Outline

- Delaware Basin Study Background
- Study Assumptions and Methodology
- Preliminary Study Results
- Next Steps
• In 2017 and 2018 the ERCOT Board endorsed the Far West, Far West DRD, and Far West 2 projects to support Delaware Basin load growth
  – These projects, along with other planned upgrades are sufficient to meet the current load forecast
  – However, if the load in the area continues to develop it will outgrow the capability of these planned upgrades
Motivation and Purpose of Delaware Basin Study

• Motivation:
  – The Far West Weather Zone, especially in the Delaware Basin area with significant oil and natural gas load, has had the highest peak demand growth rate percentage in the ERCOT region in recent years.
  – Ensuring that the transmission improvements are in place in time to serve the load has been a challenge.
  – Oil and gas customers do not typically provide financial commitment for new load additions more than one to two years in advance. However, major transmission improvements (e.g. new 345 kV lines) can take more than five years to complete.
Motivation and Purpose of Delaware Basin Study

- **Purpose:**
  - To perform higher-than-committed load growth studies to identify cost-effective bulk power system upgrades that may be necessary if load in the Delaware Basin continues to increase at rapid pace through 2024.
  - To identify long lead time transmission improvements to reliably serve the assumed load.
  - A long-term plan could reduce congestion, reduce overall transmission costs, and provide better service to customers.
Study Progress Overview

ERCOT worked with stakeholders to develop the study scope (January 2019)

TSPs provided higher-than-committed load addition (May 2019 RPG)

ERCOT conducted reliability study and provided status updates to TSPs and RPG (May ~ November 2019)

<table>
<thead>
<tr>
<th>Delaware Basin Load Projection for Year 2024</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019 Regional Transmission Plan (based on Planning Guide Section 3.1.7)</td>
</tr>
<tr>
<td>Delaware Basin Study (include higher than committed load)</td>
</tr>
</tbody>
</table>
Study Assumptions

• Solar generation resources were assumed to be offline in the Delaware Basin area.
• TSPs provided upgrades and new circuits (if there were no existing transmission facilities in the area) to interconnect the projected load additions.
• The focus of the study was on steady state analysis to identify long lead time transmission improvements needed to reliably serve the assumed load.
### Study Methodology

#### Types of Upgrades Considered

<table>
<thead>
<tr>
<th>Types of Upgrades Considered</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long lead time Extra High Voltage circuits (e.g. new 345 kV lines)</td>
<td>This was the focus of the analysis</td>
</tr>
<tr>
<td>Existing 345 kV line upgrades</td>
<td>Included in the analysis</td>
</tr>
<tr>
<td>New 138 kV lines</td>
<td>Included in the analysis, but not optimized</td>
</tr>
<tr>
<td>Existing 138 kV and 69 kV line upgrades</td>
<td>Included in the analysis, but not optimized</td>
</tr>
<tr>
<td>Voltages support devices, static and dynamic</td>
<td>Included in the analysis, but stability analysis was not performed to optimize</td>
</tr>
</tbody>
</table>
Study Methodology

1. Identify reliability criteria violations
2. Develop upgrade options
3. Short-list upgrade options
4. Finalize results

- Common HV and voltage support upgrades
- Unique EHV import options
Preliminary Result: Import Options

• More than ten import options were identified to satisfy N-1 reliability criteria to serve the Delaware Basin load. These options mainly considered the following:
  – New 345-kV, 765-kV, or HVDC circuits
  – Upgrade existing 345-kV circuits
  – Add 2\textsuperscript{nd} circuit on the existing tower structure

• Three short-listed options were selected for further analysis based on G-1-N-1, X-1-N-1, and N-1-1 reliability tests
Three short-listed import options

<table>
<thead>
<tr>
<th>Import Options</th>
<th>4b</th>
<th>4c</th>
<th>6f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upgrade Existing 345 kV Ckts</td>
<td>71</td>
<td>107</td>
<td>107</td>
</tr>
<tr>
<td>Add 2nd 345 kV circuits on the existing structure</td>
<td>111</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>New 345 kV Double Ckts</td>
<td>256</td>
<td>178</td>
<td>164</td>
</tr>
<tr>
<td>New 345 kV Single Ckt</td>
<td>20</td>
<td>169</td>
<td>198</td>
</tr>
<tr>
<td>Sub_Total</td>
<td>458</td>
<td>454</td>
<td>470</td>
</tr>
</tbody>
</table>
Preliminary Result: Common Upgrades

- Common upgrades were identified to reliably support the load additions and were included in all three short listed import options.

<table>
<thead>
<tr>
<th>Common Upgrade</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>New 345/138 kV transformer</td>
<td>8</td>
</tr>
<tr>
<td>Add new circuits (138 kV)</td>
<td>120 miles</td>
</tr>
<tr>
<td>Circuit Conversion and Upgrade (69 kV and 138 kV)</td>
<td>196 miles</td>
</tr>
<tr>
<td>Reactive Support Needs (1)</td>
<td>~1800 MVAR</td>
</tr>
</tbody>
</table>

(1) A stability analysis will be needed to determine the actual reactive support needs in terms of size, location, and technology.
Preliminary Result: Map of the Common Upgrades

Existing 69kV line to 138kV conversion or 138kV line upgrade

New 138kV line
## Preliminary Results: Load Serving Capability, Congestion Analysis, and Cost Estimate

<table>
<thead>
<tr>
<th>Option</th>
<th>Delaware Basin Load Serving Capability (1) (MW)</th>
<th>Production Cost Saving (2) ($Million)</th>
<th>Cost Estimates (3) ($Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4b</td>
<td>5,922</td>
<td>Reference</td>
<td>753</td>
</tr>
<tr>
<td>4c</td>
<td>6,052</td>
<td>2.7</td>
<td>808</td>
</tr>
<tr>
<td>6f</td>
<td>6,002</td>
<td>2.7</td>
<td>841</td>
</tr>
</tbody>
</table>

(1) Performed under N-1 for options 4b, 4c, and 6f from a steady-state voltage stability perspective. Common upgrades were also included in the study cases.
(2) Using 2019 RTP 2024 economic case.
(3) These cost estimates are based on TSP’s preliminary estimate and subject to further review and updates. These cost estimates only include the 345kV transmission upgrades/additions.
Next Steps

• ERCOT will review the three options further to optimize transmission upgrades necessary to serve the area load

• ERCOT plans to finalize the analysis and complete the report in December
Status Updates

- ERCOT presented the study scope at the Nov 2018 RPG
  [link](http://www.ercot.com/content/wcm/key_documents_lists/138710/Delaware_Basin_Load_Integration_Study_Scope_-_Nov2019_RPG.pdf)

- ERCOT presented status updates at the May, July, and September 2019 RPG meetings
  - [link](http://www.ercot.com/content/wcm/key_documents_lists/165286/Delaware_Basin_Load_Integration_Study_Update_-_May2019_RPG.pdf)
  - [link](http://www.ercot.com/content/wcm/key_documents_lists/165294/Delaware_Basin_Load_Integration_Study_Update_-_July2019_RPG.pdf)
  - [link](http://www.ercot.com/content/wcm/key_documents_lists/165302/Delaware_Basin_Load_Integration_Study_Update_-_Sept2019_RPG.pdf)
Appendix – List of the Common transmission upgrades

- Added seven reactive devices (5 placeholder synchronous condensers, 1 DRD and 1 capacitor bank)
- Tapped the new 345kV Wolf station to the Odessa/Moss – Riverton 345kV double circuit lines (TPIT 46094, Tier 3, Dec 2020)
- Tapped Tap the Wolf - Riverton 345kV double circuit at Quarry Field, and add two 345/138kV autotransformer at Quarry Field
- Built a new Owl Hills 345kV substation with two 345/138kV transformers
- Tapped a new 345kV substation on the Solstice to Sand Lake 345kV double-circuit line, and install two new 345/138kV transformers
- Converted AEP 69kV line Barrilla - Hoefs Road - Verhalen - Saragosa to 138kV
- Converted ONCOR 69kV line Yucca - Royalty - Coyanosa - Wolfcamp to 138kV
- Built a new 138kV double circuit line from Barrila Draw to Faulkner
- Built a new 138kV line from from Elcor to Faulkner
- Built a new 138kV line from from Saragosa to Faulkner
- Built a new 138kV line from Remeranch to Saragosa
- Built a new 138kV line from Conoco to TNMP 16th Street
- Converted the existing Fort Stockton - Conoco Comp station - Conoco Rgec 69kV line to 138kV
- Upgrade the existing 138kV lines from Rio Pecos to Fort Stockton
- Upgraded the Gemsbok to Gemsbok Autonomous Crypto 138kV line
- Upgraded the Solstice - Hayter - Remeranch138kV line
- Upgraded the existing Quail Switch - Odessa 345kV line
- Upgraded the existing Morgan Creek - Tonkawa 345kV line
- Upgraded the existing Midland East - Falcon Seaboard 345kV line
Option 4a: Faraday – Lamesa - Clearfork – Riverton 345kV double circuit; Big Hill – Bakersfield – Odessa 2nd circuit
Appendix – Import Option 4b

- Option 4b: Faraday – Lamesa - Clearfork – Riverton 345kV double circuit; Big Hill – Bakersfield 2nd circuit plus North McCamey – Saddleback 345kV double circuit
Appendix – Import Option 4c

- Option 4c: Faraday – Lamesa - Clearfork – Riverton 345kV double circuit; Bearkat - North McCamey – Saddleback 345kV single circuit
Option 5d: Bearkat - North McCamey – Saddleback 345kV double circuit; Clearfork – Riverton 345kV double circuit
Appendix – Import Option 5e

- Option 5e: Bearkat - North McCamey – Saddleback 345kV double circuit; Big Hill – Bakersfield 2nd circuit plus Clearfork – Riverton 345kV double circuit
Appendix – Import Option 5f

- Option 5f: Bearkat - North McCamey – Saddleback 345kV double circuit;
  Faraday - Clearfork – Riverton 345kV single circuit
Appendix – Import Option 6a

- Option 6a: Bearkat - North McCamey – Sand Lake 345kV double circuit; Big Hill – Bakersfield – Odessa 2nd circuit

- Existing 345kV lines
- New 345kV lines

- 71 miles
- 94 miles
Option 6e: Bearkat - North McCamey – Sand Lake 345kV double circuit; Big Hill – Bakersfield 2\textsuperscript{nd} circuit plus Clearfork – Riverton 345kV double circuit

- 67 miles
- 71 miles
- 94 miles
Appendix – Import Option 6f

- Option 6f: Bearkat - North McCamey – Sand Lake 345kV double circuit; Faraday – Clearfork - Riverton 345kV single circuit
Appendix – Import Option 9e

- Option 9e: 1,200 MW HVDC line (VSC) from Cagnon to Bakersfield and new 345kV double-circuit line from North McCamey to Saddleback; Big Hill – Bakersfield 2nd circuit plus Clearfork – Riverton 345kV double circuit
Appendix – Import Option 10e

- Option 10e: 765kV double-circuit line from Cagnon to Bakersfield, new 345kV double-circuit line from North McCamey to Saddleback, and Bakersfield – North McCamey 2nd circuit; Big Hill – Bakersfield 2nd circuit plus Clearfork – Riverton 345kV double circuit

[Map with distances marked: 67 miles, 78 miles, 287 miles]
### Appendix - Load Summary

<table>
<thead>
<tr>
<th>TSP</th>
<th>2018 RTP</th>
<th>2019 RTP</th>
<th>Feb 2019 SSWG</th>
<th>DBA Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEP</td>
<td>130</td>
<td>272</td>
<td>330</td>
<td>459</td>
</tr>
<tr>
<td>Golden Spread</td>
<td>8</td>
<td>6</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>LCRA</td>
<td>6</td>
<td>7</td>
<td>17</td>
<td>210</td>
</tr>
<tr>
<td>ONCOR</td>
<td>1,463</td>
<td>1,875</td>
<td>1,900</td>
<td>2,724</td>
</tr>
<tr>
<td>TNMP</td>
<td>507</td>
<td>527</td>
<td>1,254</td>
<td>1,969</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>2,114</strong></td>
<td><strong>2,688</strong></td>
<td><strong>3,509</strong></td>
<td><strong>5,372</strong></td>
</tr>
</tbody>
</table>

![Map showing power generation capacities](image-url)