Delaware Basin Load Integration Study - Update

ERCOT Transmission Planning

Regional Planning Group
September 18, 2019

Status Updates

- ERCOT presented the study scope at the Nov 2018 RPG
  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 and July 2019 RPG meetings
  - http://www.ercot.com/content/wcm/key_documents_lists/165286/Delaware_Basin_Load_Integration_Study_Update_-_May2019_RPG.pdf
  - http://www.ercot.com/content/wcm/key_documents_lists/165294/Delaware_Basin_Load_Integration_Study_Update_-_July2019_RPG.pdf

Status Updates

- Since the July RPG meeting, additional updates were made to the case based on TSPs' input. As a result, the N-0 transmission upgrades presented at the July RPG meeting were also updated. More details can be found in Appendix
- ERCOT conducted the steady-state N-1 contingency analysis and identified preliminary transmission upgrades. More details can be found in Appendix
- ERCOT is currently conducting G-1+N-1 contingency analysis

Import Path Options Tested to Address N-1 Violations

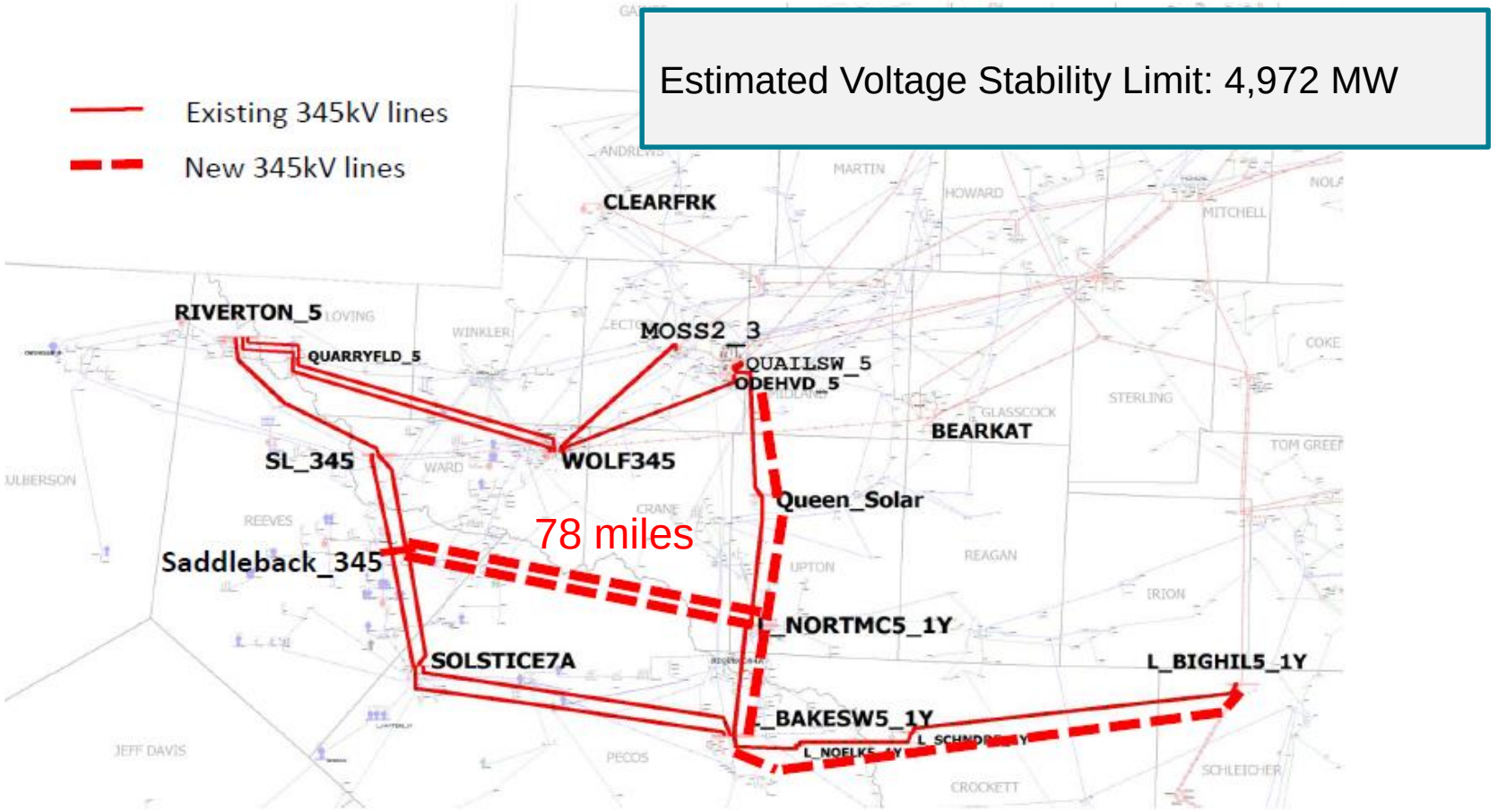
- ERCOT considered the following 345kV import path options
  - Option 1: Add a second circuit for the Big Hill – Bakersfield – North McCamey – Odessa 345kV line, and new North McCamey – Saddleback double circuit 345kV line
  - Option 2: Faraday – Lamesa - Clearfork – Riverton 345kV single circuit
  - Option 3: Bearkat – North McCamey – Saddleback 345kV single circuit
  - Option 4: Faraday – Lamesa - Clearfork – Riverton 345kV double circuit
  - Option 5: Bearkat – North McCamey – Saddleback 345kV double circuit
  - Option 6: Bearkat – North McCamey – Sand Lake 345kV double circuit
  - Option 7: Red Creek – North McCamey – Saddleback 345kV double circuit
  - Option 8: 1,000 MW HVDC line from Abernathy to Riverton
  - Option 9: 1,000 MW HVDC line from Cagnon to Bakersfield, and new 345kV double circuit line from North McCamey to Saddleback 345kV
  - Line mileage adder assumed for the new 345kV line and HVDC line options: 20% to the straight distance between two end points

Conceptual Upgrade Options for the N-1 Issues

- Additional transmission additions and upgrades for N-1 issues (these additions were included in all tested import options)
  - Build a new Owl Hill 345 kV substation with two 345/138 kV transformers, and add a new single-circuit 345 kV line from Riverton to Owl Hill
  - Tap a new 345 kV Saddleback substation on the Solstice to Sand Lake 345 kV double-circuit line, and install two new 345/138 kV transformers at the new Saddleback 345kV station
  - Build a new 138kV double circuit from Saddleback to Eagle Claw Tap
  - Build a new 138 kV line from Saragosa to Faulkner
  - Transmission addition and upgrades along Rio Pecos and Fort Stockton area
  - Upgrade the existing Morgan Creek - Tonkawa 345 kV line (21.3 miles) (~127%)
  - Upgrade the existing Morgan Creek - Longshore 345 kV line (36.5 miles) (~109%)
  - Upgrade the existing Midland East - Falcon Seaboard 345 kV line (48.4 miles) (~106%)
  - TNMP Wink – IH20 area modification
  - Wolf – Moss 138kV High Temp Upgrade (Tier 3 project)
  - Wink - No Trees – Andrews County South 138kV Second Circuit (Tier 3 project)
  - Andrews County South 345/138kV autotransformer #2 (Tier 3 project)

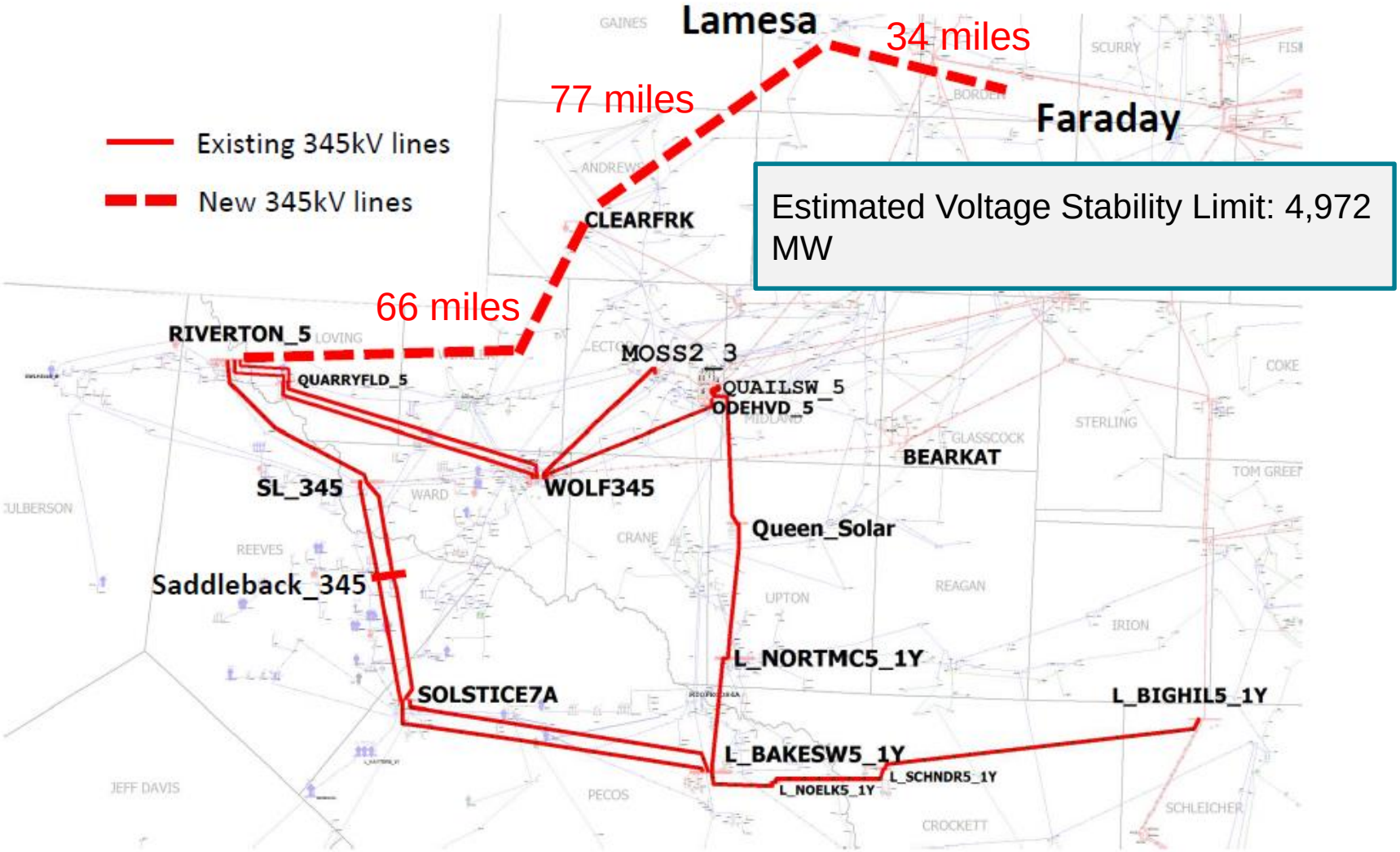
Option 1

- Option 1: Add a second circuit for the Big Hill – Bakersfield – North McCamey – Odessa 345kV line, and new North McCamey – Saddleback double circuit 345kV line



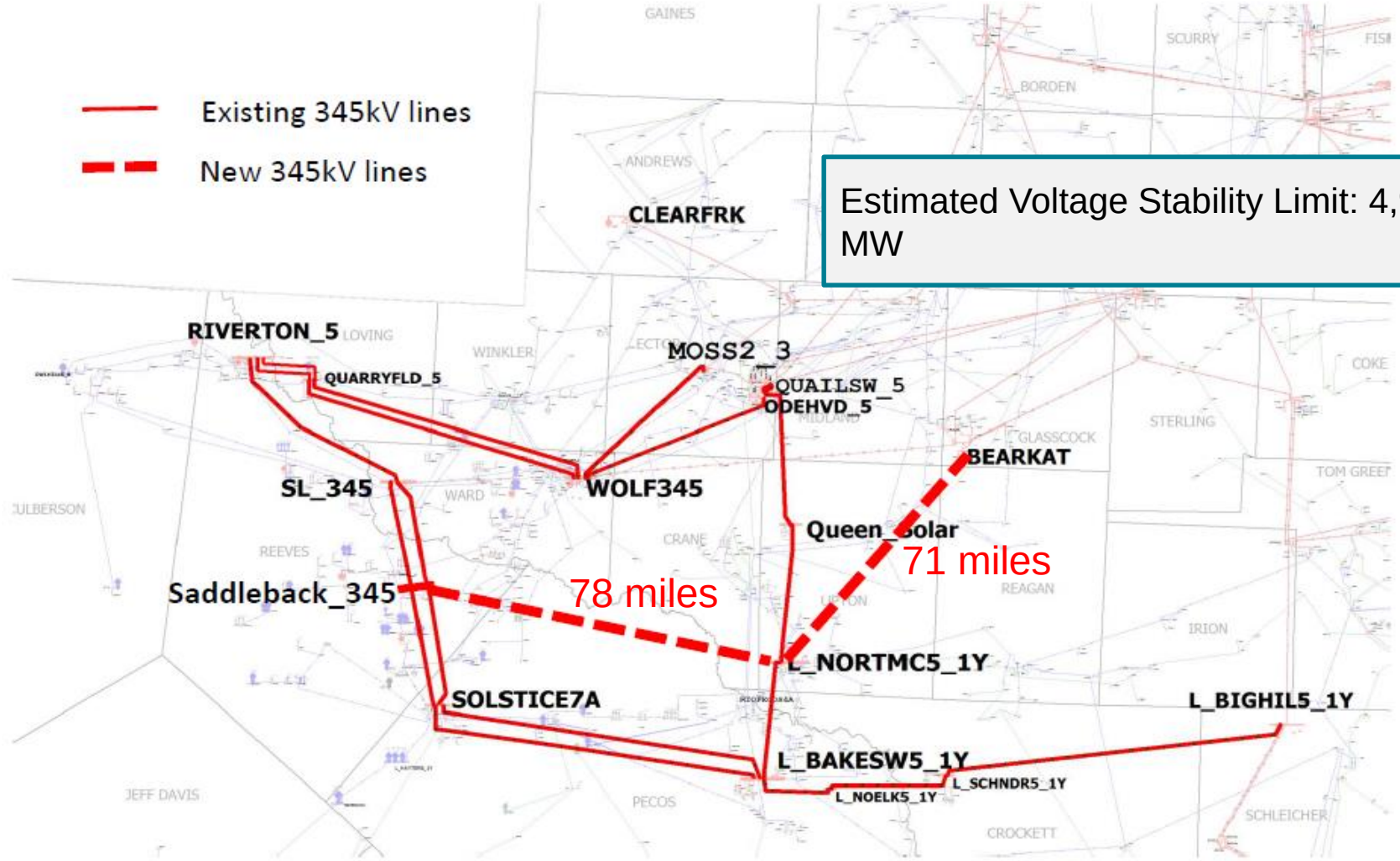
Option 2

- Option 2: Faraday – Lamesa - Clearfork – Riverton 345kV single circuit



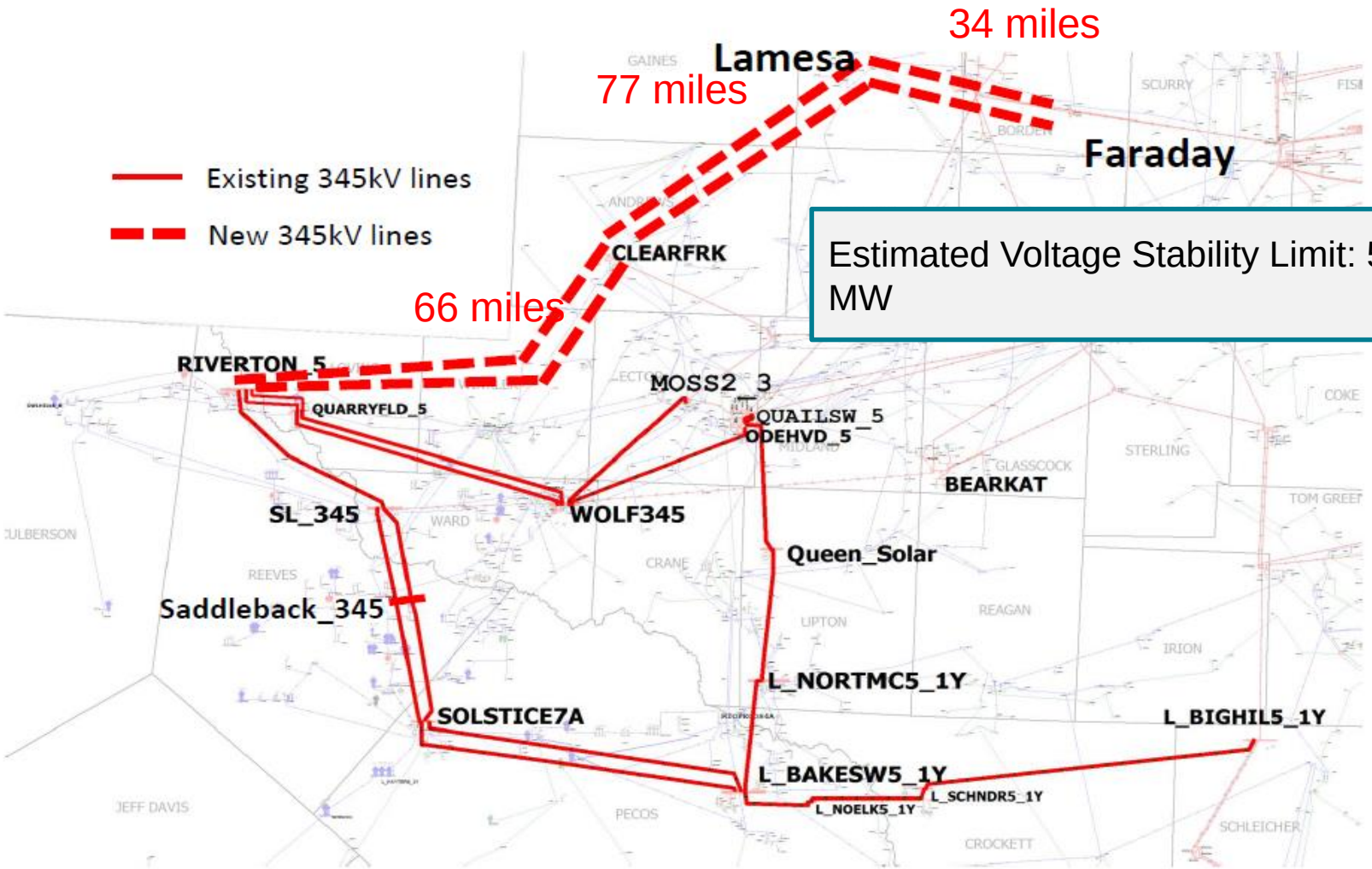
Option 3

- Option 3: Bearkat – North McCamey – Saddleback 345kV single circuit



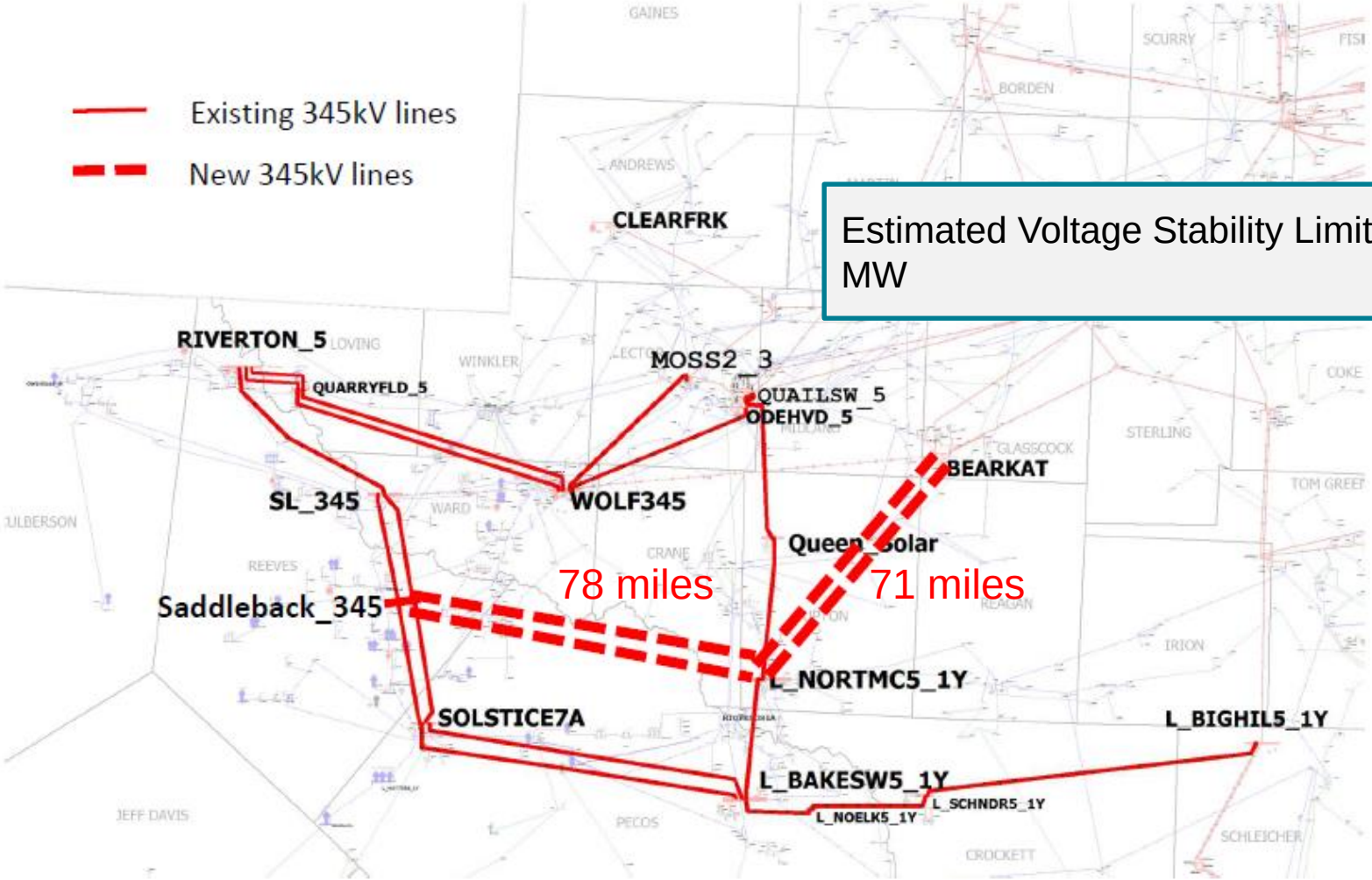
Option 4

- Option 4: Faraday – Lamesa - Clearfork – Riverton 345kV double circuit



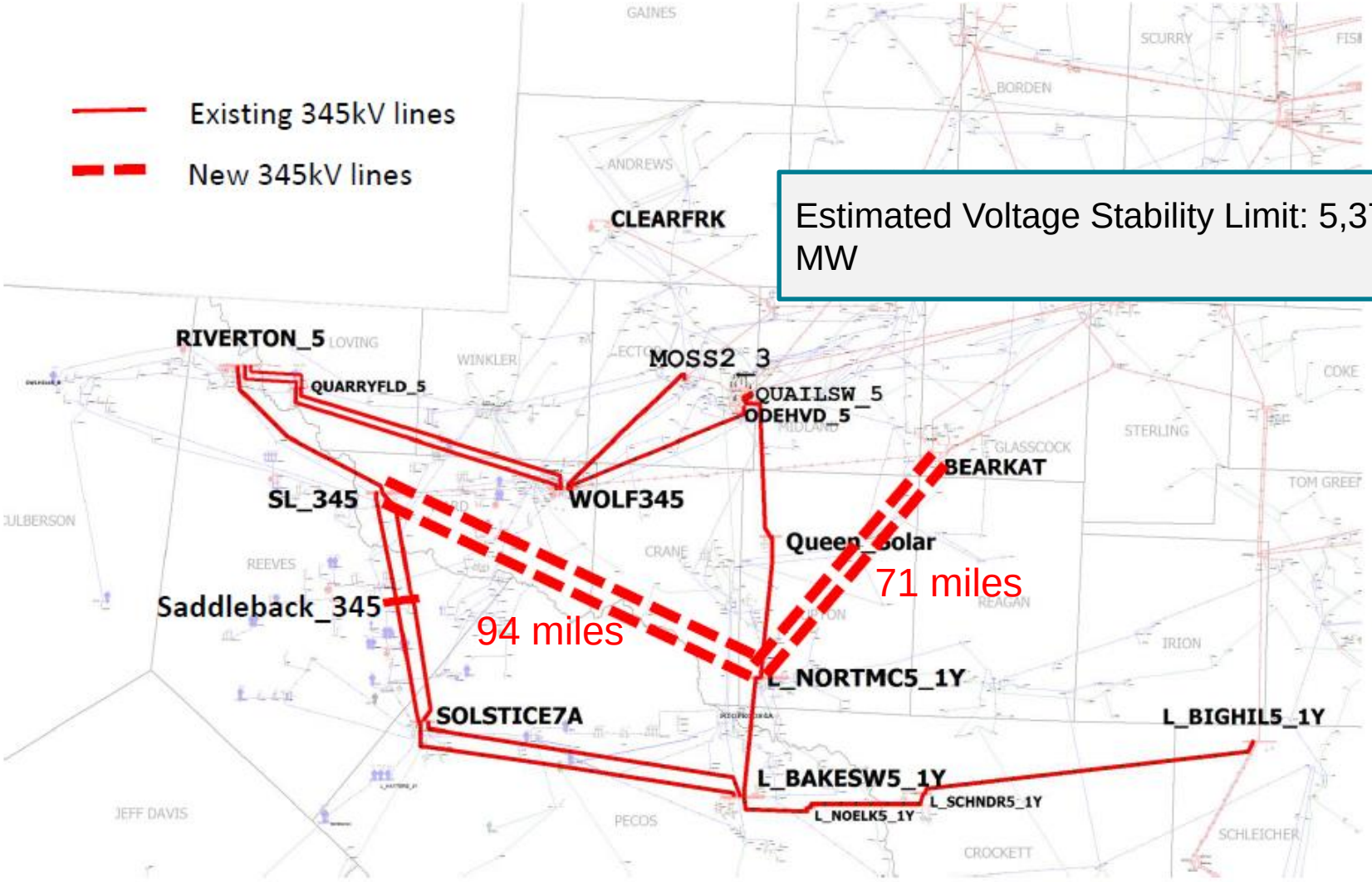
Option 5

- Option 5: Bearkat – North McCamey – Saddleback 345kV double circuit



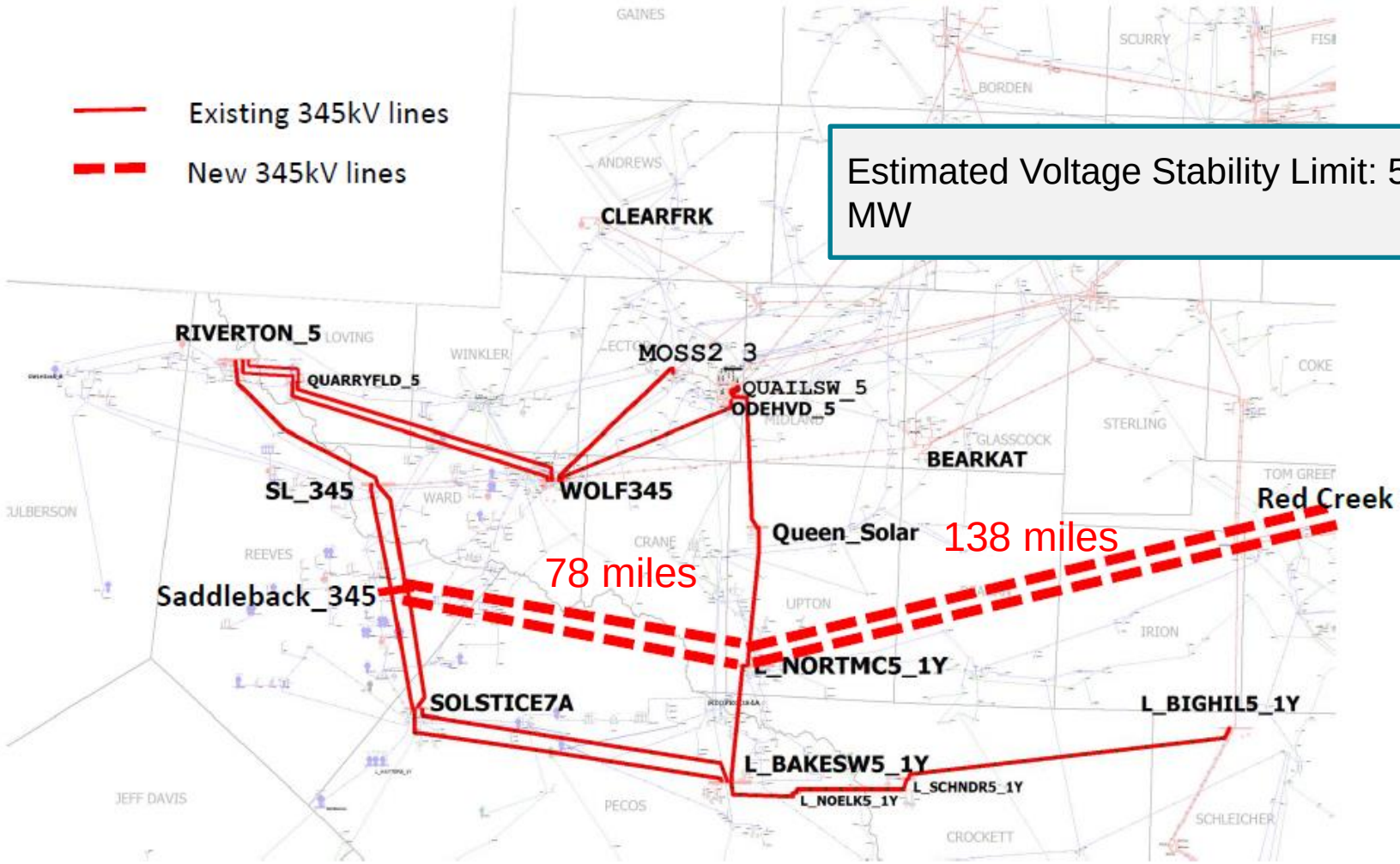
Option 6

- Option 6: Bearkat – North McCamey – Sand Lake 345kV double circuit



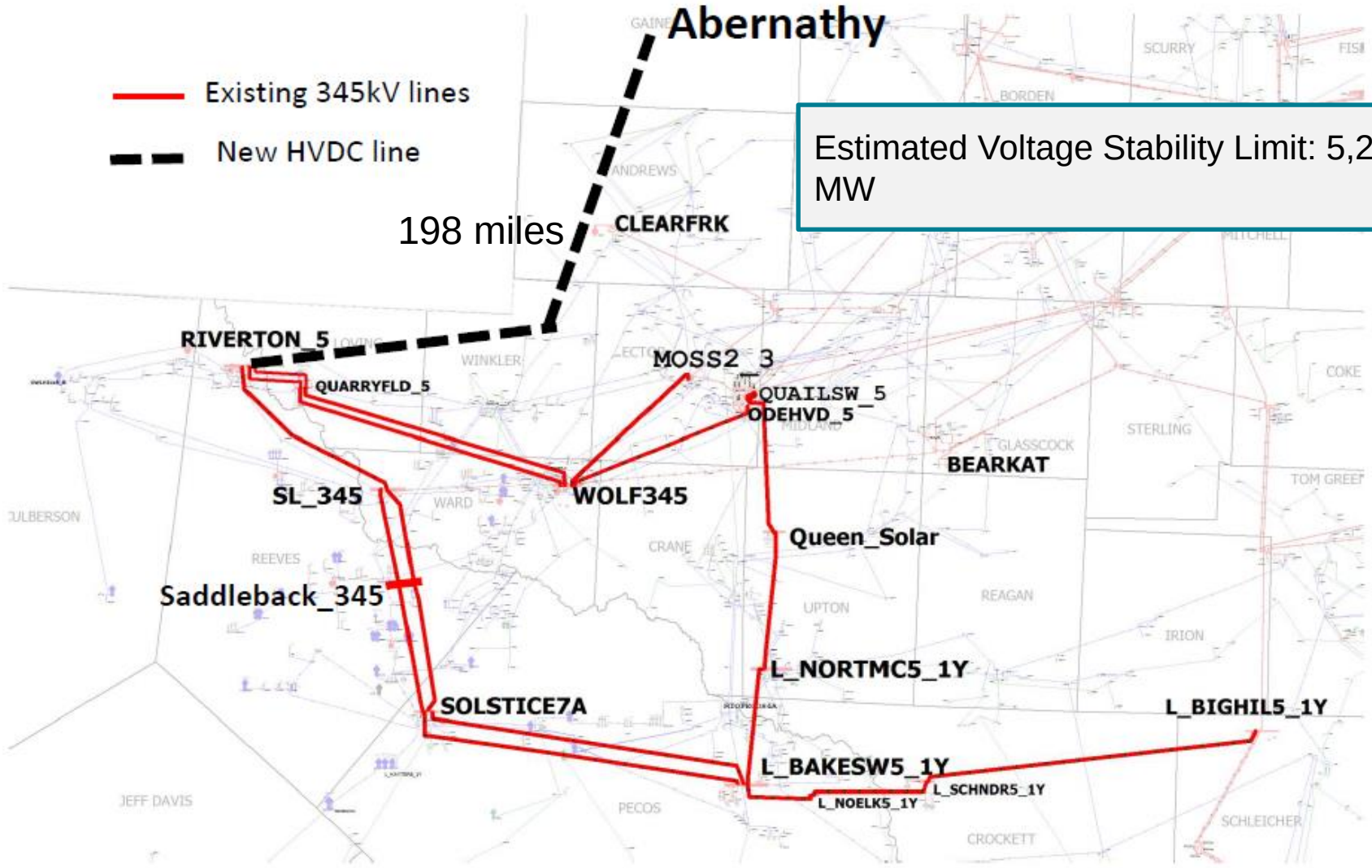
Option 7

- Option 7: Red Creek – North McCamey – Saddleback 345kV double circuit



Option 8

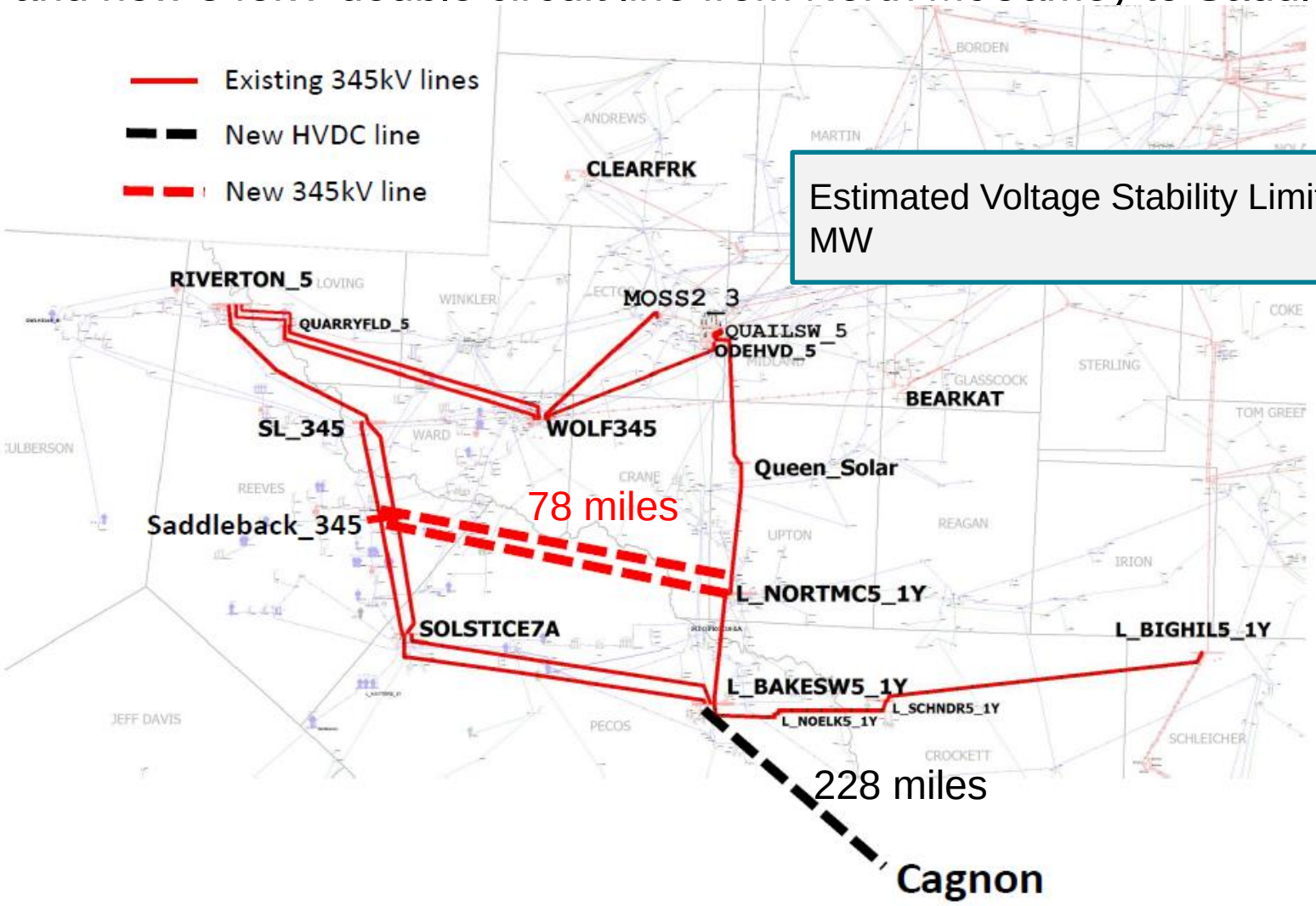
- Option 8: 1,000 MW HVDC line (VSC) from Abernathy to Riverton



Estimated Voltage Stability Limit: 5,272 MW

Option 9

- Option 9: 1,000 MW HVDC line (VSC) from Cagnon to Bakersfield, and new 345kV double circuit line from North McCamey to Saddleback



Preliminary Results of Power Transfer Analysis

- Load serving capability summary under N-1 from a steady-state voltage stability perspective (Delaware Basin area load level in this study is 5,372 MW)

Options	New ROW (miles)	Load Serving Capability (MW)
Option 1: Add a second circuit for the Big Hill – Bakersfield – North McCamey – Odessa 345kV line, and new North McCamey – Saddleback double circuit 345kV line	78	~ 4,972
Option 2: Faraday – Lamesa - Clearfork – Riverton 345kV single circuit	177	~ 4,972
Option 3: Bearkat – North McCamey – Saddleback 345kV single circuit	149	~ 4,972
Option 4: Faraday – Lamesa - Clearfork – Riverton 345kV double circuit	177	~ 5,372
Option 5: Bearkat – North McCamey – Saddleback 345kV double circuit	149	~ 5,372
Option 6: Bearkat – North McCamey – Sand Lake 345kV double circuit	164	~ 5,372
Option 7: Red Creek – North McCamey – Saddleback 345kV double circuit	216	~ 5,272
Option 8: 1,000 MW HVDC line from Abernathy to Riverton	198	~ 5,272
Option 9: 1,000 MW HVDC line from Cagnon to Bakersfield, and new 345kV double circuit line from North McCamey to Saddleback 345kV	306	~ 5,272

Remaining N-1 Thermal Violations

❑ Remaining Violations

Element	Opt 1	Opt 2	Opt 3	Opt 4	Opt 5	Opt 6	Opt 7	Opt 8	Opt 9
AROYA_8 (1001) -> YUCCADR_8 (1009)	-	102.3%	-	105.9%	100.6%	100.7%	100.1%	106.9%	-
MONAHN2T_8 (1107) -> WOLFSS_8 (1013)	-	-	-	-	-	-	100.2%	108.9%	-
TNJRMNGNDR1 (38080) -> TNSADDLEBK1 (38058)	-	-	-	-	100.7%	-	-	-	-
WARDSAND_8 (11292) -> WOLFSS_8 (1013)	-	-	-	-	-	-	-	104.1%	-
WOLFSS_8 (1013) -> YUCCADR_8 (1009)	-	-	-	100.7%	-	-	-	101.5%	-

- Aroya – Yucca 138kV and Wolf – Yucca 138kV overloads will be relieved by closing the Monahans 138kV bus tie
- 0.8 miles 138kV line from Saddleback – New Saddleback (409 MVA currently) needs to be upgraded to a higher rating
- Wardsand – Wolf – Monahans 138kV overload occurred in Options 7 & 8

Summary of Study Results (N-0 and N-1)

- Under N-1, results of the steady-state voltage stability analysis showed that the import path options with single-circuit 345 kV line or HVDC are not capable of serving the assumed Delaware Basin load (5,372 MW) without additional upgrades
- Options 4, 5, and 6 will be further evaluated for G-1+N-1, X-1+N-1 and N-1-1 scenarios. During the further evaluation, some of the unselected options may be considered to combine with Options 4, 5, or 6
- A number of local upgrades (e.g. new 138 kV line, line conversion) are necessary regardless of the import options
- Among the initial seven placeholder synchronous condensers, two of them were replaced with DRD and capacitor bank. The remaining five synchronous condensers will be further evaluated as transmission upgrades are identified
- List of the updated N-0 and N-1 upgrades can be found in Appendix

Next Step

- ERCOT will continue to study X-1+N-1, G-1+N-1, and N-1-1 analysis of the selected options
  - X-1+N-1 Scenarios
    - ✓ Riverton, Quarry Field, Sand Lake, Wolf, Solstice, and Saddleback
  - G-1+N-1 Scenarios
    - ✓ Permian Basin all five units
    - ✓ Odessa Train 1
  - Planned maintenance outage scenarios

    Note: First level contingency of N-1-1 will be single-circuit 345kV line and two DRDs in the Delaware Basin Area
    - ✓ Odessa – Wolf 345kV, Wolf-Quarry Field 345kV circuit 1
    - ✓ Faraday – Clearfork 345kV circuit 1, Clearfork – Riverton 345kV circuit 1
    - ✓ Bearkat – North McCamey 345kV circuit 1, North McCamey – Saddleback 345kV circuit 1
    - ✓ North McCamey – Sand Lake 345kV circuit 1, Riverton-Sand Lake 345kV
    - ✓ Solstice-Saddleback 345kV circuit 1, Saddleback – Sand Lake 345kV circuit 1
    - ✓ Bakersfield – Solstice 345kV circuit 1, Noelk – Bakersfield 345kV
    - ✓ Queen Solar-North McCamey 345kV
    - ✓ Rondo DRD (250Mvar), Horse Shoe DRD (250 Mvar)

Deliverables and Timeline

- Tentative Timeline

Deliverables	Tentative Schedule
Load Update by TSPs	April, 2019
Review the Data Provided by TSPs	May, 2019
Develop Study Base Case, Conduct Reliability Analysis	June, 2019
Study Potential Transmission Solutions	September, 2019
Study Report to Inform Stakeholders	November, 2019

Questions

Stakeholder Comments Also Welcomed to

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Appendix – List of the N-0 transmission upgrades

❑ Transmission additions and upgrades for N-0 issues

- 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)
- Converted AEP 69kV line Barrilla - Hoefs Road - Verhalen - Saragosa to 138kV
- Converted TNMP 69kV system from Wink to IH20 to 138kV
- Converted ONCOR 69kV line Yucca - Royalty - Coyanosa - Wolfcamp to 138kV
- Upgraded the Gemsbok to Gemsbok Autonomous Crypto 138kV line
- Tapped Tap the Wolf - Riverton 345kV double circuit at Quarry Field, and add two 345/138kV autotransformer at Quarry Field
- Upgraded Quail Switch - Odessa 345kV line
- Upgrade the Solstice - Hayter 138kV line
- Upgrade the Rio Pecos - Woodward 2 138kV line
- Upgrade the Tombstone - Lynx 138kV
- Added a placeholder 345kV import path (Bearkat – Wolf – Sand Lake)

Appendix – List of the N-1 transmission upgrades

❑ Transmission additions and upgrades for N-1 issues

- New Import path options (e.g. Options 4, 5, and 6)
- Build a new Owl Hill 345 kV substation with two 345/138 kV transformers, and add a new single-circuit 345 kV line from Riverton to Owl Hill
- Tap a new 345 kV Saddleback substation on the Solstice to Sand Lake 345 kV double-circuit line, and install two new 345/138 kV transformers at the new Saddleback 345kV station
- Build a new 138kV double circuit from Saddleback to Eagle Claw Tap
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- TNMP Wink – IH20 area modification
- Wolf – Moss 138kV High Temp Upgrade (provided by Oncor)
- Wink - No Trees – Andrews County South 138kV Second Circuit (provided by Oncor)
- Andrews County South 345/138kV autotransformer #2 (provided by Oncor)

Appendix - Load Summary

TSP	2018 RTP	2019 RTP	Feb 2019 SSWG	DBA Study
AEP	130	272	330	459
Golden Spread	8	6	7	9
LCRA	6	7	17	210
ONCOR	1,404	1,817	1,841	2,665
TNMP	507	527	1,254	1,969
Grand Total	**2,055**	**2,630**	**3,450**	**5,313**