ERCOT Independent Review of the AEP Corpus Christi North Shore Project

Version 1.0

Document Revisions

Date	Version	Description	Author(s)
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Executive Summary

On October 7, 2019, American Electric Power (AEP) submitted the Corpus Christi North Shore project to the Regional Planning Group (RPG). AEP is experiencing an increase in new industrial load requests in San Patricio County, near Sinton and Gregory, Texas, on the north side of Nueces Bay and Corpus Christi Bay. Recently, AEP has executed contracts to construct interconnection facilities to serve 557 MW of new industrial load and 528 MW of Liquefied Natural Gas (LNG) related load for a total of 1,085 MW of confirmed new load in this area.

The purpose of this independent review was to examine the transmission reliability impact of these load additions and to identify system improvements to integrate the confirmed new load into the ERCOT grid while satisfying ERCOT and NERC Transmission Planning reliability standards.

Based on this independent review, ERCOT recommends the following transmission upgrades:

- A new Angstrom 345-kV substation tapped into the 345-kV line from Whitepoint to STP
- A new 345/138-kV Naismith substation
- Two new 345/138-kV transformers at Naismith
- Two new 138-kV circuits on a double-circuit tower from Naismith to Resnik (~3 miles)
- One new 345-kV line on a double-circuit tower from Grissom to Angstrom (~17 miles)
- One new 345-kV line on a double-circuit tower from Angstrom to Naismith (~19 miles)
- A new second 345/138-kV transformer at the Whitepoint substation
- Upgrade the 4.7-mile, 138-kV transmission line from Pelican to Whitepoint. This upgrade was identified based on the congestion analysis described in Section 10 of this report.

The recommended project is a Tier 1 project estimated to cost approximately $218.5 Million. A Certificate of Convenience and Necessity (CCN) application will be required for the new rights-of-way (~39 miles). This recommendation is designed to address long lead time upgrade requirements. Although reactive compensation related improvements are anticipated, ERCOT is not recommending any specific reactive compensation upgrades for this area at this time. Reactive needs in the area can be addressed with shorter lead time projects, and the detailed load dynamic information required to finalize reactive support recommendations were not available at the time of this review. The reactive upgrades are expected to address anticipated local reactive power imbalances and therefore are not expected to change this initial upgrade recommendation.

AEP is expecting this project to be in-service by the second quarter of 2024. According to AEP, portions of this load are anticipated to come online before 2024. If reliability issues arise before the entire recommended project is constructed, ERCOT and AEP will work together to develop mitigation plans as necessary. AEP has requested ERCOT designate the recommended project “critical” to the reliability of the system per PUCT Substantive Rule 25.101(b)(3)(D). Since there is a reliability need to have the project in place as soon as possible, ERCOT deems this project critical to reliability.

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1. Introduction

On October 7, 2019, AEP submitted the Corpus Christi North Shore project to the Regional Planning Group (RPG). The AEP submittal included the following confirmed new load additions:

- 528 MW of LNG load to be served from the existing 138-kV Resnik substation
- 400 MW of industrial load to be served from a new 345-kV Angstrom substation
- 144 MW of industrial load to be served from the existing 138-kV Gibbs substation
- On March 27, 2020, AEP augmented the submittal to include 13 MW of additional industrial load to be served from the existing Homeport substation

Together, this represents a total of 1,085 MW of new load that is expected to be added to the ERCOT grid near the north shore of the Corpus Christi Bay by 2024. These new load additions are all located within San Patricio County, and they are the primary driver for the Corpus Christi North Shore project.

The approximate geographic locations of these loads are shown in Figure 1.1.

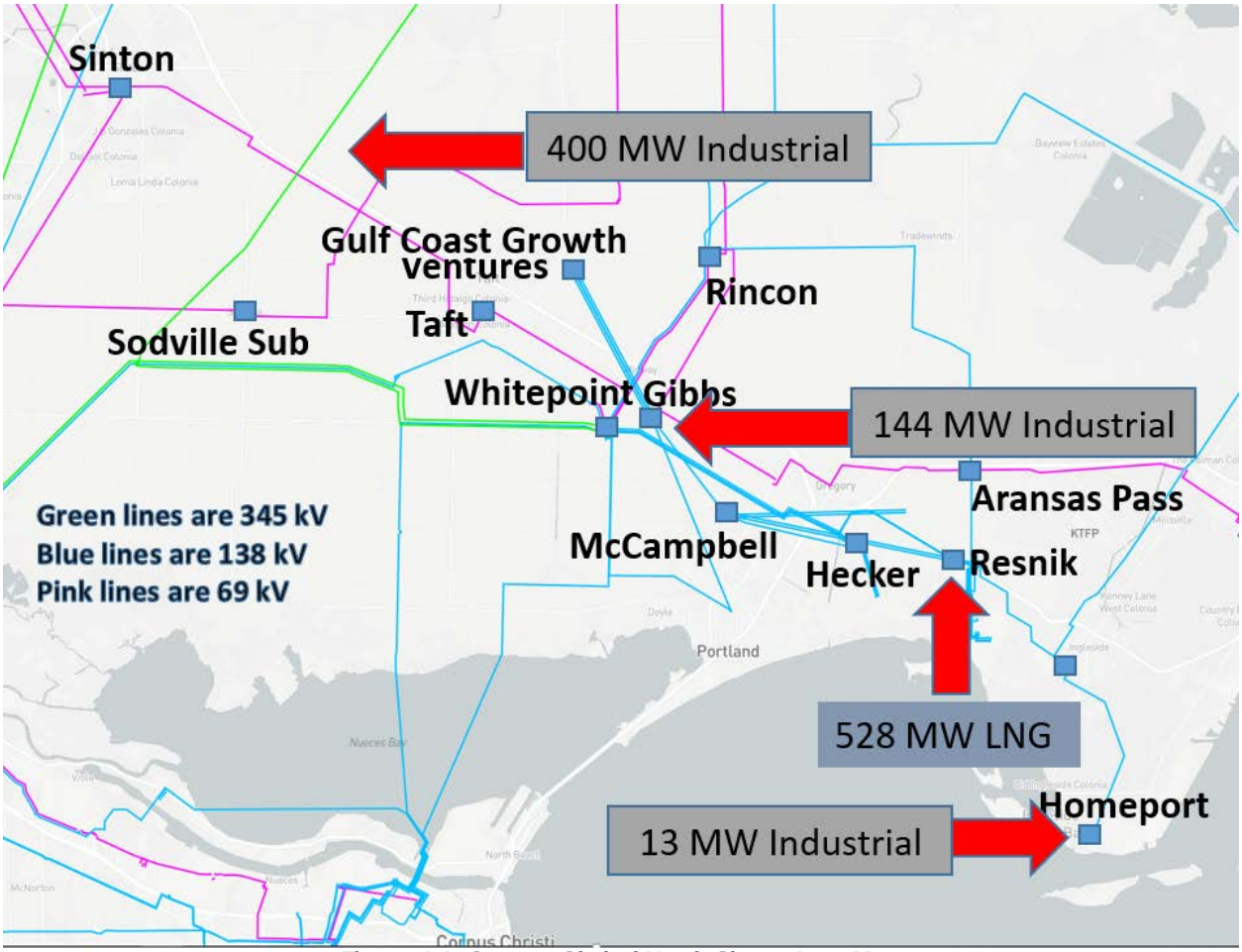

Figure 1.1: Corpus Christi North Shore Area Map

To facilitate these load additions, the AEP Corpus Christi North Shore project submittal proposed a $291[1] Million transmission improvement project that included:

- A new Angstrom 345-kV substation tapped into the 345-kV line from Whitepoint to STP
- A new "Resnik" 345/138-kV substation[2]
- Two new 345/138-kV transformers at Resnik
- Two new 345-kV circuits sharing double-circuit towers from Grissom to Angstrom (~17 miles)
- One new 345-kV line on double-circuit towers from Angstrom to Resnik (~19 miles)
- One new 345-kV line on double-circuit towers from Resnik to Whitepoint (~8 miles)
- One new 345-kV line installed on the double-circuit towers between Angstrom and Resnik continuing on the double-circuit towers between Resnik and Whitepoint but only electrically connecting Angstrom to Whitepoint (~26 miles) – in other words sharing towers but bypassing Resnik
- A new second 345/138-kV transformer at the Whitepoint substation[3]

AEP also requested ERCOT designate these upgrades "critical" to the reliability of the system.

As a result, ERCOT conducted an independent review to examine the transmission reliability impact of the 1,085 MW load additions and to identify system improvements to integrate the confirmed new load into the ERCOT Grid while satisfying ERCOT and NERC Transmission Planning reliability standards. This report describes the study assumptions, methodology and the results of the ERCOT Independent Review (EIR) of the project.

[1] The original AEP submittal estimated the cost of Option 3 to be $256 million but that estimate excluded the cost of the 2nd Whitepoint transformer as well as the cost of the Naismith substation in lieu of a new "Resnik" 345/138-kV station near the existing Resnik 138-kV substation. On April 20, 2020 AEP provided an updated cost estimate ($291 Million) to include the cost of the Naismith substation as well as the cost of including the second Whitepoint transformer in AEP proposed Option 3.

[2] Subsequent to the AEP submittal, the new "Resnik" 345/138-kV station near the existing 138-kV Resnik substation was sited and named "Naismith." Accordingly, this upgrade is listed as the new Naismith substation within the equivalent Option 3 studied by ERCOT.

[3] Based on discussions with AEP, the second 345/138-kV transformer at Whitepoint was added to their Option 3 upgrade.

2. Study Assumptions and Methodology

This section describes study assumptions and methodology that ERCOT employed to perform this independent review of the AEP Corpus Christi North Shore project.

2.1 Assumptions

This section describes the assumptions that ERCOT employed to construct both the steady-state study base case and the economic study base case.

2.1.1 Steady-State Study Base Case

The study region for this review was the ERCOT South Weather Zone since the Corpus Christi area is located in San Patricio County.

2.1.1.1. Base Case

The steady-state study base case was constructed from the following final 2019 Regional Transmission Plan (RTP) case posted on the MIS on October 1, 2019:

- 2019RTP_2024_SUM_SSC_10012019

2.1.1.2. Transmission Topology

Transmission projects expected to be in-service within the study region by 2024 were added to the study case. The following Tier 4 projects were added:

- Whitepoint Area Improvements (TPIT 50950): Whitepoint to Rincon reconductor 1026 ACCC
- Whitepoint: Add Series Reactors (TPIT 50952)

The placeholder projects associated with the Corpus Christi North Shore project in the 2019 RTP case were removed.

2.1.1.3. Generation

Based on the September 2019 Generator Interconnection Status (GIS) report posted on the ERCOT website on October 1, 2019, generator additions planned to connect to the study area and meeting Planning Guide Section 6.9(1) for inclusion in the planning models were added to the study base cases. These generator additions are listed in Table 2.1. All of the new wind and solar generation units added to the case were dispatched consistent with the 2019 RTP methodology.

Table 2.1 Generation Units Added to Base Case

GINR Number	Project Name	County	Capacity (MW)	Fuel	Projected Commercial Operations Date
17INR0025	Reloj Del Sol Wind	Zapata	202	Wind	10/31/2020
17INR0035	Las Majadas Wind	Willacy	273	Wind	10/01/2020
19INR0073	Shakes Solar	Zavala	206	Solar	06/24/2020
20INR0088	West Raymond (El Trueno) Wind	Willacy	240	Wind	12/15/2020
20INR0272	RIO NOGALES AGP UPGRADE CT3	Guadalupe	19	Gas	04/20/2020
21INR0261	Horizon Solar	Frio	204	Solar	12/31/2021
21INR0276	Elara Solar	Frio	178	Solar	04/01/2021

The status of the units either mothballed or retired were reviewed at the time of this study and the following units were removed from the study case:

- AMOCOOIL_AMOCO_5 (Coast)
- Gibbons Creek G1 (Coast)

2.1.1.4. Loads

The load levels outside of the study weather zone, excluding the South Central and Coast Weather Zones, were adjusted as necessary for power balance consistent with the 2019 RTP assumptions. For the confirmed load, specific power factors were determined based on input from AEP.

2.1.2 Economic Study Base Case

2.1.2.1. Base Case

The 2024 economic case from the 2019 RTP was used as the base case for congestion analysis. The 2024 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 2024 were added to the study base case. The ERCOT Transmission Project Information and Tracking (TPIT) report posted on October 1, 2019 was used as reference. The added TPIT projects are listed in Table 2.2.

Table 2.2 Transmission Projects Added to Base Cases

TPIT Number	Project Name	County	Projected In-service Date	Planning Charter Tier
48407	Chaparrosa: Construct New 138 kV Box Bay	Zavala	Mar-20	Tier 4
45340	Lemay: Build 138 kV Box Bay	La Salle	Mar-20	Tier 4
5218A	San Miguel 345/138 kV autotransformer replacements	Atascosa	Mar-20	Tier 4
5218B	San Miguel 345/138 kV autotransformer replacements	Atascosa	Sep-20	Tier 4
48778	Dustdevil: Construct New Distribution Station	Webb	Dec-20	Tier 4
50334	Rebuild Mccoy to Tordillo	Atascosa	Mar-21	Tier 4
50336	Rebuild Pleasanton to Mccoy	Atascosa	May-21	Tier 4
48774	Fincas: Construct New Distribution Station	Webb	May-21	Tier 4
45511	Laredo - Del Mar: 138 kV Line Rebuild	Webb	Jul-23	Tier 4
45513	Santo Nino - Wormser: 138 kV Line Rebuild	Webb	Jul-23	Tier 4
50880	Lon Hill - STEC Warburton: Line Rebuild	Refugio	Nov-21	Tier 3
50872	Structure 25/7 - Medio Creek: Line Rebuild	San Patricio	Apr-22	Tier 3
50882	Lon Hill - Structure 25/4: Line Rebuild	San Patricio	Nov-22	Tier 3

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 2020 March GIS report) were added to the study case. The added generators are listed in Table 2.3.

Table 2.3 Generation Units Added to Base Case

GINR Number	Project Name	County	Capacity (MW)	Fuel	Projected Commercial Operations Date
17INR0035	Las Majadas Wind	Willacy	273	Wind	10/29/2020
19INR0155	Morrow Lake Solar	Frio	200	Solar	04/01/2021
20INR0068	Blackjack Creek Wind	Bee	240	Wind	12/15/2021
20INR0088	West Raymond (El Trueno) Wind	Willacy	240	Wind	12/15/2020

20INR0272	Rio Nogales AGP Upgrade CT3	Guadalupe	19	Gas	04/20/2020
21INR0261	Horizon Solar	Frio	204	Solar	12/31/2021
21INR0276	Elara Solar	Frio	178	Solar	05/11/2021
17INR0031	Espiritu Wind	Cameron	25.2	Wind	12/21/2020
18INR0030	Canyon Wind	Scurry	360	Wind	03/31/2021
18INR0031	Maryneal Windpower	Nolan	182.4	Wind	02/15/2021
19INR0034	Greasewood Solar	Pecos	255	Solar	11/30/2020
19INR0088	Aragorn Solar	Culberson	187.2	Solar	06/30/2021
20INR0032	IP Titan	Culberson	270	Solar	06/30/2021
20INR0033	WILDWIND	Cooke	180.08	Wind	12/15/2020
20INR0037	Coniglio Solar	Fannin	135	Solar	12/11/2020
20INR0069	Danish Fields Solar	Wharton	201	Solar	06/01/2021
20INR0204	BlueBell Solar II	Sterling	115	Solar	06/01/2021
20INR0219	Eunice Solar	Andrews	420	Solar	12/31/2020
20INR0286	Wise County Power Repower (CT1, CT2)	Wise	21	Gas	12/01/2020
21INR0016	Danish Fields II	Wharton	201	Solar	06/01/2021
21INR0017	Danish Fields III	Wharton	201	Solar	06/01/2021
21INR0026	Juno Solar	Borden	313.2	Solar	05/15/2021
21INR0467	Apogee Wind	Haskell	451.5	Wind	12/31/2021
18INR0050	Mustang Creek Solar	Jackson	150	Solar	05/01/2021

The final 2019 RTP economic models reflect the latest generation retirement information available to ERCOT at the time of this study. Unit retirement and mothball information was maintained consistent with the 2019 RTP models.

2.1.2.4. Loads

The confirmed loads expected for 2024 along with transmission upgrades associated with the preferred Corpus Christi North Shore project option described in Section 8 were added to the 2024 economic study case.

2.2 Methodology

This section describes the methodology that ERCOT employed to determine system improvements that will be needed to integrate the Corpus Christi North Shore load additions into the ERCOT grid.

2.2.1 Reliability Assessment

To perform the reliability assessment, the steady-state study base case was analyzed to determine if transmission upgrades would be required to accommodate the new load additions. Transmission upgrade options were then identified, evaluated and a short-list of options was developed. Those short-listed options were then evaluated using a maintenance scenario and evaluated to estimate maximum thermal and voltage stability load serving capability. Based on these results, ERCOT identified a preferred option.

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 steady-state contingencies were simulated for the study region

- P0
- P1 (N-1)
- P2-1 (N-1)
- P2-2, P2-3 (All EHV only)
- P3: G-1 + N-1 {G-1: NUECESCC, INGLCOS_CC, and LGE_LGE_CC}
- P4-1, P4-2, P4-3, P4-4, P4-5 (All EHV only)

- P5-1, P5-2, P5-3, P5-4, P5-5 (All EHV only)
- P6-2: X-1 + N-1 {X-1(345/138-kV transformers at: Whitepoint, Lon Hill, Naismith)}
- P7-1 (N-1)

All 69-kV and above buses, transmission lines, and transformers in the study region were monitored (excluding generator step-up transformers) and the following thermal and voltage limits were enforced:

- Thermal
  - Rate A for pre-contingency conditions
  - Rate B for post-contingency conditions
- Voltages
  - Voltages exceeding pre-contingency and post-contingency limits
  - Voltage deviations exceeding 8% on non-radial load buses

2.2.2 Congestion Analysis

Once the preferred option was identified, that option was added to the economic study base case and evaluated to determine if it resulted in any additional congestion.

2.2.3 Study Tools

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

- PowerWorld Simulator version 21 for Security Constrained Optimal Power Flow (SCOPF) and steady-state contingency analysis
- UPLAN version 10.4.0.22733 to perform congestion analysis.

3. Project Need

The study base case was evaluated with the new loads but without any system improvements to determine if system improvements would be necessary to accommodate the 1,085 MW load addition. The reliability assessment results revealed that both thermal overloads and voltage violations would occur without system improvements. Those violations are shown in Table 3.1 and Table 3.2.

Table 3.1 Thermal Overloading in the Study Region

Element	Length (miles)	Loading
Airco to Melon Creek 138-kV ckt 1	23	109%
Blessing to Palacios 69-kV ckt 1	10	112%
Gila to Mayo 138-kV ckt 1	6	148%
Hecker to McCambell 138-kV ckt 1	2	121%
Hecker to Resnik 138-kV ckt 1	3	127%
Holly to Southside 138-kV ckt 1	2	101%
Mayo to Whitepoint 138-kV ckt 1	6	145%
San Miguel to Choke Canyon AEP 138-kV ckt 1	26	103%
North Carbide to Airco 138-kV ckt 1	1	109%
Portland to Gibbs 138-kV ckt 1	2	124%
Victoria DuPont Switch to Big Three138-kV ckt 1	4	114%
Whitepoint to Portland 138-kV ckt 1	5	131%

Table 3.2 Voltage Violations in the Study Region

Bus	Nominal Voltage (KV)	Per Unit Voltage
COYCTP2A	69	0.69
PLEASANT2A	69	0.88
PLEASANT2B	69	0.88
FASHING2A	69	0.68
JOURDNTN2A	69	0.89
OLMOSSUB9	69	0.91
STADIUM2A	69	0.90
RIVIERASUB9	69	0.89
LOYOLASW9	69	0.89
RICARDOSUB9	69	0.90
CORPSCHRSSW9	69	0.90
ROBSTOWNSUB9	69	0.89
CORPSCHRSUB9	69	0.89
WSINTONSW9	69	0.91
WSINTONSUB9	69	0.91
SODVILLESUB9	69	0.91
TAFTSUB9	69	0.92

4. Project Options

Due to the uncertainty in the load dynamic characteristics associated with the new load additions, AEP included the three reactive compensation devices listed below as placeholders in the load flow models associated with its proposed project. ERCOT also included these as placeholders within its options cases.

- 173 Mvar Switched Shunt at Resnik
- 115 Mvar Switched Shunt at McCampbell
- 115 Mvar Switched Shunt at Hecker

However, during the course of the ERCOT independent review, ERCOT and AEP agreed to re-visit the reactive power compensation needs at a later time when load dynamic characteristics information becomes available. While reactive devices will likely be necessary to balance reactive power supply and demand in the Corpus Christi North Shore area, these future reactive power upgrades are not expected to materially affect nor be affected by the preferred option identified by this independent review. In addition, as short lead-time projects, these reactive devices can be studied at a later time and still be installed prior to system need in 2024. As such, the placeholders noted above were considered sufficient for this independent review, and the focus of this study was limited to identifying any necessary long lead-time transmission upgrades.

To address the reliability needs in the study area, ERCOT evaluated the following five options:

Option 1

- A new Angstrom 345-kV substation tapped into the 345-kV line from Whitepoint to STP
- A new second 345/138-kV transformer at the Whitepoint substation
- Reconductor 69-kV line from Blessing to Palacios (2.9 miles)

Option 2

- A new 345-kV Angstrom substation tapped into the Whitepoint to STP 345-kV line
- A new 345/138-kV Naismith substation
- Two new 345/138-kV transformers at Naismith
- Two new 138-kV circuits on a double-circuit tower from Naismith to Resnik (~3 miles)
- One new 345-kV line from Angstrom to Naismith (~17 miles)
- One new 345-kV line from Naismith to Whitepoint (~8 miles)
- A new second 345/138-kV transformer at the Whitepoint substation

Option 3 (updated version of AEP Option 3)

- A new 345-kV Angstrom substation tapped into the Whitepoint to STP 345-kV line
- A new 345/138-kV Naismith substation
- Two new 345/138-kV transformers at Naismith
- Two new 138-kV circuits on a double-circuit tower from Naismith to Resnik (~3 miles)
- Two new 345-kV circuits on a double-circuit tower from Grissom to Angstrom (~17 miles)
- One new 345-kV line on a double-circuit tower from Angstrom to Naismith (~19 miles)
- One new 345-kV line on a double-circuit tower from Naismith to Whitepoint (~8 miles)

- One new 345-kV line installed on the double-circuit tower between Angstrom and Naismith continuing on the double-circuit tower between Naismith and Whitepoint but only electrically connecting Angstrom to Whitepoint (~26 miles)
- A new second 345/138-kV transformer at the Whitepoint substation

Option 4

- A new 345-kV Angstrom substation tapped into the Whitepoint to STP 345-kV line
- A new 345/138-kV Naismith substation
- Two new 345/138-kV transformers at Naismith
- Two new 138-kV circuits on a double-circuit tower from Naismith to Resnik (~3 miles)
- One new 345-kV line on a double-circuit tower from Grissom to Angstrom (~17 miles)
- One new 345-kV line on a double-circuit tower from Angstrom to Naismith (~19 miles)
- A new second 345/138-kV transformer at the Whitepoint substation

Option 5

- A new 345-kV Angstrom substation tapped into the Whitepoint to STP 345-kV line
- One new 345-kV line on a double-circuit tower from Grissom to Angstrom (~17 miles)
- A new second 345/138-kV transformer at the Whitepoint substation
- Reconductor 69 kV line from Blessing to Palacios (2.9 miles)

These options were evaluated based on the contingencies described in the methodology section of this report and no reliability criteria violation were identified as shown in Table 4.1.

Table 4.1 Result of Initial Reliability Assessment

	N-1		X-1 N-1		G-1 N-1	
	Thermal Violations	Voltage Violations	Thermal Violations	Voltage Violations	Thermal Violations	Voltage Violations
Option 1	No	No	No	No	No	No
Option 2	No	No	No	No	No	No
Option 3	No	No	No	No	No	No
Option 4	No	No	No	No	No	No
Option 5	No	No	No	No	No	No

5. Maintenance Outage Scenarios

As the majority of the new confirmed load is industrial in nature, the entire 1,085 MW load was assumed to be constant throughout the year. On October 17, 2019, the LGE Combined Cycle unit (365 MW) located in San Patricio County was designated as a seasonal mothball unit, scheduled to only be available during the peak season summer months (June – September). As a result, ERCOT developed an off-peak maintenance season scenario to determine if there were any system needs that arose when that unit was not available.

The load in the South Weather Zone was reduced by 6%, excluding flat load, to reflect assumed off-peak season load based on Real-Time ERCOT South Weather Zone load data. The LGE Combined Cycle unit was modeled as off-line and unavailable. Using these conditions as a starting case, each of the following six maintenance outage conditions were simulated with each of the five system improvement options:

1. STP to Angstrom 345-kV line outage
2. Angstrom to Whitepoint 345-kV line outage
3. Whitepoint to Lon Hill 345-kV line outage
4. Whitepoint to Portland 138-kV line outage
5. Whitepoint to Rincon 138-kV line outage
6. Portland to Gibbs 138-kV line outage

P1 and P7 contingencies were simulated for each of these maintenance scenarios. As shown in Table 5.1, the results of this maintenance assessment indicated that Option 3 and Option 4 performed the best among the options evaluated. A significant number of thermal overloads and/or low voltage issues were observed under Options 1, 2 and 5.

Table 5.1 Result of Maintenance Assessment

	Unsolved Power Flow	Planned Maintenance Outages Study	
		Thermal Violations	Voltage Violations
Option 1	0	30 miles 69-kV 123 miles 138-kV	No
Option 2	0	10 miles 69-kV 59 miles 138-kV	No
Option 3	0	No	No
Option 4	0	No	No
Option 5	2	68 miles 138-kV	Yes

6. Short-listed Options

Based on the results of Maintenance Outage Scenario Assessment, ERCOT identified Option 3 and Option 4 as the short-listed options. These options are illustrated in Figures 6.1 and 6.2 below.

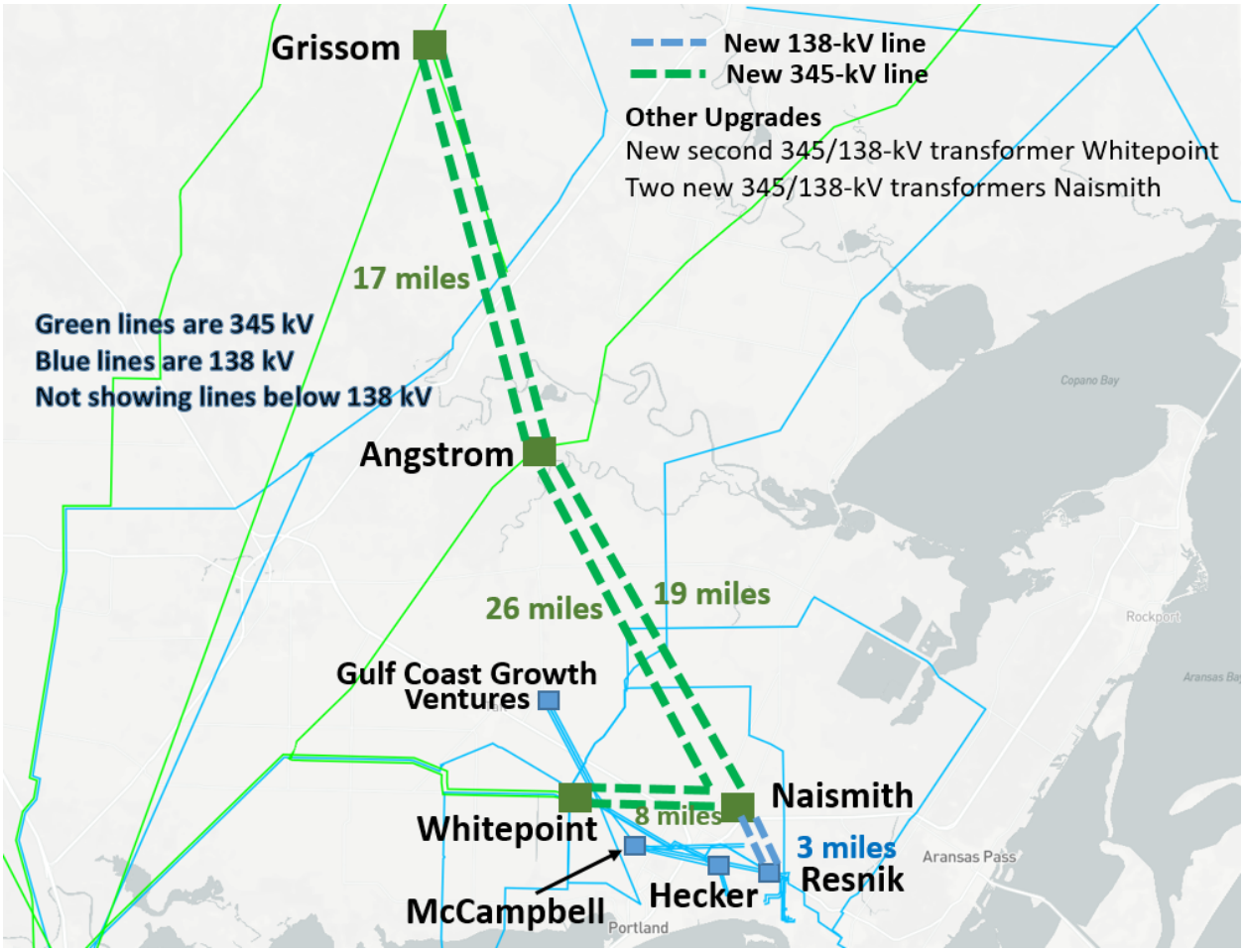

Figure 6.1: Corpus Christi North Shore Option 3

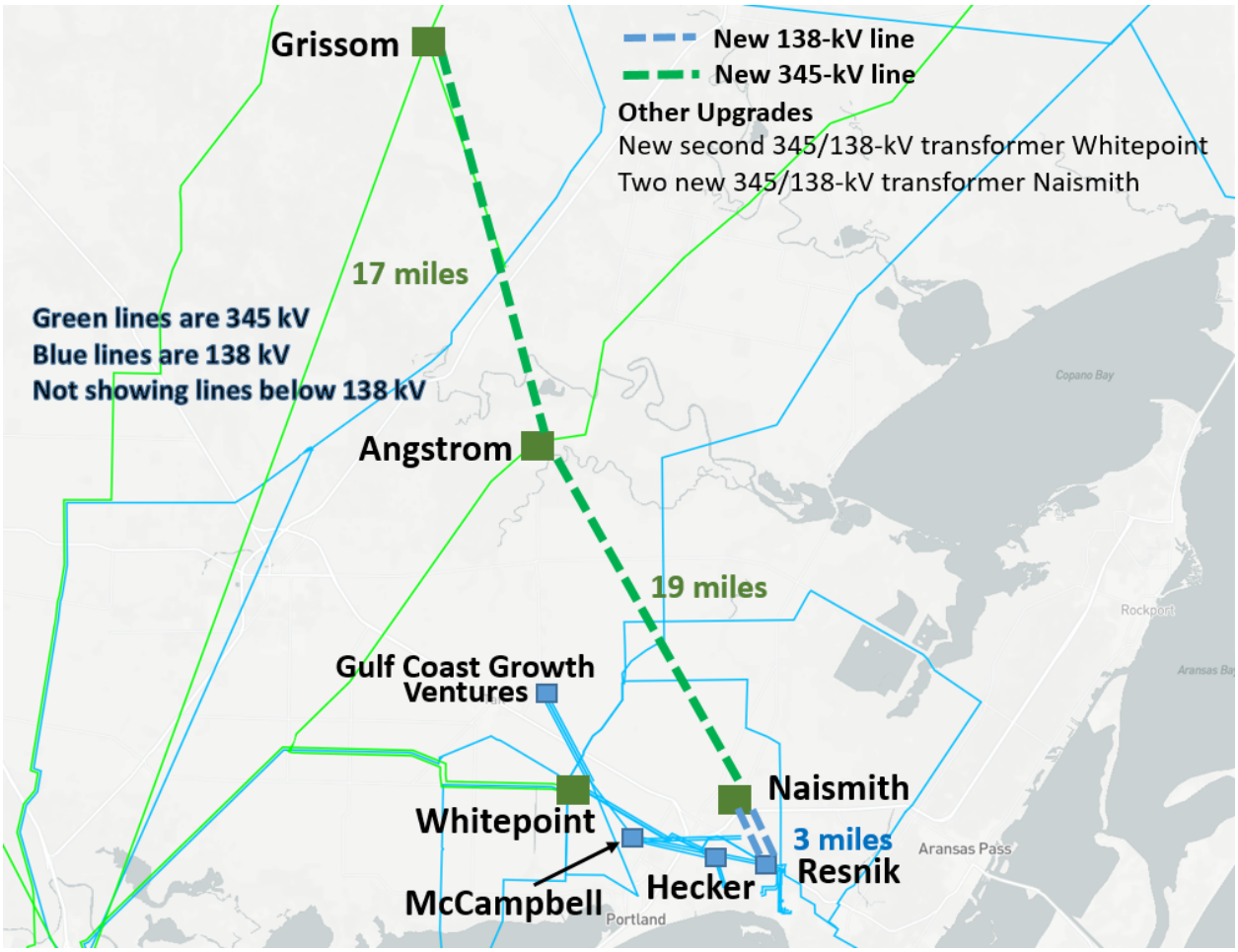

Figure 6.2: Corpus Christi North Shore Option 4

7. Load Serving Capability Analysis

According to AEP's submittal "…a number of industrial customers have expressed interest in siting within the study region but have not yet reached a stage in the development of their projects where they have executed service agreements." The submittal also stated that: "The total amount of known prospective load in the region is approximately 730 MW." This represents "potential new load" that could become confirmed in the near-term.

Accordingly, ERCOT estimated the load serving capability of each of the short-listed options from thermal and steady-state voltage stability perspectives. Since the exact location of these "potential new loads" was not confirmed at the time of this study, this load serving capability analysis was performed based on the following assumptions:

1. Gregory Power Plant (LGE) combined-cycle (CC) unit offline
2. A 4.5 mile Victoria DuPont Switch to Big Three 138-kV line upgrade since this was a common limiting element for both of the short-listed options[4]
3. Scaling up the loads served at the following six substations per the section "Study Area Load Growth" of the AEP Corpus Christi North Shore Report and based on further input from AEP: Resnik, Angstrom, Gibbs, Cheniere, Hot Ion, and TPCO (McCampbell)
4. Exclude/Ignore the limiting element within the 138-kV Corpus Christi North Shore network defined as 138-kV between Ingleside DuPont and Whitepoint due to location uncertainty of "known prospective load"
5. Voltage instability was assumed when voltage at any 100-kV and above bus in the area reached 0.8 p.u.
6. P1 and P7 contingency conditions

As shown in Table 7.1, Option 4 provides a better thermal load serving capability, while both options provide relatively similar performance from a steady-state voltage stability perspective. Option 3 increased the ratio of power imported from the west into the Corpus Christi North Shore area relative to Option 4. This shift in power flow caused the Option 3 upgrade to reach a thermal limit at a lower incremental load serving level than Option 4. It should be noted that the estimated load serving capability was based on the assumptions described in this section and will need to be revised if new load becomes confirmed in the future.

Table 7.1 Result of Load Serving Estimate

	Incremental Import Limits (MW)	
	Thermal	Voltage Stability
Option 3	72	1,216
Option 4	426	1,035

[4] This line was not overloaded with Option 3 or Option 4 in-service with the additional 1,085 MW of new load. However, it became overloaded under the same contingencies for both options as the Corpus Christi North Shore load was increased above the confirmed load level.

8. Preferred Option

Capital costs estimates shown in Table 8.1 were provided by AEP for the short-listed options. In addition to the cost estimates, Table 8.1 summarizes the overall comparison of the two short-listed options.

Table 8.1 Comparison of Short-listed Options

	Option 3	Option 4
Met ERCOT and NERC Reliability Criteria	Yes	**Yes**
Improved Operational Flexibility (Planned Maintenance Outages)	Yes	**Yes**
Load Serving Capability (Thermal limited)	--	**Better**
Capital Cost Estimates	$291 M	**$215 M**

Based on these comparisons, Option 4 was selected as the ERCOT preferred option. Option 4 also provides a path for expansion in the event that additional load becomes confirmed within the Corpus Christi North Shore area.

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

For the preferred option identified in Section 8, 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.

9.1 SSR Assessment

Pursuant to Nodal Protocol Section 3.22.1.3(2), ERCOT conducted a sub-synchronous-resonance (SSR) screening for the preferred option (Option 4) and found no adverse SSR impacts to the existing and planned generation resources in the study area.

9.2 Planning Guide Section 3.1.3 (4) Sensitivities

9.2.1 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 2019 and the January 2020 GIS reports, the generators listed in Table 9.1 are near the study area and have signed interconnection agreements (IA) but were not included in the study base case because they did not meet all of the conditions for inclusion in the case pursuant to Section 6.9 of the Planning Guide.

Table 9.1 Generators with IA but not Meeting PG 6.9 Conditions

INR	Project Name	Capacity	County
20INR0068	Blackjack Creek Wind	240 MW	Bee
21INR0244	Madero Grid	202 MW	Hidalgo
17INR0031	Espiritu Wind	25 MW	Cameron

These units are not within the San Patricio County load pocket and are relatively far away from the study area. Accordingly, these generator additions were not able to resolve the reliability criteria violations and the preferred option would remain the same even if all these generators were included in the base case analysis.

9.2.2 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. As stated in Section 2.1.1, ERCOT used the 2024 South/South Central (SSC) summer peak case from the 2019 RTP for the steady state analysis. This case was created in accordance with the 2019 RTP Study Scope and Process document which included load scaled down from the respective non-coincident peaks forecasted in the North, North Central, West, Far West, Coast, and East weather zones.

The Outage Transfer Distribution Factors (OTDFs) of overloaded elements with respect to the load transfer for each weather zone (excluding South/Southcentral) were calculated using PowerWorld Simulator. The OTDFs were less than 1% for each of the overloaded elements. These values were

not significant enough to impact the overloaded elements. ERCOT concluded that the load scaling did not have a material impact on the project need, which was primarily driven by the new load additions in the Corpus Christi North Shore area.

9.3 Sensitivity Analysis for Potential LNG Load in Lower Rio Grande Valley

AEP submitted the Lower Rio Grande Valley (LRGV) Import Project in January 2018 to address the native LRGV load growth beyond 2021 and the addition of potential LNG loads in Valley. Additionally, STEC submitted the LRGV Transmission Expansion Proposal Project in May 2019 to integrate a potential 405 MW LNG load and the addition of a potential 840 MW LNG load in the LRGV. This represents a total of 1,245 MW of potential LNG load that could be added to the LRGV.

At the time of this independent review, none of the 1,245 MW LNG customers in the LRGV had reached a stage in the development of their projects where they had executed service agreements with full financial commitment. Therefore, this 1,245 MW of potential LRGV load had not yet been confirmed.

Nevertheless, ERCOT combined the independent reviews for AEP and STEC Valley Import RPG projects to identify the need for serving LRGV load growth and potential LNG load. ERCOT also identified preferred transmission improvement projects anticipating that this load could become confirmed. Details on the ERCOT preferred upgrade options for the LRGV (Import Option 3 + Additional Upgrades for 1,245 MW LNG) were presented on pages 18 and 19 of ERCOT's December 17, 2019 RPG presentation entitled "Lower Rio Grande Valley Project - Status Updates of ERCOT Independent Review."[5]

ERCOT performed a sensitivity analysis of 2024 summer peak conditions with both the potential future load in the LRGV (1,245 MW) as well as the new load in the Corpus Christi area (1,085 MW) along with the preferred transmission solutions for both the Corpus Christi area and the LRGV, to identify any reliability violations that could occur if both of these projects were needed and developed. The results of this sensitivity analysis are shown in Tables 9.1 and 9.2. Since the potential LRGV load is not confirmed, these results are for informational purposes only and no system upgrades are recommended to address these potential violations at this time.

Table 9.1 Thermal Overloading for Potential LRGV LNG Sensitivity Analysis

Element	Length (miles)	Loading
Spruce to Pawnee 345-kV ckt 1	46	109%
Airco to Melon Creek 138-kV ckt 1	23	100%
Blessing to Palacios 69 kV ckt 1	10	113%
Asherton to Catarina 138-kV ckt 1	8	103%
Holly to Southside 138-kV ckt 1	2	101%
Dilley Switch 138/69-kV transformer	-	103%
Victoria DuPont Switch to Big Three138-kV ckt 1	4	104%
Victoria to Warburton Rd 138-kV ckt 1	15	104%

Table 9.2 Voltage Violations for Potential LRGV LNG Sensitivity Analysis

Bus	Nominal Voltage (KV)	Per Unit Voltage
None	None	None

[5] http://www.ercot.com/content/wcm/key_documents_lists/165315/LRGV_Transmission_Expansion_Project_-_Dec_17_RPG.PDF

10. Congestion Analysis

ERCOT conducted a congestion analysis to determine if the addition of the preferred Corpus Christi North Shore project, Option 4, would result in new or additional congestion.

These studies determined that the addition of Option 4 will not result in any new or additional congestion. However, the results of the congestion analysis did reveal that, following completion of these upgrades, significant congestion remained on the existing Pelican-Whitepoint 138-kV line. Further, these results showed that a project to upgrade the congested line to a normal rating of 489 MVA and an emergency rating of 705 MVA will meet the economic criteria as shown in Table 10.1[6]. The capital cost of the upgrade and associated ratings for the Pelican-Whitepoint 138-kV line were provided by AEP.

Based on the results of the congestion analysis, ERCOT added the upgrade of the existing Pelican to Whitepoint 138-kV line to the preferred option.

Table 10.1 Economic Benefit of Pelican to Whitepoint Upgrade

	Upgrade Pelican to Whitepoint 489/705 MVA
Annual Production Cost Savings ($M)	1.4
Capital Cost Estimate ($M)	3.9*
Annual Benefit to Capital Cost Ratio (%)	36%

*Capital cost estimate was $3.5 Million in 2020 dollars but escalated to 2024 dollars using an annual inflation rate of 2.5%.

[6] Note: Pursuant to Protocol Section 3.11.2(5), for a transmission project to pass the ERCOT economic planning criteria, the expected annual production cost (PC) savings of the project must be equal to or exceed the first year annual revenue requirement for the project. Based on the most recent review of financial assumptions, the first year annual revenue requirement for a project is assumed to be 14% of the project's estimated capital cost (https://mis.ercot.com/pps/tibco/mis/Pages/Grid+Information/Long+Term+Planning)

11. Conclusion

The results of this independent review revealed that Option 4 can reliably integrate the 1,085 MW confirmed Corpus Christi load into the ERCOT grid and is the most cost-effective of the short-listed options. Option 4 is illustrated in Figure 6.2 of this report and it includes the following system improvements:

- A new Angstrom 345-kV substation tapped into the 345-kV line from Whitepoint to STP
- A new 345/138-kV Naismith substation
- Two new 345/138-kV transformers at Naismith
- Two new 138-kV circuits on a double-circuit tower from Naismith to Resnik (~3 miles)
- One new 345-kV line on a double-circuit tower from Grissom to Angstrom (~17 miles)
- One new 345-kV line on a double-circuit tower from Angstrom to Naismith (~19 miles)
- A new second 345/138-kV transformer at the Whitepoint substation

This review also reveals that Option 4 should be supplemented with the following economic project:

- Upgrade the 138-kV 4.7 mile Pelican to Whitepoint transmission line to achieve at least 489 MVA normal and 705 MVA emergency ratings

This recommended project is a Tier 1 project estimated to cost approximately $218.5 Million. A Certificate of Convenience and Necessity (CCN) application is required for the new rights-of-way (~39 miles). AEP is expecting this project to be in-service by the 2nd quarter of 2024. According to AEP, portions of this load are anticipated to be placed in-service before 2024. If reliability issues arise before the entire recommended project is constructed, ERCOT and AEP will work together to develop mitigation plans as necessary. AEP has requested ERCOT designate the recommended project “critical” to the reliability of the system per PUCT Substantive Rule 25.101(b)(3)(D). Since there is a reliability need to have the project in place as soon as possible, ERCOT deems the project critical to reliability.

This recommendation is designed to address long lead time upgrade requirements. The recommended option is based on reactive compensation improvement assumptions described in Section 4. Reactive compensation related improvements are expected to be required to serve the new loads projected for the Corpus Christi North Shore area. However, ERCOT is not recommending any specific reactive compensation upgrades at this time, since these needs can be addressed with shorter lead time projects that can be studied when detailed load dynamic characteristics information for the Corpus Christi North Shore area becomes available. The reactive compensation upgrades are expected to address anticipated local reactive power imbalances and therefore would not change this initial upgrade recommendation.