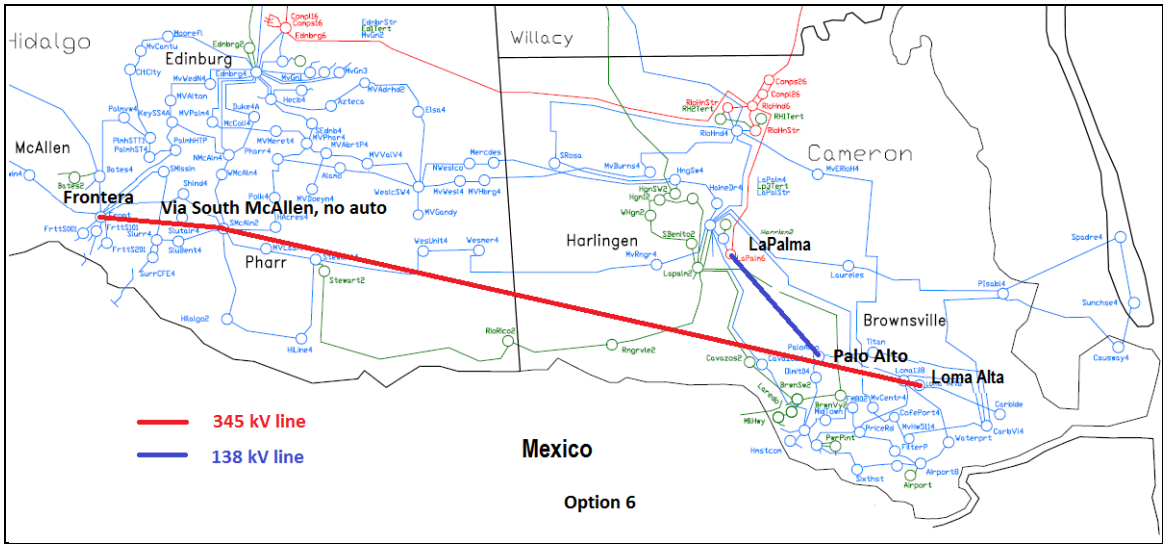

Figure 15: Option 6

7. Conclusion

The results presented in this report are indicative of the following:

- A 345 kV source from the west side to the east side of the LRGV is necessary to limit the N-1-1 load shedding to within acceptable and/or manageable levels. The N-1-1 conditions correspond to the loss of the 345 kV sources supporting the Rio Hondo station
- The need for the 345kV source into the Brownsville region under the aforementioned N-1-1 conditions is independent of the assumed 250 MW load additions at Loma Alta station
- In order to support the long-term reliability needs of the Brownsville region, routing the 345kV source in proximity to the existing South McAllen Substation is recommended

However, the decision concerning which project set to recommend hinges on the assumption of the 250 MW load additions in Brownsville. During the RPG comment period for this project, two market

participants commented on the appropriateness of the inclusion of the 250 MW load additions. BPUB indicated that they had a new potential industrial customer that was planning to add 250 MW of load at the Port of Brownsville; however, the customer chose to locate in another state due to the lack of electrical energy infrastructure in Brownsville. The Brownsville Economic Development Council indicated that this has occurred multiple times in the past. At this time, BPUB is reviewing new industrial customer projects with similar loads wishing to locate at the Port of Brownsville, but does not have a committed customer that will add this magnitude of load at the time of this review. For this reason Texas Industrial Energy Customers commented that it would be inappropriate to plan transmission facilities for the addition of "speculative future loads."

In ERCOT, the Transmission and Distribution Service Providers (TDSPs) provide the load forecast assumptions used in the planning models. While ERCOT does perform system-wide load forecasts for use in planning studies, ERCOT has not historically made judgment on the validity of specific load additions in the study models and relies upon the TDSPs to assess the likelihood of those specific additions. Accordingly, the recommendation of this review will assume the 250 MW load addition in Brownsville based on BPUB's input. Ultimately, the transmission providers who will construct the new facilities will be required to obtain a Certificate of Convenience and Necessity and/or cost recovery from the Public Utility Commission of Texas (PUCT). However, in order to satisfy the comments received through the RPG process, ERCOT has provided analysis in this report on the transmission needs in the area assuming normal load growth without the 250 MW load addition.

For these reasons ERCOT recommends that the facilities associated with Option 5 be constructed in order to meet the needs of the Brownsville area for 2016 and beyond. This recommendation is further supported by the fact that the North Edinburg to South McAllen 345 kV line portion of this project will be needed by 2020 and the South McAllen to east LRGV 345 kV line portion will most likely be needed sometime in the 2020s for N-1 contingency conditions. Hence, these facilities will meet both near-term and long-term needs for the entire LRGV. The following are the recommended transmission system improvements associated with Option 5:

- Construct a new La Palma-Palo Alto 138 kV line (~12 miles) on new ROW with a rating of at least 215 MVA
- Construct a new North Edinburg-Loma Alta 345 kV line (double circuit capable with one circuit in place) routed in proximity to the existing South McAllen Substation (~106.5 miles) on new ROW
- Construct a new 345kV bus at the Loma Alta station with one 345/138kV autotransformer

It should be noted that ERCOT recommends that the Loma Alta 345/138 kV autotransformer be rated at least 600 MVA and the North Edinburg-Loma Alta 345 kV line have an emergency rating of at least 1600 MVA.

This project is needed in order to ensure reliability for the Brownsville area, specifically to prevent a large amount of load shed under N-1-1 contingency conditions. While this load shed is allowed under NERC and ERCOT planning criteria, the required amount of load shed is not appropriate for the Brownsville area. Additionally, the cold weather event of February 2011 highlighted the fact that load in this area has grown more than previously forecasted. For these reasons, and given the long-lead time necessary to implement the transmission upgrades, it is suggested that the 345 kV line portion of the project be deemed critical to reliability per PUCT Substantive Rule 25.101 (b)(3)(D).

In addition, the analysis of the transmission system needs without the 250 MW load addition (Scenario 1) should serve as a guide if the assumption on the new load changes.

8. Designated Provider of Transmission Facilities

In accordance with the ERCOT RPG Planning Charter and Procedures Section 2.3.4, 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.

Both Brownsville Public Utilities Board and American Electric Power Texas Central Company (AEP TCC) own endpoints of the new 138 kV line from La Palma to Palo Alto and the new 345 kV line from North Edinburg to Loma Alta listed in the project scope of this recommendation. Therefore, ERCOT designates both Brownsville Public Utilities Board and American Electric Power Texas Central Company (AEP TCC) as co-providers of the 138 kV and 345 kV transmission facilities recommended in this report.

Appendix A

Cost Estimates for Project Alternatives

Project option	Project description	Cost $ (in millions)
1	New La Palma – Palo Alto 138 kV line (~12 mi)	$12.60
	Palo Alto Station Work	$0.50
	La Palma Station Work	$5.40
	New 345 kV transmission line from Frontera to La Palma (~56.6 mi)	$141.00
	Build Frontera 345 kV ring bus substation with one 345/138 kV auto and 2 - 345 kV line terminals	$26.80
	Add new 345 kV terminal at La Palma station	$17.90
	Total Cost	$204.20
2	New La Palma – Palo Alto 138 kV line with (~12 mi)	$12.60
	Palo Alto Station Work	$0.50
	La Palma Station Work	$5.40
	New 345 kV transmission line from South McAllen to La Palma (~42.15 mi)	$105.00
	Build South McAllen station with one 345/138 kV auto and 1 - 345 kV line terminal (expandable to 3 bkr ring)	$24.10
	Add new 345 kV South McAllen station terminal	$2.70
	Add new 345 kV terminal at La Palma station	$17.90
	Total Cost	$168.20
3	New 345 kV transmission line from N.Edinburg to Loma Alta (~106.5 mi)	$235.00
	Add new 345 kV terminal at North Edinburg	$3.40
	Add new 345 kV Loma Alta station with one 345/138kV auto with 345 kV line terminal	$17.80
	Total Cost	$256.20

Cost Estimates for Project Alternatives

Project option	Project description	Cost $ (in millions)
4	New La Palma – Palo Alto 138 kV line (~12 mi)	$12.60
	Palo Alto Station Work	$0.50
	La Palma Station Work	$5.40
	New 345 kV transmission line from N.Edinburg to La Palma (~89.9 mi)	$195.00
	Add new 345 kV terminal at North Edinburg	$3.40
	Add new 345 kV terminal at La Palma station	$17.90
	Total Cost	$234.80
5	New La Palma – Palo Alto 138 kV line (~12 mi)	$12.60
	Palo Alto Station Work	$0.50
	La Palma Station Work	$5.40
	New 345 kV transmission line from N.Edinburg to Loma Alta (~106.5 mi)	$235.00
	Add new 345 kV terminal at North Edinburg	$3.40
	Add new 345 kV Loma Alta station with one 345/138kV 450 MVA auto with 345 kV line terminal	$17.80
	Total Cost	$274.70
6	New La Palma – Palo Alto 138 kV line (~12 mi)	$12.60
	Palo Alto Station Work	$0.50
	La Palma Station Work	$5.40
	New 345 kV transmission line from Frontera to Loma Alta (~73.2 mi)	$182.30
	Build Frontera 345 kV ring bus substation with one 345/138 kV auto and 2 - 345 kV line terminals	$26.80
	Add new 345 kV Loma Alta station with one 345/138kV auto with 345 kV line terminal	$17.80
	Total Cost	$245.40
Sharyland BPUB Submitted Project	New 345 kV transmission line from Frontera to Loma Alta (~73.2 mi)	$182.30
	New 345 kV transmission line from La Palma to Loma Alta (~14.0 mi)	$35.60
	Add new 345 kV Loma Alta station with two 345/138kV autos with 345 kV line terminal	$24.10
	Add new 345 kV terminal at La Palma station	$17.90
	Total Cost	$259.90