Delaware Basin Load Integration Study - Update

ERCOT Transmission Planning

Regional Planning Group
November 12, 2019

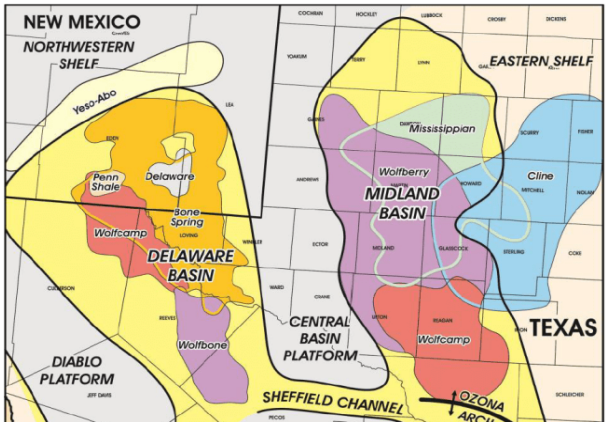
Outline

- Delaware Basin Study Background
- Study Assumptions and Methodology
- Preliminary Study Results
- Next Steps

Background

- 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

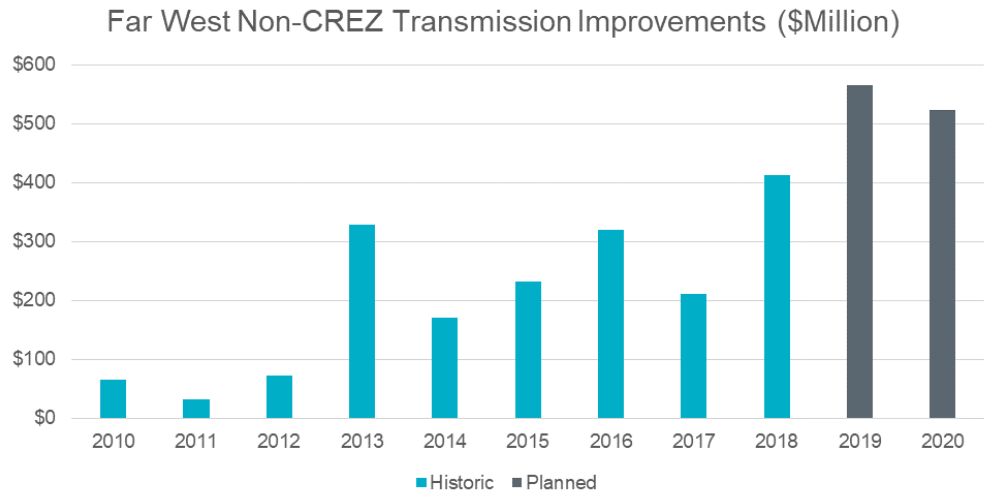
Motivation and Purpose of Delaware Basin Study



- 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)

Delaware Basin Load Projection for Year 2024	
2019 Regional Transmission Plan (based on Planning Guide Section 3.1.7)	2,688 MW
Delaware Basin Study (include higher than committed load)	5,372 MW

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	Comment
Long lead time Extra High Voltage circuits (e.g. new 345 kV lines)	**This was the focus of the analysis**
Existing 345 kV line upgrades	Included in the analysis
New 138 kV lines	Included in the analysis, but not optimized
Existing 138 kV and 69 kV line upgrades	Included in the analysis, but not optimized
Voltages support devices, static and dynamic	Included in the analysis, but stability analysis was not performed to optimize

Study Methodology

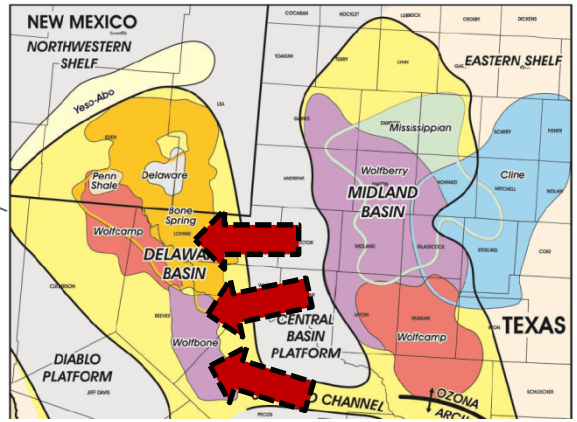
Identify reliability criteria violations

Develop upgrade options

Short-list upgrade options

Finalize results

- Common HV and voltage support upgrades
- Unique EHV import options

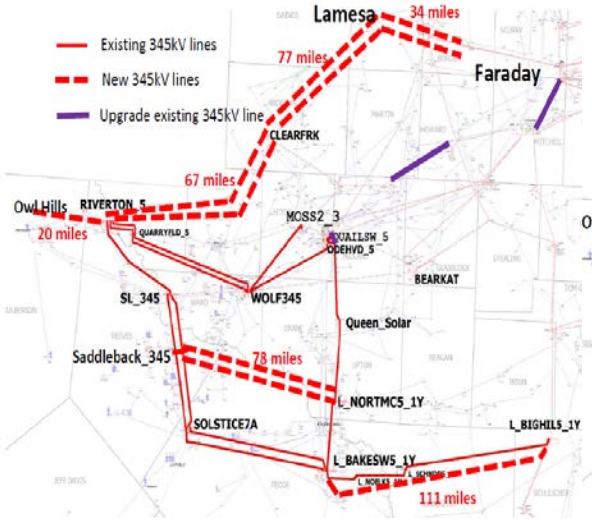


Preliminary Result: Import Options

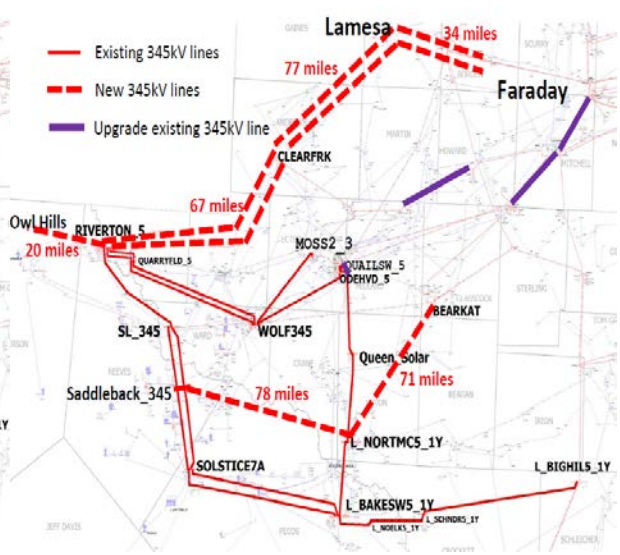
- More than ten import options were identified to satisfy N-1 reliability criteria to serve the Delaware Basin load. These options mainly considered the following:
  - New 345-kV, 765-kV, or HVDC circuits
  - Upgrade existing 345-kV circuits
  - Add 2nd circuit on the existing tower structure
- Three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

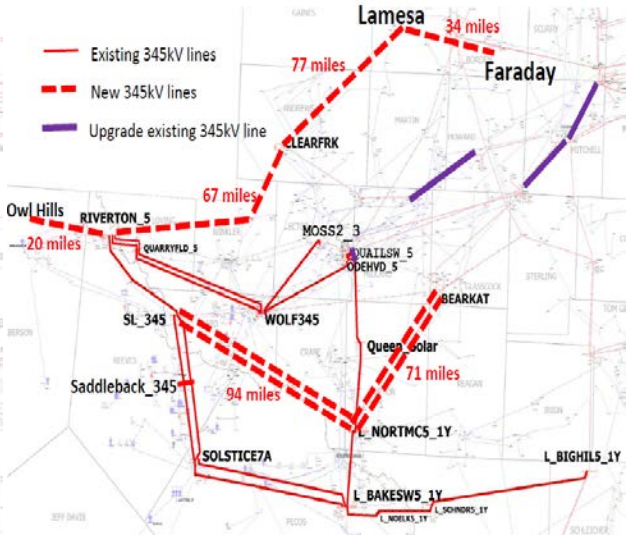
Option 4b



Option 4c



Option 6f



Import Options	4b	4c	6f
	Miles	Miles	Miles
Upgrade Existing 345 kV Ckts	71	107	107
Add 2nd 345 kV circuits on the existing structure	111	--	--
New 345 kV Double Ckts	256	178	164
New 345 kV Single Ckt	20	169	198
Sub_Total	458	454	470

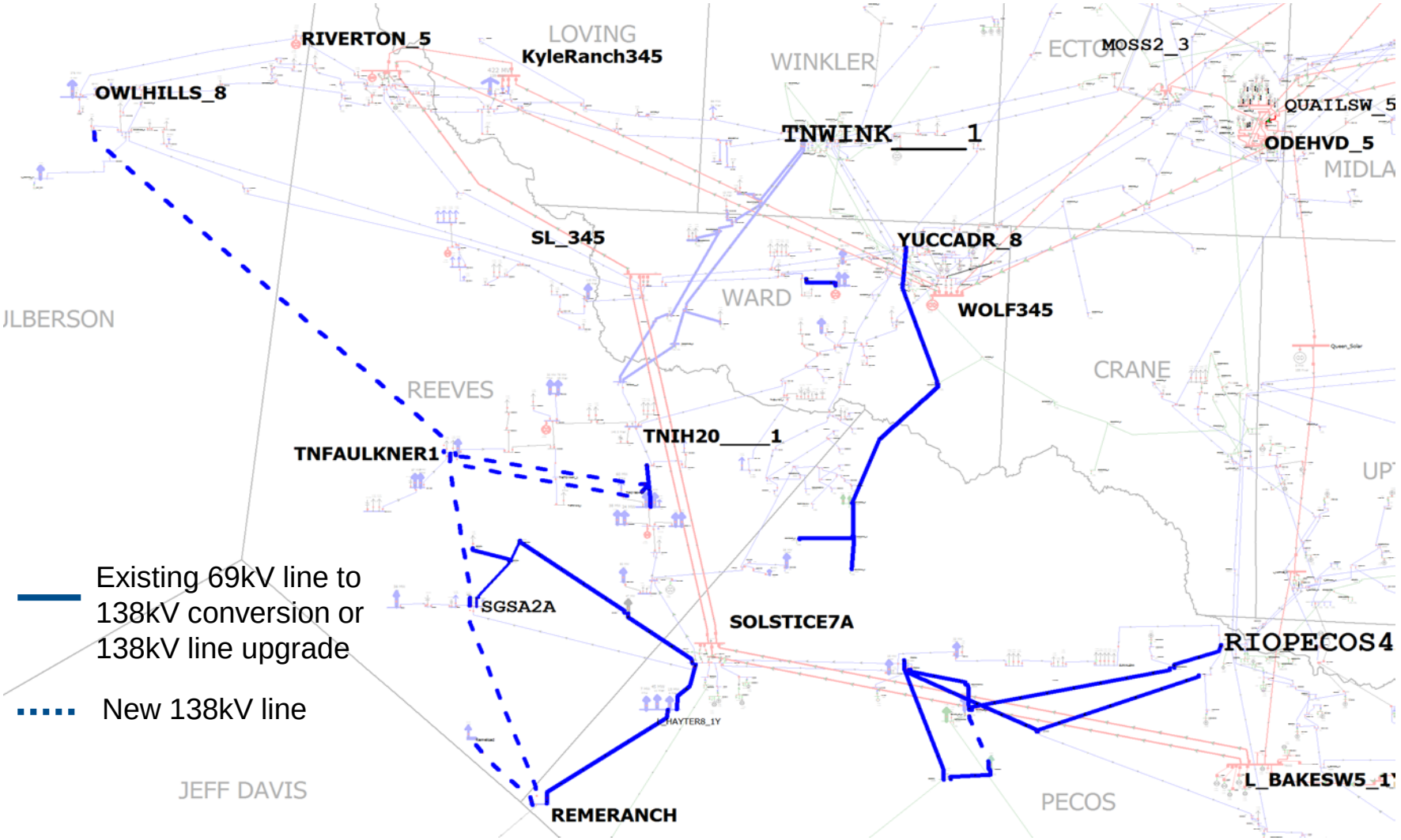
Preliminary Result: Common Upgrades

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

Common Upgrade	Unit
New 345/138 kV transformer	8
Add new circuits (138 kV)	120 miles
Circuit Conversion and Upgrade (69 kV and138 kV)	196 miles
Reactive Support Needs (1)	~1800 MVAR

(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



Preliminary Results: Load Serving Capability, Congestion Analysis, and Cost Estimate

Option	Delaware Basin Load Serving Capability (1) (MW)	Production Cost Saving (2) ($Million)	Cost Estimates (3) ($Million)
4b	5,922	Reference	753
4c	6,052	2.7	808
6f	6,002	2.7	841

(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
  http://www.ercot.com/content/wcm/key_documents_lists/138710/Delaware_Basin_Load_Integration_Study_Scope_-_Nov2019_RPG.pdf

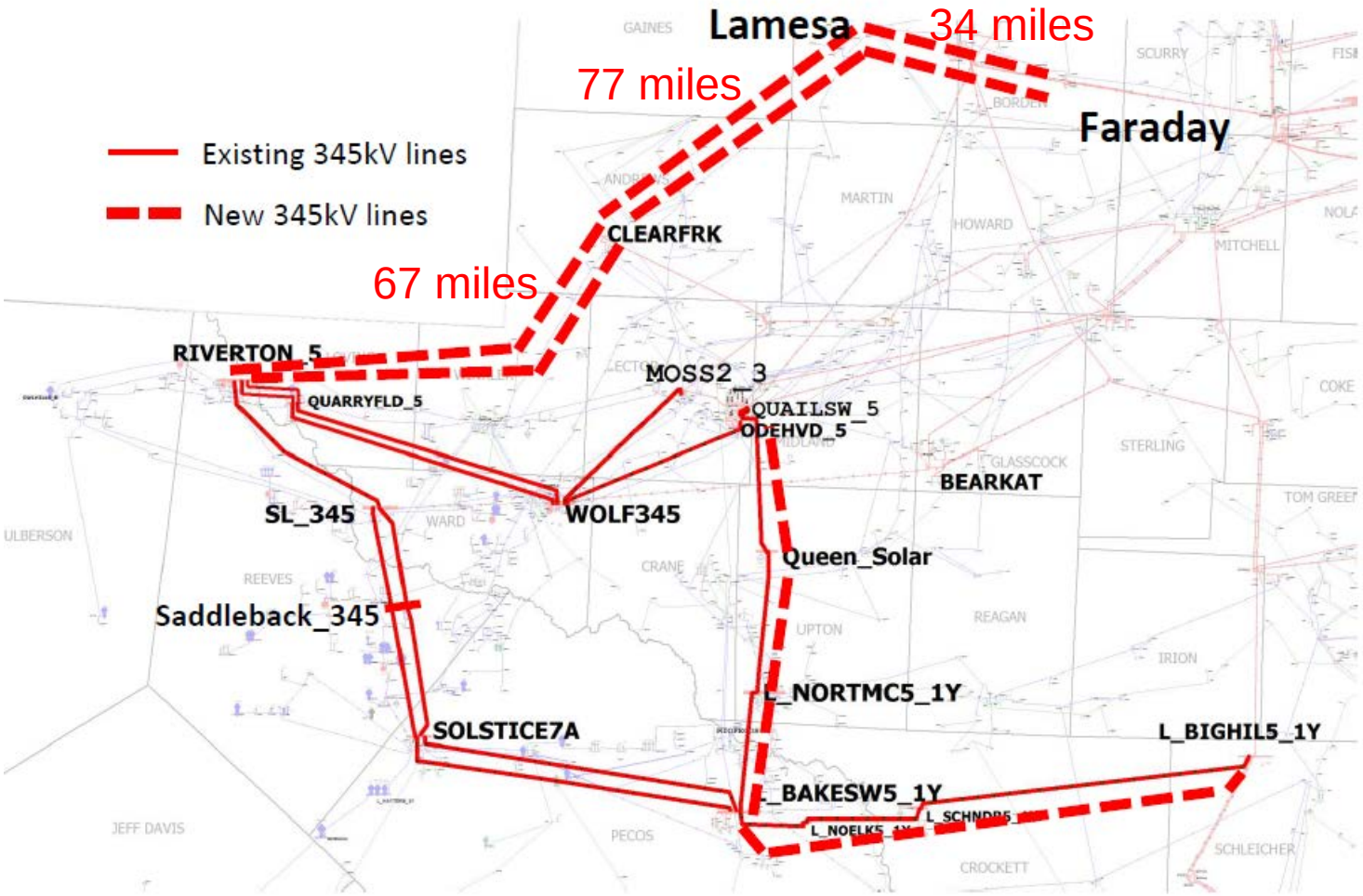
- ERCOT presented status updates at the May, July, and September 2019 RPG meetings
  - http://www.ercot.com/content/wcm/key_documents_lists/165286/Delaware_Basin_Load_Integration_Study_Update_-_May2019_RPG.pdf
  - http://www.ercot.com/content/wcm/key_documents_lists/165294/Delaware_Basin_Load_Integration_Study_Update_-_July2019_RPG.pdf
  - 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 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

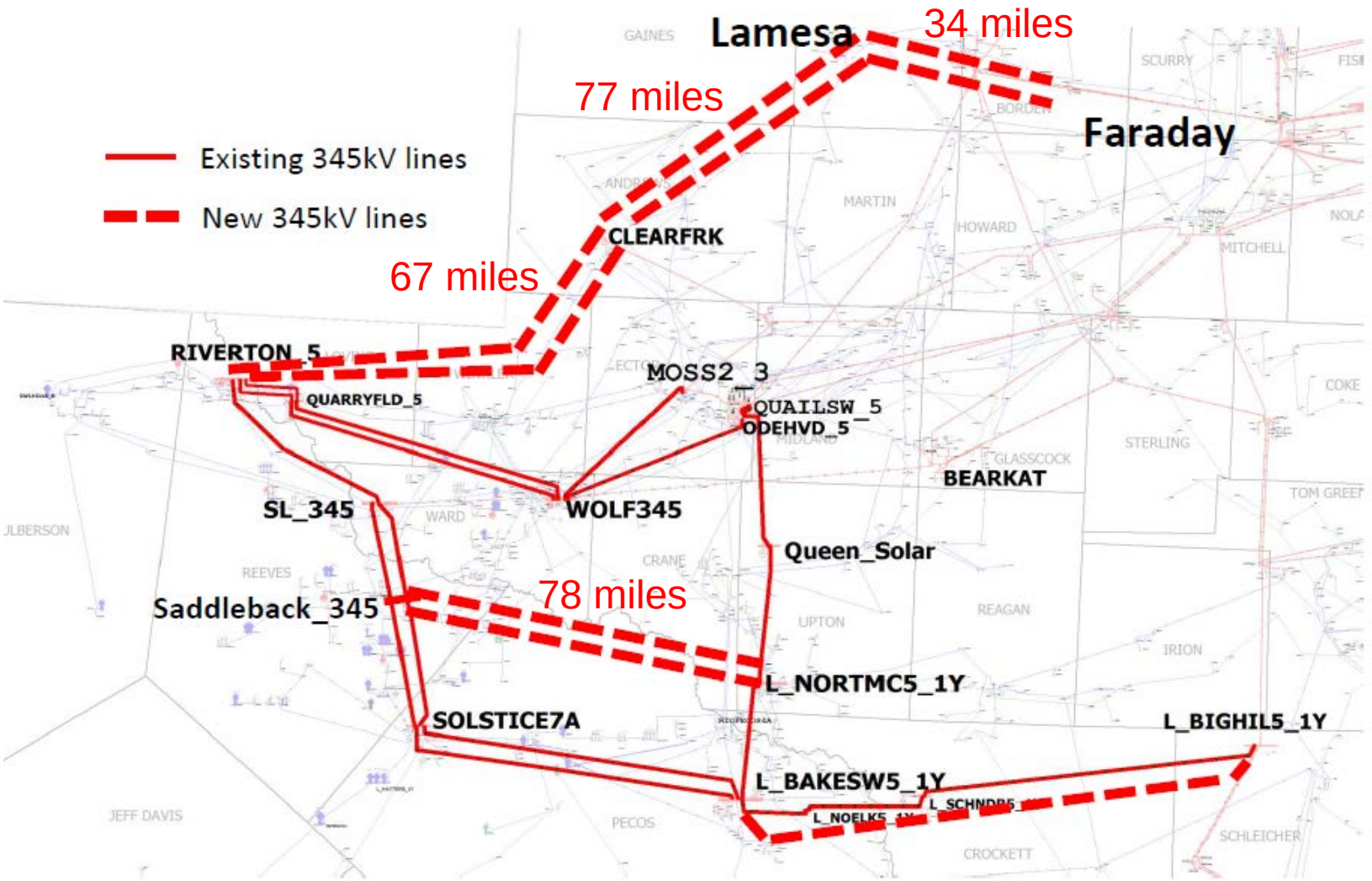
Appendix – Import Option 4a

- Option 4a: Faraday – Lamesa - Clearfork – Riverton 345kV double circuit; Big Hill – Bakersfield – Odessa 2nd circuit



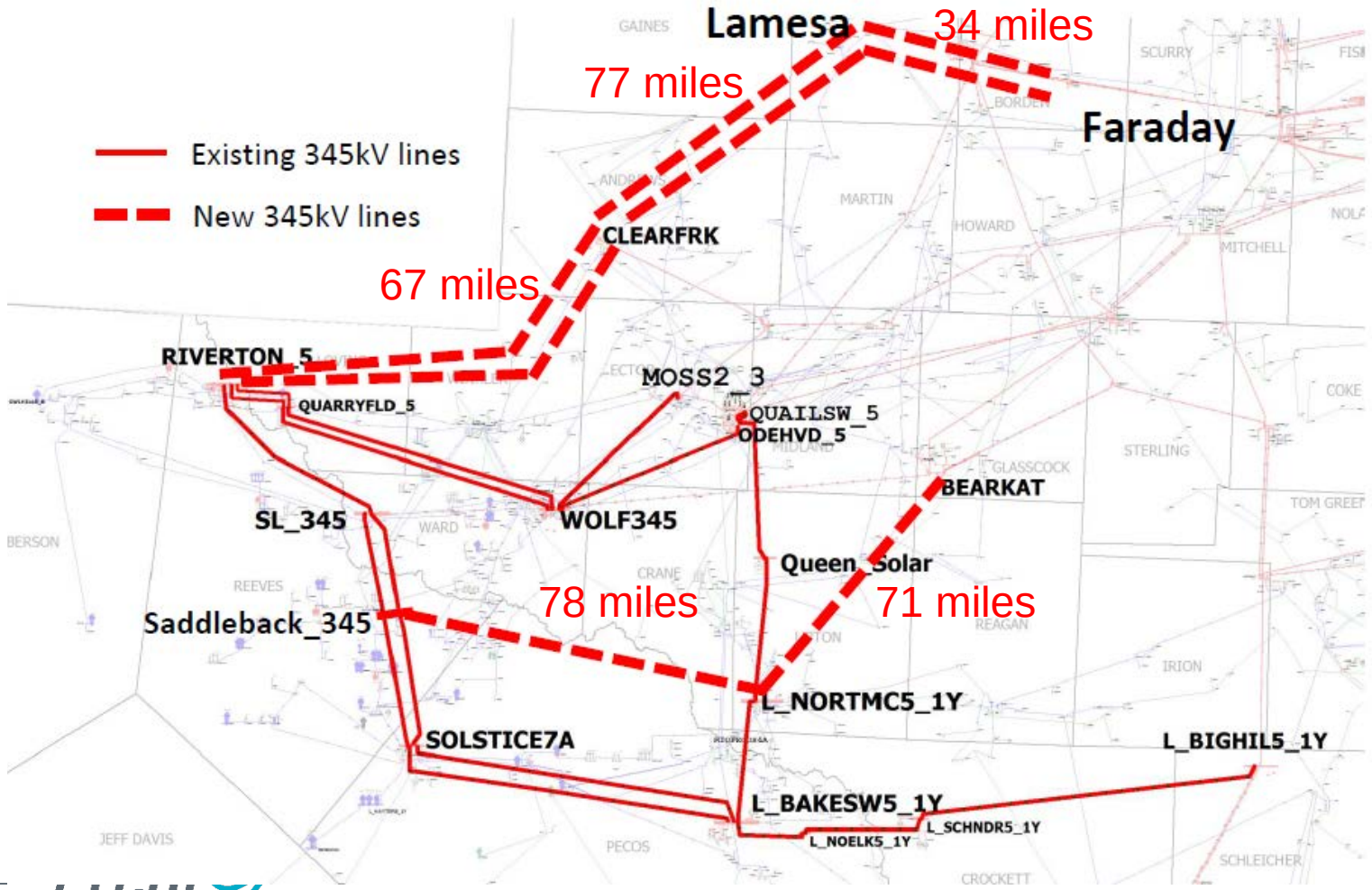
Appendix – Import Option 4b

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



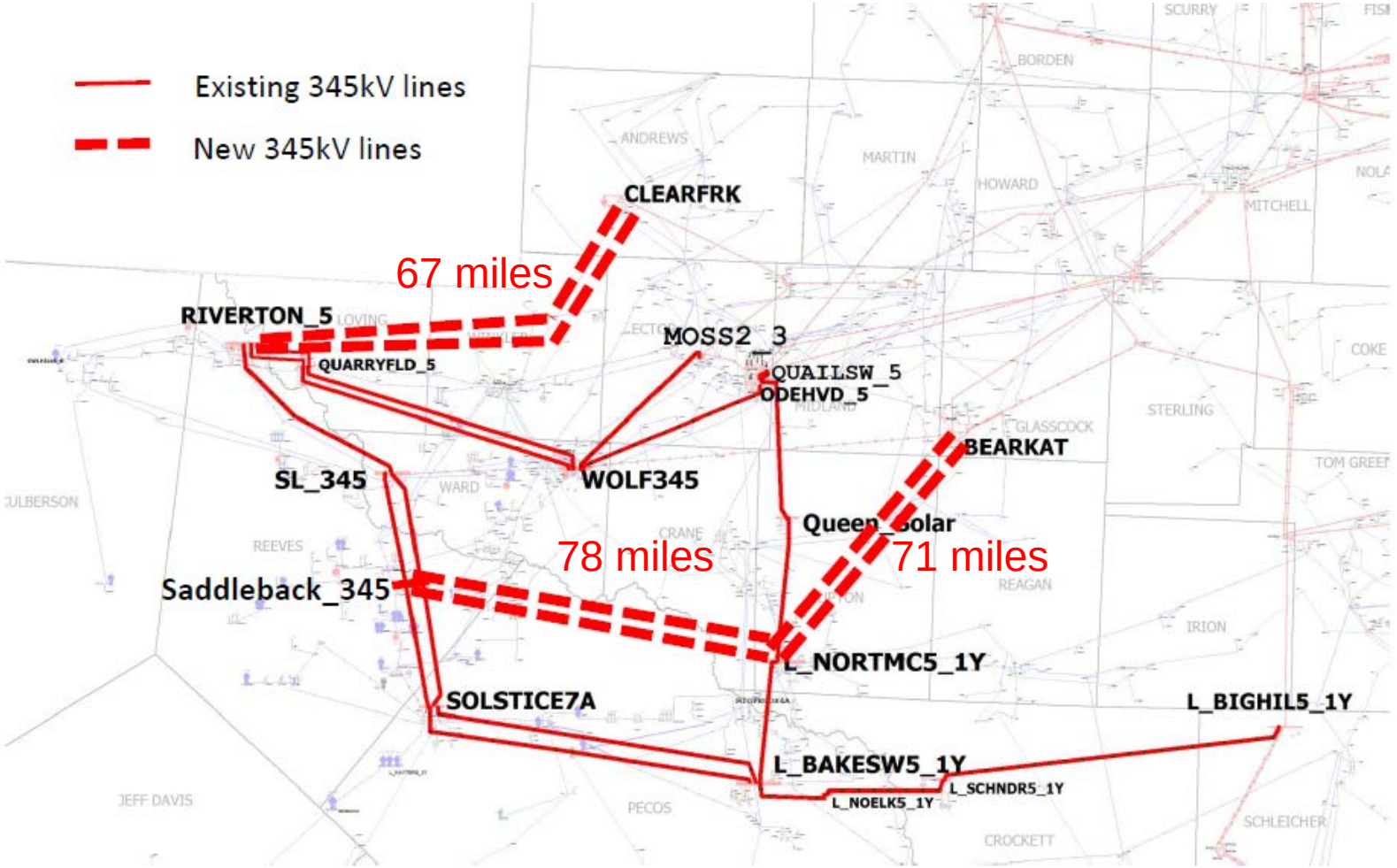
Appendix – Import Option 4c

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



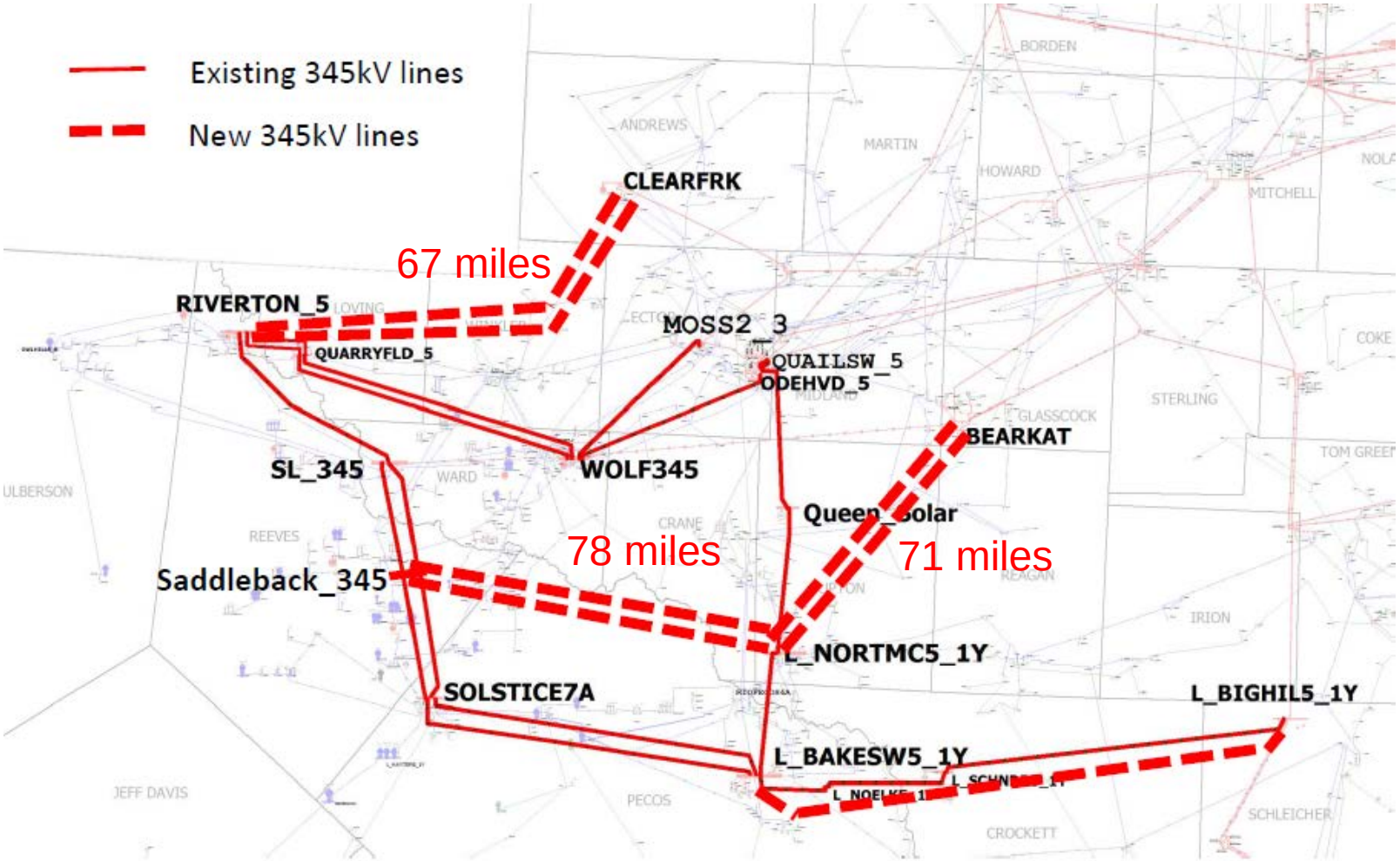
Appendix – Import Option 5d

- Option 5d: Bearkat - North McCamey – Saddleback 345kV double circuit; Clearfork – Riverton 345kV double circuit



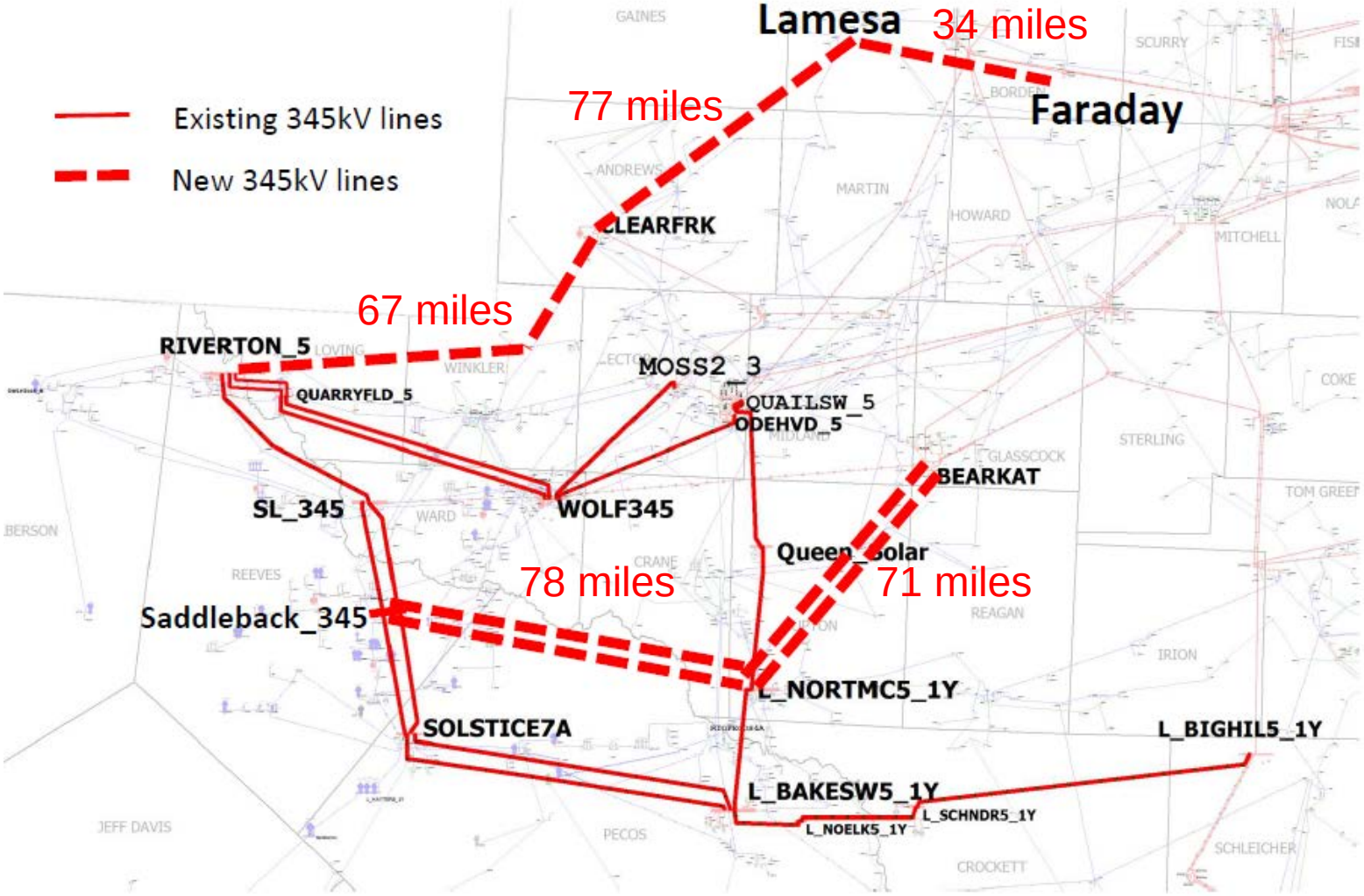
Appendix – Import Option 5e

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



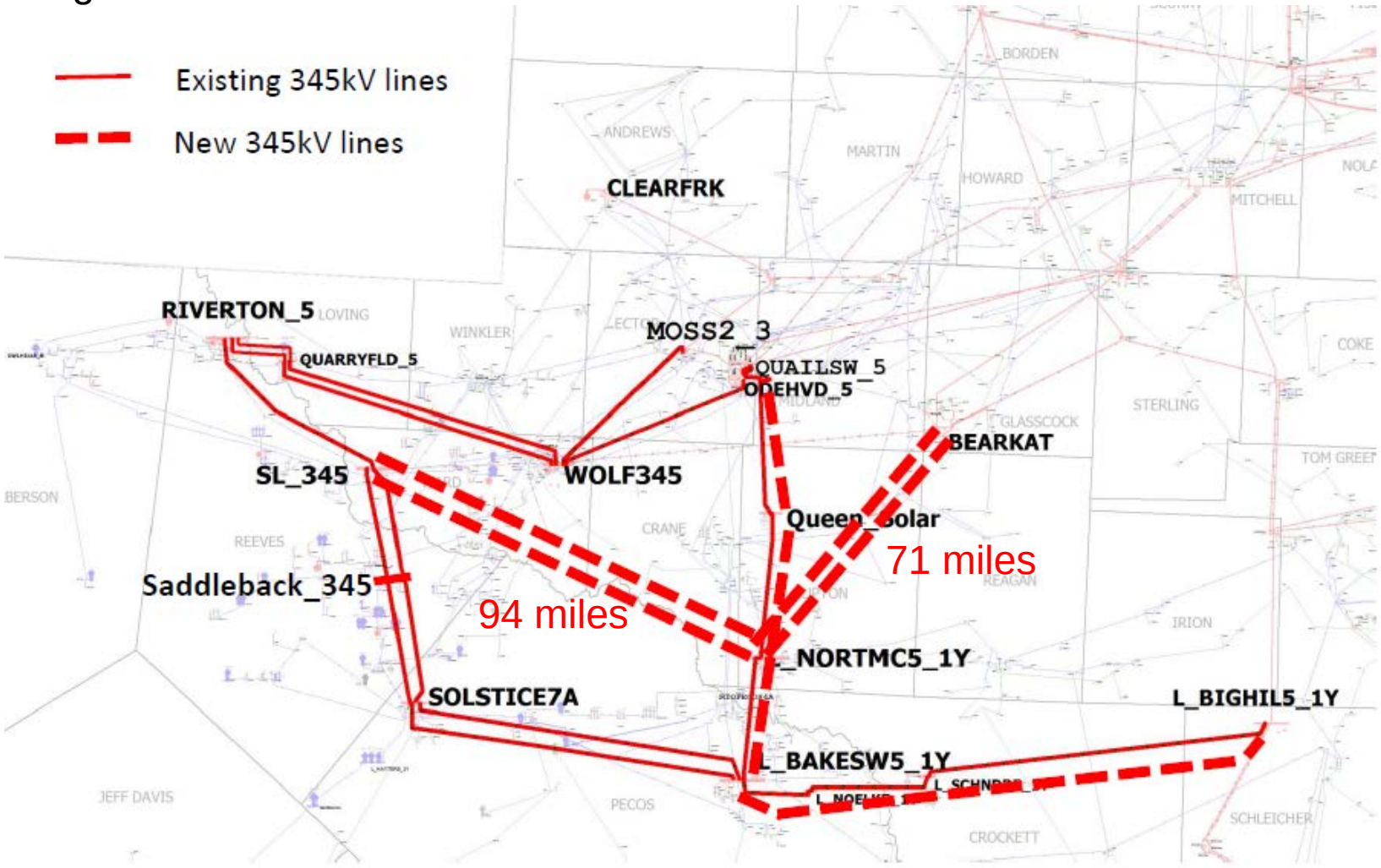
Appendix – Import Option 5f

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



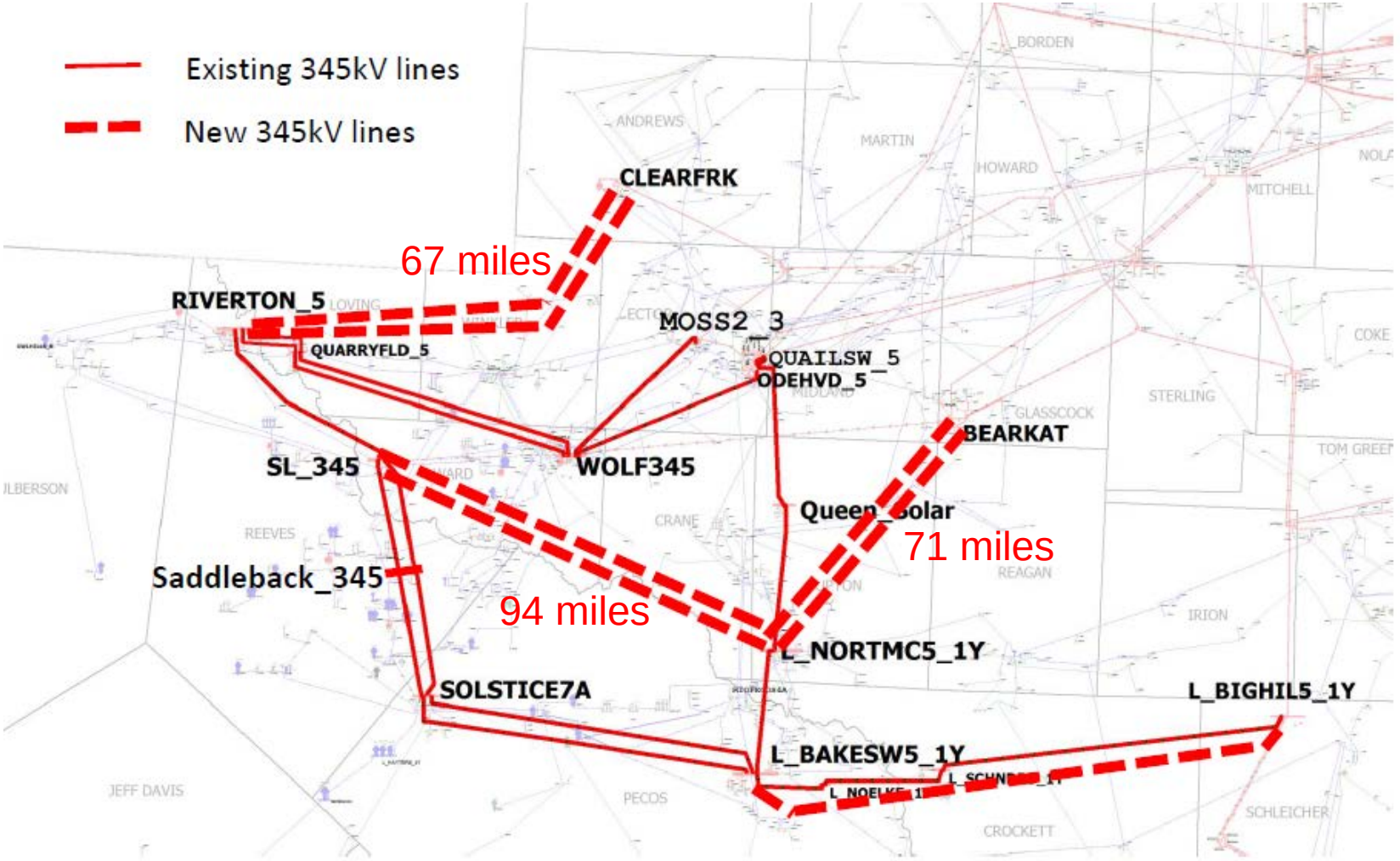
Appendix – Import Option 6a

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



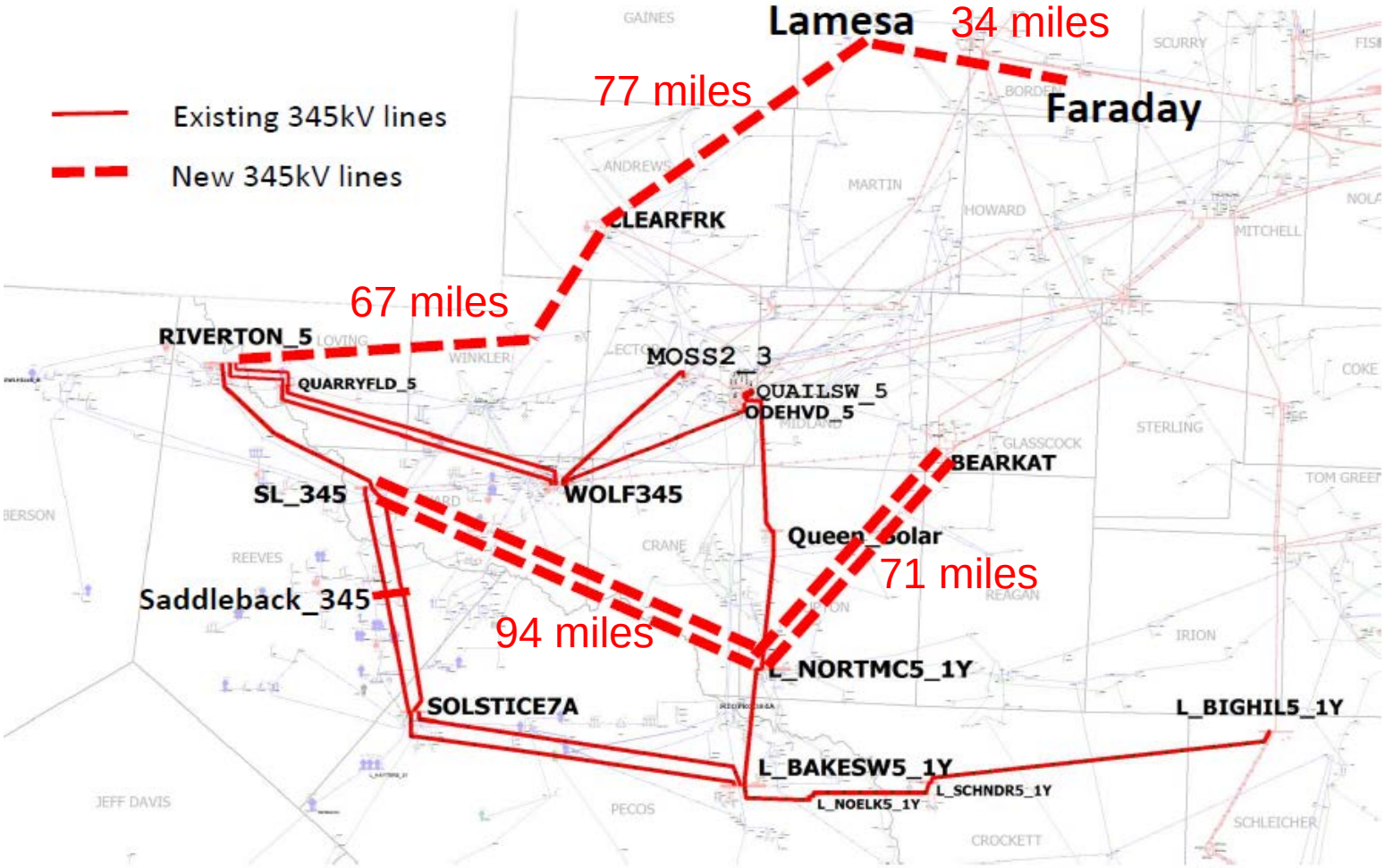
Appendix – Import Option 6e

- Option 6e: Bearkat - North McCamey – Sand Lake 345kV double circuit; Big Hill – Bakersfield 2nd circuit plus Clearfork – Riverton 345kV double circuit



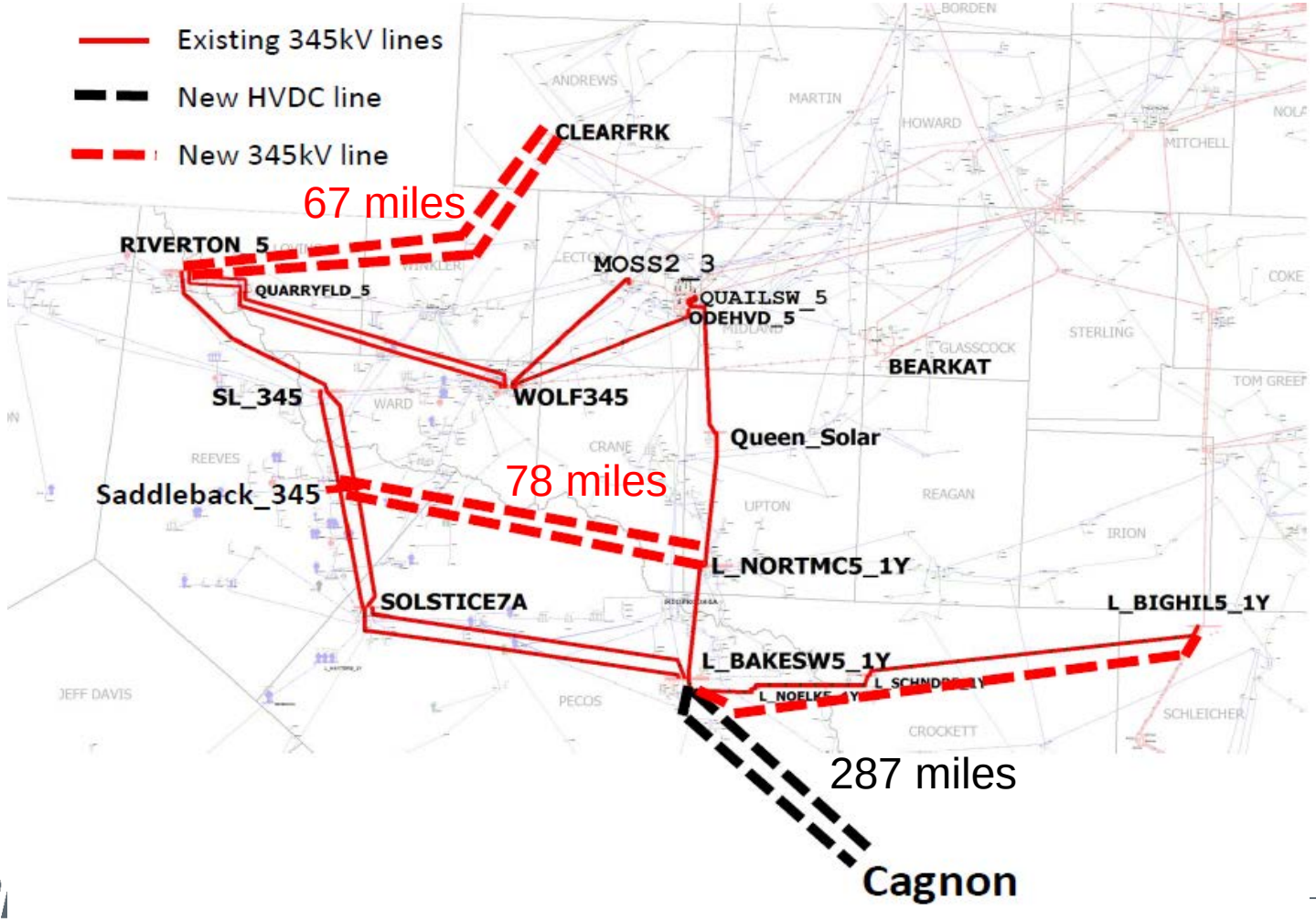
Appendix – Import Option 6f

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



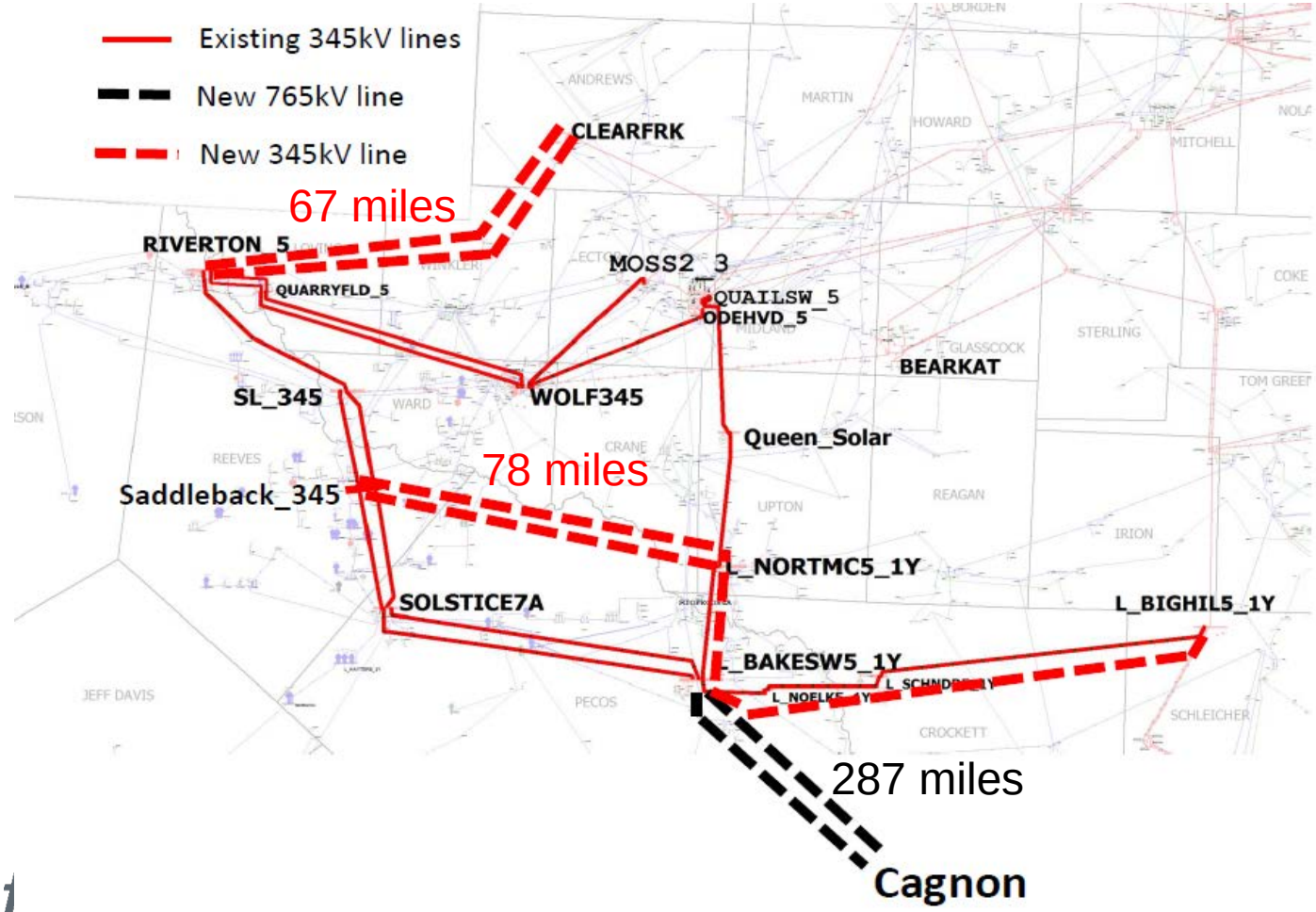
Appendix – Import Option 9e

- 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



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	1,463	1,875	1,900	2,724
TNMP	507	527	1,254	1,969
Grand Total	**2,114**	**2,688**	**3,509**	**5,372**