# Oncor and LCRA TSC Muscovy and Voss Lake 345/138-kV Project – ERCOT Independent Review (EIR) Status Update

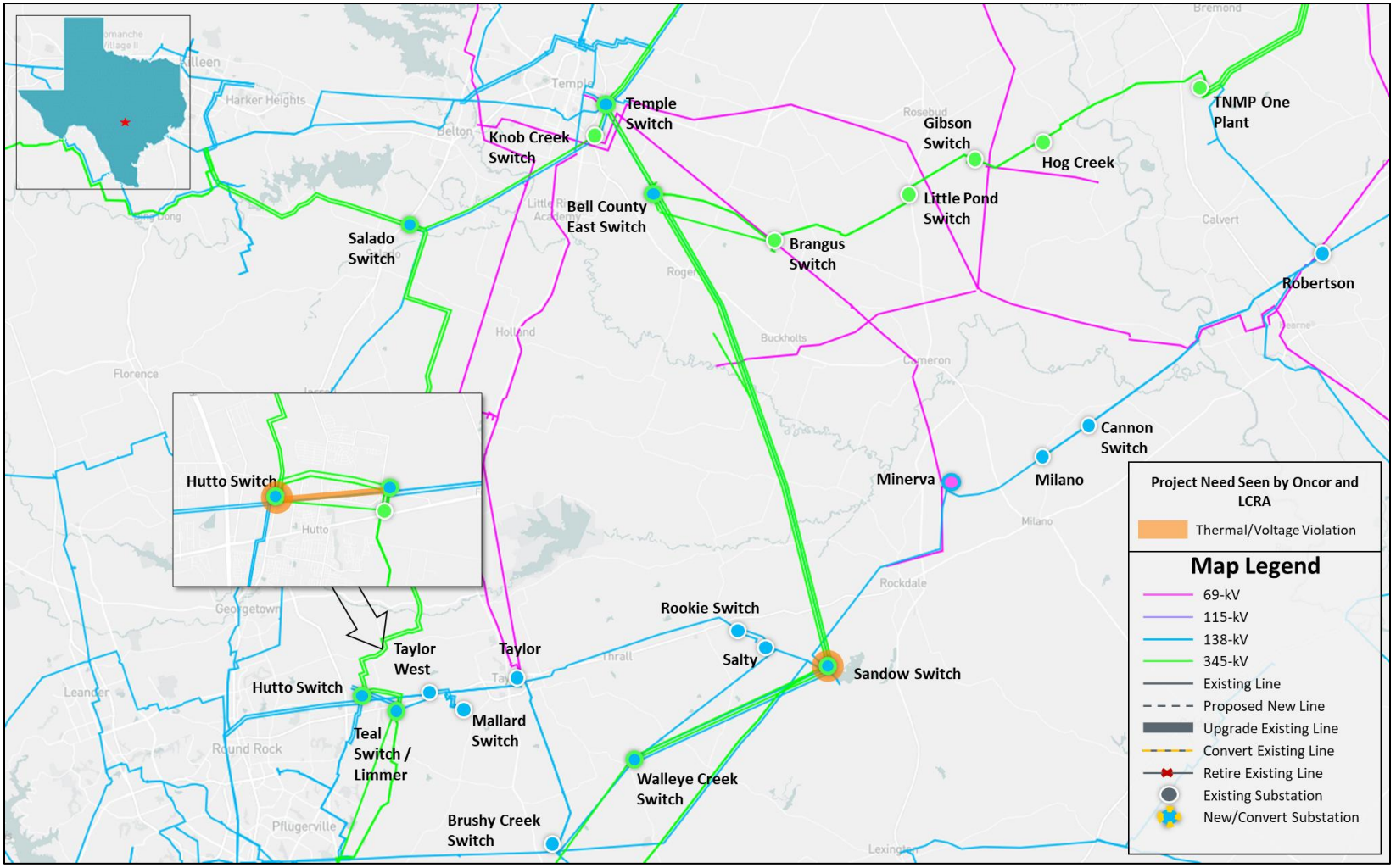
Abishek Penti

RPG Meeting
March 17, 2026

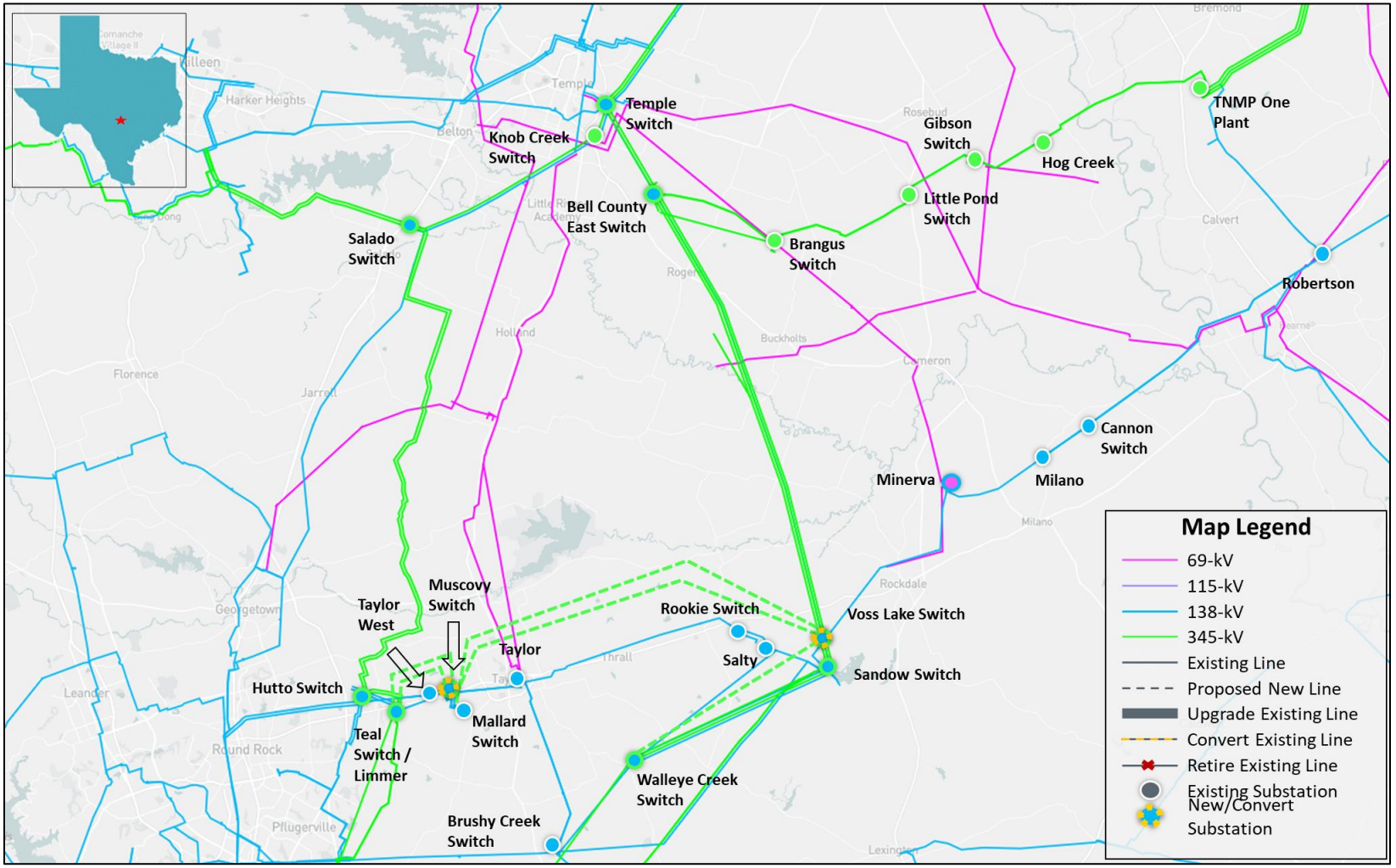
# Introduction

- Oncor and LCRA TSC submitted the Muscovy and Voss Lake Project for Regional Planning Group (RPG) review in April 2025.
  - This Tier 1 project is estimated to cost $381.83 million and will require a Certificate of Convenience and Necessity (CCN)
  - Estimated in-service date (ISD) is December 2028
  - To address reliability violations seen by Oncor and LCRA TSC
  - Observed similar violations in 2024 RTP (2024-SC28 and 2024-SC29)
- Oncor provided an overview presentation and ERCOT provided the study scope at the May RPG Meeting
  - https://www.ercot.com/calendar/05202025-RPG-Meeting
- ERCOT provided a status update at the June, July October 2025 and January 2026 RPG Meeting
  - https://www.ercot.com/calendar/06172025-RPG-Meeting
  - https://www.ercot.com/calendar/07292025-RPG-Meeting
  - https://www.ercot.com/calendar/10282025-RPG-Meeting
  - https://www.ercot.com/calendar/01162026-RPG-Meeting
- This project is currently under ERCOT Independent Review (EIR)

# Recap – Study Area Map with project need as seen by Oncor and LCRA TSC



# Recap – Project Proposed by Oncor and LCRA TSC



# Recap – Project Proposed by Oncor and LCRA TSC

- Establish the new Muscovy 345/138-kV Switch by installing ten 345-kV, 5000 A and twelve 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 3.3 miles east of the co-located 345-kV Limmer Substation (LCRA TSC) and 138-kV Teal Switch (Oncor);
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Install three 36.8 MVAr capacitor banks
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a new 345-kV double-circuit transmission line which will require a CCN from Limmer Substation (LCRA TSC) to Muscovy Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 4 miles;
- Construct a loop of the existing Teal Switch to Pintail Switch 138-kV double-circuit transmission line with a normal and emergency ratings of at least 614 MVA into the new Muscovy 138 kV Switch, approximately 0.1 miles;

# Recap – Project Proposed by Oncor and LCRA TSC

- Establish the new Voss Lake 345/138-kV Switch by installing ten 345-kV, 5000 A and nine 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 1.9 miles north of Sandow 345/138-kV Switch;
  - Install one 345/138-kV autotransformer with normal ratings of at least 700 MVA and emergency ratings of atleast 750 MVA
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a loop of the existing Sandow Switch to Bell County East Switch 345-kV double-circuit transmission line into the Voss Lake 345-kV Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Temple Switch 138-kV transmission line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Minerva Switch 138-kV line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;

# Recap – Project Proposed by Oncor and LCRA TSC

- Construct a new 345-kV transmission line which will require a certificate of convenience and necessity (CCN) from Voss Lake Switch to Walleye Creek Switch with a normal and emergency ratings of at least 2987 MVA or greater on double-circuit structures with one circuit installed initially, approximately 2 miles; and
- Construct a new, 345-kV double-circuit line which will require a CCN from Muscovy Switch to Voss Lake Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 25 miles.
- Install terminal equipment in existing bays at Limmer Substation to connect both circuits of the new 345-kV double-circuit transmission lines to Muscovy Switch, including two circuit breakers, two switches, six coupling capacitor voltage transformers (CCVTs), and six surge arrestors, as well as two A-frame structures. All associated terminal equipment will have a minimum rating of 5000 A.

# Recap – Study Assumptions – Load, Reserve, Transmission & Generation

- 2024 Regional Transmission Planning (RTP) 2029 summer peak case was used as the start case
- Load in study area
  - Loads in study area were updated to create the study base case
  - Added ~2GW of substantiated load in the study region
- Reserve
  - Reserve levels are consistent with the 2024 RTP
- Transmission
  - See Appendix A for a list of transmission projects added
  - See Appendix B for a list of RTP placeholder projects that were removed
- Generation
  - See Appendix C for a list of generation projects added

# Updated – Preliminary Results of Reliability Assessment – Need Analysis

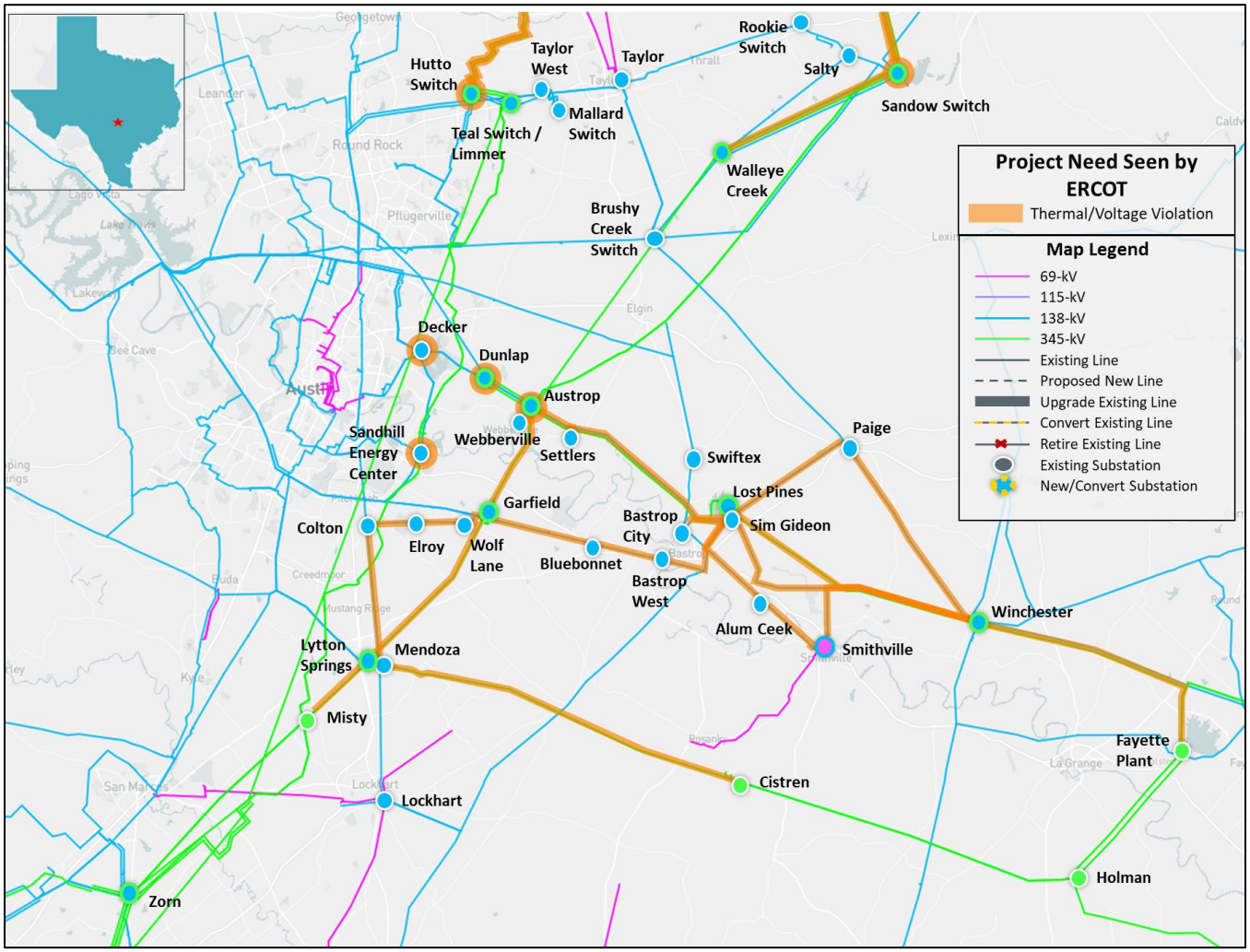
- ERCOT conducted steady-state load flow analysis for the study base case according to the NERC TPL-001-5.1 and ERCOT Planning Criteria to identify project need

| Contingency Category | Voltage Violations | Thermal Violations | Unsolved Power Flow |
|---|---|---|---|
| P0: N-0 | 7 | 16 | None |
| P1, P2-1, P7: N-1 | 28 | 19 | 13 |
| P3: G-1+N-1 * | 50+ | 50+ | 25 |
| P6-2: X-1+N-1 * | 50+ | 40+ | 13 |

* See Appendix D for list of G-1 generators and X-1 transformers tested

# Updated – Study Area 1 Map with Violations seen by ERCOT

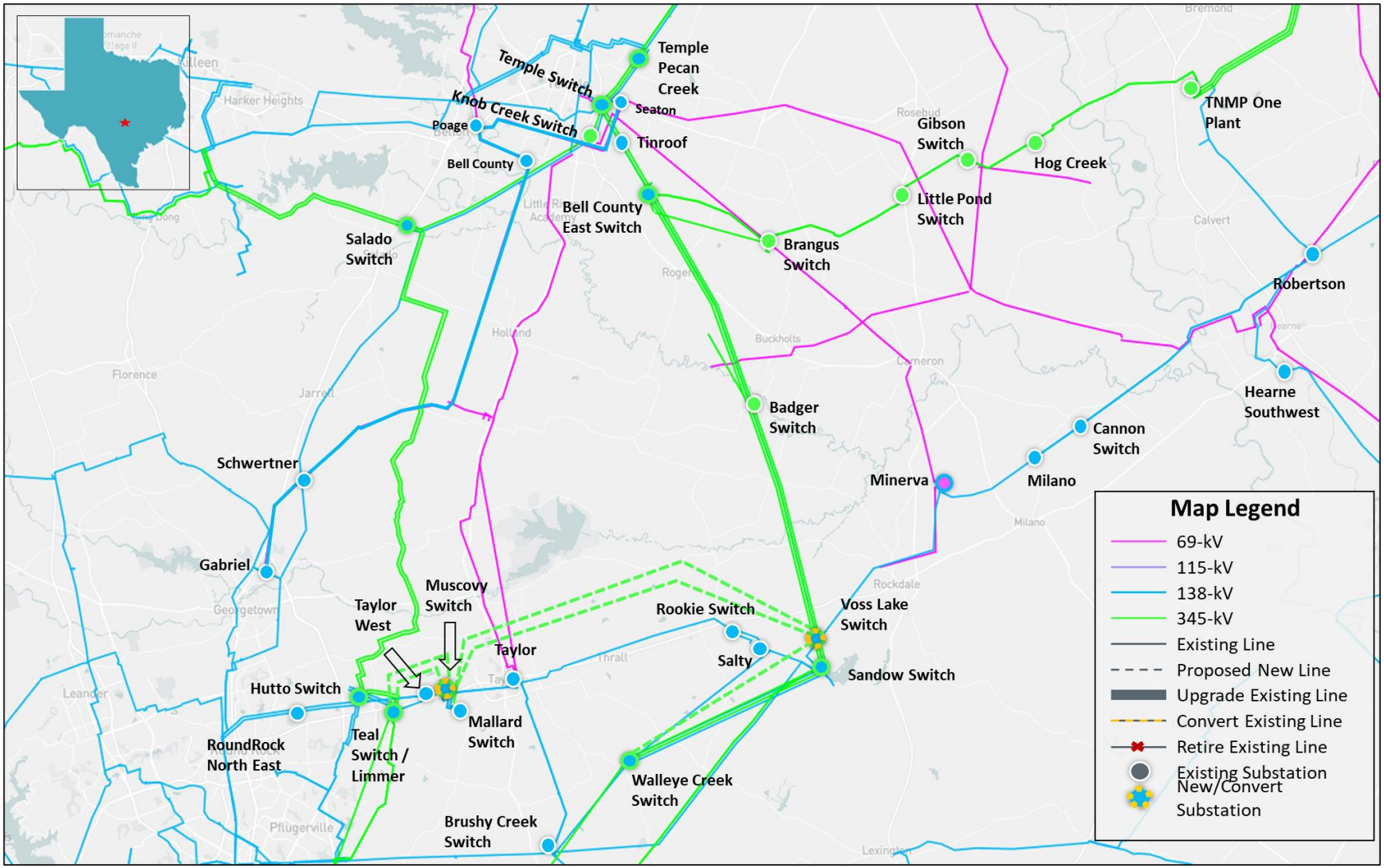
# Recap – Study Area 2 Map with Violations seen by ERCOT



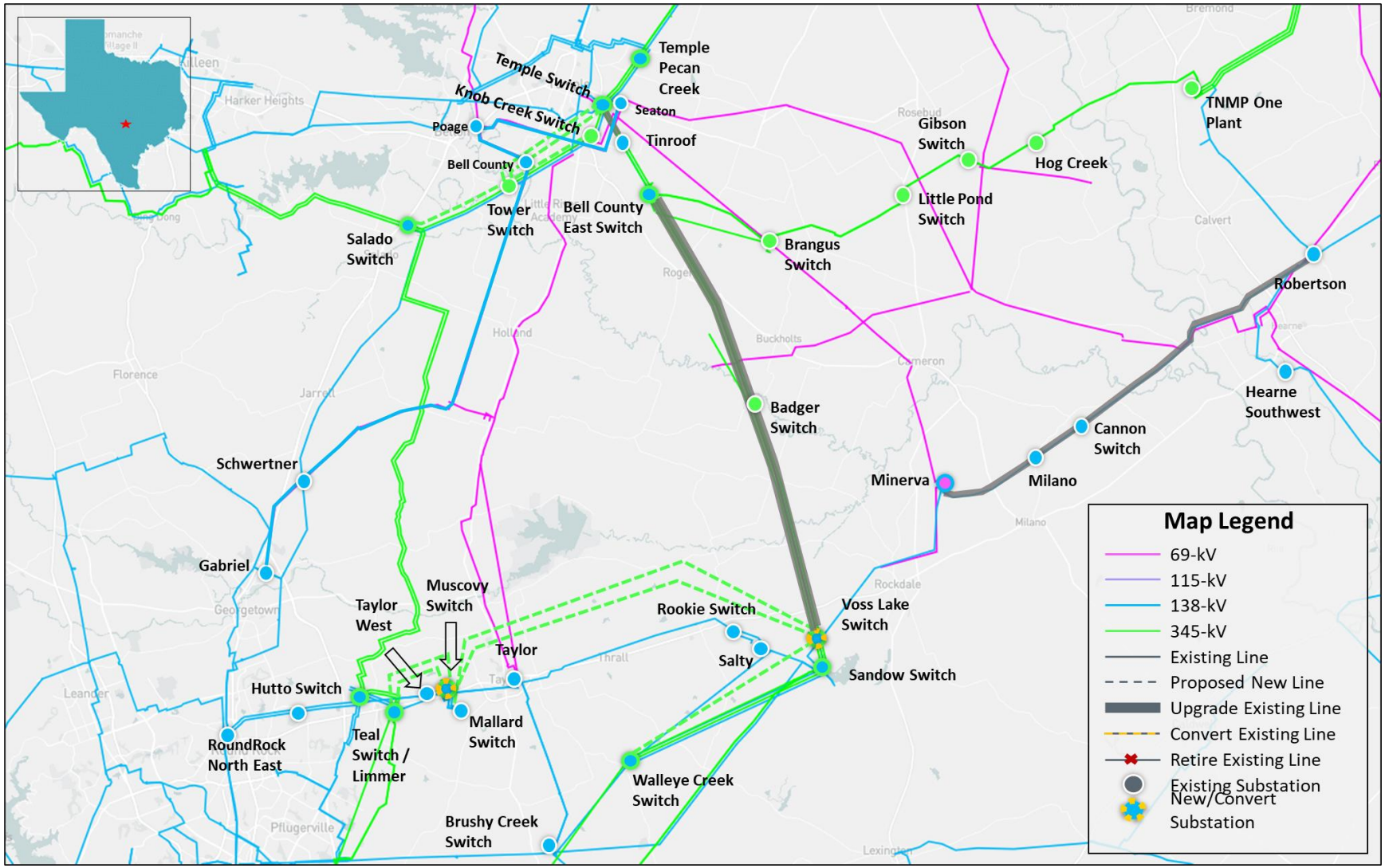
# Recap – Phased Approach Evaluation

- The ongoing Oncor and LCRA TSC Muscovy and Voss Lake 345/138-kV Project EIR was separated into two Phases
- Phase 1 of the EIR
  - To address the violations identified in Study area 1
- Phase 2 of the EIR
  - To address the violations identified in study area 2
  - Include upgrades identified in Phase 1
  - ERCOT final recommendation will be coordinated with the 2025 RTP evaluations
  - ERCOT anticipates the completion of phase 2 EIR study after phase 1 EIR Study

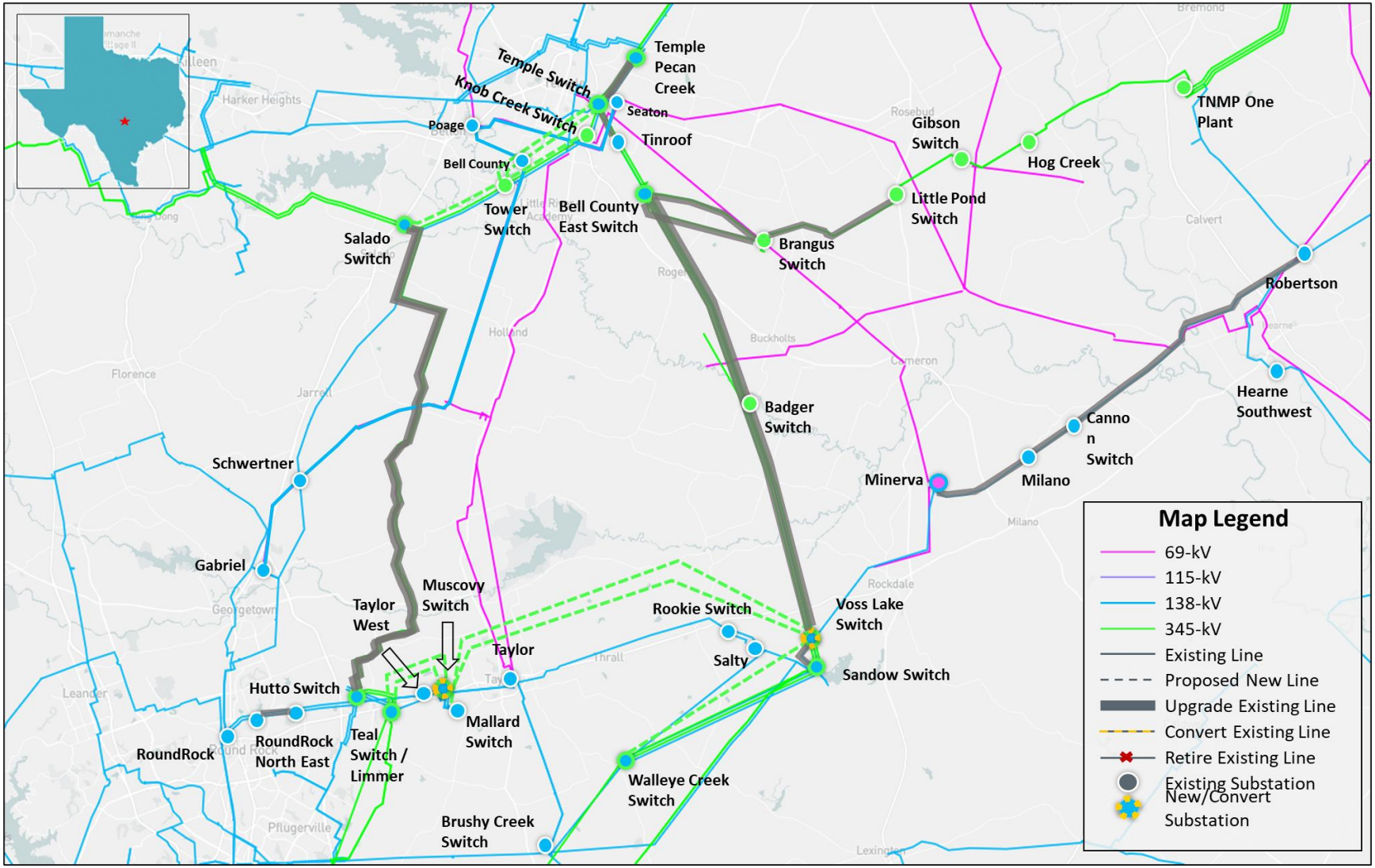
# Option 1 – LCRA & Oncor Option



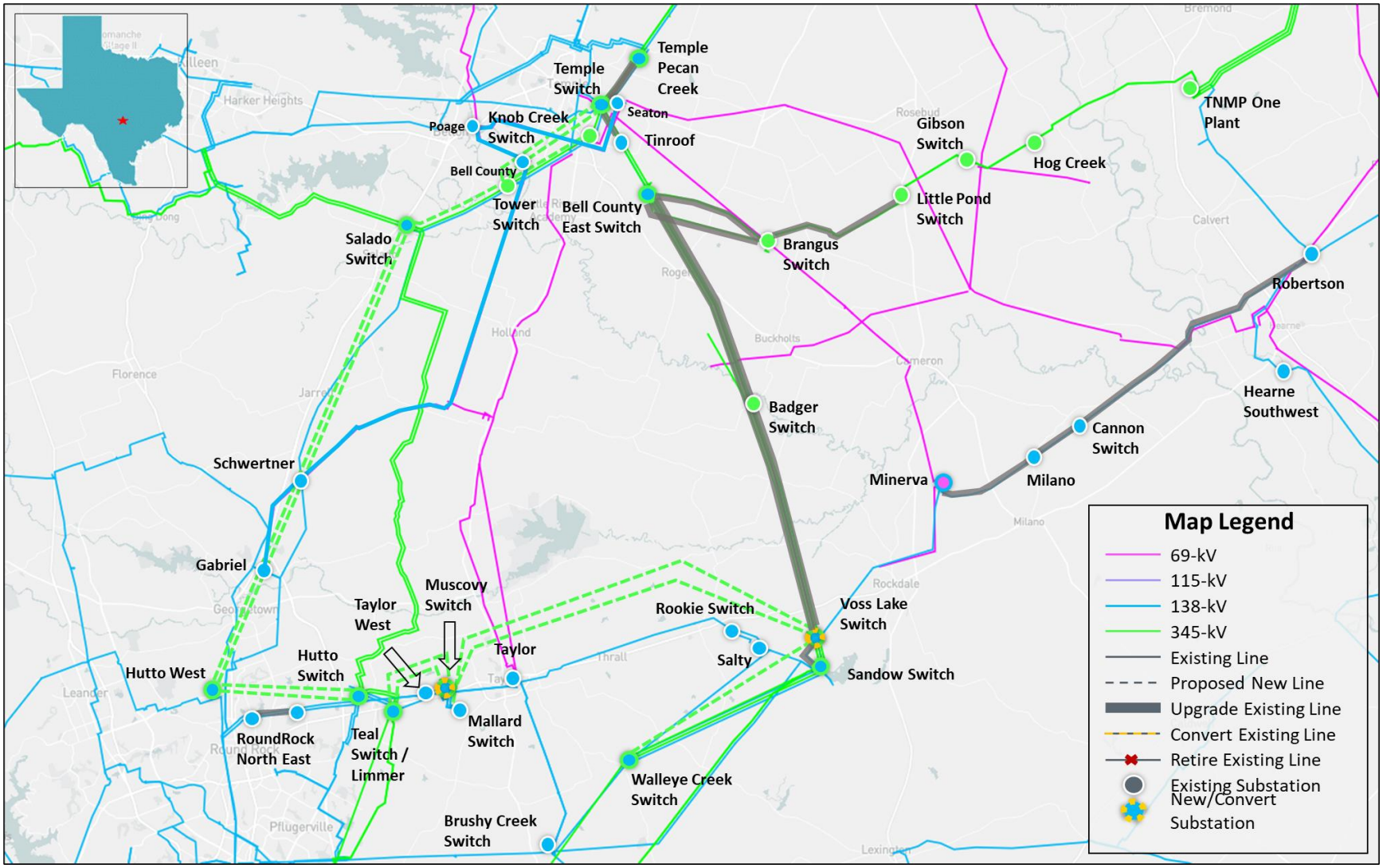
# Option 2 – Alternative ERCOT Option



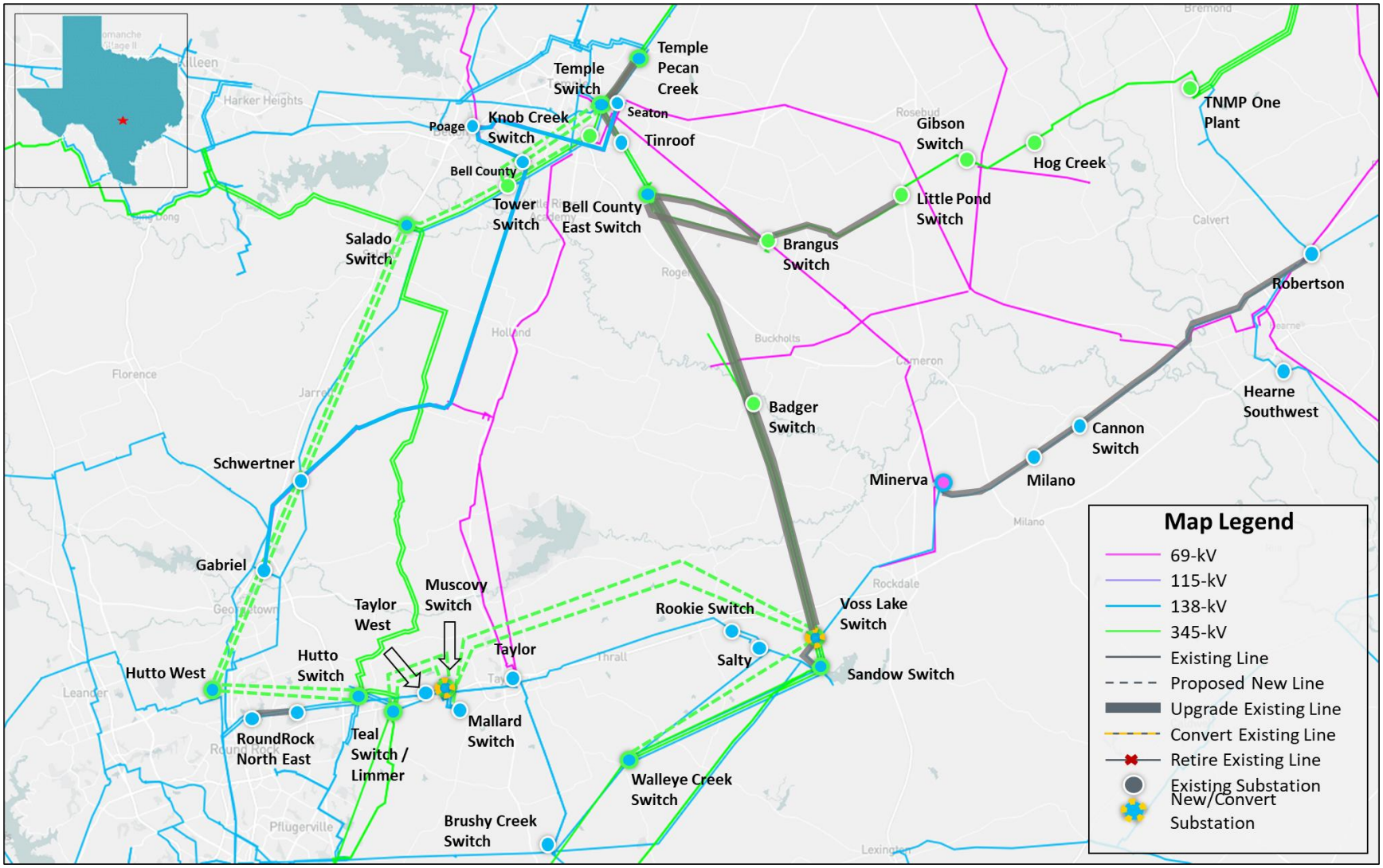
# Option 3 – ERCOT Alternative Option



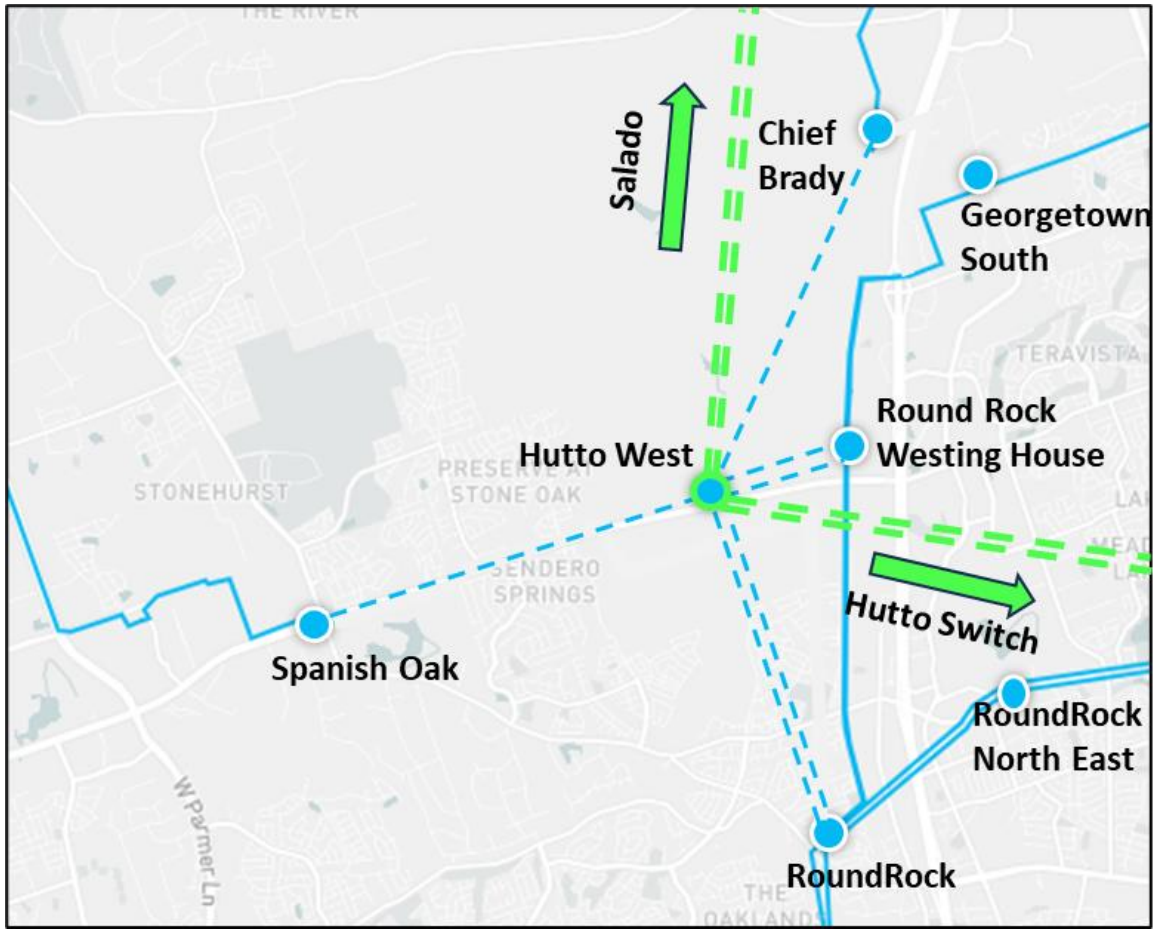
# Option 4 – Alternative Oncor Option



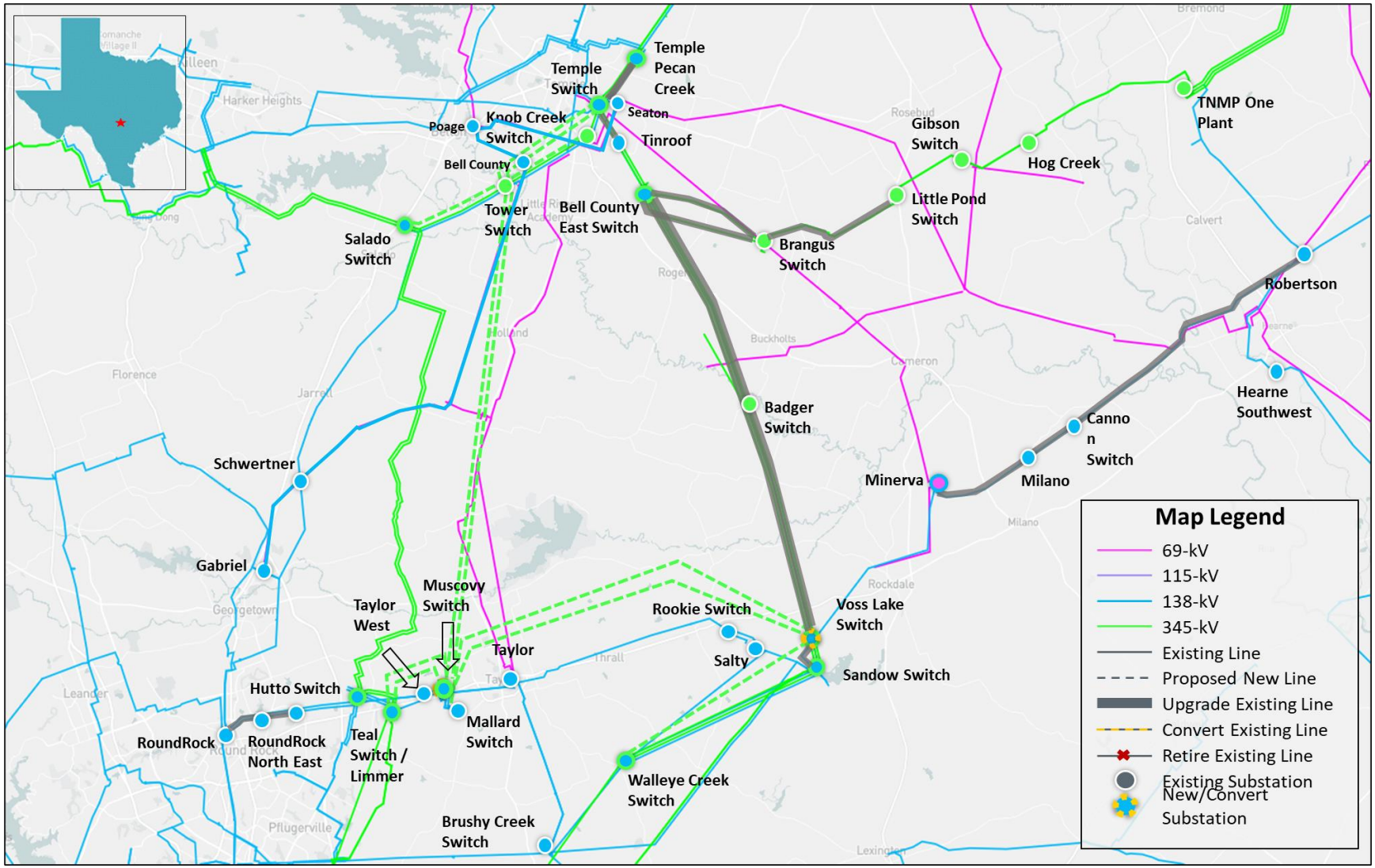
# Option 4A – Alternative Oncor Option



# Option 4A – Alternative Oncor Option - Cont., Hutto West Zoomed in

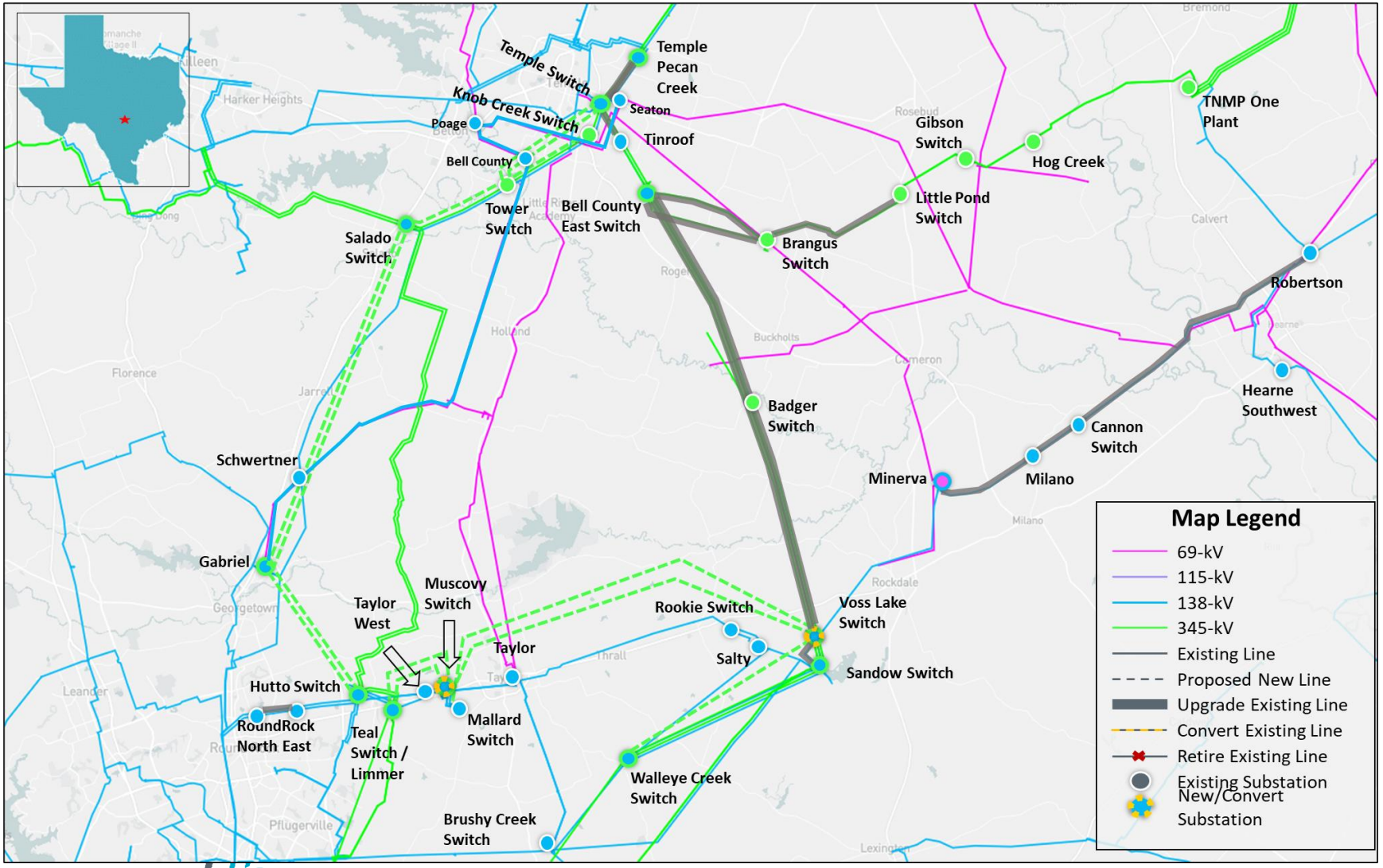


# Option 5 – ERCOT Alternative Option

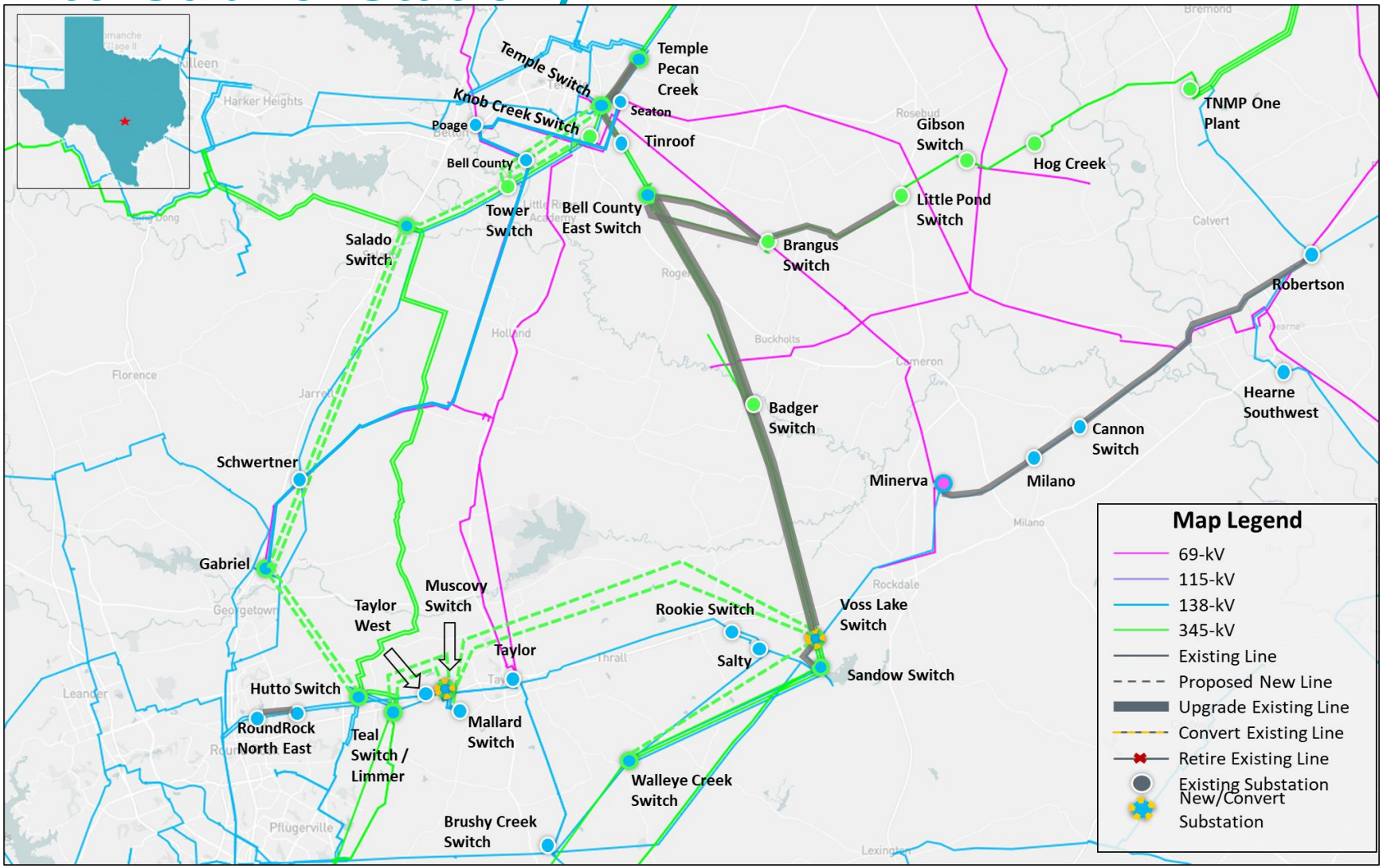


# Option 6 – Brazos Suggested Option

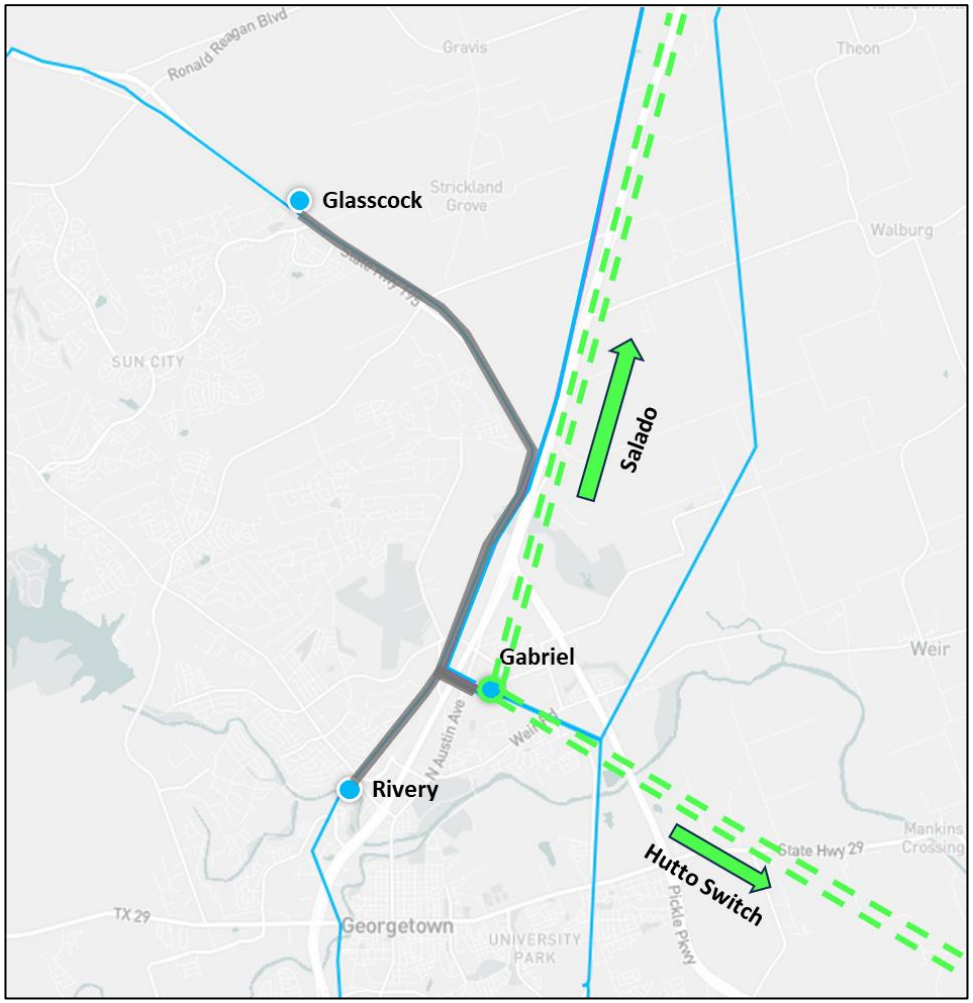
# Option 7 – LCRA Suggested Option (looping into Gabriel Station)



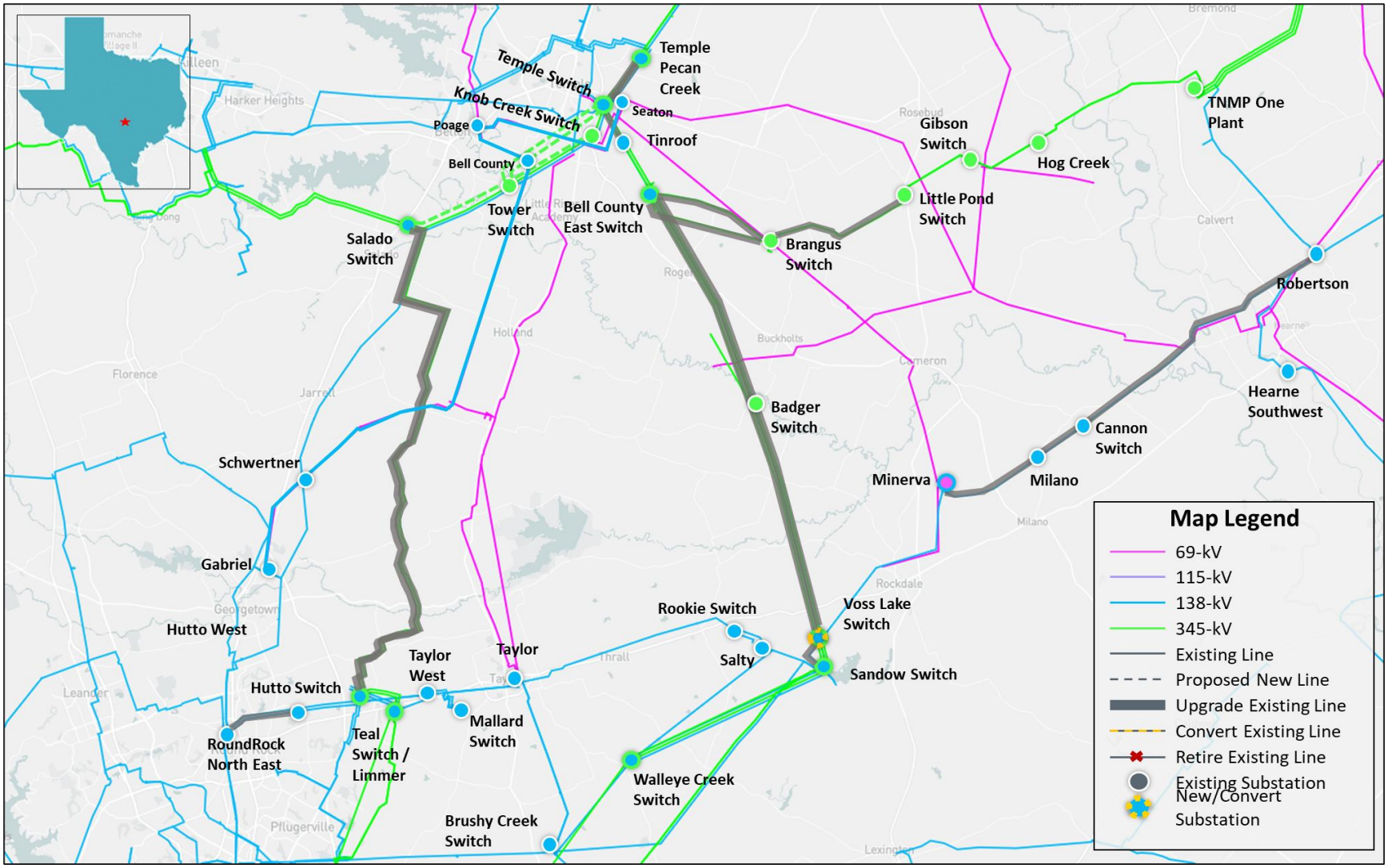
# Option 7A – LCRA Suggested Option (looping into Gabriel Station)



# Option 7A – LCRA Suggested Option (looping into Gabriel Station) - Cont.,



# Option 8 – No Muscovy Voss Lake Project



# Preliminary Results of Reliability Assessment - Options

| Option | N-0 | | N-1 | | X-1+N-1* | | G-1+N-1* | | Unsolved Violations |
|---|---|---|---|---|---|---|---|---|---|
| | Thermal Violations | Voltage Violations | Thermal Violations | Voltage Violations | Thermal Violations | Voltage Violations | Thermal Violations | Voltage Violations | |
| 1 | 4 | None | 6 | None | 3 | None | 3 | None | None |
| 2 | None | None | 5 | None | 4 | None | None | None | None |
| 3 | None | None | None | None | None | None | None | None | None |
| 4 | 2 | None | None | None | None | None | None | None | None |
| 4A | None | None | None | None | None | None | None | None | None |
| 5 | None | None | None | None | None | None | None | None | None |
| 6 | None | None | 4 | None | 10 | 3 | 7 | 3 | 1 |
| 7 | 2 | None | None | None | None | None | None | None | None |
| 7A | None | None | None | None | None | None | None | None | None |
| 8 | None | None | 6 | 2 | 5 | 2 | 1 | 2 | 1 |

* List of Transformer and Generation contingencies are listed in Appendix D

- Option 3, Option 4A, Option 5, and Option 7A are short-listed for further evaluation.

# Results of Maintenance Outage Analysis – Options

- ERCOT conducted maintenance outage analysis on the four short-listed options to determine relative performance between the options

| Option | Thermal Violations | Voltage Violations | Unsolvable Contingencies |
|---|---|---|---|
| 3 | None | None | None |
| 4A | None | None | None |
| 5 | None | None | None |
| 7A | None | None | None |

- Option 3, Option 4A, Option 5, and Option 7A are short-listed for further evaluation.

# Next Steps and Tentative Timelines

- ERCOT will continue to evaluate options to resolve violations in Study Area 1 as phase 1 of this RPG evaluation and provide status updates at future RPG meetings
  - Long-term load-serving capability assessment
  - Cost estimates and feasibility assessment
- Generation Addition and Load Scaling Sensitivity Analyses
  - Planning Guide Section 3.1.3(4)
- Subsynchronous Oscillations (SSO) Assessment
  - Nodal Protocol Section 3.22.1.3(2)
- Congestion Analysis
  - Congestion analysis may be performed based on the recommended transmission upgrades to ensure that the identified transmission upgrades do not result in new congestion within the study area
- Tentative timeline
  - Final recommendation for Phase 1 – Q2 2026
  - Final recommendation for Phase 2 – Q3 2026

# Thank you!


Stakeholder comments also welcomed through:

Abishek.Penti@ercot.com
Robert.Golen@ercot.com

# Appendix A – Transmission Projects

- List of transmission projects added to study base case

| RPG/TPIT No | Project Name | Tier | Project ISD | TSP |
|---|---|---|---|---|
| 24RPG001 | Temple Area Project | Tier 1 | Dec-28 | Oncor |
| 24RPG013 | FPP Yard 2 to Lytton Springs Transmission Line Overhaul Project | Tier 4 | May-26 | LCRA TSC, AEN |
| 24RPG014 | Sim Gideon to Cedar Hill Transmission Line Upgrade Project | Tier 3 | May-27 | LCRA TSC |
| 24RPG018 | Salado Switch to Hutto Switch 138-kV Line Project | Tier 3 | May-27 | Oncor |
| 25RPG006 | Resubmission for Salado Switch to Hutto Switch 138-kV Line Project | Tier 3 | May-27 | Oncor, LCRA TSC |
| 72588A | Trading Post to Cedar Valley Storm Hardening | Tier 4 | May-25 | PEC |
| 86319 | AEN_Garfield_HiCross_CKT_963_Reconductor | Tier 4 | Jun-25 | AEN |
| 86325 | AEN_McNeil_Magnesium_Plant_Ckt_977_RECONDUCTOR | Tier 4 | Jun-25 | AEN |
| 87758 | Badger 345 kV Switch | Tier 4 | Dec-25 | ONCOR |
| 87395 | Caldwell Substation Addition | Tier 4 | Mar-26 | LCRATSC |
| 86323 | AEN_MagnesiumPlant_Northland_Ckt_979_RECONDUCTOR | Tier 4 | Jun-26 | AEN |
| 86912 | BEPC_TPIT_86912_Gabriel_Schwertner | Tier 4 | Mar-27 | BEPC |
| 87673 | Rebuild the Salado - Bell County 138 kV Line | Tier 1 | May-27 | ONCOR |
| 87770 | Establish a 110.4 MVAR Capacitor Bank at Midnight 138 kV Substation | Tier 4 | May-27 | ONCOR |
| 87768 | Establish a 110.4 MVAR Capacitor Bank at Pintail 138 kV Switch | Tier 4 | May-27 | ONCOR |
| 87677 | Rebuild the Fryers Creek - Temple 138 kV Line | Tier 1 | May-27 | ONCOR |
| 87675 | Rebuild the Bell County - Fryers Creek 138 kV Line | Tier 1 | May-27 | ONCOR |
| 85973 | Georgetown - Rivery Transmission Line Upgrade | Tier 4 | May-26 | LCRATSC |

# Appendix A – Transmission Projects

- List of transmission projects added to study base case

| RPG/TPIT No | Project Name | Tier | Project ISD | TSP |
|---|---|---|---|---|
| 80546C | Upgrade the Hutto & Round Rock - Salado 138 kV Line | Tier 3 | May-26 | ONCOR |
| 80546E | Upgrade the Hutto & Round Rock - Salado 138 kV Line | Tier 3 | May-27 | ONCOR |
| 86331 | AEN_Wheless_Mueller_Ckt_1016_Reconductor | Tier 4 | Jun-27 | AEN |
| 86321 | AEN_Lakeshore_Northland_Ckt_916_Reconductor | Tier 4 | Jun-27 | AEN |
| 86327 | AEN_New_138kV_Southshore_Substation_Addition | Tier 4 | Sep-27 | AEN |
| 86317 | AEN_DP_OnionCreek_Ckt_924_Reconductor | Tier 4 | Sep-27 | AEN |
| 86333 | AEN_OnionCreek_StoneyRidge_Ckt_1026_Reconductor | Tier 4 | Sep-27 | AEN |
| 87367 | BEPC_TPIT_87367_TempleAreaImprovements | Tier 1 | Oct-27 | BEPC |
| 87699 | Belton - Killeen 138 kV Line via Belton Southwest | Tier 1 | Dec-27 | ONCOR |
| 80546D | Upgrade the Hutto & Round Rock - Salado 138 kV Line | Tier 3 | Dec-27 | ONCOR |
| 87707 | Salado 345/138 kV Autotransformer #1 and #2 | Tier 1 | Dec-27 | ONCOR |
| 87701 | Establish the Watercrest 138 kV Switch | Tier 1 | May-28 | ONCOR |
| 86838 | AEN_JustinLane_KoenigLane_Ckt__conversion_to_138kV | Tier 4 | Jun-28 | AEN |
| 86315 | AEN_Barton_Vega_Ckt_928_Reconductor | Tier 4 | Jun-28 | AEN |
| 72588B | Trading Post to Cedar Valley Storm Hardening | Tier 4 | Sep-24 | PEC |

# Appendix B – Transmission Projects

- List of transmission projects removed from the study base case

| TPIT No | Project Name | County |
|---|---|---|
| 2022-SC7 | Decker (9188) 138-kV Bus Tie Breaker Upgrade | Travis |
| 2023-SC3 | Dessau (9193) to McNeil AEN (9076) 138-kV Circuit 2 Upgrade | Travis |
| 2023-SC15 | Sim Gideon Area 138-kV Line Upgrades | Bastrop, Fayette, Williamson |
| 2023-SC17 | Georgetown Area 138-kV Line Upgrades | Williamson |
| 2024-SC2 | Trading Post (70505) 138-kV Cap Bank Addition | Travis |
| 2024-SC8 | Milano (64) to Minerva (3683) and Cannon (3707) 138-kV Line Upgrades | Milam |
| 2024-SC11 | Vega (9285) to Barton (9158) 138-kV Line Upgrade | Travis |
| 2024-SC14 | Elroy (7209) 138-kV Cap Bank Addition | Travis |
| 2024-SC16 | Limmer (7341) 345-kV Cap Bank Addition | Williamson |
| 2024-SC17 | SLR AMLC (3740) 138-kV Cap Bank Addition | Milam |
| 2024-SC19 | Hillje (44200) to Zorn (7042) 345-kV Line Upgrades | Wharton, Fayette, Bastrop, Caldwell, Guadalupe |
| 2024-SC20 | Lytton Area 138-kV Line Upgrades | Caldwell, Travis, Bastrop |

# Appendix B – Transmission Projects

- List of transmission projects removed from the study base case

| TPIT No | Project Name | County |
|---|---|---|
| 2024-SC21 | Austrop (9328) to Dunlap (9045) 138-kV Double Circuit Line Addition | Travis |
| 2024-SC22 | Austrop 345/138-kV Transformer Addition | Travis |
| 2024-SC23 | Dunlap 345/138-kV Transformer Addition | Travis |
| 2024-SC24 | Gillelend Creek (7340) 345-kV Cap Bank Addition | Travis |
| 2024-SC27 | Lytton Springs (9074) to Garfield (7048) to Austrop (7040) 345-kV Line Upgrades | Caldwell, Bastrop, Travis |
| 2024-SC28 | Voss Lake 345/138-kV Substation Expansion and Bell County East (3687) to Voss Lake (3751) 345-kV Double Circuit Line Upgrade | Milam |
| 2024-SC29 | Muscovy 345/138-kV Substation Addition and Salado (3699) to Muscovy (3700) to Voss Lake (3751) 345-kV Double Circuit Addition | Bell, Williamson, Milam |
| 2024-SC32 | McNeil AEN (9076) 138-kV Bus Tie Breaker Upgrade | Travis |
| 2024-E4 | Bryan Area Project | Brazos, Burleson, Robertson |
| 2024-E4 | Knob Creek Switch (3413) to Salado Switch (3699) 345-kV Line Upgrade | Bell |
| 2024-NC23 | Bale (3711) to St Johns Switch (3384) to Lake Creek SES (3409) 345-kV Line Upgrades | Falls, McLennan |
| 2024-NC24 | Lake Creek SES (3410) to Riesel Switch (3702) 138-kV Line Upgrade | Falls, McLennan |
| 2024-NC37 | Bell East (3687) to Salado (3699) 345-kV Line Addition | Bell, Williamson |

# Appendix B – Transmission Projects

- List of transmission projects removed from the study base case

| TPIT No | Project Name | County |
|---|---|---|
| 2024-NC43 | Temple Switch (3415) to Belton (3610) 138-kV Line Upgrades | Bell |
| 2024-NC60 | Bell County East Switch (3687) to Littlepond (3377) , and Bell County East Switch (3687) to Brangus Switch (3705) 345-kV Line Upgrades | Milam, Bell |

# Appendix C – New Generation Projects to Add

| GINR | Project Name | Fuel | Projected COD | Max Capacity (~MW) | County |
|---|---|---|---|---|---|
| 22INR0503 | Tidwell Prairie II Batt | OTH | 03/01/2026 | 203.6 | Robertson |
| 22INR0504 | Barton Branch IA | OTH | 03/01/2026 | 203.6 | Robertson |
| 23INR0079 | Chillingham Storage | OTH | 07/15/2025 | 153.9 | Bell |
| 23INR0118 | Blevins Solar | SOL | 10/30/2025 | 271.6 | Falls |
| 23INR0119 | Blevins Storage | OTH | 07/28/2025 | 181.3 | Falls |
| 23INR0235 | Hoyte Solar | SOL | 12/15/2026 | 206.8 | Milam |
| 23INR0249 | Limewood Solar | SOL | 12/31/2025 | 204.6 | Bell |
| 23INR0344 | Hermes Solar | SOL | 09/30/2025 | 100.4 | Bell |
| 24INR0031 | Stoneridge Solar | SOL | 04/30/2025 | 201.6 | Milam |
| 24INR0166 | Stillhouse Solar | SOL | 09/02/2025 | 210.8 | Bell |
| 24INR0169 | Yaupon Storage SLF | OTH | 07/01/2028 | 102.0 | Milam |
| 24INR0365 | Hermes Storage | OTH | 09/30/2025 | 100.4 | Bell |
| 25INR0389 | Stoneridge BESS | OTH | 09/01/2025 | 101.9 | Milam |
| 22INR0605 | Camino Santiago Solar | SOL | 02/18/2027 | 196.3 | Milam |
| 24INR0476 | DOS RIOS ENERGY STORAGE SLF | OTH | 03/15/2027 | 164.5 | Milam |
| 25INR0281 | Cosper Solar | SOL | 11/12/2027 | 148.16 | Bell |

# Appendix D – G-1 Generators and X-1 Transformers

| G-1 Generators | X-1 Transformers |
|---|---|
| Bastrop Energy Center | Sandow – Ckt 1 345/138-kV |
| Giga Energy Storage | Hutto – Ckt 1 345/138-kV |
| East Backland Solar | Teal – Ckt 1 345/138-kV |
| Garfield Generator | Austrop –Ckt 1 345/138-kV |
| LostPines Generator | Dunlap –Ckt 1 345/138-kV |
| | Gilleland Creek –Ckt 1 345/138-kV |
| | Muscovy–Ckt 1 345/138-kV |
| | Lytton–Ckt 1 345/138-kV |
| | Salado–Ckt 1 345/138-kV |
| | Temple–Ckt 1 345/138-kV |
| | Temple Pecan–Ckt 1 345/138-kV |
| | Voss Lake–Ckt 1 345/138-kV |

# Option 1 – LCRA & Oncor Option

- Establish the new Muscovy 345/138-kV Switch by installing ten 345-kV, 5000 A and twelve 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 3.3 miles east of the co-located 345-kV Limmer Substation (LCRA TSC) and 138-kV Teal Switch (Oncor);
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Install three 36.8 MVAr capacitor banks
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a new 345-kV double-circuit transmission line which will require a CCN from Limmer Substation (LCRA TSC) to Muscovy Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 4 miles;
- Construct a loop of the existing Teal Switch to Pintail Switch 138-kV double-circuit transmission line with a normal and emergency ratings of at least 614 MVA into the new Muscovy 138-kV Switch, approximately 0.1 miles;

# Option 1 – LCRA & Oncor Option

- Establish the new Voss Lake 345/138-kV Switch by installing ten 345-kV, 5000 A and nine 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 1.9 miles north of Sandow 345/138-kV Switch;
  - Install one 345/138-kV autotransformer with normal ratings of at least 700 MVA and emergency ratings of at least 750 MVA
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a loop of the existing Sandow Switch to Bell County East Switch 345-kV double-circuit transmission line into the Voss Lake 345-kV Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Temple Switch 138-kV transmission line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Minerva Switch 138-kV line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;

# Option 1 – LCRA & Oncor Option

- Construct a new 345-kV transmission line which will require a CCN from Voss Lake Switch to Walleye Creek Switch with a normal and emergency ratings of at least 2987 MVA or greater on double-circuit structures with one circuit installed initially, approximately 2 miles; and
- Construct a new, 345-kV double-circuit line which will require a CCN from Muscovy Switch to Voss Lake Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 25 miles.
- Install terminal equipment in existing bays at Limmer Substation to connect both circuits of the new 345-kV double-circuit transmission lines to Muscovy Switch, including two circuit breakers, two switches, six CCVTs, and six surge arrestors, as well as two A-frame structures. All associated terminal equipment will have a minimum rating of 5000 A.

# Option 2 – Alternative ERCOT Option

- Establish the new Muscovy 345/138-kV Switch by installing ten 345-kV, 5000 A and twelve 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 3.3 miles east of the co-located 345-kV Limmer Substation (LCRA TSC) and 138-kV Teal Switch (Oncor);
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Install three 36.8 MVAr capacitor banks
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a new 345-kV double-circuit transmission line which will require a CCN from Limmer Substation (LCRA TSC) to Muscovy Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 4 miles;
- Construct a loop of the existing Teal Switch to Pintail Switch 138-kV double-circuit transmission line with a normal and emergency ratings of at least 614 MVA into the new Muscovy 138-kV Switch, approximately 0.1 miles;

# Option 2 – Alternative ERCOT Option

- Establish the new Voss Lake 345/138-kV Switch by installing ten 345-kV, 5000 A and nine 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 1.9 miles north of Sandow 345/138-kV Switch;
  - Install one 345/138-kV autotransformer with normal ratings of at least 700 MVA and emergency ratings of at least 750 MVA
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a loop of the existing Sandow Switch to Bell County East Switch 345-kV double-circuit transmission line into the Voss Lake 345-kV Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Temple Switch 138-kV transmission line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Minerva Switch 138-kV line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;

# Option 2 – Alternative ERCOT Option

- Construct a new 345-kV transmission line which will require a CCN from Voss Lake Switch to Walleye Creek Switch with a normal and emergency ratings of at least 2987 MVA or greater on double-circuit structures with one circuit installed initially, approximately 2 miles; and
- Construct a new, 345-kV double-circuit line which will require a CCN from Muscovy Switch to Voss Lake Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 25 miles.
- Install terminal equipment in existing bays at Limmer Substation to connect both circuits of the new 345-kV double-circuit transmission lines to Muscovy Switch, including two circuit breakers, two switches, six CCVTs, and six surge arrestors, as well as two A-frame structures. All associated terminal equipment will have a minimum rating of 5000 A.

# Option 2 – Alternative ERCOT Option

- Establish the Tower 345-kV Switch by installing ten 345-kV, 5000 A circuit breakers in a breaker-and-a-half bus arrangement.
  - Loop the existing Salado Switch to Knob Creek Switch 345-kV Line into Tower 345-kV Switch to create the new 12.4 miles Salado Switch – Tower Switch 345-kV Line and 2.9 miles Tower Switch to Temple Switch 345-kV Line
  - Construct two new approximately 1.2 miles 345-kV single circuit lines from Tower Switch to Knob Creek Switch on independent, single circuit structures using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), this upgrade will require a CCN
  - Ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)
- Rebuild the 12.4 miles Salado Switch to Tower Switch 345-kV Line using double-circuit capable structures with one circuit installed, using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA), this upgrade will require a CCN

# Option 2 – Alternative ERCOT Option

- Rebuild the 29.6 miles Bell County East Switch to Voss Lake Switch 345-kV Double-Circuit Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 9.9 miles Minerva Switch to Robertson 138-kV Line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)
- Rebuild the 1.85 miles Temple Switch to Tinroof 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)

# Option 3 – Alternative ERCOT Option

- Establish the new Muscovy 345/138-kV Switch by installing ten 345-kV, 5000 A and twelve 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 3.3 miles east of the co-located 345-kV Limmer Substation (LCRA TSC) and 138-kV Teal Switch (Oncor);
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Install three 36.8 MVAr capacitor banks
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a new 345-kV double-circuit transmission line which will require a CCN from Limmer Substation (LCRA TSC) to Muscovy Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 4 miles;
- Construct a loop of the existing Teal Switch to Pintail Switch 138-kV double-circuit transmission line with a normal and emergency ratings of at least 614 MVA into the new Muscovy 138-kV Switch, approximately 0.1 miles;

# Option 3 – Alternative ERCOT Option

- Establish the new Voss Lake 345/138-kV Switch by installing ten 345-kV, 5000 A and nine 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 1.9 miles north of Sandow 345/138-kV Switch;
  - Install one 345/138-kV autotransformer with normal ratings of at least 700 MVA and emergency ratings of at least 750 MVA
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a loop of the existing Sandow Switch to Bell County East Switch 345-kV double-circuit transmission line into the Voss Lake 345-kV Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Temple Switch 138-kV transmission line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Minerva Switch 138-kV line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;

# Option 3 – Alternative ERCOT Option

- Construct a new 345-kV transmission line which will require a CCN from Voss Lake Switch to Walleye Creek Switch with a normal and emergency ratings of at least 2987 MVA or greater on double-circuit structures with one circuit installed initially, approximately 2 miles; and
- Construct a new, 345-kV double-circuit line which will require a CCN from Muscovy Switch to Voss Lake Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 25 miles.
- Install terminal equipment in existing bays at Limmer Substation to connect both circuits of the new 345-kV double-circuit transmission lines to Muscovy Switch, including two circuit breakers, two switches, six CCVTs, and six surge arrestors, as well as two A-frame structures. All associated terminal equipment will have a minimum rating of 5000 A.

# Option 3 – Alternative ERCOT Option

- Establish the Tower 345-kV Switch by installing ten 345-kV, 5000 A circuit breakers in a breaker-and-a-half bus arrangement.
  - Loop the existing Salado Switch to Knob Creek Switch 345-kV Line into Tower 345-kV Switch to create the new 12.4 miles Salado Switch – Tower Switch 345-kV Line and 2.9 miles Tower Switch to Temple Switch 345-kV Line
  - Construct two new approximately 1.2 miles 345-kV single circuit lines from Tower Switch to Knob Creek Switch on independent, single circuit structures using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), this upgrade will require a CCN
  - Ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)
- Rebuild the 12.4 miles Salado Switch to Tower Switch 345-kV Line using double-circuit capable structures with one circuit installed, using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA), this upgrade will require a CCN

# Option 3 – Alternative ERCOT Option

- Rebuild the 29.6 miles Bell County East Switch to Voss Lake Switch 345-kV Double-Circuit Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 9.9 miles Minerva Switch to Robertson 138-kV Line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)
- Rebuild the 1.85 miles Temple Switch to Tinroof 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)

# Option 3 – Alternative ERCOT Option

- Rebuild the 17.75 miles Bell County East Switch to Little Pond 345-kV Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 23.19 miles Bell County East Switch to Gibson 345-kV Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 4.5 miles Temple Switch to Temple Pecan Creek Switch 345 kV Double-Circuit Line using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA) on separate structures, and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)
- Rebuild the 36.9 miles Hutto to Salado 345 kV Double-Circuit Line using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)

# Option 3 – Alternative ERCOT Option

- Rebuild the 5.3 miles Hutto to Round Rock NorthEast 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)
- Rebuild the 3 miles Hutto to Limmer 345 kV double-circuit Line on separate structures
- ~~Install 110.4 MVAr Cap Bank at Hutto 138-kV~~

# Option 4 – Alternative Oncor Option

- Establish the new Muscovy 345/138-kV Switch by installing ten 345-kV, 5000 A and twelve 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 3.3 miles east of the co-located 345-kV Limmer Substation (LCRA TSC) and 138-kV Teal Switch (Oncor);
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Install three 36.8 MVAr capacitor banks
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a new 345-kV double-circuit transmission line which will require a CCN from Limmer Substation (LCRA TSC) to Muscovy Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 4 miles;
- Construct a loop of the existing Teal Switch to Pintail Switch 138-kV double-circuit transmission line with a normal and emergency ratings of at least 614 MVA into the new Muscovy 138-kV Switch, approximately 0.1 miles;

# Option 4 – Alternative Oncor Option

- Establish the new Voss Lake 345/138-kV Switch by installing ten 345-kV, 5000 A and nine 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 1.9 miles north of Sandow 345/138-kV Switch;
  - Install one 345/138-kV autotransformer with normal ratings of at least 700 MVA and emergency ratings of at least 750 MVA
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a loop of the existing Sandow Switch to Bell County East Switch 345-kV double-circuit transmission line into the Voss Lake 345-kV Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Temple Switch 138-kV transmission line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Minerva Switch 138-kV line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;

# Option 4 – Alternative Oncor Option

- Construct a new 345-kV transmission line which will require a CCN from Voss Lake Switch to Walleye Creek Switch with a normal and emergency ratings of at least 2987 MVA or greater on double-circuit structures with one circuit installed initially, approximately 2 miles; and
- Construct a new, 345-kV double-circuit line which will require a CCN from Muscovy Switch to Voss Lake Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 25 miles.
- Install terminal equipment in existing bays at Limmer Substation to connect both circuits of the new 345-kV double-circuit transmission lines to Muscovy Switch, including two circuit breakers, two switches, six CCVTs, and six surge arrestors, as well as two A-frame structures. All associated terminal equipment will have a minimum rating of 5000 A.

# Option 4 – Alternative Oncor Option

- Establish the Tower 345-kV Switch by installing ten 345-kV, 5000 A circuit breakers in a breaker-and-a-half bus arrangement.
  - Loop the existing Salado Switch to Knob Creek Switch 345-kV Line into Tower 345-kV Switch to create the new 12.4 miles Salado Switch – Tower Switch 345-kV Line and 2.9 miles Tower Switch to Temple Switch 345-kV Line
  - Construct two new approximately 1.2 miles 345-kV single circuit lines from Tower Switch to Knob Creek Switch on independent, single circuit structures using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), this upgrade will require a CCN
  - Ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)
- Rebuild the 12.4 miles Salado Switch to Tower Switch 345-kV Line using double-circuit capable structures with one circuit installed, using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA), this upgrade will require a CCN

# Option 4 – Alternative Oncor Option

- Rebuild the 29.6 miles Bell County East Switch to Voss Lake Switch 345-kV Double-Circuit Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 9.9 miles Minerva Switch to Robertson 138-kV Line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)
- Rebuild the 1.85 miles Temple Switch to Tinroof 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)

# Option 4 – Alternative Oncor Option

- Rebuild the 17.75 miles Bell County East Switch – Little Pond 345-kV Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 23.19 miles Bell County East Switch – Gibson 345-kV Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 4.5 miles Temple Switch – Temple Pecan Creek Switch 345 kV Double-Circuit Line using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA) on separate structures, and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)

# Option 4 – Alternative Oncor Option

- Establish a new Hutto West 345-kV Switch by installing ten 345-kV, 5000 A circuit breakers in a breaker-and-a-half bus arrangement.
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Construct new approximately 38.9 miles 345-kV double circuit lines from Salado to Hutto West Switch using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), this upgrade will require a CCN
  - Construct new approximately 10.25 miles 345-kV double circuit lines from Hutto West to Hutto Switch using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), this upgrade will require a CCN
  - Construct a loop of the existing Round Rock Westing House to Round Rock 138-kV line into the Hutto West 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;
  - Construct a loop of the existing Round Rock Westing House to Midnight 138-kV line into the Hutto West 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV

# Option 4 – Alternative Oncor Option

- Rebuild the 5.3 miles Hutto to Round Rock Northeast 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)
- Rebuild the 3 miles Hutto to Limmer 345 kV double-circuit Line on separate structures
- ~~Install 110.4 MVAr Cap Bank at Hutto 138-kV~~

# Option 4A – Alternative Oncor Option

- Upgrades included in Option 4;
- Loop the existing Spanish Oak to Round Rock 138-kV line into the Hutto West 138-kV Switch; and
- Loop the existing Chief Brady to Round Rock 138-kV line into the Hutto West 138-kV Switch.

# Option 5 – Alternative ERCOT Option

- Establish the new Muscovy 345/138-kV Switch by installing ten 345-kV, 5000 A and twelve 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 3.3 miles east of the co-located 345-kV Limmer Substation (LCRA TSC) and 138-kV Teal Switch (Oncor);
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of at least 750 MVA
  - Install three 36.8 MVAr capacitor banks
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a new 345-kV double-circuit transmission line which will require a CCN from Limmer Substation (LCRA TSC) to Muscovy Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 4 miles;
- Construct a loop of the existing Teal Switch to Pintail Switch 138-kV double-circuit transmission line with a normal and emergency ratings of at least 614 MVA into the new Muscovy 138-kV Switch, approximately 0.1 miles;

# Option 5 – Alternative ERCOT Option

- Establish the new Voss Lake 345/138-kV Switch by installing ten 345-kV, 5000 A and nine 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 1.9 miles north of Sandow 345/138-kV Switch;
  - Install one 345/138-kV autotransformer with normal ratings of at least 700 MVA and emergency ratings of at least 750 MVA
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a loop of the existing Sandow Switch to Bell County East Switch 345-kV double-circuit transmission line into the Voss Lake 345-kV Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Temple Switch 138-kV transmission line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Minerva Switch 138-kV line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;

# Option 5 – Alternative ERCOT Option

- Construct a new 345-kV transmission line which will require a CCN from Voss Lake Switch to Walleye Creek Switch with a normal and emergency ratings of at least 2987 MVA or greater on double-circuit structures with one circuit installed initially, approximately 2 miles; and
- Construct a new, 345-kV double-circuit line which will require a CCN from Muscovy Switch to Voss Lake Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 25 miles.
- Install terminal equipment in existing bays at Limmer Substation to connect both circuits of the new 345-kV double-circuit transmission lines to Muscovy Switch, including two circuit breakers, two switches, six coupling capacitor voltage transformers (CCVTs), and six surge arrestors, as well as two A-frame structures. All associated terminal equipment will have a minimum rating of 5000 A.

# Option 5 – Alternative ERCOT Option

- Establish the Tower 345-kV Switch by installing ten 345-kV, 5000 A circuit breakers in a breaker-and-a-half bus arrangement.
  - Loop the existing Salado Switch to Knob Creek Switch 345-kV Line into Tower 345-kV Switch to create the new 12.4 miles Salado Switch – Tower Switch 345-kV Line and 2.9 miles Tower Switch to Temple Switch 345-kV Line
  - Construct two new approximately 1.2 miles 345-kV single circuit lines from Tower Switch to Knob Creek Switch on independent, single circuit structures using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), this upgrade will require a CCN
  - Ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)
- Rebuild the 12.4 miles Salado Switch to Tower Switch 345-kV Line using double-circuit capable structures with one circuit installed, using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA), this upgrade will require a CCN

# Option 5 – Alternative ERCOT Option

- Rebuild the 29.6 miles Bell County East Switch to Voss Lake Switch 345-kV Double-Circuit Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 9.9 miles Minerva Switch to Robertson 138-kV Line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)
- Rebuild the 1.85 miles Temple Switch to Tinroof 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)

# Option 5 – Alternative ERCOT Option

- Rebuild the 17.75 miles Bell County East Switch – Little Pond 345-kV Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 23.19 miles Bell County East Switch – Gibson 345-kV Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 4.5 miles Temple Switch – Temple Pecan Creek Switch 345 kV Double-Circuit Line using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA) on separate structures, and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)
- Construct two new approximately 36 miles 345-kV double circuit lines from Tower Switch to Muscovy double circuit structures using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), this upgrade will require a Certificate of Convenience and Necessity (CCN)

# Option 5 – Alternative ERCOT Option

- Rebuild the 3.5 miles Muscovy to Limmer 345 kV Double-Circuit Line on separate structures
- Rebuild the 5.3 miles Hutto to Round Rock Northeast 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)
- Rebuild the 3.8 miles Round Rock Northeast to Round Rock 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)
- Rebuild the 3 miles Hutto to Limmer 345 kV double-circuit Line on separate structures
- Install 110.4 MVAr Cap Bank at Hutto 138-kV

# Option 6 – Brazos Suggested Option

- Establish the new Ding Dong Station 345/138-kV Switch
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Loop the existing Kill Switch to Buck House 345-kV line into the new Ding Dong Station.
  - Loop the existing Russell Gap station to Kill Switch 345-kV line into the new Ding Dong Station.
  - Remove the existing Solana to Cedar Valley double circuit 138-kV transmission lines, Cedar Valley to DingDong 138-kV transmission line and Dingdong to Trimmer 138-kV Transmission line
  - Construct the following new 138-kV transmission lines
    - DingDong to Solana 138-kV transmission line, approximately 12.7-mile and Normal and emergency ratings of 418 MVA or greater
    - Solana to Cedar Valley, approximately 1.9-mile and Normal and emergency ratings of 418 MVA or greater
    - Dingdong to Trimmer, approximately 5.8-mile and Normal and emergency ratings of 418 MVA or greater
  - Construct new Double Circuit lines from Solana to Schwertner 138-kV, approximately 15.7-mile with a normal and emergency ratings of 837 MVA or greater

# Option 6 – Brazos Suggested Option

- Establish the new Schwertner Station 345/138-kV Switch
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Loop the existing Double circuit transmission lines from Salado Substation to Hutto Station into the new Schwertner Station
  - Construct a new Single circuit 345-kV transmission line on a Double circuit capable structures which will require a CCN from Ding Dong Substation to Schwertner with a normal and emergency ratings of at least 2980 MVA or greater, approximately 25.9 miles;
  - Construct the following new 138-kV transmission lines
    - Schwertner Switch to Schwertner 138-kV transmission line, which will require a CCN, approximately 5.81 miles, with a normal and emergency ratings of at least 837 MVA or greater
    - Schwertner Switch to Bartlett switch double circuit 138-kV transmission lines, which will require a CCN, approximately 5.81 miles, with a normal and emergency ratings of at least 837 MVA or greater
    - Bartlett switch to Bartlett double circuit 138-kV transmission lines, which will require a CCN, approximately 2.52 miles, with a normal and emergency ratings of at least 837 MVA or greater
    - Schwertner switch to Solana double circuit 138-kV transmission lines, which will require a CCN, approximately 15.7 miles, with a normal and emergency ratings of at least 837 MVA or greater

# Option 6 – Brazos Suggested Option

- Establish the new Taplin Station 345/138-kV Switch
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Loop the existing Badger to Sandow switch double circuit 345-kV line into the new Taplin Station
  - Construct a new Single circuit 345-kV transmission line on a Double circuit capable structures which will require a CCN from Schwertner Substation to Taplin with a normal and emergency ratings of at least 2980 MVA or greater, approximately 19.4 miles;
  - Construct a new Single circuit 345-kV transmission line on a Double circuit capable structures which will require a CCN from Taplin to Gibson with a normal and emergency ratings of at least 2980 MVA or greater, approximately 23.6 miles;
  - Construct a new Single circuit 345-kV transmission line on a Double circuit capable structures which will require a CCN from Gibson to Steckly Dam with a normal and emergency ratings of at least 2980 MVA or greater, approximately 27 miles;
  - Loop the existing Rodgers to Voss Lake 138-kV transmission line into the new Taplin 138-kV station
- Convert the existing Buck Holts 69-kV station and Silver City 69-kV Station into 138-kV station
- Construct the following new 138-kV Transmission lines
  - A new double circuit 138-kV transmission lines from Taplin 138-kV station to Buck Holts, approximately 1.2 miles, with a normal and emergency ratings of at least 524 MVA or greater
  - A new double circuit 138-kV transmission lines from Taplin 138-kV station to Silver City, approximately 14.3 miles, with a normal and emergency ratings of at least 837 MVA or greater
  - A new double circuit 138-kV transmission lines from Bartlett 138-kV station to Buck Holts, approximately 14.4 miles, with a normal and emergency ratings of at least 837 MVA or greater

# Option 6 – Brazos Suggested Option

- Convert existing Branchville, Baggins,Barclay, Calvert switch, Calvert, Baileyville, Pleasant grove, Midway 69-kV Stations to 138-kV Stations
- Decommission the existing 138/69-kV Auto at Seaton station
- Move the existing BranchVille 69-kV Station to Hearne 69-kV station transmission line to BranchVille 138-kV station to Hearne 138-kV station transmission line
- Move the Barclay 69-kV Station to Seaton 69-kV station line to Barclay 138-kV station to Seaton 138-kV station transmission line
- Convert the following existing 69-kV transmission lines to 138-kV transmission lines
  - Branchville to Silver City, approximately 10.18 miles, with a normal and emergency ratings of at least 237 MVA or greater
  - Barclays to Baggins, approximately 8.7 miles, with a normal and emergency ratings of at least 237 MVA or greater
  - Baggins to Silver City, approximately 8.2 miles, with a normal and emergency ratings of at least 237 MVA or greater
  - Silver City to Calvert Switch, approximately 7.3 miles, with a normal and emergency ratings of at least 418 MVA or greater
  - Calvert Switch to Calvert, approximately 6.9 miles, with a normal and emergency ratings of at least 144 MVA or greater
  - Calvert to BaileyVille, approximately 0.02 miles, with a normal and emergency ratings of at least 88 MVA or greater
  - Clavert Switch to Pleasant Grove, approximately 7.95 miles, with a normal and emergency ratings of at least 418 MVA or greater
  - Pleasant Grove to Midway approximately 12.45 miles, with a normal and emergency ratings of at least 418 MVA or greater

# Option 6 – Brazos Suggested Option

- Move the Midway 69-kV Station to Perry 69-kV station  line to Midway 138-kV station to Perry 138-kV station transmission line
- Construct a new 138-kV transmission line from Midway to Spring Valley, which will require a CCN, approximately 18.5 miles, with a normal and emergency ratings of at least 837 MVA or greater
- Install two 345/138-kV autotransformers at Gibson 345-kV station with the secondary terminal at Calvert Switch 138-kV station with normal rating of 700 MVA and emergency rating of 750 MVA
- Establish the new Mclarge Station 345/138-kV Switch
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Construct a new single circuit 345-kV transmission line on a double circuit capable structures which will require a CCN from Steckly Dam Station to new Mclarge Station with a normal and emergency ratings of at least 2980 MVA or greater, approximately 19.3 miles;
  - Loop the existing Judith to McGregor 138-kV line into the McLarge 138-kV station
  - Construct a new line from Bewley 138-kV station to Mclarge 138-kV station, approximately 0.1 miles, with a normal and emergency ratings of at least 837 MVA or greater
  - Move the existing Spring Valley station to Spring Valley tap 138-kV transmission line to Spring Valley to Mclarge 138-kV transmission line

# Option 7 – Alternative LCRA Option

- Establish the new Muscovy 345/138-kV Switch by installing ten 345-kV, 5000 A and twelve 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 3.3 miles east of the co-located 345-kV Limmer Substation (LCRA TSC) and 138-kV Teal Switch (Oncor);
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Install three 36.8 MVAr capacitor banks
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a new 345-kV double-circuit transmission line which will require a CCN from Limmer Substation (LCRA TSC) to Muscovy Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 4 miles;
- Construct a loop of the existing Teal Switch to Pintail Switch 138-kV double-circuit transmission line with a normal and emergency ratings of at least 614 MVA into the new Muscovy 138-kV Switch, approximately 0.1 miles;

# Option 7 – Alternative LCRA Option

- Establish the new Voss Lake 345/138-kV Switch by installing ten 345-kV, 5000 A and nine 138-kV, 3200 A breakers in a breaker-and-a-half bus arrangement, approximately 1.9 miles north of Sandow 345/138-kV Switch;
  - Install one 345/138-kV autotransformer with normal ratings of at least 700 MVA and emergency ratings of at least 750 MVA
  - Ensure all line terminal and associated equipment elements are rated to meet or exceed 5000 A for 345-kV and 3200 A for 138-kV
- Construct a loop of the existing Sandow Switch to Bell County East Switch 345-kV double-circuit transmission line into the Voss Lake 345-kV Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Temple Switch 138-kV transmission line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;
- Construct a loop of the existing Sandow Switch to Minerva Switch 138-kV line into the Voss Lake 138-kV Switch with a normal and emergency ratings of at least 614 MVA or greater, approximately 0.1 miles;

# Option 7 – Alternative LCRA Option

- Construct a new 345-kV transmission line which will require a CCN from Voss Lake Switch to Walleye Creek Switch with a normal and emergency ratings of at least 2987 MVA or greater on double-circuit structures with one circuit installed initially, approximately 2 miles; and
- Construct a new, 345-kV double-circuit line which will require a CCN from Muscovy Switch to Voss Lake Switch with a normal and emergency ratings of at least 2987 MVA or greater, approximately 25 miles.
- Install terminal equipment in existing bays at Limmer Substation to connect both circuits of the new 345-kV double-circuit transmission lines to Muscovy Switch, including two circuit breakers, two switches, six CCVTs, and six surge arrestors, as well as two A-frame structures. All associated terminal equipment will have a minimum rating of 5000 A.

# Option 7 – Alternative LCRA Option

- Establish the Tower 345-kV Switch by installing ten 345-kV, 5000 A circuit breakers in a breaker-and-a-half bus arrangement.
  - Loop the existing Salado Switch to Knob Creek Switch 345-kV Line into Tower 345-kV Switch to create the new 12.4 miles Salado Switch – Tower Switch 345-kV Line and 2.9 miles Tower Switch to Temple Switch 345-kV Line
  - Construct two new approximately 1.2 miles 345-kV single circuit lines from Tower Switch to Knob Creek Switch on independent, single circuit structures using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), this upgrade will require a CCN
  - Ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)
- Rebuild the 12.4 miles Salado Switch to Tower Switch 345-kV Line using double-circuit capable structures with one circuit installed, using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA), this upgrade will require a CCN

# Option 7 – Alternative LCRA Option

- Rebuild the 29.6 miles Bell County East Switch to Voss Lake Switch 345-kV Double-Circuit Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 9.9 miles Minerva Switch to Robertson 138-kV Line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)
- Rebuild the 1.85 miles Temple Switch to Tinroof 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)

# Option 7 – Alternative LCRA Option

- Rebuild the 17.75 miles Bell County East Switch – Little Pond 345-kV Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 23.19 miles Bell County East Switch – Gibson 345-kV Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 4.5 miles Temple Switch – Temple Pecan Creek Switch 345 kV Double-Circuit Line using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA) on separate structures, and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)

# Option 7 – Alternative LCRA Option

- Establish a new Gabriel 345-kV Switch by installing ten 345-kV, 5000 A circuit breakers in a breaker-and-a-half bus arrangement.
  - Install two 345/138-kV autotransformers with normal rating of 700 MVA and emergency rating of 750 MVA
  - Construct new approximately 27 miles 345-kV double circuit lines from Salado to Gabriel Switch using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), this upgrade will require a CCN
  - Construct new approximately 10 miles 345-kV double circuit lines from Gabriel to Hutto Switch using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), this upgrade will require a CCN

# Option 7A – Alternative LCRA Option

- Upgrades included in Option 7;
- Rebuild the 2.5 miles Gabriel to Rivery 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA); and
- Rebuild the 6.6 miles Gabriel to Glasscock 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA);

# Option 8 – No Muscovy Voss Lake

- Establish the Tower 345-kV Switch by installing ten 345-kV, 5000 A circuit breakers in a breaker-and-a-half bus arrangement.
  - Loop the existing Salado Switch to Knob Creek Switch 345-kV Line into Tower 345-kV Switch to create the new 12.4 miles Salado Switch – Tower Switch 345-kV Line and 2.9 miles Tower Switch to Temple Switch 345-kV Line
  - Construct two new approximately 1.2 miles 345-kV single circuit lines from Tower Switch to Knob Creek Switch on independent, single circuit structures using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), this upgrade will require a CCN
  - Ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)
- Rebuild the 12.4 miles Salado Switch to Tower Switch 345-kV Line using double-circuit capable structures with one circuit installed, using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA), this upgrade will require a CCN

# Option 8 – No Muscovy Voss Lake

- Rebuild the 29.6 miles Bell County East Switch to Voss Lake Switch 345-kV Double-Circuit Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 9.9 miles Minerva Switch to Robertson 138-kV Line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)
- Rebuild the 1.85 miles Temple Switch to Tinroof 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)

# Option 8 – No Muscovy Voss Lake

- Rebuild the 17.75 miles Bell County East Switch to Little Pond 345-kV Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 23.19 miles Bell County East Switch to Gibson 345-kV Line using a conductor rated 5000 A or greater (due to the existing 3200 A terminal equipment, this line will be operated at a normal and emergency rating 1912 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (1912 MVA)
- Rebuild the 4.5 miles Temple Switch to Temple Pecan Creek Switch 345 kV Double-Circuit Line using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA) on separate structures, and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)
- Rebuild the 36.9 miles Hutto to Salado 345 kV Double-Circuit Line using a conductor rated 5000 A or greater (normal and emergency rating 2987 MVA), and ensure all associated terminal equipment to meet or exceed 5000 A (2987 MVA)

# Option 8 – No Muscovy Voss Lake

- Rebuild the 5.3 miles Hutto to Round Rock NorthEast 138-kV line using double-circuit capable structures with one circuit installed and a conductor rated 2569 A or greater (normal and emergency rating 614 MVA), and ensure all associated terminal equipment to meet or exceed 3200 A (764 MVA)