Item 12: Roanoke Area Upgrades RPG Project

Woody Rickerson
Vice Present, Grid Planning and Operations

Board of Directors Meeting

ERCOT Public
August 16, 2022

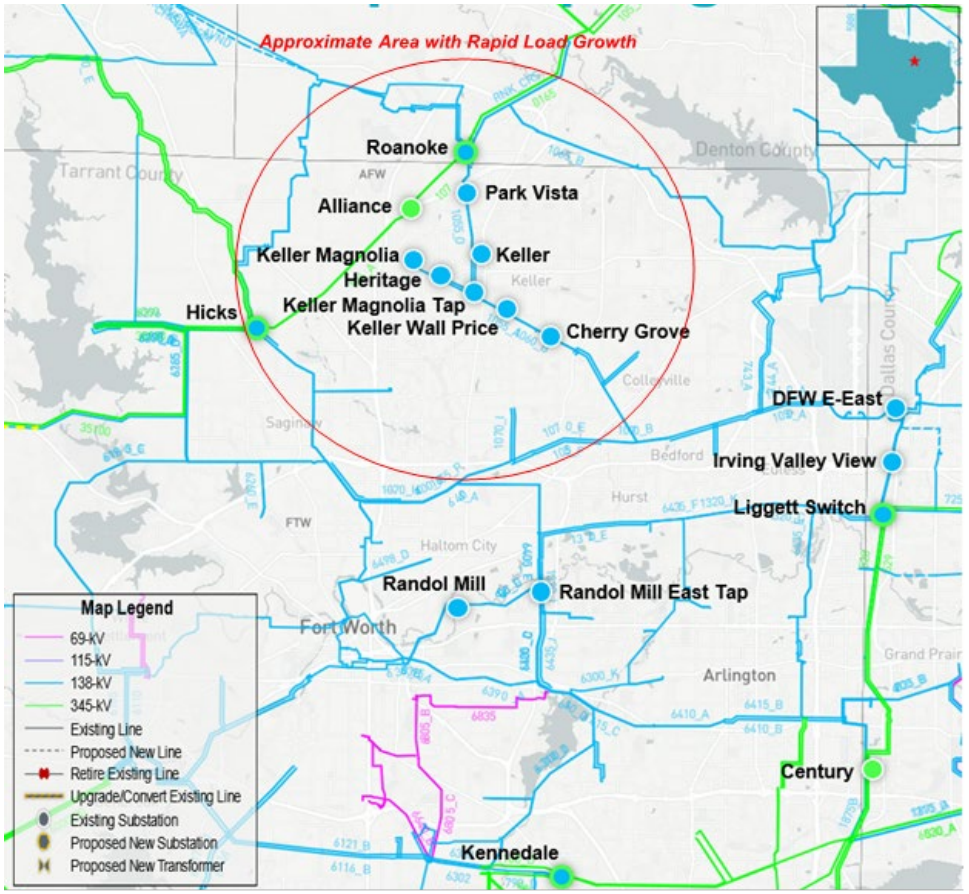
Action

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

Roanoke Area Upgrades Project

- Oncor submitted the Roanoke Area Upgrades Project for RPG review in February 2022

- The purpose of the project is to address reliability needs driven by rapid load growth in the Roanoke area



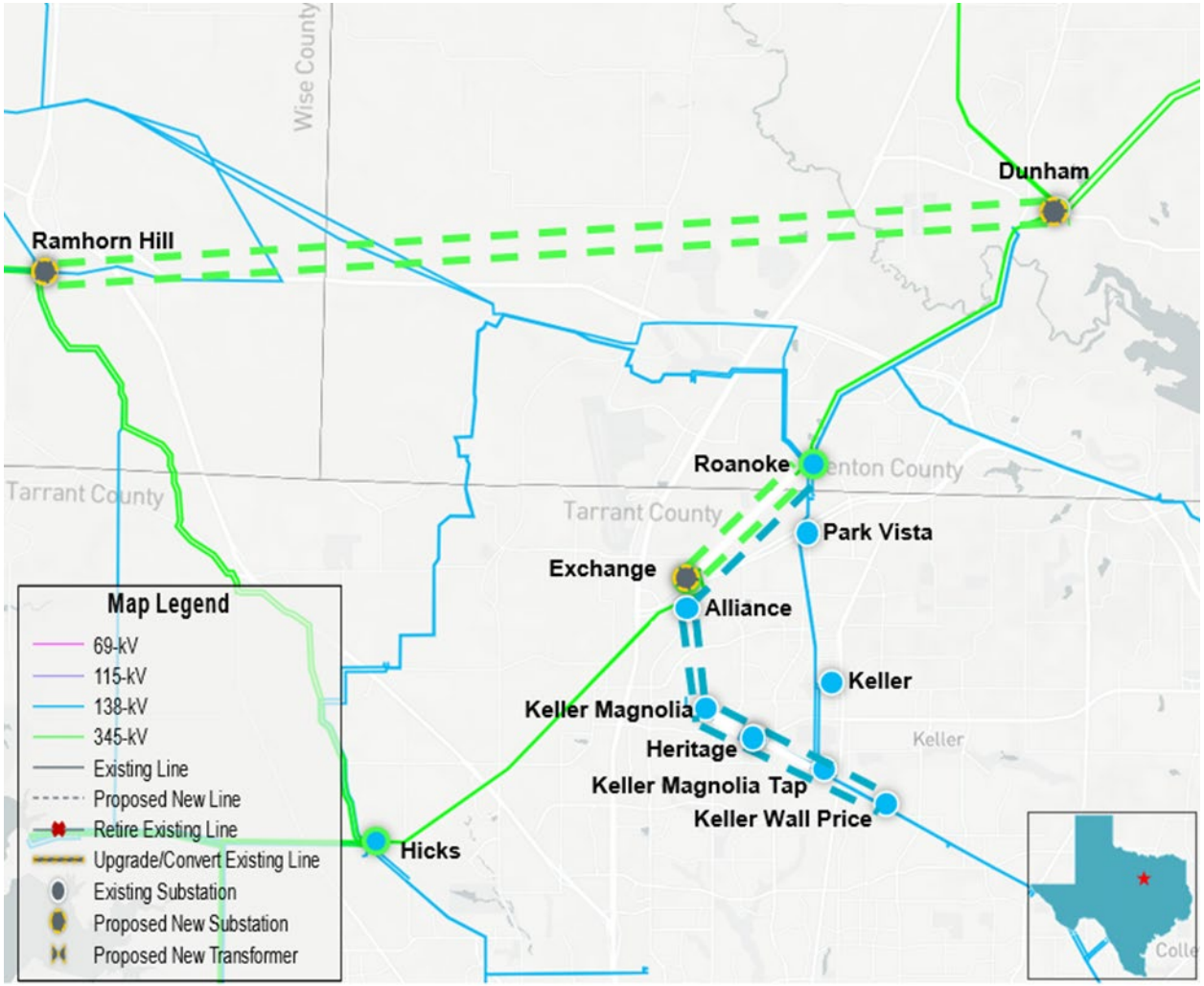
TAC Endorsement

- ERCOT presented the project to the Technical Advisory Committee on July 27, 2022
- TAC voted unanimously to endorse the project (Option 2)

Request for Board Vote

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

Questions?


Wise County
Tarrant County
Tarrant County
Dunham
Ramhorn Hill
Roanoke
Park Vista
Exchange
Alliance
Keller
Keller Magnolia
Heritage
Keller Magnolia Tap
Keller Wall Price
Hicks
Keller
Map Legend
69-kV
115-kV
138-kV
345-kV
Existing Line
Proposed New Line
Retire Existing Line
Upgrade/Convert Existing Line
Existing Substation
Proposed New Substation
Proposed New Transformer

ERCOT Recommendation: Option 2

- Construct a new Ramhorn Hill 345-kV switching station in a 10-breaker breaker-and-a-half arrangement tapped into existing double-circuit Hicks to Willow Creek 345-kV lines
- Construct a new Dunham 345-kV switching station in a 10-breaker breaker-and-a-half arrangement tapped into existing Lewisville to Krum West and Lewisville to Roanoke 345-kV lines
- Construct two new Ramhorn Hill to Dunham 345-kV transmission lines, with conductor rated to at least 2987 MVA, in a new (estimated 18.4-mile) right-of-way installed on new triple-circuit towers leaving one 138-kV vacant position
- Rebuild Exchange to Roanoke 345-kV double-circuit lines, upgrading both with conductors rated to at least 2987 MVA, using separate double-circuit capable structures for each line. The line rating will be 1912/1912 MVA limited by terminal equipment at Roanoke
- Construct a new Exchange to Roanoke 138-kV circuit, with conductor rated to at least 764 MVA, using one of the Exchange to Roanoke 345-kV line double-circuit capable structures
- Construct a new Exchange 345/138-kV Switching Station, adjacent to Alliance 345-kV substation, with two new 600 MVA (nameplate) transformers in an 8-breaker 345-kV breaker-and-a-half bus arrangement and a 9-breaker 138-kV breaker-and-a-half arrangement. The normal/emergency ratings of the new transformers will be 700/750 MVA
- Convert the existing Alliance 345-kV load serving substation to 138-kV load serving operation
- Construct a new Exchange to Alliance 138-kV double-circuit line with conductors rated to at least 746 MVA
- Construct a new Alliance to Keller Magnolia and Alliance to Heritage 138-kV double-circuit line with conductors rated to at least 746 MVA in a new (estimated 1.4-mile) right-of-way
- Upgrade the existing Keller Magnolia to Heritage 138-kV line with conductor rated to at least 746 MVA to be installed on Alliance to Keller Magnolia and Alliance to Heritage 138-kV double-circuit towers
- Upgrade the existing Heritage to Keller Magnolia Tap double-circuit lines with conductors rated to at least 746 MVA
- Construct a new 138-kV switching station at Keller Wall Price in a 6-breaker ring bus arrangement
- Disconnect the double-circuit Heritage to Keller Magnolia Tap lines at Keller Magnolia Tap and terminate both at Keller Wall Price by constructing two new 0.3-mile 138-kV transmission lines added to the existing Keller Magnolia Tap to Keller Wall Price right-of-way with both new line conductors rated to at least 746 MVA
- Retire Keller Magnolia Tap

Date: August 9, 2022
To: Board of Directors
From: Woody Rickerson, Vice Present, Grid Planning and Operations
Subject: Roanoke Area Upgrades RPG Project

Issue for the ERCOT Board of Directors

ERCOT Board of Directors Meeting Date: August 16, 2022
Item No.: 12

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

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

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

- Construct a new Ramhorn Hill 345-kV switching station in a 10-breaker breaker-and-a-half arrangement tapped into existing double-circuit Hicks to Willow Creek 345-kV lines
- Construct a new Dunham 345-kV switching station in a 10-breaker breaker-and-a-half arrangement tapped into existing Lewisville to Krum West and Lewisville to Roanoke 345-kV lines
- Construct two new Ramhorn Hill to Dunham 345-kV transmission lines, with conductor rated to at least 2987 MVA, in a new (estimated 18.4-mile) right-of-way installed on new triple-circuit towers leaving one 138-kV vacant position
- Rebuild Exchange to Roanoke 345-kV double-circuit lines, upgrading both with conductors rated to at least 2987 MVA, using separate double-circuit capable structures for each line. The line rating will be 1912/1912 MVA limited by terminal equipment at Roanoke
- Construct a new Exchange to Roanoke 138-kV circuit, with conductor rated to at least 764 MVA, using one of the Exchange to Roanoke 345-kV line double-circuit capable structures

- Construct a new Exchange 345/138-kV Switching Station, adjacent to Alliance 345-kV substation, with two new 600 MVA (nameplate) transformers in an 8-breaker 345-kV breaker-and-a-half bus arrangement and a 9-breaker 138-kV breaker-and-a-half arrangement. The normal/emergency ratings of the new transformers will be 700/750 MVA
- Convert the existing Alliance 345-kV load serving substation to 138-kV load serving operation
- Construct a new Exchange to Alliance 138-kV double-circuit line with conductors rated to at least 746 MVA
- Construct a new Alliance to Keller Magnolia and Alliance to Heritage 138-kV double-circuit line with conductors rated to at least 746 MVA in a new (estimated 1.4-mile) right-of-way
- Upgrade the existing Keller Magnolia to Heritage 138-kV line with conductor rated to at least 746 MVA to be installed on the Alliance to Keller Magnolia and Alliance to Heritage 138-kV double-circuit towers
- Upgrade the existing Heritage to Keller Magnolia Tap double-circuit lines with conductors rated to at least 746 MVA
- Construct a new 138-kV switching station at Keller Wall Price in a 6-breaker ring bus arrangement
- Disconnect the double-circuit Heritage to Keller Magnolia Tap lines at Keller Magnolia Tap and terminate both at Keller Wall Price by constructing two new 0.3-mile 138-kV transmission lines added to the existing Keller Magnolia Tap to Keller Wall Price right-of-way with both new line conductors rated to at least 746 MVA
- Retire Keller Magnolia Tap

The estimated cost for these improvements is $285.9 million.

The Roanoke area is expected to have the reliability need as early as 2023 based on the ERCOT Regional Transmission Plan (RTP) and the RPG submittal submitted by Oncor. Therefore, ERCOT recommends the Roanoke Area Upgrades RPG Project be designated critical to the reliability of the ERCOT System pursuant to PUCT Substantive Rule 25.101(b)(3)(D). Designating a project requiring a Certificate of Convenience and Necessity (CCN) application (*i.e.*, those requiring a new right-of-way) as critical will reduce the risk of exposure to reliability issues by shortening the time to complete the improvements.

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

Key Factors Influencing Issue:

1. Transmission system improvements are needed to meet reliability planning criteria for the Roanoke area.

2. The recommended set of improvements was found to be the most efficient solution for meeting the planning reliability criteria, providing a long-term transmission capability for future load in the area, and providing a better operational flexibility during planned maintenance outage conditions.
3. Protocol Section 3.11.4.7 requires Board endorsement of a project with an estimated capital cost of $100 million or greater.
4. TAC voted unanimously to endorse the Roanoke Area Upgrades RPG Project (Option 2) on July 27, 2022.
5. Since there is reliability need to have the project in place as soon as possible, ERCOT staff has deemed this project critical to reliability.
6. If the Roanoke Area Upgrades RPG Project (Option 2) is designated as critical to the reliability of the ERCOT System, the review process at the PUCT will be expedited pursuant to Substantive Rule 25.101.(b)(3)(D).

Conclusion/Recommendation:

ERCOT staff recommends, and the Reliability and Markets Committee is expected to consider and to likely recommend, that the Board: (1) endorse the need for the Roanoke Area Upgrades RPG Project (Option 2), which ERCOT staff has independently reviewed, and which TAC has voted unanimously to endorse, based on NERC and ERCOT reliability planning criteria, and (2) designate the Roanoke Area Upgrades RPG Project (Option 2) as critical to the reliability of the ERCOT System pursuant to PUCT Substantive Rule 25.101(b)(3)(D).

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

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

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

CORPORATE SECRETARY'S CERTIFICATE

I, Jonathan M. Levine, Assistant Corporate Secretary of ERCOT, do hereby certify that, at its August 16, 2022 meeting, the Board passed a motion approving the above Resolution by _____.

IN WITNESS WHEREOF, I have hereunto set my hand this ___ day of August, 2022.

_____
Jonathan M. Levine
Assistant Corporate Secretary

ERCOT Independent Review of Oncor Roanoke Area Upgrades Project

Document Revisions

Date	Version	Description	Author(s)
July 19, 2022	1.0	Final	A. Benjamin Richardson
		Reviewed by	Sun Wook Kang, Prabhu Gnanam

Executive Summary

Oncor submitted the Roanoke Area Upgrades Project to the Regional Planning Group (RPG) in February 2022. Oncor proposed this project to address rapid load growth, existing transmission capacity limitations and forecasted reliability needs in the north Fort Worth/Roanoke – Alliance area. According to the RPG submittal, beginning in late 2021, Oncor has since received several requests for load interconnections at both distribution and transmission levels within this area; however, Oncor has been limited in fulfilling or unable to fulfill some requests for service due to transmission capacity limitations. Some project additions require Certificate of Convenience and Necessity (CCN) applications, and Oncor estimates the total cost of the project at approximately $286 Million. Therefore, this submitted RPG project was classified as a Tier 1 project pursuant to ERCOT Protocol Section 3.11.4.3 categorization of proposed transmission projects.

ERCOT performed an Independent Review of the RPG submittal and confirmed the reliability needs in the north Fort Worth/Roanoke – Alliance area. Based on this independent review of various transmission improvement options, ERCOT recommends Option 2 (Same as Oncor's Proposal) to address the reliability needs in the area.

Oncor is expecting this project to be in-service by May 2025. If reliability issues arise before the entire recommended project is constructed, ERCOT and Oncor will work together to develop mitigation plans as necessary. Oncor has requested that 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 early as 2023 based on the 2021 ERCOT Regional Transmission Plan (RTP) and the RPG submittal, ERCOT deems the project critical to reliability.

Table of Contents

1 Introduction

Oncor submitted the Roanoke Area Upgrades Project to RPG in February 2022. Oncor proposed this project to address rapid load growth, existing transmission capacity limitations and forecasted reliability needs in the north Fort Worth/Roanoke – Alliance area. According to the RPG submittal, beginning in late 2021, Oncor has since received several requests for load interconnections at both the distribution and transmission levels within this area; however, Oncor has been limited in fulfilling or unable to fulfill some requests for service due to transmission capacity limitations. The approximate geographic locations with the rapid load growth are shown in Figure 1.

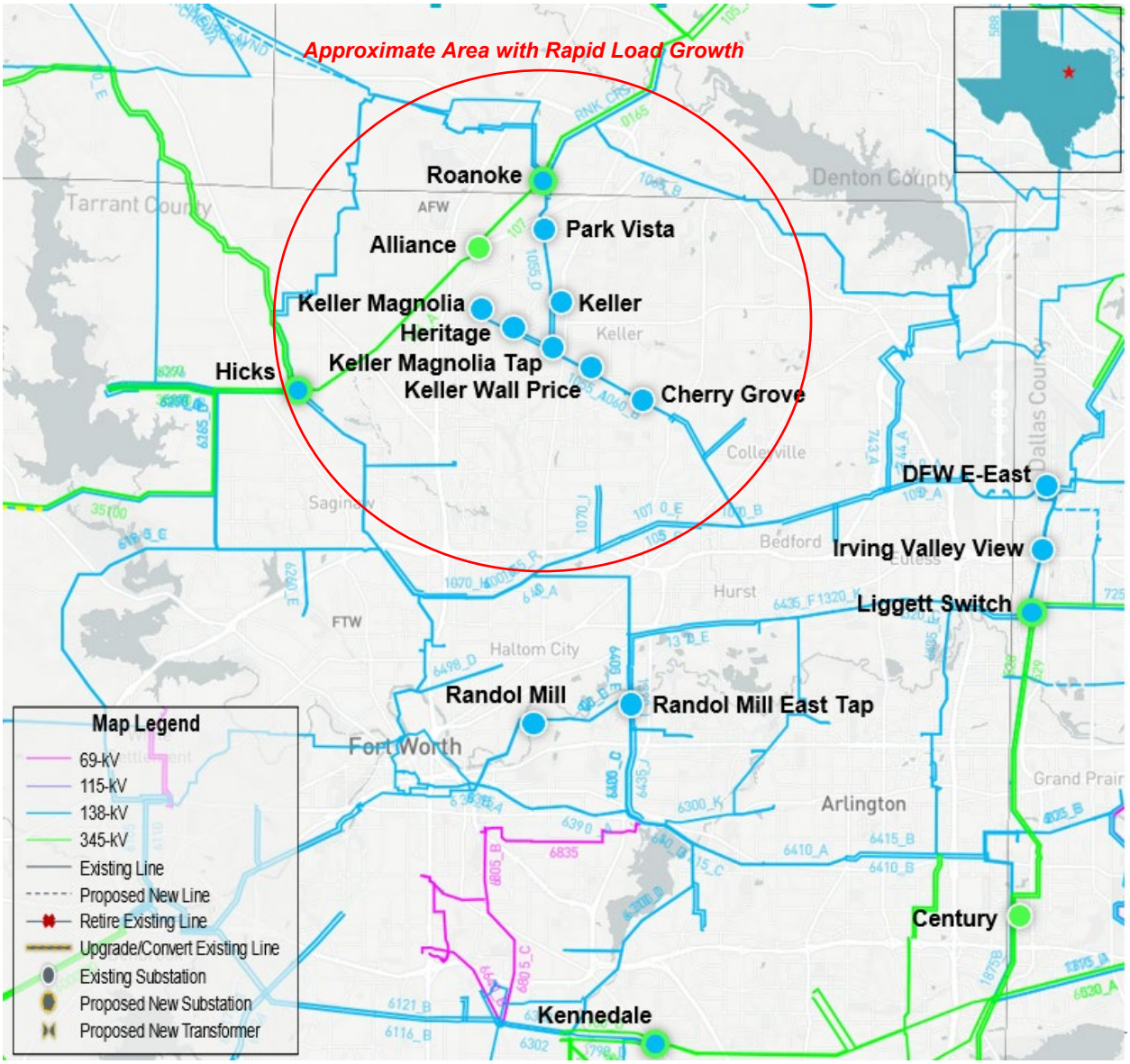


Figure 1: Map of Study Area

To address these reliability needs, the Oncor Roanoke Area Upgrades Project submittal proposed an approximately $286 Million transmission improvement project to:

- Construct a new Ramhorn Hill 345-kV switching station in a 10-breaker breaker-and-a-half arrangement tapped into existing double-circuit Hicks to Willow Creek 345-kV lines
- Construct a new Dunham 345-kV switching station in a 10-breaker breaker-and-a-half arrangement tapped into existing Lewisville to Krum West and Lewisville to Roanoke 345-kV lines
- Construct two new Ramhorn Hill to Dunham 345-kV transmission lines, with conductor rated to at least 2987 MVA, in a new (estimated 18.4-mile) right-of-way installed on new triple-circuit towers leaving one 138-kV vacant position
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- Upgrade the existing Keller Magnolia to Heritage 138-kV line with conductor rated to at least 746 MVA to be installed on the Alliance to Keller Magnolia and Alliance to Heritage 138-kV double-circuit towers.
- Upgrade the existing Heritage to Keller Magnolia Tap double-circuit lines with conductors rated to at least 746 MVA
- Construct a new 138-kV switching station at Keller Wall Price in a 6-breaker ring bus arrangement
- Disconnect the double-circuit Heritage to Keller Magnolia Tap lines at Keller Magnolia Tap and terminate both at Keller Wall Price by constructing two new 0.3-mile 138-kV transmission lines added to the existing Keller Magnolia Tap to Keller Wall Price right-of-way with both new line conductors rated to at least 746 MVA
- Retire Keller Magnolia Tap

Oncor also requested that ERCOT designate the recommended project “critical” to the reliability of the system per PUCT Substantive Rule 25.101(b)(3)(D).

ERCOT performed an Independent Review for this RPG project to identify the reliability need and evaluate various transmission upgrade options to address the reliability need. This report describes the study assumptions, methodology and the results of the ERCOT Independent Review (EIR) of the project.

2 Study Assumptions and Methodology

This section describes study assumptions and methodology that ERCOT employed to perform this independent review of the Oncor Roanoke Area Upgrades Project.

2.1 Study Assumptions for Reliability Analysis

The study area for this review included transmission facilities in the North Central Weather Zone that are electrically close to the north Fort Worth/Roanoke – Alliance area.

2.1.1 Steady-State Study Base Case

The Final 2021 RTP cases, published on the Market Information System (MIS) on December 23, 2021, were used as reference cases in this study. Year 2026 Summer was selected for the study period. The steady-state study base case for the North Central weather zone was constructed by updating transmission, generation, and loads of the following 2026 Summer Peak Load case for the North/North Central (NNC) weather zone.

- Case: 2021RTP_2026_SUM_NNC_12232021[1]

2.1.1.1 Transmission Topology

Other transmission projects within the study area with in-service dates (ISD) by May 2025 were added to the study base case. The ERCOT Transmission Project Information and Tracking (TPIT)[2] report posted in February 2022 was used as reference to determine these other transmission projects for inclusion. All approved Tier 1, 2, and 3 projects in addition to Tier 4 projects were already modeled in the base case. Therefore, no new Tier 1, 2, 3 or 4 transmission projects were added.

Transmission projects within the study area that are not approved by RPG were removed from the base case. These projects are listed in Table 1 below.

Table 1: List of transmission projects removed from the study base case

RTP Project Index	Project Name	County
2021-NC8	Roanoke Area Upgrade Project	Wise, Tarrant

2.1.1.2 Generation

Based on the January 2022 Generator Interconnection Status (GIS)[3] report posted on the ERCOT website on February 2, 2022, generators in the study area that met Planning Guide Section 6.9(1) conditions with Commercial Operations Dates (COD) prior to May 2025 were added to the study base case. These generation additions are listed in Table 2 below. All new generation dispatches were consistent with the 2021 RTP methodology.

[1] 2021 Regional Transmission Plan Postings: https://mis.ercot.com/secure/data-products/grid/regional-planning?id=PG3-2178-M
[2] TPIT Report: https://www.ercot.com/files/docs/2022/03/02/ERCOT%20February%20TPIT%20No%20Cost%20020122.xlsx
[3] GIS Report: https://www.ercot.com/mp/data-products/data-product-details?id=PG7-200-ER

Table 2: List of generation added to the study base case based on January 2022 GIS Report

GINR	Project Name	Project COD	Capacity (MW)	County
19INR0169	Sun Valley Solar	Dec 2022	252.00	Hill
20INR0091	Fagus Solar Park	Jul 2023	517.35	Childress
20INR0205	Roseland Solar	Jul 2022	254.00	Falls
20INR0214	Noble Solar	May 2022	279.00	Denton
20INR0230	Markum Solar	Feb 2024	161.00	McLennan
21INR0375	Grizzly Ridge Solar	Aug 2022	101.68	Hamilton
21INR0434	Golinda Solar	Feb 2023	103.10	Falls
21INR0473	Vortex BESS	May 2022	121.83	Throckmorton
21INR0474	Anchor BESS	Apr 2022	71.45	Eastland
21INR0490	Samson Solar 2	Jun 2023	200.00	Lamar
21INR0493	Ellis Solar	Jun 2022	81.00	Ellis
21INR0539	Anchor Wind II	Apr 2022	128.70	Eastland
22INR0270	Brass Fork Solar 1	May 2023	304.78	Haskell
22INR0436	Noble Storage	Aug 2022	127.00	Denton
22INR0506	Roseland Solar II	Jul 2022	254.00	Falls

The status of the units either indefinitely mothballed or retired at the time of the study were reviewed, and no units were turned off that were not already reflected in the Final 2021RTP cases.

2.1.1.3 Loads

New confirmed loads in the study area were also added to the study base case. Load outside the NNC weather zone was adjusted to meet the minimum reserve to be consistent with the 2021 RTP assumptions.

2.2 Study Assumptions for Congestion Analysis

Congestion analysis was conducted to identify any new congestion in the study area with the addition of the preferred transmission upgrade option.

2.2.1 Economic Study Base Case

The 2026 economic starting case from the 2021 RTP available at the time of the study was used as the base case for congestion analysis. The 2026 study year was selected based on the proposed in-service date of the project.

2.2.1.1 Transmission Topology

The project listed in Table 3 below was removed from the economic base case, since it was a placeholder project for the Roanoke Area Upgrades Project subject of this review.

Table 3: Transmission projects removed from Economic base case

RTP Project Index	Project Name	County
2021-NC8	Roanoke Area Upgrade Project	Wise, Tarrant

2.2.1.2 Generation

New generation listed in Table 4 were added to the economic base case.

Table 4: List of Generation added to the economic base case

GINR	Project Name	Project COD	Capacity (MW)	County
19INR0169	Sun Valley Solar	Dec 2022	252.00	Hill
20INR0091	Fagus Solar Park	Jul 2023	517.35	Childress
20INR0205	Roseland Solar	Jul 2022	254.00	Falls
20INR0214	Noble Solar	May 2022	279.00	Denton
20INR0230	Markum Solar	Feb 2024	161.00	McLennan
21INR0375	Grizzly Ridge Solar	Aug 2022	101.68	Hamilton
21INR0434	Golinda Solar	Feb 2023	103.10	Falls
21INR0473	Vortex BESS	May 2022	121.83	Throckmorton
21INR0474	Anchor BESS	Apr 2022	71.45	Eastland
21INR0490	Samson Solar 2	Jun 2023	200.00	Lamar
21INR0493	Ellis Solar	Jun 2022	81.00	Ellis
21INR0539	Anchor Wind II	Apr 2022	128.70	Eastland
22INR0270	Brass Fork Solar 1	May 2023	304.78	Haskell
22INR0436	Noble Storage	Aug 2022	127.00	Denton
22INR0506	Roseland Solar II	Jul 2022	254.00	Falls

2.2.1.3 Loads

New confirmed loads in the study area were also added to create the economic base case.

2.3 Methodology

The reliability assessments were performed based on NERC Reliability Standard TPL-001-4, the applicable ERCOT Nodal Protocols, and Planning Criteria[4].

2.3.1 Contingencies

Contingencies[5] were updated based on the changes made to the topology as described in Section 2.1.1.1 above. The following steady state contingencies were simulated for the study area:

- P0 (System Intact)
- P1, P2-1, P7 (N-1 conditions)

[4] ERCOT Planning Criteria: http://www.ercot.com/mktrules/guides/planning/current
[5] Details of each event and contingency category is defined in the NERC reliability standard TPL-001-4

- P2-2, P2-3, P4, and P5 (EHV only)
- P3-1: G-1 + N-1 (G-1: generation outages)
- P6-2: X-1 + N-1 (X-1: EHV transformers only)

2.3.2 Criteria

All 69-kV and above buses, transmission lines, and transformers in the study area 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

2.3.3 Study Tool

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

- PowerWorld Simulator version 21 for Security Constrained Optimal Power flow (SCOPF) and steady-state contingency analysis
- UPLAN version 11.4.0.27191 to perform congestion analysis

3 Project Need

This section describes transmission overloads and voltage violations that were observed in the study area with no new system upgrades.

3.1 Steady-State reliability Analysis

Steady-state reliability analysis was performed in accordance with NERC TPL-001-4 and ERCOT Planning Criteria described in Section 2.3 above. This analysis indicated thermal overload and low voltage issues in the study area under NERC Category P1, P3, and P6 contingencies. These issues are summarized in the tables below while Figure 2 illustrates the need visually.

Table 5: Thermal overloads observed in the study area for 2026 Summer Peak

NERC Contingency Category	Overloaded Element	Voltage Level (kV)	Length (miles)	Loading %
P1: N-1	Roanoke Transformer #1 and #2	345/138	-	101.68
P6: (X-1 + N-1)	Roanoke Transformer #1 and #2	345/138		117.27
P6: (X-1 + N-1)	Hicks Transformer #1 and #2	345/138	-	100.00
P3: (G-1 + N-1)	Hicks to Roanoke	345	9.6	100.73
P3: (G-1 + N-1)	Hicks to Alliance	345	5.8	100.28
P6: (X-1 + N-1)	Kennedale to Century	345	10.5	100.69
P6: (X-1 + N-1)	Randol Mill Tap East to Randol Mill	138	2.2	100.63
P6: (X-1 + N-1)	Liggett Switch to DFW E East	138	3.0	100.96
P6: (X-1 + N-1)	Liggett Switch to Irving Valley View	138	1.5	104.96

P6: (X-1 + N-1)	Bennett Road Switch to Decatur	138	0.8	100.29

Table 6: Voltage Violations observed in the study area for 2026 Summer Peak

NERC Contingency Category	Substation	Voltage Level (kV)	Post-contingency Voltage (pu)
P3: (G-1 + N-1)	Park Vista	138	0.89
P3: (G-1 + N-1)	Keller Tap	138	0.90
P3: (G-1 + N-1)	Keller Magnolia Tap	138	0.90
P6: (X-1 + N-1)	Heritage	138	0.90
P3: (G-1 + N-1)	Cherry Grove	138	0.90

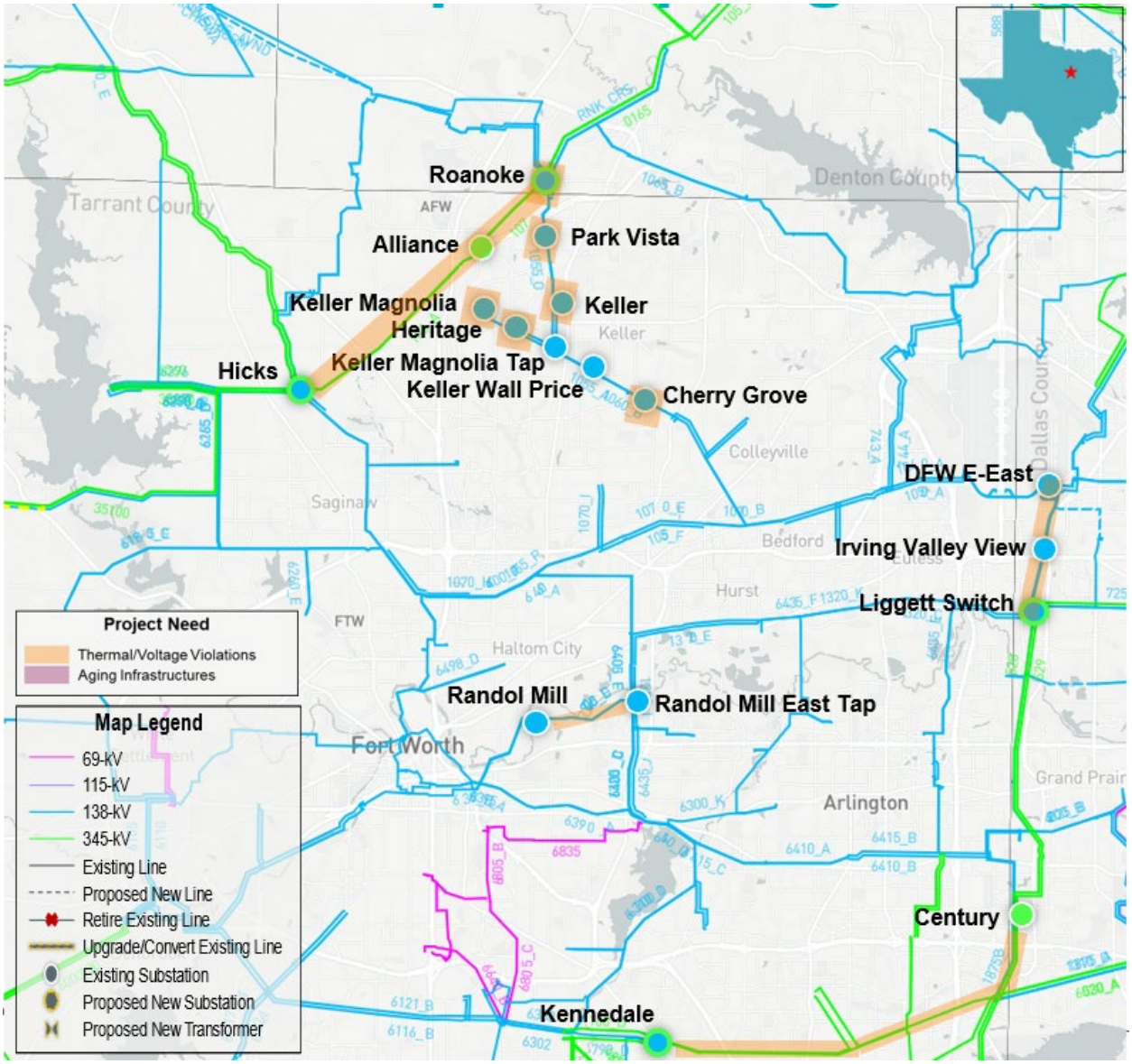

Figure 2: Study area Map showing project need(s)

3.2 Initial Options

ERCOT initially evaluated four system improvement options to address the thermal overloads and voltage violations that were observed in the study base case in the north Fort Worth/Roanoke – Alliance area. Table 7 shows the components of the four initial options.

Table 7: Components of the four initial options studied

Transmission Upgrade	Approximate Length of Line (mile)	Normal / Emergency Rating (MVA)	Options 1	2	3	4
Construct a new Ramhorn Hill 345-kV switching station in a 10-breaker breaker-and-a-half arrangement tapped into existing double-circuit Hicks to Willow Creek 345-kV lines				✓	✓	✓
Construct a new Dunham 345-kV switching station in a 10-breaker breaker-and-a-half arrangement tapped into existing Lewisville to Krum West and Lewisville to Roanoke 345-kV lines				✓	✓	✓
Construct two new Ramhorn Hill to Dunham 345-kV transmission lines, with conductor rated to at least 2987 MVA, in a new (estimated 18.4-mile) right-of-way installed on new triple-circuit towers leaving one 138-kV vacant position	18.4	2987/2987		✓	✓	✓
Upgrade Hicks to Exchange 345-kV double-circuit line with conductors rated to at least 2987 MVA	5.8	2987/2987	✓			
Rebuild Exchange to Roanoke 345-kV double-circuit lines, upgrading both with conductors rated to at least 2987 MVA, using separate double-circuit capable structures for each line	3.6	1912/1912*		✓		
Construct a new Exchange to Roanoke 138-kV circuit, with conductor rated to at least 764 MVA, using one of the Exchange to Roanoke 345-kV line double-circuit capable structures	3.8	764/764		✓		
Upgrade Exchange to Roanoke 345-kV double-circuit lines with conductor rating to at least 2987 MVA	3.6	1912/1912*	✓		✓	
Construct a new Exchange 345/138-kV Switching Station, adjacent to Alliance 345-kV substation, with two new 600 MVA transformers (nameplate) in an 8-breaker 345-kV breaker-and-a-half bus arrangement and a 9-breaker 138-kV breaker-and-a-half arrangement		700/750	✓	✓	✓	✓
Convert the existing Alliance 345-kV load serving substation to 138-kV load serving operation			✓	✓	✓	✓
Construct a new Exchange to Alliance 138-kV double-circuit line with conductors rated to at least 746 MVA	0.1	746/746	✓	✓	✓	✓
Construct a new Alliance to Keller Magnolia and Alliance to Heritage 138-kV double-circuit line with conductors rated to at least 746 MVA	1.4 Keller Magnolia 2.5 Heritage	746/746	✓	✓	✓	✓
Upgrade the existing Keller Magnolia to Heritage 138-kV line with conductor rated to at least 746 MVA to be installed on the Alliance to Keller Magnolia and Alliance to Heritage 138-kV double-circuit towers	1.0	746/746	✓	✓	✓	✓
Upgrade the existing Heritage to Keller Magnolia Tap double-circuit lines with conductors rated to at least 746 MVA	1.3	746/746	✓	✓	✓	✓
Construct a new 138-kV switching station at Keller Wall Price in a 6-breaker ring bus arrangement			✓	✓	✓	✓
Disconnect the double-circuit Heritage to Keller Magnolia Tap lines at Keller Magnolia Tap and terminate both at Keller Wall Price by constructing two new 0.3-mile 138-kV transmission lines added to	0.3	746/746	✓	✓	✓	✓

the existing Keller Magnolia Tap to Keller Wall Price right-of-way with both new line conductors rated to at least 746 MVA						
Retire Keller Magnolia Tap			✓	✓	✓	✓

* Exchange to Roanoke 345-kV conductor will be capable of 2987/2987 MVA, however terminal equipment at Roanoke will limit the line ratings to 1912/1912 MVA.

3.3 Initial Reliability Assessment Results

All initial options were evaluated based on the contingencies described in Methodology Section 2.3 above, and no reliability criteria violations were identified for Option 2, 3, and 4 as shown in Table 8. Based on the review of these results, Option 1 was eliminated from further evaluation due to identification of thermal overload violation.

Table 8: Results of initial reliability assessment of all four Options

	N-1		X-1 + N-1		G-1 + N-1	
Option	Thermal Overload	Voltage Violation	Thermal Overload	Voltage Violation	Thermal Overload	Voltage Violation
1	No	No	Yes	No	No	No
2	No	No	No	No	No	No
3	No	No	No	No	No	No
4	No	No	No	No	No	No

4 Short-listed Options

As shown in Table 8 above, Option 2, 3 and 4 met all the reliability criteria, and these options were short-listed for further assessment. These short-listed options are visually illustrated in Figures 3, 4, and 5 below.

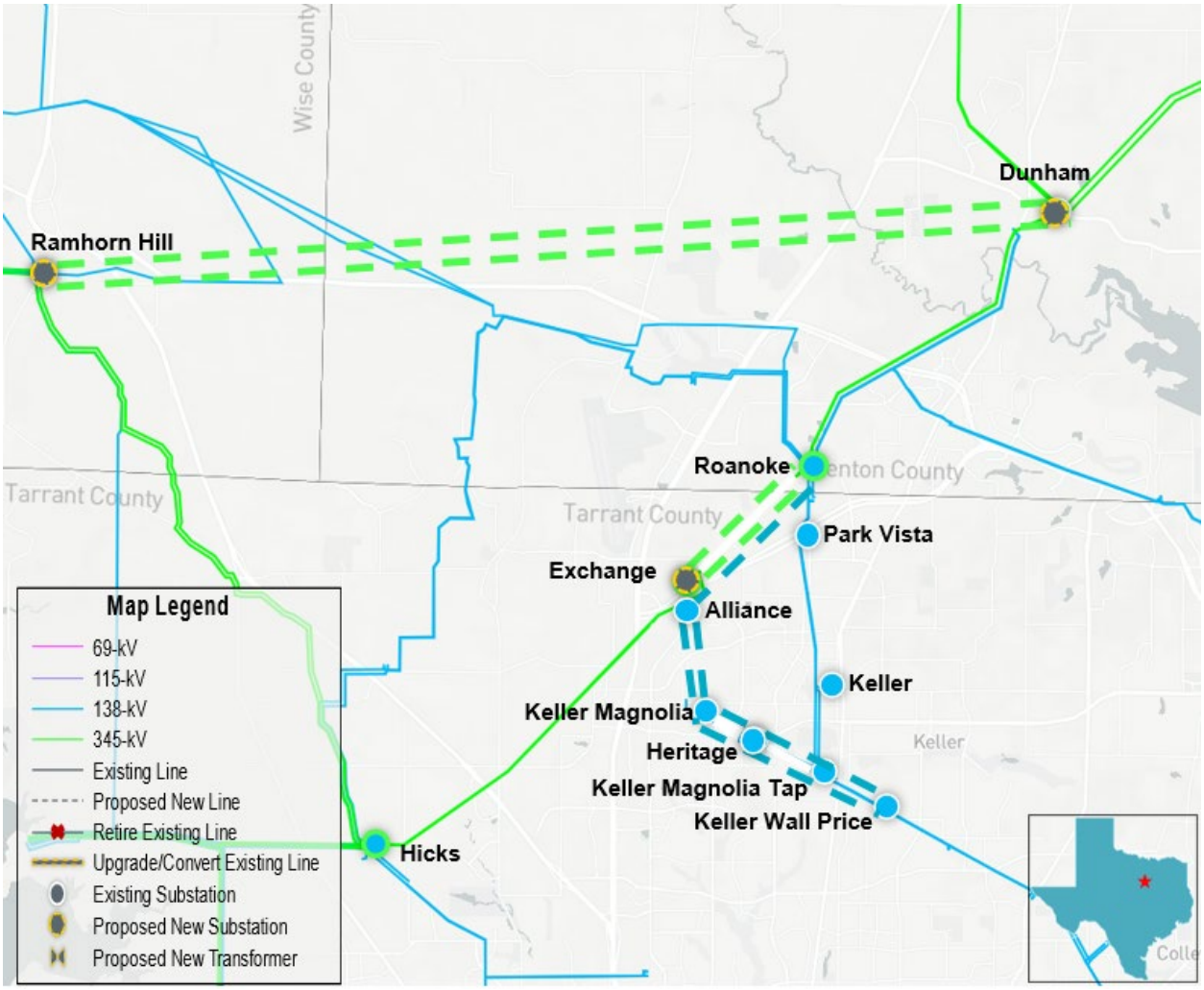

Figure 3: Map of Option 2

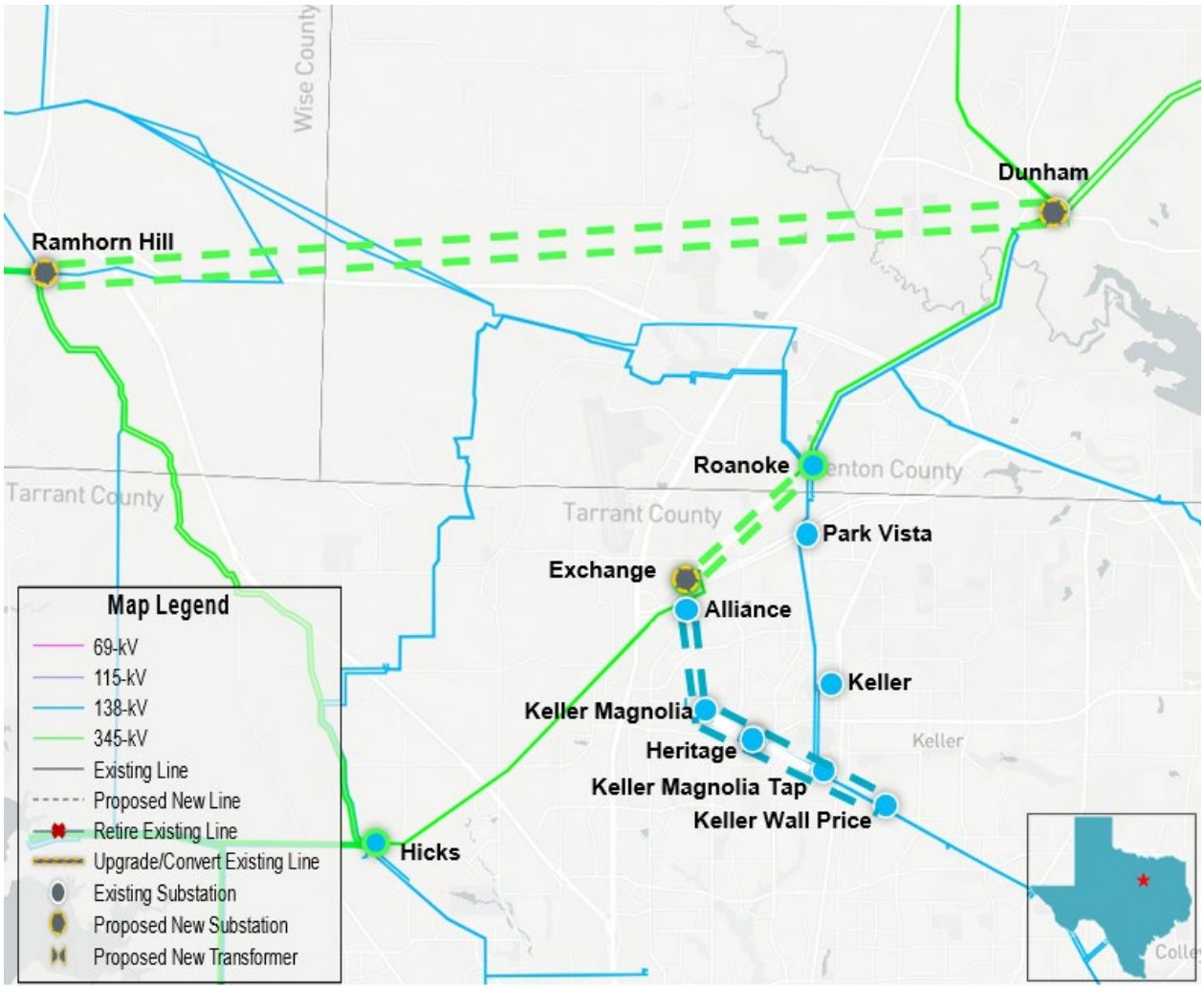

Figure 4: Map of Option 3

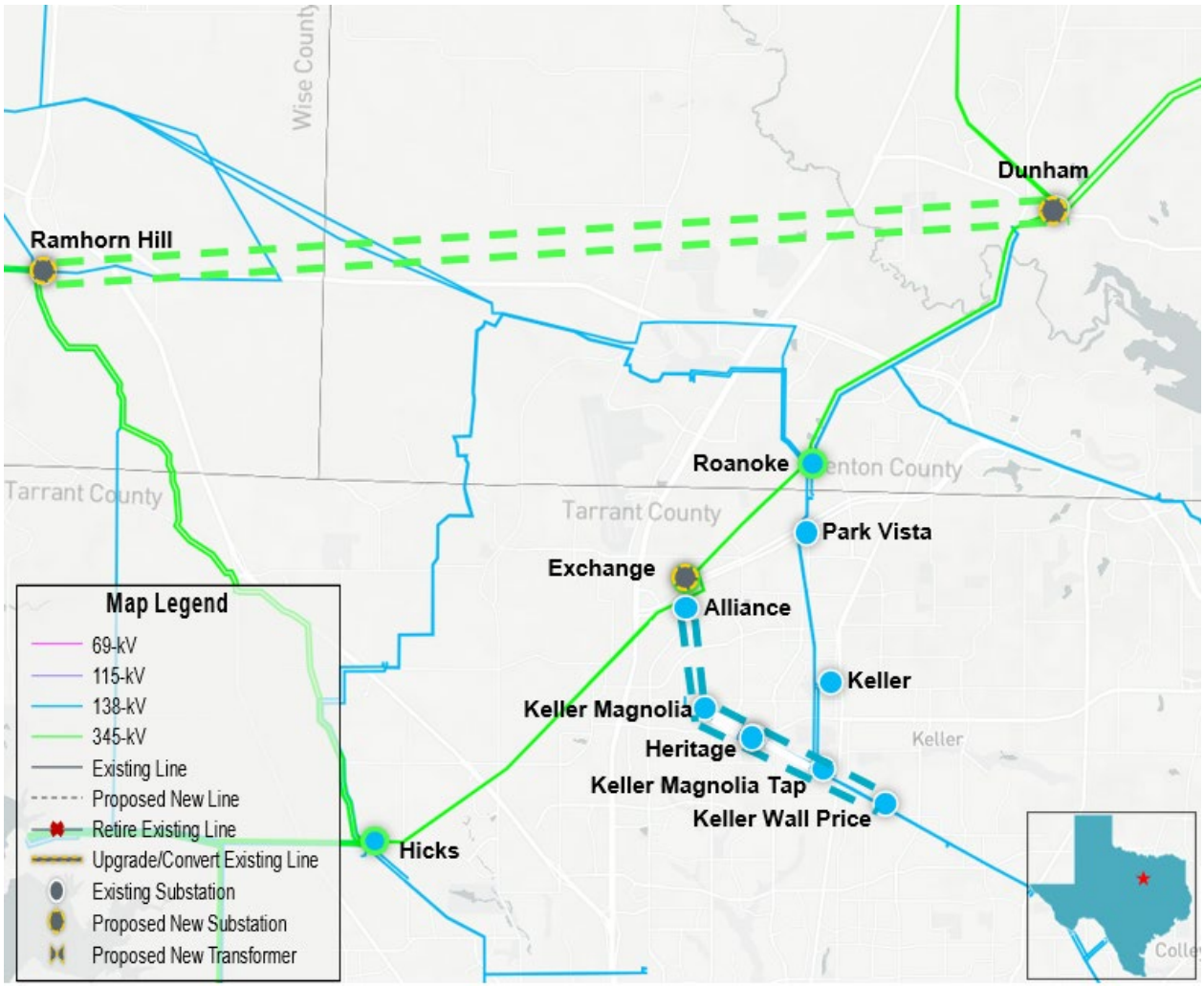

Figure 5: Map of Option 4

4.1 Planned Maintenance Outage (N-1-1) Analysis

ERCOT developed an off-peak scenario for planned maintenance outage (N-1-1) analysis to evaluate the operational flexibility of the short-listed options.

The load levels in the North Central Weather Zone were set to 89.3% of Summer Peak, excluding non-conforming loads, to reflect assumed off-peak season load. This was based on the review of historical real-time load data of the North Central Weather Zone.

To represent system element outages under planned maintenance conditions in the area, ERCOT conducted an N-1-1 contingency analyses based on selected single-circuit prior outages as well as based on selected double-circuit common tower prior outages for each short-listed option. As shown in Table 9, the performance of the three short-listed options was similar.

Table 9: Results of planned maintenance outage analysis

	Planned Maintenance Single Circuit Prior Outage		Planned Maintenance Double Circuit Common Tower Prior Outage	
	Thermal Overloads	Voltage Instability	Thermal[6] Overloads	Voltage Instability
Option 2	No	No	No	No
Option 3	No	No	No	No
Option 4	No	No	No	No

To further evaluate the operational flexibility of the short-listed options, an additional prior outage maintenance scenario was conducted based on input from Oncor. The results of this scenario are shown in Table 10.

Table 10: Results of TSP Requested planned maintenance outage analysis

	Planned Maintenance TSP Requested Scenario (X-1 + Double-Circuit Line Segment)	
	Thermal Overloads	Voltage Stability
Option 2	No	Ok
Option 3	Yes*	Ok
Option 4	Yes*	Ok

*Roanoke 345/138-kV transformer overload

Option 2 performed better under the TSP-requested maintenance scenario.

4.2 Long-term Load Serving Capability Analysis

To estimate and compare the long-term load serving capability of the three short-listed options, ERCOT adjusted load up in the substations identified in the "Area Load Growth Description" Section of Oncor's RPG submittal. To balance power, conforming load outside of the North Central weather zone was adjusted down, and N-1 contingencies were simulated.

The results of the analysis revealed that six 138-kV and one 345-kV transmission line thermal overloads would need to be addressed for all short-listed options to increase long-term load serving capability. In addition, Options 3 and 4 would require additional transmission improvements to address the overloads of the two existing 345/138-kV transformers at Roanoke in order to further increase load serving capability. The lack of a need of the additional major transmission improvements indicates that Option 2 offers a more favorable path for increasing long-term load serving capability.

[6] Terminal upgrade may be needed at Argyle to Corinth 138-kV line based on the double-circuit prior outage results. Independent from this RPG review, Oncor will perform more detailed review and determine the need to upgrade the terminal equipment.

5 Preferred Option

The study results demonstrated that all three short-listed options addressed the reliability criteria violations in the north Fort Worth/Roanoke – Alliance area. A comparison of the short-listed options, with corresponding cost estimates provided by Oncor, is summarized in Table 11.

Table 11: Results of TSP Requested planned maintenance outage analysis

	Option 2	Option 3	Option 4
Met ERCOT and NERC Reliability Criteria	Yes	Yes	Yes
Improved Operational Flexibility	Better	Yes	Yes
Long-term Load Serving Performance	Better	Yes	Yes
Capital Cost Estimates*	$286 M	$264 M	$254 M

* Cost estimates provided by TSP

Although Option 2 is slightly more expensive than Option 3 and 4, Option 2 provides the following benefits over the other options:

- Better long-term load serving capability
- Better operational flexibility during transformer prior outage conditions
- Eliminates 345-kV (P7) double-circuit contingency associated with transmission between Exchange and Roanoke
- Better flexibility for future utilization associated with transmission between Exchange and Roanoke

Based on the comparison of the short-listed options, ERCOT recommends Option 2 as the preferred option to address the reliability need issues in the north Fort Worth/Roanoke – Alliance area. Figure 6 shows visual depiction of the option recommended by ERCOT.

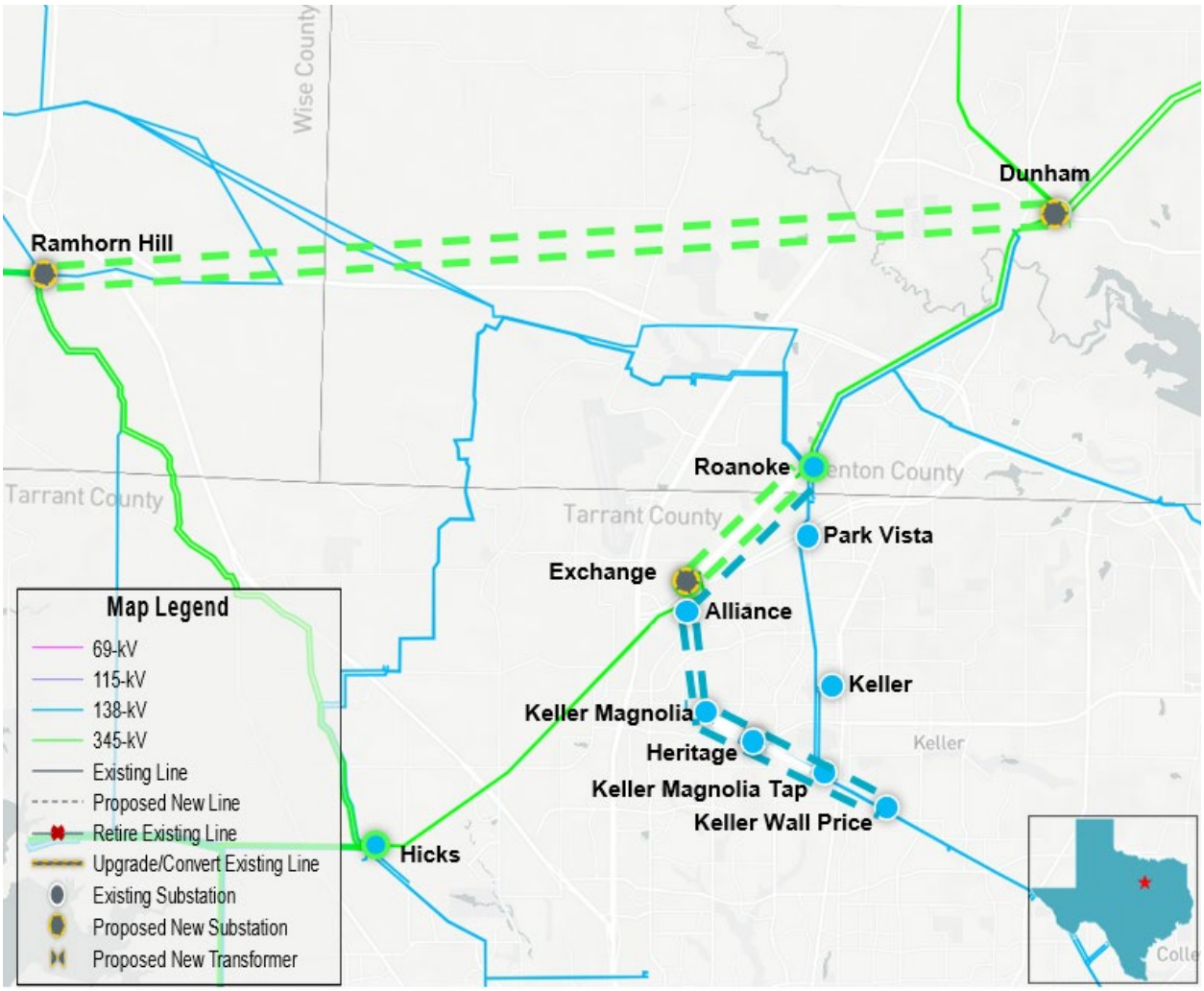

Figure 6: Map of ERCOT's Recommended Option (Option 2)

6 Sensitivity Studies and Sub-synchronous Resonance (SSR) Assessment

The preferred option (Option 2) is categorized as a Tier 1 project, pursuant to ERCOT Protocol Section 3.11.4.3. Therefore, ERCOT performed additional studies as required by the ERCOT Protocols and Planning Guide.

6.1 Planning Guide Section 3.1.1(4) Sensitivities

As required by Planning Guide Section 3.1.3(4), ERCOT performed the following generation and load sensitivity studies.

6.1.1 Generation Addition Sensitivity Analysis

ERCOT performed a generation addition sensitivity analysis based on Planning Guide Section 3.1.3(4)(a). Applicable generating units were taken from the May 2022 GIS[7] reports and are shown in Table 12.

Table 12: Generators with Interconnection Agreement (IA) but not Meeting Planning Guide Sec. 6.9 Conditions

INR	Project Name	Capacity	County
20INR0208	Signal Solar	50.00	Hunt
21INR0362	Oystercatcher Solar	220.33	Ellis
21INR0421	Armadillo Solar	204	Navarro
21INR0458	Porter Solar	245	Denton
22INR0327	Hummingbird Storage	103.8	Denton
22INR0335	Estonian Solar Farm	204.47	Delta
22INR0336	Estonian Energy Storage	102.5	Delta
22INR0552	Sowers Storage	203	Kaufman
22INR0598	Noble Storage Phase II	62.5	Denton

Contingency analysis was performed with all the generators in Table 12 modeled in the study base case and dispatched based on the 2021 RTP assumptions. The results of this sensitivity analysis indicated that the generation addition cannot resolve the reliability criteria violations that serve as the need drivers for this project.

6.1.2 Load Scaling Sensitivity Analysis

Planning Guide Section 3.1.3(4)(b) requires an evaluation of the potential impact of load scaling on the criteria violations seen in this ERCOT independent review. As stated in Section 2.1, ERCOT used the 2026 NNC summer peak case from the 2021 RTP and adjusted the load to create the 2026 North Central summer peak case to study the north Fort Worth/Roanoke – Alliance area. This study base case, which was created in accordance with the 2021 RTP Study Scope and Process document and Section 2.1 of this document, included load scaled down from the respective non-coincident peaks in the West, Far West, East, Coast, South and South-Central Weather Zones.

[7] May 2022 GIS Report: https://www.ercot.com/mp/data-products/data-product-details?id=PG7-200-ER

The Outage Transfer Distribution Factors (OTDFs) of overloaded elements with respect to the load transfer for each Weather Zone (excluding North and North Central Weather Zones) were calculated using PowerWorld Simulator. The OTDFs were less than 2.5% for each of the overloaded elements, i.e., they were not significant enough to have an impact on the overloaded elements. ERCOT concluded that the load scaling used to develop the base case in this study did not have a material impact on the project need.

6.2 Sub-synchronous Resonance (SSR) Assessment and Sensitivity Studies

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

7 Congestion Analysis

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

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

8 Conclusion

The results of this independent review revealed that Option 2 can reliably address system improvement needs; improving operational flexibility and offer improved long-term load serving capability for future load growth in the north Fort Worth/Roanoke – Alliance area. Option 2, the ERCOT recommended option, includes the following system improvements:

- Construct a new Ramhorn Hill 345-kV switching station in a 10-breaker breaker-and-a-half arrangement tapped into existing double-circuit Hicks to Willow Creek 345-kV lines
- Construct a new Dunham 345-kV switching station in a 10-breaker breaker-and-a-half arrangement tapped into existing Lewisville to Krum West and Lewisville to Roanoke 345-kV lines
- Construct two new Ramhorn Hill to Dunham 345-kV transmission lines, with conductor rated to at least 2987 MVA, in a new (estimated 18.4-mile) right-of-way installed on new triple-circuit towers leaving one 138-kV vacant position
- Rebuild Exchange to Roanoke 345-kV double-circuit lines, upgrading both with conductors rated to at least 2987 MVA, using separate double-circuit capable structures for each line. The line rating will be 1912/1912 MVA limited by terminal equipment at Roanoke
- Construct a new Exchange to Roanoke 138-kV circuit, with conductor rated to at least 764 MVA, using one of the Exchange to Roanoke 345-kV line double-circuit capable structures
- Construct a new Exchange 345/138-kV Switching Station, adjacent to Alliance 345-kV substation, with two new 600 MVA (nameplate) transformers in an 8-breaker 345-kV breaker-and-a-half bus arrangement and a 9-breaker 138-kV breaker-and-a-half arrangement. The normal/emergency ratings of the new transformers will be 700/750 MVA
- Convert the existing Alliance 345-kV load serving substation to 138-kV load serving operation
- Construct a new Exchange to Alliance 138-kV double-circuit line with conductors rated to at least 746 MVA
- Construct a new Alliance to Keller Magnolia and Alliance to Heritage 138-kV double-circuit line with conductors rated to at least 746 MVA in a new (estimated 1.4-mile) right-of-way
- Upgrade the existing Keller Magnolia to Heritage 138-kV line with conductor rated to at least 746 MVA to be installed on the Alliance to Keller Magnolia and Alliance to Heritage 138-kV double-circuit towers
- Upgrade the existing Heritage to Keller Magnolia Tap double-circuit lines with conductors rated to at least 746 MVA
- Construct a new 138-kV switching station at Keller Wall Price in a 6-breaker ring bus arrangement
- Disconnect the double-circuit Heritage to Keller Magnolia Tap lines at Keller Magnolia Tap and terminate both at Keller Wall Price by constructing two new 0.3-mile 138-kV transmission lines added to the existing Keller Magnolia Tap to Keller Wall Price right-of-way with both new line conductors rated to at least 746 MVA
- Retire Keller Magnolia Tap

The recommended project is a Tier 1 project estimated to cost approximately $286 Million. According to Oncor, this project will require applications for Certificate of Convenience and Necessity (CCN) for the following new line sections:

- Exchange – Keller Magnolia 138-kV double-circuit line

- Keller Magnolia Tap – Keller Wall Price 138 kV Double-circuit line
- Ramhorn Hill – Dunham 345-kV double-circuit line
- Exchange – Roanoke 138-kV line

Oncor is expecting this project to be in-service by May 2025. If reliability issues arise before the entire recommended project is constructed, ERCOT and Oncor will work together to develop mitigation plans as necessary. Oncor 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 early as 2023 based on the 2021 ERCOT Regional Transmission Plan (RTP) and the RPG submittal, ERCOT deems the project critical to reliability.