Item 20: Lower Rio Grande Valley (LRGV) System Enhancement Regional Planning Group Project

Woody Rickerson
Vice Present, Grid Planning and Operations

Board of Director Meeting

ERCOT Public
December 9-10, 2021

Action

- At the conclusion of this presentation the Board of Directors will be asked to:
  1. Endorse the Lower Rio Grande Valley (LRGV) System Enhancement Regional Planning Group (RPG) Project based on NERC and ERCOT reliability planning criteria; and
  2. Designate the project as critical to the reliability of the ERCOT System pursuant to PUCT Substantive Rule 25.101(b)(3)(D)

Lower Rio Grande Valley (LRGV) System Enhancement Project

- ERCOT submitted the Lower Rio Grande Valley System Enhancement project for Regional Planning Group review

- The purpose of the project is to address reliability needs and improve the system resilience in the area

ERCOT Independent Review

- ERCOT performed an independent review of the project and identified NERC and ERCOT reliability planning criteria violations without a project

Base Case	Reliability Need Year
All in service (Base Case, Normal System Condition)	2027
Outage of two conventional plants in LRGV	Current
Outage of one 345-kV import circuit	Current
Outage of two 345-kV import circuits	Current
Very Low Wind/Solar Conditions	Current

- ERCOT analyzed two project options to resolve the planning criteria violations and improve system resilience

Comparison of Project Options

- ERCOT recommended Option 2, which provides better operational flexibility and system resilience

Items	System Improvement	
	Option 1	Option 2
Estimated new 345-kV right of way (miles)	357	351
Estimated cost ($billion)	$1.34	$1.28
LRGV load serving capability (BAU)	> 2040	> 2040
Improve system resilience and operation flexibility	Yes	Yes
Improve stability constraints	Yes	Yes (Superior to Opt. 1)
Reduce SSR vulnerability	Yes	Yes (Superior to Opt. 1)
Reduce the impact of hurricane	Yes	Yes (Superior to Opt. 1)
Future load and generation integration	Yes	Yes

Tier 1 Project Requirements

- Pursuant to Protocol Section 3.11.4, Regional Planning Group Project Review Process:
  - Projects with an estimated capital cost of $100 million or greater are classified as Tier 1 projects
  - Tier 1 projects require ERCOT independent review
    - Whether the proposed project is needed
    - Whether the proposed project is the preferred solution to the identified system performance deficiency that the project is intended to resolve
  - Tier 1 projects require Board endorsement

Basis for Board Endorsement

- ERCOT's independent review identified a reliability need for the Lower Rio Grande Valley System Enhancement Project to satisfy:
  - NERC TPL-001-4 Table 1 reliability criteria
  - ERCOT Planning Guide Section 4.1.1.2 Reliability Performance Criteria
- ERCOT's independent review identified Option 2 as the best project to satisfy the reliability criteria and provide system resilience

Projects Designated Critical to Reliability

- PUCT Substantive Rule 25.101(b)(3)(D):
  - Applications for transmission lines which have been formally designated by a PURA §39.151 organization as critical to the reliability of the system shall be considered by the commission on an expedited basis. The commission shall render a decision approving or denying an application for a certificate under this subparagraph within 180 days of the date of filing a complete application for such a certificate unless good cause is shown for extending that period.
- Factors to consider for this project:
  - The LRGV has a reliability need today under all studied high-impact weather conditions beyond Business as Usual (BAU)
  - Designating a project requiring a Certificate of Convenience and Necessity (CCN) application (*i.e.*, those requiring new Right of Way) as critical will reduce the risk of exposure to reliability issues by shortening the time to complete the improvements

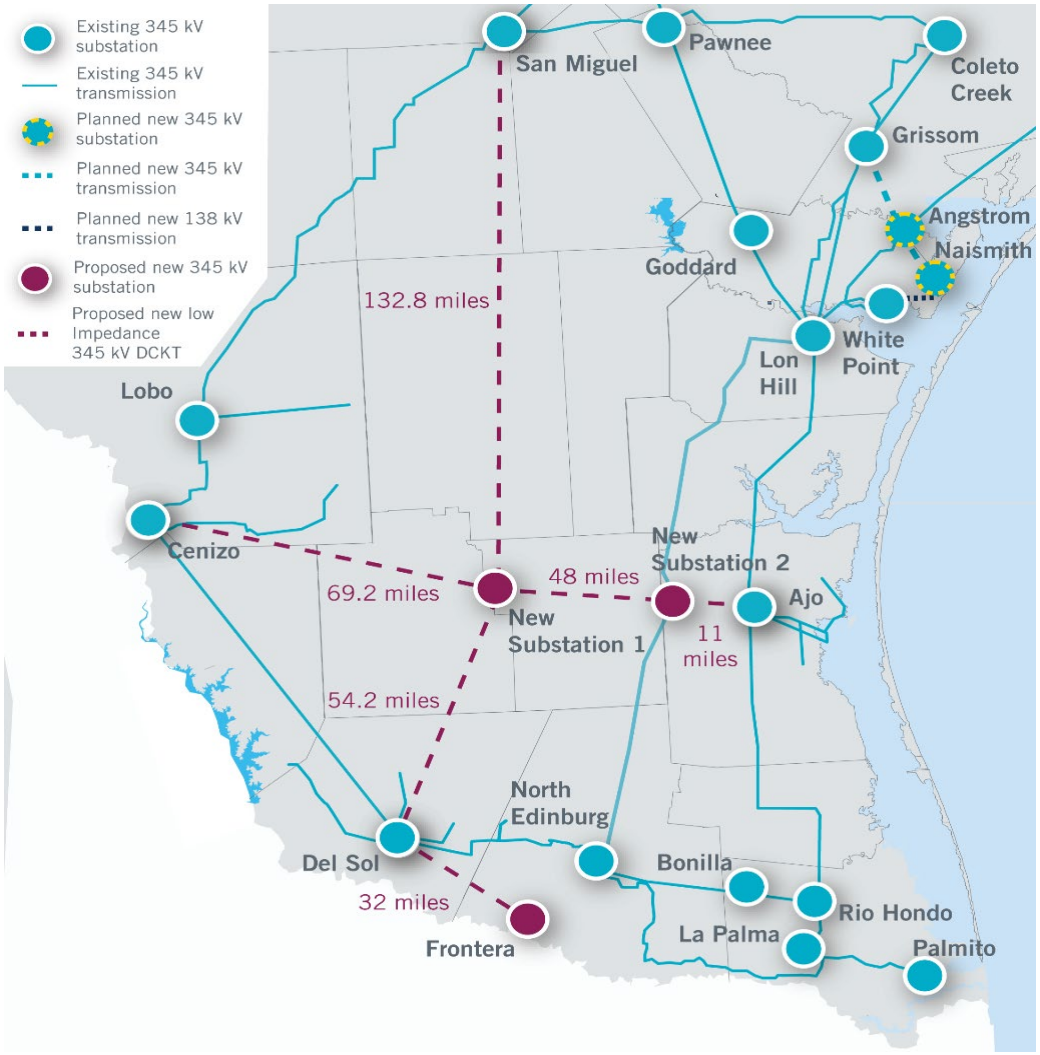
TAC Endorsement

- ERCOT presented the project to the Technical Advisory Committee on November 29, 2021
- TAC voted unanimously to endorse the project (Option 2)

Request for Board Vote

- ERCOT staff requests and recommends that the Board of Directors vote to endorse the need for the Lower Rio Grande Valley (LRGV) System Enhancement Project (Option 2) based on NERC and ERCOT reliability planning criteria
- ERCOT staff requests and recommend that Board of Directors designate the Lower Rio Grande Valley (LRGV) System Enhancement Project (Option 2) as critical to the reliability of the ERCOT System pursuant to PUCT Substantive Rule 25.101(b)(3)(D)

Questions?


Existing 345 kV substation
Existing 345 kV transmission
Planned new 345 kV substation
Planned new 345 kV transmission
Planned new 138 kV transmission
Proposed new 345 kV substation
Proposed new low Impedance 345 kV DCKT
San Miguel
Pawnee
Coleto Creek
Grissom
Angstrom
Naismith
Goddard
132.8 miles
White Point
Lon Hill
Lobo
Cenizo
New Substation 2
48 miles
69.2 miles
New Substation 1
Ajo
11 miles
54.2 miles
North Edinburg
Del Sol
Bonilla
32 miles
Rio Hondo
La Palma
Frontera
Palmito

ERCOT Recommendation: Option 2

- Construct a new 345-kV New Substation 1 approximately 69.2 miles east of existing Cenizo 345-kV substation
- Construct a new 345-kV New Substation 2 tapped into the existing 345-kV line from Lon Hill to North Edinburg approximately 48 miles east of New Substation 1
- Build a new double-circuit 345-kV line from existing San Miguel substation to New Substation 1 (approximately 132.8 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from New Substation 1 to existing Del Sol substation (approximately 54.2 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from New Substation 1 to existing Cenizo 345 kV substation (approximately 69.2 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line between New Substation 1 and New Substation 2 (approximately 48 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from existing Ajo substation to New Substation 2 (approximately 11 miles, normal and emergency ratings of at least 1,784 MVA)
- Construct a new Frontera 345-kV substation at the existing Frontera 138-kV substation
- Build a new double-circuit 345-kV line from existing Del Sol substation to new Frontera substation (approximately 36.5 miles, normal and emergency ratings of at least 1,784 MVA)
- Install two new 345/138-kV transformers at the Frontera substation (normal and emergency ratings of at least 743 MVA)

Date: December 2, 2021
To: Board of Directors
From: Woody Rickerson, Vice Present, Grid Planning and Operations
Subject: Lower Rio Grande Valley (LRGV) System Enhancement Regional Planning Group Project

Issue for the ERCOT Board of Directors

ERCOT Board of Directors Meeting Date: December 9-10, 2021
Item No.: 20

Issue:
Whether the Board of Directors (Board) of Electric Reliability Council of Texas, Inc. (ERCOT) should accept the recommendation of ERCOT staff to: (1) endorse the need for the Lower Rio Grande Valley (LRGV) System Enhancement Regional Planning Group (RPG) Project in order to meet the reliability requirements for the ERCOT System, which ERCOT staff has independently reviewed and which the Technical Advisory Committee (TAC) has voted unanimously to endorse, and (2) designate the LRGV System Enhancement RPG Project as critical to the reliability of the ERCOT System pursuant to Public Utility Commission of Texas (PUCT) Substantive Rule 25.101(b)(3)(D).

Background/History:
ERCOT submitted a proposed project for RPG review to address potential reliability needs driven by the expected load growth in the LRGV area.

ERCOT performed an independent review of the proposed project and confirmed the reliability need for transmission system improvements based on North American Electric Reliability Corporation (NERC) and ERCOT reliability planning criteria. Based on its independent review, ERCOT recommends the following transmission upgrades (Option 2):

- Construct a new 345-kV New Substation 1 approximately 69.2 miles east of existing Cenizo 345-kV substation
- Construct a new 345-kV New Substation 2 tapped into the existing 345-kV line from Lon Hill to North Edinburg approximately 48 miles east of New Substation 1
- Build a new double-circuit 345-kV line from existing San Miguel substation to New Substation 1 (approximately 132.8 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from New Substation 1 to existing Del Sol substation (approximately 54.2 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from New Substation 1 to existing Cenizo 345 kV substation (approximately 69.2 miles, normal and emergency ratings of at least 1,784 MVA)

- Build a new double-circuit 345-kV line between New Substation 1 and New Substation 2 (approximately 48 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from existing Ajo substation to New Substation 2 (approximately 11 miles, normal and emergency ratings of at least 1,784 MVA)
- Construct a new Frontera 345-kV substation at the existing Frontera 138-kV substation
- Build a new double-circuit 345-kV line from existing Del Sol substation to new Frontera substation (approximately 36.5 miles, normal and emergency ratings of at least 1,784 MVA)
- Install two new 345/138-kV transformers at the Frontera substation (normal and emergency ratings of at least 743 MVA)

The estimated cost for these improvements is $1.28 billion.

The LRGV has a reliability need today under all studied high-impact weather conditions beyond Business-as-Usual (BAU). Therefore, ERCOT recommends the LRGV System Enhancement RPG Project be designated critical to the reliability of the ERCOT System pursuant to PUCT Substantive Rule 25.101(b)(3)(D). Designating a project requiring a Certificate of Convenience and Necessity (CCN) application (*i.e.*, those requiring a new right-of-way) as critical will reduce the risk of exposure to reliability issues by shortening the time to complete the improvements.

The report describing the ERCOT Independent Review of the LRGV System Enhancement RPG Project, including ERCOT staff's recommendation for Option 2, is attached as ***Attachment A***.

Key Factors Influencing Issue:

1. Transmission system improvements are needed to meet reliability planning criteria for the LRGV area.
2. The recommended set of improvements was found to be the most efficient solution for meeting the planning reliability criteria, improving the stability constraints, improving system resilience under high-impact weather conditions, providing a long-term transmission capability for future load and generation development in the area, and providing a better operational flexibility during planned maintenance outage conditions.
3. Protocol Section 3.11.4.7 requires Board endorsement of a project with an estimated capital cost of $100 million or greater.
4. TAC voted unanimously to endorse the LRGV System Enhancement RPG Project (Option 2) on November 29, 2021.
5. Since there is reliability need to have the project in place as soon as possible, ERCOT staff has deemed this project critical to reliability.

6. If the LRGV System Enhancement RPG Project (Option 2) is designated as critical to the reliability of the ERCOT System, the review process at the PUCT will be expedited pursuant to Substantive Rule 25.101.(b)(3)(D).

Conclusion/Recommendation:

ERCOT staff recommends that the Board: (1) endorse the need for the LRGV System Enhancement RPG Project (Option 2), which ERCOT staff has independently reviewed and which TAC has voted unanimously to endorse, based on NERC and ERCOT reliability planning criteria, and (2) designate the LRGV System Enhancement RPG Project (Option 2) as critical to the reliability of the ERCOT System pursuant to PUCT Substantive Rule 25.101(b)(3)(D).

ELECTRIC RELIABILITY COUNCIL OF TEXAS, INC.
BOARD OF DIRECTORS RESOLUTION

WHEREAS, after due consideration of the alternatives, the Board of Directors (Board) of Electric Reliability Council of Texas, Inc. (ERCOT) deems it desirable and in the best interest of ERCOT to accept ERCOT staff's recommendation to (1) endorse the need for Lower Rio Grande Valley (LRGV) System Enhancement Regional Planning Group Project (Option 2), which ERCOT staff has independently reviewed and which the Technical Advisory Committee (TAC) has voted unanimously to endorse, based on North American Electric Reliability Corporation (NERC) and ERCOT reliability planning criteria, and (2) designate the LRGV System Enhancement Regional Planning Group Project (Option 2) as critical to the reliability of the ERCOT System pursuant to Public Utility Commission of Texas (PUCT) Substantive Rule 25.101(b)(3)(D);

THEREFORE, BE IT RESOLVED, that is the Board hereby (1) endorses the need for the LRGV System Enhancement Regional Planning Group Project (Option 2), which ERCOT staff has independently reviewed and which TAC has voted unanimously to endorse, based on NERC and ERCOT reliability planning criteria, and (2) designates LRGV System Enhancement Regional Planning Group Project (Option 2) as critical to the reliability of the ERCOT System pursuant to PUCT Substantive Rule 25.101(b)(3)(D).

CORPORATE SECRETARY'S CERTIFICATE

I, Jonathan M. Levine, Assistant Corporate Secretary of ERCOT, do hereby certify that, at its December 9-10, 2021 meeting, the Board passed a motion approving the above Resolution by _____.

IN WITNESS WHEREOF, I have hereunto set my hand this ___ day of December, 2021.

_____
Jonathan M. Levine
Assistant Corporate Secretary

ERCOT Independent Review of the Lower Rio Grande Valley (LRGV) System Enhancement Project (21RPG017)

Version 1.0

Document Revisions

Date	Version	Description	Author(s)
October 28, 2021	1.0	Final	Muhammad Khan, Priya Ramasubbu
		Reviewed by	Sun Wook Kang, John Schmall, Shun Hsien (Fred) Huang

Executive Summary

At the September 15, 2021 Regional Planning Group meeting, ERCOT presented the Lower Rio Grande Valley (LRGV) System Enhancement Project. The recommended system improvement option is based on ERCOT's independent review results described in this report. The LRGV area, which primarily encompasses the counties of Cameron, Hidalgo, Starr, and Willacy, is in the southernmost part of the ERCOT system and largely relies on three major 345-kV long-distance transmission lines connecting to the rest of the ERCOT transmission grid. The LRGV area, being close to the Gulf of Mexico, is susceptible to high-impact weather conditions such as tropical storms and hurricanes. In addition, there is limited existing conventional generation capacity and no planned conventional generation in the LRGV area. Historically, the LRGV area has experienced reliability challenges, especially under transmission and/or generation outages including those associated with extreme weather events, to serve the existing and projected electricity demand growth.

The LRGV area is one of the load centers in ERCOT and is expected to have continuous electrical demand growth and potential industrial customer developments. The summer peak demand in the LRGV area is projected to reach 3,200 MW and 3,300 MW by 2027 and 2030, respectively. As described in Section 3 of this report, the study results indicated potential planning reliability criteria violation with no outages at or above the 3,200 MW summer peak demand level and the system improvements will be required by 2027. ERCOT also performed reliability analysis for the high-impact weather conditions, considering potential affected transmission or generation outages, and identified system instability and reliability violations under the existing system conditions below the 3,200 MW projected summer peak demand level.

In addition to the NERC and ERCOT reliability criteria violation, a significant amount of renewable resources has been integrated in and around the LRGV area that has limited transmission import and export capability, contributing to an increase in stability constraints associated with the long-distance power transfer between the LRGV area and the rest of the ERCOT system. By the end of 2021, the combined wind and solar generation capacity is expected to reach approximately 7 GW in and around the LRGV area. Among the sixteen existing Generic Transmission Constraints (GTCs) used by ERCOT Operations to manage system stability in real time operation, seven GTCs are in and around the LRGV area. Continuous growth of renewable generation resources is expected which can lead to the increase in number of GTCs and create significant operational challenges in and around the LRGV area.

ERCOT identified two short-listed long-term LGRV system enhancement options to address the planning reliability criteria violation, improve the stability constraints, improve system resiliency under high-impact weather conditions, provide a long-term transmission capability for future load and generation development in the area, and provide a better operational flexibility during planned maintenance outage conditions.

Based on this independent review, Option 2 is recommended that includes the following transmission upgrades:

- Construct a new 345-kV New Substation 1 approximately 69.2 miles east of existing Cenizo 345-kV substation
- Construct a new 345-kV New Substation 2 tapped into the existing 345-kV line from Lon Hill to North Edinburg approximately 48 miles east of New Substation 1
- Build a new double-circuit 345-kV line from existing San Miguel substation to New Substation 1 (approximately 132.8 miles, normal and emergency ratings of at least 1,784 MVA)

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- Install two new 345/138-kV transformers at the Frontera substation (summer normal and emergency ratings of at least 743 MVA)

ERCOT assumed the use of low impedance 345-kV circuit technology for all new lines in the recommended Option 2 to effectively address the planning reliability criteria violations and enhance the system reliability and resilience in the LRGV. The recommended Option 2 is a Tier 1 project estimated to cost approximately $1.28 Billion. A Certificate of Convenience and Necessity (CCN) application filings will be required for the new transmission project (approximately 351 miles of new double-circuit 345-kV lines). The project is expected to be in-service by Summer of 2027. As requested by PUCT Commission, ERCOT designates the recommended project “critical” to the reliability of the system per PUCT Substantive Rule 25.101(b)(3)(D). Since there is reliability need to have the project in place as soon as possible, ERCOT deems this project critical to reliability.

Table of Contents

1. Introduction

The LRGV area, as shown in Figure 1.1, is in the southernmost part of the ERCOT Region and is one of the load centers projected to have continuous load growth and potential large industrial demand developments.

Figure 1.1 Existing 345-kV Transmission Grid in the LRGV Area

Table 1.1 lists several major transmission improvements that were constructed in the LRGV area over the last several years. These transmission improvements have been providing necessary support to reliably serve the electricity demand in the LRGV area. However, as the LRGV area is continuously evolving and experiencing significant demand growth with potential industrial demand additions (e.g., Liquefied Natural Gas development) and rapid development of renewable resources, the need for additional transmission upgrades has been evaluated by ERCOT and Transmission Service Providers (TSPs) in the past through the Regional Planning Group (RPG) process. Figure 1.2 shows the ERCOT 90/10 demand forecast for the LRGV area. The summer peak demand in the LRGV area is projected to reach 3,200 MW and 3,300 MW by 2027 and 2030, respectively. The winter peak demand is projected to reach 3,200 MW and 3,300 MW by 2026 and 2029, respectively.

Table 1.1 Recent Major Transmission Improvements in the LRGV Area

RPG Project Name	Items	ERCOT BOARD Endorsement	Construction Complete Date
Laredo to Lower Rio Grande Valley Project	Lobo – Rio Bravo – North Edinburg 345-kV line	2011	2016
Cross Valley 345 kV Project	North Edinburg – Loma Alta 345-kV line	2012	2016
Hidalgo-Starr Transmission project	New double-circuit 345-kV line from Stewart Road to the existing North Edinburg - Loma Alta (i.e., Palmito) 345-kV line	2016	2021
LRGV Area Transmission Improvements project	300 MVar STATCOM at La Palma 300 MVar STATCOM at Phar	2016	2018

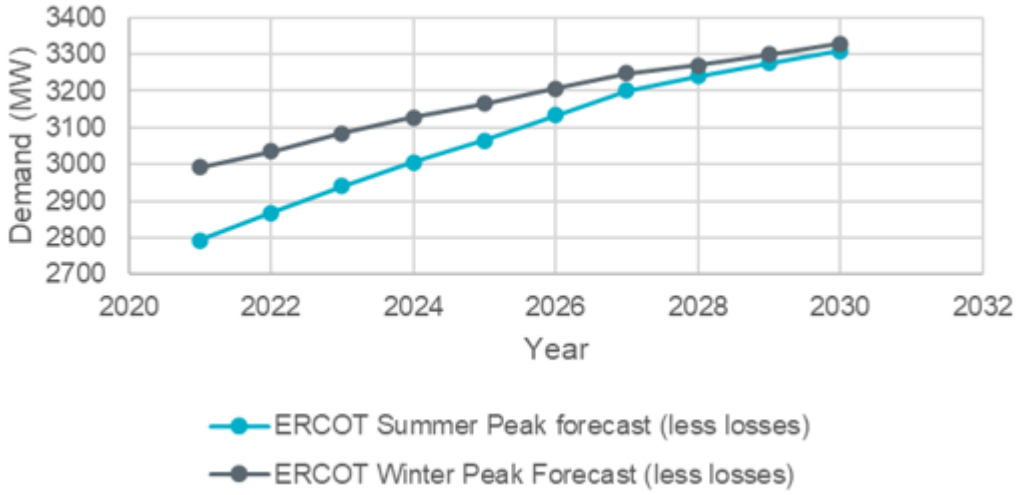

Figure 1.2 ERCOT 90/10 Peak Demand Forecast for the LRGV

As shown in Figure 1.1, the LRGV area is primarily connected to the ERCOT transmission grid through three long distance 345-kV circuits. Currently, four existing conventional power plants with a total of 1,461 MW are available in the LRGV area: Duke (466 MW), North Edinburg (666 MW), Red Gate (225 MW), and Silas Ray (104 MW). While there is no planned conventional generation that satisfied Planning Guide 6.9(1) as of September 2021, there has been a significant increase in renewable generation in and around the LRGV area. The wind and solar generation capacity are expected to reach approximately 7 GW by end of the year 2021. Figure 1.3 shows the operational and planned renewable capacity up to the year 2021 based on the information obtained from Resource Integration & On-going Operations (RIOO) as of August 2021.

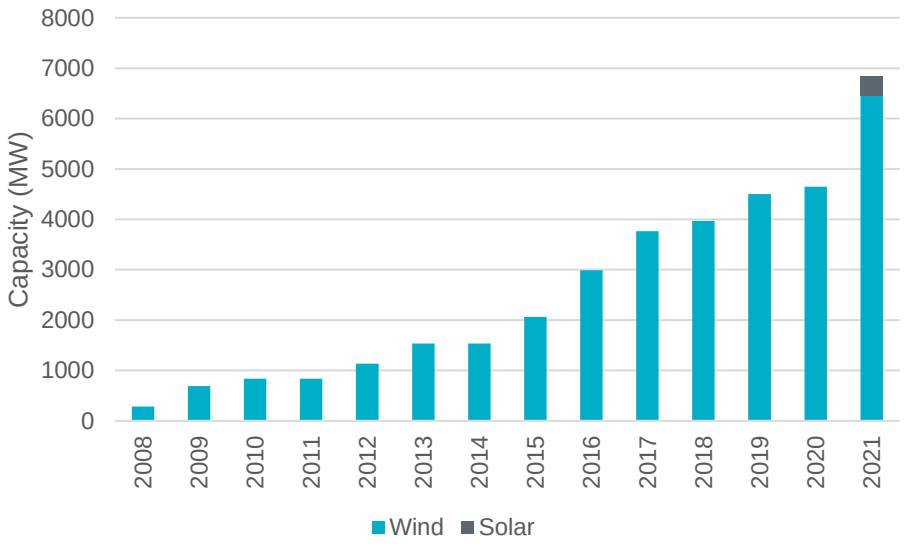

Figure 1.3 Cumulative Operational and Planned Wind and Solar in LRGV

ERCOT uses generic transmission constraints (GTCs) to monitor flows between areas of the ERCOT grid and control those flows using market-based mechanisms to maintain stability in real time operation. Currently, seven of the total of sixteen existing GTCs in the ERCOT grid are used to maintain grid stability of the LRGV area. If a GTC in the area is activated during the real-time operation, it may result in a generation dispatch limitation in the area. Figure 1.4 shows the approximate locations of seven GTCs in the LRGV area.

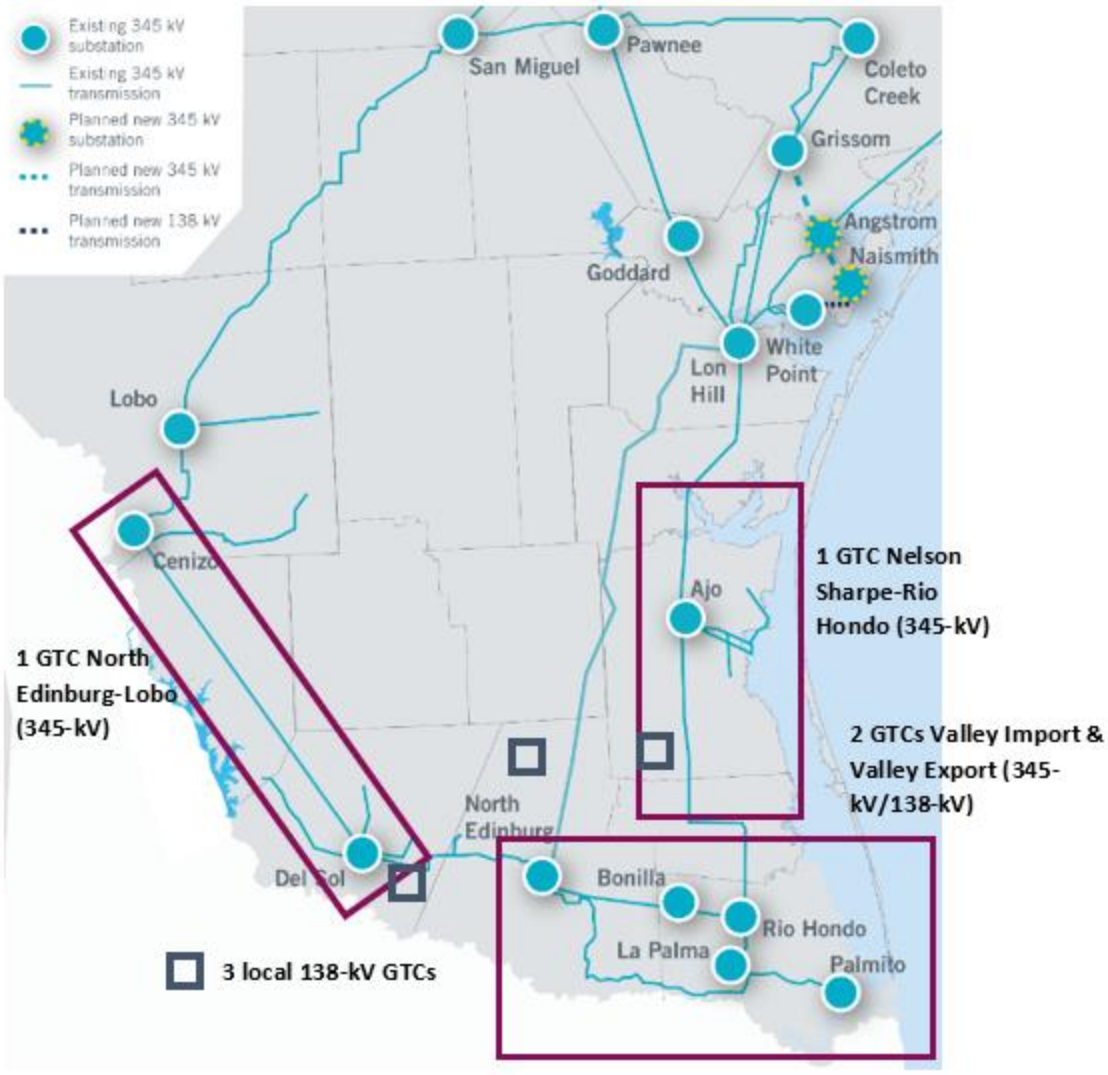

Figure 1.4 Seven GTCs in the LRGV Area

Like other areas that are close to the Gulf of Mexico, the LRGV area is susceptible to high-impact weather conditions such as tropical storms, hurricanes, droughts, and/or the intermittence of renewable generation. For example, three of the top ten congested constraints in South Texas in 2020 were caused by outages related to Hurricane Hanna storm damage[1]. According to National Hurricane Center (NHC), several other hurricanes rated category 3 or above such as Beulah (1967), Allen (1980), and Brett (1999) landed in the LRGV area in the past. Due to limited local conventional generation and transmission infrastructure serving the LRGV area, such extreme weather conditions or extended outages of transmission and/or generation could significantly reduce the load serving capability and reliability in the LRGV area under existing system conditions.

ERCOT initiated a South Texas Stability Assessment in late 2020 and provided status updates to ERCOT Reliability and Operations Subcommittee (ROS) and Regional Planning Group (PRG) in early

[1] 2020 Constraints and Needs Report
http://www.ercot.com/content/wcm/key_documents_lists/89026/2020_Report_on_Existing_and_Potential_Electric_System_Constraints_and_Needs.pdf

2021. As the assessment evolved, ERCOT identified the reliability needs in the LRGV area under the normal condition with no outages. On July 13, 2021, ERCOT delivered the "Roadmap to Improving Grid Reliability" to Governor Greg Abbott, members of the Texas Legislature and the Public Utility Commission (PUC). Among the 60 items in the Roadmap, Item 18 puts a clear focus on initiating a process to address transmission limitations and provide increased market access for resources in the LRGV, in addition to improving reliability for customers during normal conditions and high-impact weather conditions. As a result, ERCOT focused on identifying the system improvements, named as the LRGV System Enhancement Project, to:

- identify the potential reliability planning criteria violations and system needs;
- improve system resiliency under high-impact weather conditions;
- provide a long-term transmission capability for future load and generation development in the area;
- mitigate the stability constraints and subsynchronous resonance vulnerability; and
- improve operational flexibility.

This report describes the study assumptions, methodology and the results of ERCOT's assessment and serves as the ERCOT Independent Review (EIR) of the recommended project.

2. Study Assumptions and Methodology

This section describes study assumptions and methodology that ERCOT employed to perform this independent review of the LRGV System Enhancement project.

2.1 Assumptions

The study region included transmission facilities in the South Weather Zone that are electrically close to the LRGV area.

2.1.1 Reliability Study Base Case

The reliability study base cases were developed based on the assumptions in the subsequent sections.

2.1.1.1. Base Case

- 2020 Dynamic Working Group (DWG) 2023 High Wind Low Load (HWLL) case was used to develop a study case to assess export capability under various LRGV area generation commitment and dispatch scenarios
- 2020 DWG 2022 Summer Peak case was used to develop a study case to assess load serving capability based on the LRGV demand growth assumptions and various generation commitment and dispatch scenarios

The load serving capability analysis was performed using the summer peak case because the load models (see Section 2.1.1.4) assumed in the summer peak cases are expected to result in more stressed conditions due to anticipated significant larger motor type load (e.g., air conditioning) than typical winter peak load conditions.

2.1.1.2. Transmission Topology

There were no new approved transmission projects expected to have a material impact on the project need, which were not already in the base cases. Therefore, no transmission topology changes were made to the base cases.

2.1.1.3. Generation

At the start of this study, based on the October 2020 Generator Interconnection Status (GIS) report posted on the ERCOT website in November 2020, generator additions planned to connect to the study area and meeting Planning Guide Section 6.9(1) for inclusion in the planning models that were not in the base cases were added to the study base cases. These generator additions are listed in Table 2.1. All the new wind and solar generation units added to the cases were dispatched consistent with the 2020 RTP methodology. Pursuant to Protocol Section 3.15, Voltage Support, Intermittent Renewable Resources (IRRs, including wind and solar) were modeled with no voltage support if the output was below 10% of its nameplate capacity.

Table 2.1 Generation Units Added to Reliability Base Case

GINR Number	Project Name	County	Capacity (MW)	Fuel	Projected Commercial Operation Date
15INR0044	Corazon Solar	Webb	202.6	Solar	10/08/2021
17INR0031	Espiritu Wind	Cameron	25.2	Wind	In-service
16INR0111	Venado Wind	Starr	201.6	Wind	09/30/2021

2.1.1.4. Loads

The majority of LRGV loads are in the Cameron, Hidalgo, Starr, and Willacy counties, and are defined in the zones 610, 615, 800, 829, 875 and 876 in the study cases. Load in these zones was scaled up proportionally in the reliability assessment to evaluate the load serving capability. Load outside the LRGV area in Coast and North zones was scaled down as necessary for power balance.

Composite load model was used to represent the LRGV demand in the dynamic assessment for summer peak condition. The composite load model consists of multiple components representing different categories of load including three-phase induction machine and single-phase air conditioning load.

2.1.1.5. DC Tie

DC ties in the LRGV area were assumed at zero transfer in the case. The associated capacitor banks were also assumed unavailable.

2.1.2 Economic Study Base Case

2.1.2.1. Base Case

The 2026 economic case from the 2021 Regional Transmission Plan (RTP) available at the time of the study was used to develop a study base case for congestion analysis. The 2026 study year was selected based on the proposed in-service date of the project.

2.1.2.2. Transmission Topology

All RPG-approved Tier 1, 2, and 3 and all Tier 4 transmission projects expected to be in-service within the study region by 2026 as of April 2021 were already added to the study base case.

2.1.2.3. Generation

Planned generators in the ERCOT system that met Planning Guide Section 6.9(1) conditions for inclusion in the base cases (based on the 2021 March GIS report) were added to the 2021 RTP case for 2026. Therefore, no additional units were added to this base case.

The final 2021 RTP economic model for 2026 reflects the latest generation retirement information available to ERCOT at the time of this study. Unit retirement and mothball information was maintained consistent with the 2021 RTP models.

2.1.2.4. Loads

Loads were maintained consistent with the 2021 RTP economic model for the year 2026.

2.2 Methodology

2.2.1 Reliability Assessment

To perform the reliability assessment, the developed DWG 2022 summer peak and DWG 2023 HWLL study cases were analyzed to determine if transmission upgrades would be required to address reliability needs and improve the load serving capability in the LRGV area. Transmission upgrade options were then evaluated to determine load serving capability and other system impact, such as stability constraints and high-impact weather conditions.

2.2.1.1. Contingencies and Criteria

The reliability assessments were performed based on NERC Reliability Standard TPL-001-4, ERCOT Nodal Protocol and Planning Criteria.

The following contingencies were simulated for the study region

- P0
- P1 (N-1)
- P2-1 (N-1)
- P2-2, P2-3 (EHV only)
- P3: G-1 + N-1 {G-1: North Edinburg CC, Duke CC}
- P4-1, P4-2, P4-3, P4-4, P4-5 (EHV only)
- P5-1, P5-2, P5-3, P5-4, P5-5 (EHV only)
- P6-2: X-1 + N-1 {X-1: 345/138-kV transformers at Rio Hondo, North Edinburg and Stewart Road}
- P7-1 (N-1)

For steady-state load serving capability analysis, all 69-kV and above buses, transmission lines, and transformers in the study region were monitored (excluding generator step-up transformers) for voltage stability issues.

For dynamic stability analysis, the following criteria were enforced:

- For any operating condition in category P1 of the NERC Reliability Standard addressing Transmission System Planning Performance Requirements, voltage shall recover to 0.90 p.u. within five seconds after clearing the fault,
- For any operating condition in categories P2 through P7 of the NERC Reliability Standard addressing Transmission System Planning Performance Requirements, voltage shall recover to 0.90 p.u. within ten seconds after clearing the fault, and
- Triggering of under-voltage load shed is considered unacceptable for NERC and ERCOT planning events that do not allow non-consequential load loss.

2.2.2 Congestion Analysis

Once the recommended option was identified, the recommended option was added to the economic study base case described in Section 2.1.2 to identify any potential impact on system congestion related to the addition of the recommended project.

2.2.3 Study Tools

ERCOT utilized the following software tools to perform this independent review:

- PSSE version 33.12.2 for stability analysis
- VSAT version 18 for PV (Power-Voltage) analysis

- UPLAN version 10.4.0.22733 for congestion analysis.

3. Project Need

The reliability analysis was performed in accordance with NERC TPL-001-4 and ERCOT Planning Criteria. In addition to normal system conditions with no outages, ERCOT also evaluated high-impact weather conditions (e.g., hurricanes, droughts or pipeline disruptions that could affect conventional units, or the intermittence of renewable generation during peak conditions) which can result in system conditions that may significantly reduce the load serving capability and reliability in the LRGV area. For example, the outage of the single and two largest conventional power plants in the LRGV area accounts for 45% and 77% of total conventional generation capacity, respectively. The outage of generation would lead to the increase of power imported through the existing transmission circuits to serve the load in the LRGV area. Similarly, according to the methodologies of the existing GTCs[2] in and around the LRGV area, the outage of a 345-kV circuit could reduce the transmission import and export capability in the LRGV area up to approximately 40% and 70%, respectively. Both under-frequency load shedding (UFLS) and under-voltage load shedding (UVLS) relays are implemented in the LRGV area as a safety net to disconnect load automatically if the voltage and/or frequency drop below the defined threshold and exceed the defined duration. It should be noted that both UFLS and UVLS are expected to be used only under extreme events and are not considered as tools to maintain reliability under normal and anticipated system conditions.

The steady-state voltage stability (PV) analysis was used as a screening tool to identify the potential critical contingencies, and then the dynamic stability analysis was performed with the identified critical contingencies to determine the LRGV load serving capability. If the PV analysis indicated reliability violations or instability, it is assumed that system improvements are needed.

For the normal system conditions with all equipment in service, the dynamic stability results, as summarized in Table 3.1, indicated slow voltage recovery that could trigger UVLS for demand levels greater than 3,200 MW in the LRGV under NERC category P3 contingency conditions. This is violation of NERC and ERCOT planning criteria.

Table 3.1 Instability Under Normal Conditions

Scenario	LRGV Load Serving Capability (MW)	Critical Contingency	Reliability Violation
Normal System Condition	3,200	P3 (G-1 + N-1)(1)	Yes

(1). G-1 includes the outage of a generation unit or a combined cycle train. N-1 includes the outage of a generation unit, a combined cycle train, a transmission line, or a transformer.

Steady-state voltage stability (PV) analyses were also performed using 2020 DWG 2022 Summer Peak case to evaluate load serving capability of the LRGV area under various system conditions including the high-impact weather conditions:

- hurricane impact causing outage of major 345-kV transmission lines serving the LRGV area,
- pipeline disruptions or drought causing outage of major generators inside the LRGV area, and
- limited availability of renewable generation

The PV results showed potential voltage instability for load levels as low as 2,635 MW which is lower than the recorded peak demand in the LRGV area. Table 3.2 summarizes the PV results of the

[2] https://mis.ercot.com/secure/data-products/grid/transmission?id=NP3-770-M

estimated load serving capability in the LRGV area at or below 3,200 MW under tested system conditions.

Table 3.2 PV Load Serving Capability Under Tested System Conditions

Initial System Conditions	Worst Limiting Contingency	LRGV Load Serving Capability (MW)
Outage of Cebolla – Rio Hondo 345-kV circuit (potential hurricane Impact or extended force outage)	P3 (G-1 + N-1)	3,135
Outage of Lon Hill – North Edinburg 345-kV circuit (potential hurricane Impact or extended force outage)	P3 (G-1 + N-1)	3,135
Outage of Cebolla – Rio Hondo 345-kV and Lon Hill -North Edinburg 345-kV circuits (potential hurricane Impact)	P1 (N-1)	2,755
	P3 (G-1 + N-1)	2,635
No wind (potential extreme weather under high demand periods)	P3 (G-1 + N-1)	2,995

As shown in Tables 3.1 and 3.2, the need for system improvements was identified in both normal system condition and multiple high-impact weather scenarios under the NERC and ERCOT reliability criteria. The study results also indicated that the need for transmission improvements may appear earlier than the year 2027 (i.e., the need year under normal system condition) of the LRGV area if the high-impact weather scenario listed in Table 3.2 occurs.

4. Project Options

Various transmission technologies, including typical 345-kV AC circuits, low-impedance 345-kV AC circuits, and 500-kV AC circuits, were tested when ERCOT evaluated potential system improvement options to address the needs identified in Section 3. Like all three existing 345-kV circuits connected to the LRGV, the typical 345-kV AC circuit option would require series compensation to provide effective transfer capability. However, the concerns and challenges of potential sub-synchronous resonance (SSR) vulnerability to both existing and all the future synchronous generators (i.e., gas and coal power plants) and inverter-based resources (wind, solar, and battery) must be addressed. The ultra-high voltage 500-kV AC circuit option was also evaluated and determined that it could provide sufficient transfer capability improvement. However, the impact of requiring more rights-of-way and resulting in higher project cost should also be considered. The low-impedance 345-kV circuit technology has also been considered as an option. This option could require less rights-of-way at similar or lower cost compared to typical 345-kV or 500-kV circuits and still provide effective transfer capability without series compensation.

Based on the review of various transmission technologies mentioned above, ERCOT, in consultation with TSPs in the LRGV area, developed and evaluated the following two short-listed long-term system improvement options involving the low-impedance 345-kV circuit technology to address the reliability needs, improve operational challenges associated with stability constraints, and improve system resiliency in the area. ERCOT assumed the low impedance 345-kV circuit technology for all new transmission lines in each option. More details such as circuit impedance are posted on the Market Information System (MIS) Secure Area[3].

Option 1

- Construct a new 345-kV New Substation tapped into the existing 345-kV line from Lon Hill to North Edinburg approximately 11 miles west of existing Ajo substation
- Build a new double-circuit 345-kV line from existing San Miguel substation to New Substation (approximately 139.9 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from New Substation to existing Bonilla substation (approximately 54.6 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from existing Ajo substation to New Substation (approximately 11 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from New Substation to existing Cenizo 345-kV substation (approximately 115.2 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line between New Substation 1 and New Substation 2 (approximately 48 miles, normal and emergency ratings of at least 1,784 MVA)
- Construct a new Frontera 345-kV substation at the existing Frontera 138-kV substation
- Install two new 345/138-kV transformers at the Frontera substation (normal and emergency ratings of at least 743 MVA)
- Build a new double-circuit 345-kV line from existing Del Sol substation to new Frontera substation (approximately 36.5 miles, normal and emergency ratings of at least 1784 MVA)

[3] https://mis.ercot.com/misdownload/servlets/mirDownload?doclookupId=796969322

Based on the cost estimates provided by the Transmission Service Providers (TSPs), the total cost estimate for Option 1 is approximately $1.34 Billion. Figure 4.1 illustrates Option 1.

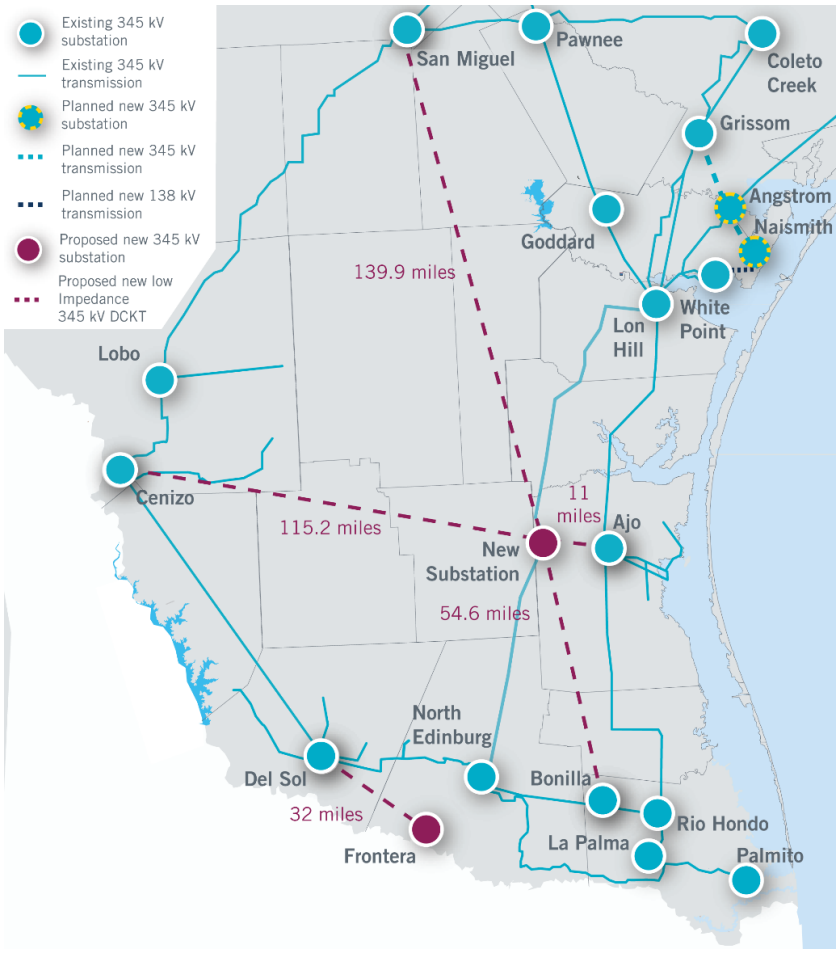

Figure 4.1 LRGV System Enhancement Project Option 1

Option 2

- Construct a new 345-kV New Substation 1 approximately 69.2 miles east of existing Cenizo 345-kV substation
- Construct a new 345-kV New Substation 2 tapped into the existing 345-kV line from Lon Hill to North Edinburg approximately 48 miles east of New Substation 1
- Build a new double-circuit 345-kV line from existing San Miguel substation to New Substation 1 (approximately 132.8 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from New Substation 1 to existing Del Sol substation (approximately 54.2 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from New Substation 1 to existing Cenizo 345 kV substation (approximately 69.2 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line between New Substation 1 and New Substation 2 (approximately 48 miles, normal and emergency ratings of at least 1,784 MVA)

- Build a new double-circuit 345-kV line from existing Ajo substation to New Substation 2 (approximately 11 miles, normal and emergency ratings of at least 1,784 MVA)
- Construct a new Frontera 345-kV substation at the existing Frontera 138-kV substation
- Install two new 345/138-kV transformers at the Frontera substation (normal and emergency ratings of at least 743 MVA)
- Build a new double-circuit 345-kV line from existing Del Sol substation to new Frontera substation (approximately 36.5 miles, normal and emergency ratings of at least 1,784 MVA)

Based on the cost estimates provided by the Transmission Service Providers (TSPs), the total cost estimate for Option 2 is approximately $1.28 Billion. Figure 4.2 illustrates Option 2.

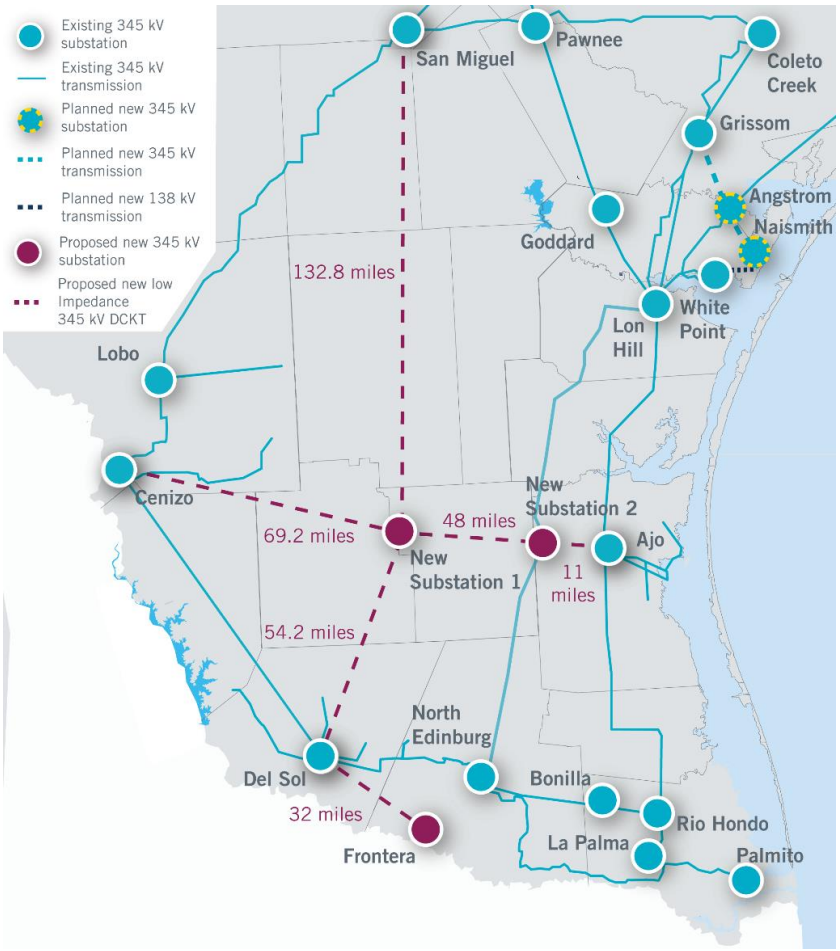

Figure 4.2 LRGV System Enhancement Project Option 2

These two short-listed options were evaluated in the dynamic stability analysis based on the contingencies described in the project need section of this report and the potential transmission maintenance outage scenario in addition to the initial system conditions. As shown in Table 4.1, no reliability criteria violations were identified. Both Options 1 and 2 were estimated to improve the LRGV load serving capability beyond 2040 under normal system condition. The current ERCOT load forecast has the load projection up to the year 2030. Based on the ERCOT load forecast, 2% annual load growth was assumed for the LRGV area, and the LRGV area loads by 2030 and 2040 were estimated to be 3.3 GW and 4 GW, respectively.

Table 4.1 LRGV Reliability Assessment Results – With System Improvements

Initial System Conditions	Reliability Need Year	
	Without System Improvements	With System Improvements (Option 1 or Option 2)
All in service (Base Case, Normal System Condition)	2027	> 2040
Outage of two conventional plants in LRGV	Current(2)	~ 2030(1)
Outage of one 345-kV import circuit	Current(2)	> 2040
Outage of two 345-kV import circuits	Current(2)	~ 2030(1)
Very Low Wind/Solar Conditions	Current(2)	2027(1)

Note:

(1) Additional voltage support in the LRGV is expected to further improve reliability.

(2) Identified the reliability issues under the tested system conditions.

4.1 Impact on Stability Constraints Associated with Existing GTCs

ERCOT assessed the impact of stability constraints associated with the existing stability constraints in and around the LRGV area. The results of this assessment showed that both Options 1 and 2 improve the stability constraints related to the existing 345-kV GTCs in the LRGV area.

- The LRGV Import GTC is estimated to increase by more than 1,000 MW under normal condition
- No stability constraint for Nelson Sharpe – Rio Hondo GTC under normal condition
- Both LRGV Export and North Edinburg – Lobo GTCs are improved from 60% to 80% of total maximum capacity of wind and solar generation in the LRGV area under normal condition. If necessary, additional system improvements such as reactive power devices may further increase the export limit

5. Comparison of Options

Table 5.1 shows the overall comparison of the two short-listed options (i.e., Options 1 and 2). Costs of Option 1 and Option 2 in Table 5.1 were estimated based on transmission (e.g., per-mile-cost) and substation costs provided by Transmission Service Providers (TSPs).

Table 5.1 Comparison of System Improvement Options

Item	Option 1	Option 2
Estimated new 345-kV rights of way (miles)	357(1)	351(1)
CCN required?	Yes	Yes
Estimated cost ($Billion)(2)	$1.34	$1.28
LRGV load serving capability (normal system condition)	> 2040(3)	> 2040(3)
Improve system resilience and operation flexibility	Yes	Yes
Improve stability constraints	Yes	Yes, Better(4)
Reduce SSR vulnerability	Yes	Yes, Better(4)
Reduce the impact of hurricane	Yes	Yes, Better(5)
Future load and generation integration	Yes	Yes

Note:

(1) New line distance was estimated as 120% of point-to-point distance.
(2) The cost estimates are based on the inputs provided by TSPs. The average per-mile cost and the higher of provided estimates by TSPs were used to estimate the two short-listed options.
(3) Assuming 2% annual load growth in the LRGV.
(4) Option 2 provides one more circuit connected to the existing Lobo-North Edinburg 345-kV line compared to Option 1 to improve the stability under both normal condition with no outage or with transmission outage conditions.
(5) Option 2 is relatively farther away from the coastal area compared to Option 1.

Based on the comparison in Table 5.1 and the following reasons, ERCOT recommends Option 2 as the preferred option:

- Option 2 is relatively less costly than Option 1, requiring less new rights-of-way.
- Option 2 improves stability constraints in the LRGV area and reduce SSR vulnerability in the region better than Option 1 since Option 2 provides one more 345-kV transmission path connected to the Lobo – North Edinburg 345-kV line.
- Option 2 provides a better reliability support and improve outage coordination to the LRGV area than Option 1 even under entire substation outage. For example, Option 2 will provide three major 345-kV transmission paths to the LRGV area for the loss of New Substation 2 that is tapped to the existing Lon Hill – North Edinburg 345-kV line. However, Option 1 will provide only two 345-kV transmission import paths to the LRGV area if the similar substation outage condition occurs.

- Compared to Option 1, Option 2 is more geographically diversified as most of the new lines and substations in Option 2 are located further inland and relatively farther away from the coastal area making it less prone to high-impact weather conditions such as hurricanes.

6. Sub-synchronous resonance (SSR) Assessment and Sensitivity Studies

For the preferred Option 2, an SSR assessment was performed to identify any adverse impacts to the system in the study area. In addition, sensitivity studies were performed to identify the preferred option performance under certain sensitivity scenarios.

6.1 SSR Assessment

Pursuant to Nodal Protocol Section 3.22.1.3, ERCOT conducted a sub-synchronous-resonance (SSR) screening for the preferred Option 2 and found no adverse SSR impacts to the existing and planned generation resources in the study area. Although the preferred option provided additional paths in the LRGV area and is not expected to aggravate any SSR related issues in the region, a detailed SSR assessment is recommended due to historical SSR challenges in the LRGV area. The TSP that owns the affected series capacitors shall coordinate with ERCOT to perform and complete a detailed SSR assessment and SSR Mitigation, if required, prior to energization of the preferred Option 2.

6.2 Planning Guide Section 3.1.3 (4) Sensitivities

The preferred Option 2 is categorized as a Tier 1 project, pursuant to ERCOT Protocol 3.11.4.3. As required by Planning Guide Section 3.1.3 (4), ERCOT performed generation and load sensitivity studies.

6.2.1 Generation Addition Sensitivity Analysis

ERCOT performed a generation addition sensitivity analysis based on Planning Guide Section 3.1.3(4)(a). Based on a review of the September 2021 GIS reports, the following generators near the study area shown in Table 6.1 have a signed Interconnection Agreement (IA) but have not met all the conditions for inclusion in the case pursuant to Section 6.9 of the Planning Guide.

Table 6.1 Generation Units with Signed IA

GINR Number	Project Name	County	Capacity (MW)	Fuel	Projected Commercial Operation Date
19INR0022	Monte Alto I	Willacy	223.8	Wind	12/31/2022
20INR0097	El Suaz Ranch	Willacy	301.5	Wind	09/30/2022
21INR0226	Equinox Solar 1	Starr	200.0	Solar	12/01/2025
20INR0086	Arroyo Solar	Cameron	180.0	Solar	12/15/2022

These potential renewable resources are located inside the LRGV area. Although it may slightly improve the LRGV load serving capability under normal system conditions if these potential renewable resources become materialized, it is not expected to be enough to address the reliability needs in the LRGV area. In addition, these future renewable resources are not expected to have a material impact on the need of the preferred Option 2.

6.2.2 Load Scaling Sensitivity Analysis

Planning Guide Section 3.1.3(4)(b) requires evaluation of the potential impact of load scaling on the criteria violations seen in this ERCOT independent review. ERCOT concluded that the load scaling would not have a material impact on the project need because of the following reasons:

- The LRGV area is remotely located at the southernmost part of the ERCOT system relying on three major long-distance 345-kV lines coming from the northern part of the ERCOT system.
- The load scaling outside the LRGV area is not expected to have a material impact on the need of the preferred Option 2.

7. Congestion Analysis

ERCOT conducted a congestion analysis to identify any potential impact on system congestion related to the addition of the recommended Option 2, using the 2021 RTP 2026 economic study case.

The results of congestion analysis indicated no additional congestion in the area due to the addition of the recommended transmission upgrades.

8. Conclusion

ERCOT identified the NERC and ERCOT reliability criteria violations in the LRGV area under the normal system condition with no outage and the high-impact weather conditions. ERCOT evaluated two short-listed options to address the need drivers. Based on the results of this Independent Review, ERCOT recommends Option 2 as the preferred solution because of the following reasons:

- Provide reliable long-term infrastructure in the LRGV area for future electricity demand growth and generation development
- Improve reliability by increasing load serving capability in the LRGV area
- Provide the framework for future system improvements
- Improve system resilience under high-impact weather conditions (hurricanes and tropical storms) and generation/transmission outages
- Improve stability constraints in the LRGV area
- Minimize the construction impact to the existing system
- Superior to Option 1 from an outage coordination standpoint

Option 2 is illustrated in Figure 4.2 of this report and it includes the following system improvements. ERCOT assumed the use of low impedance 345-kV circuit technology for all new lines in the recommended option:

- Construct a new 345-kV New Substation 1 approximately 69.2 miles east of existing Cenizo 345-kV substation
- Construct a new 345-kV New Substation 2 tapped into the existing 345-kV line from Lon Hill to North Edinburg approximately 48 miles east of New Substation 1
- Build a new double-circuit 345-kV line from existing San Miguel substation to New Substation 1 (approximately 132.8 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from New Substation 1 to existing Del Sol substation (approximately 54.2 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from New Substation 1 to existing Cenizo 345 kV substation (approximately 69.2 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line between New Substation 1 and New Substation 2 (approximately 48 miles, normal and emergency ratings of at least 1,784 MVA)
- Build a new double-circuit 345-kV line from existing Ajo substation to New Substation 2 (approximately 11 miles, normal and emergency ratings of at least 1,784 MVA)
- Construct a new Frontera 345-kV substation at the existing Frontera 138-kV substation
- Build a new double-circuit 345-kV line from existing Del Sol substation to new Frontera substation (approximately 36.5 miles, normal and emergency ratings of at least 1,784 MVA)
- Install two new 345/138-kV transformers at the Frontera substation (normal and emergency ratings of at least 743 MVA)

This recommended project (21RPG017) is a Tier 1 project estimated to cost approximately $1.28 Billion. A Certificate of Convenience and Necessity (CCN) applications will be required for the new transmission project (approximately 351 miles of 345-kV circuits). The project is expected to be in-

service by 2027. Based on the actual demand and generation growth, additional local system improvements within the LRGV area may be identified in the future planning assessments. As requested by PUCT Commission, ERCOT designate the recommended project “critical” to the reliability of the system per PUCT Substantive Rule 25.101(b)(3)(D). Since there is reliability need to have the project in place as soon as possible, ERCOT deems this project critical to reliability.