



Far West Texas Project 2 and Dynamic Reactive Devices - ERCOT Independent Review

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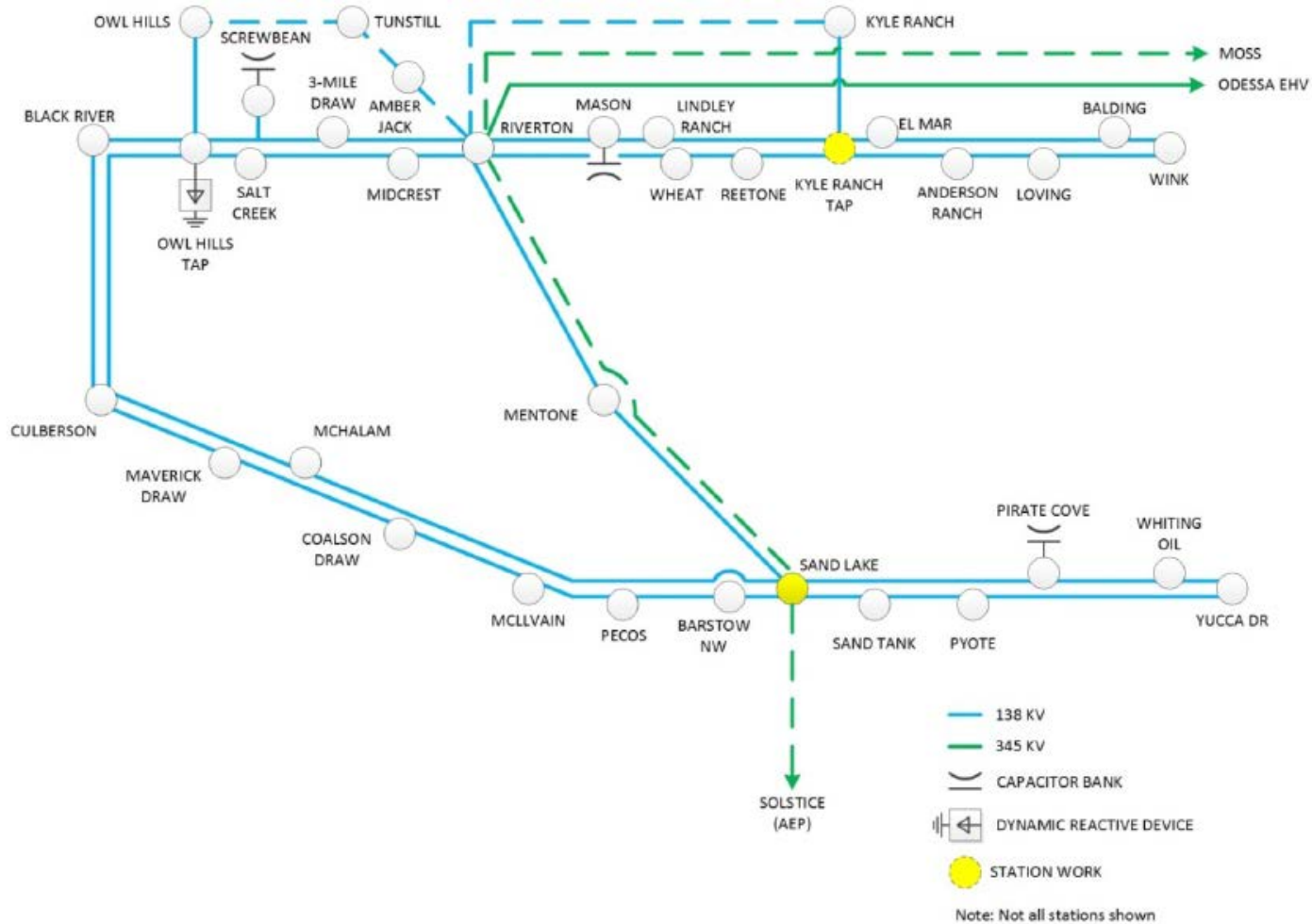
ERCOT Transmission Planning

Regional Planning Group
May 22, 2018

Overview

- Oncor submitted Far West Texas Dynamic Reactive Devices (DRD) and Far West Texas Project 2 (FWTP2) for Regional Planning Group review. Both are Tier 1 projects that were estimated to cost \$86 million for DRD project and \$194 million for FWTP2 project.
 - Proposed for both 2019 and 2023 timeframe
 - Addresses oil and gas related load forecasts
 - Reliability Issues: voltage collapse, loss of load, voltage violations
 - Provide operational flexibility
 - Provides future load growth and generation interconnection for the Culberson loop and Far West Region

Far West DRD and FWTP2 Projects Proposal

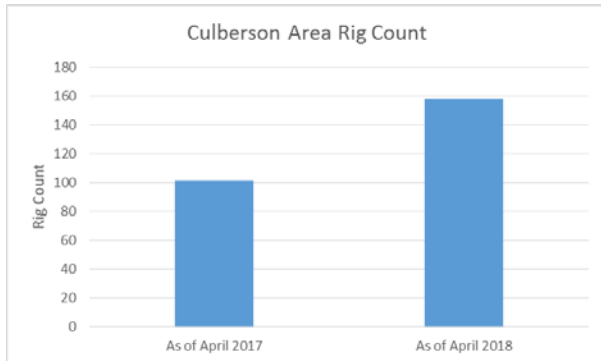
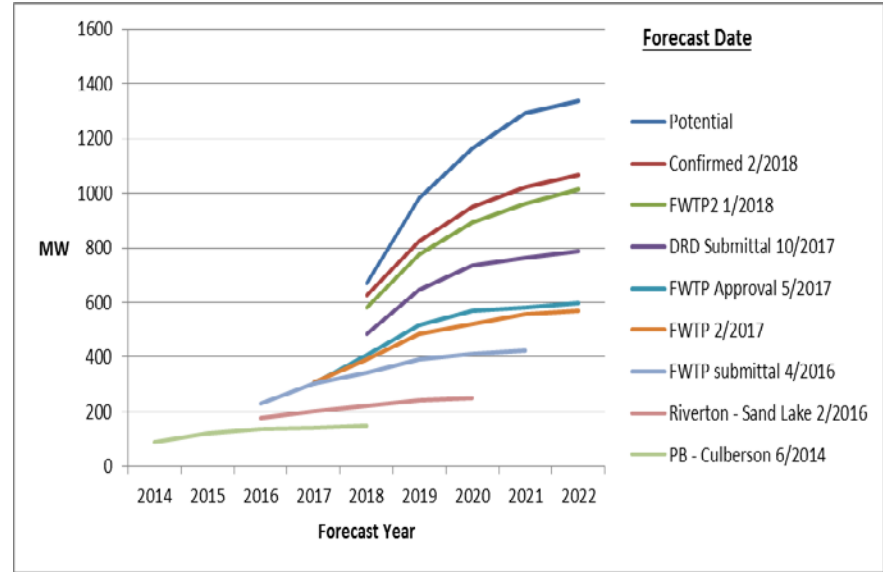
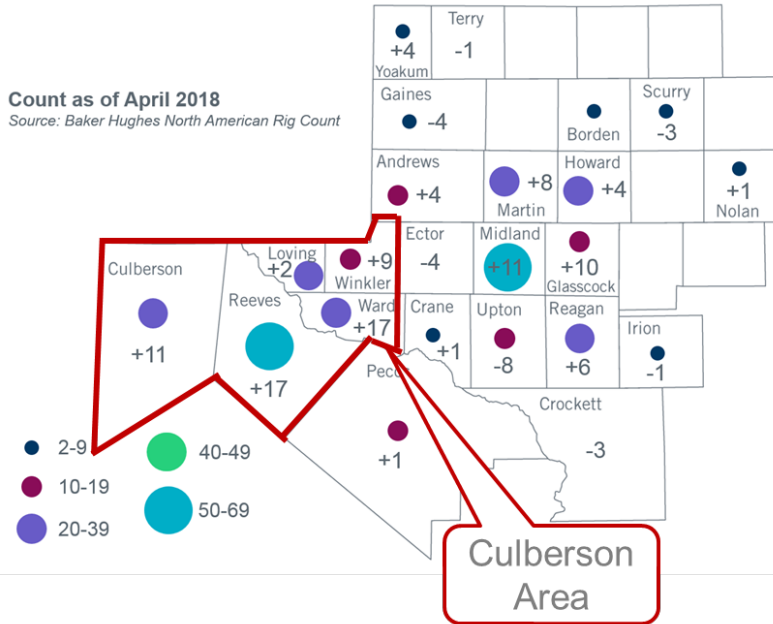


Source: ONCOR RPG submittal on February 1, 2018

Culberson Loop Load Growth

Count as of April 2018

Source: Baker Hughes North American Rig Count



- Existing and confirmed load requests of 880 MW by 2019
- Existing, confirmed, and conceptual load of 1347 MW by 2023



Project Needs

Steady State Voltage Stability Assessment for the Base Case Condition

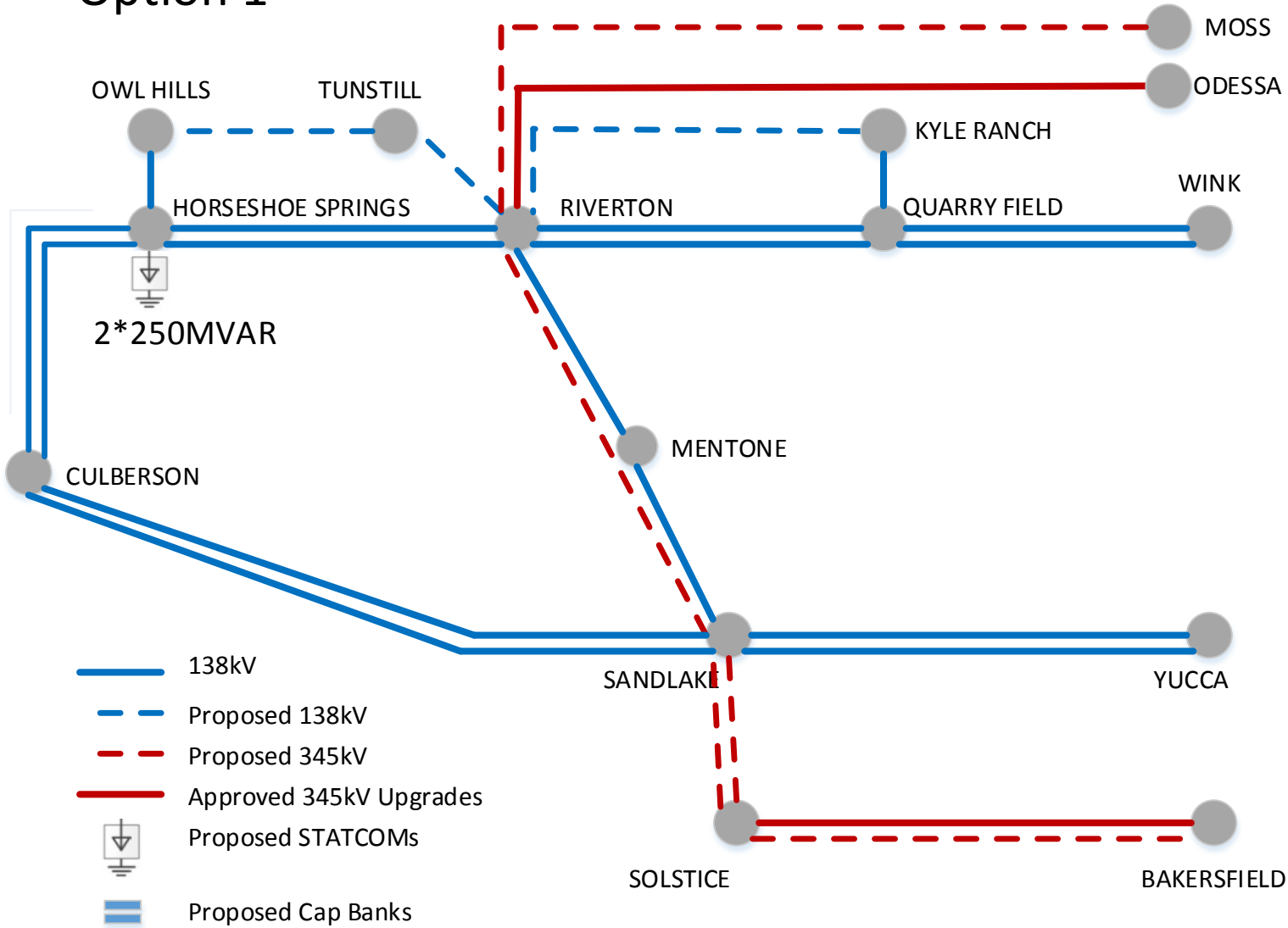
Scenario	Load (MW)	Transmission Upgrades	Culberson Load Serving Capability	
			NERC P1, P7	NERC P6
1.	880 (2019 Summer Peak)	None	Pre-contingency Voltage Collapse	
2.	880 (2019 Summer Peak)	FWTP*	Voltage Violation Voltage Collapse	Voltage Violation Voltage Collapse

*The Far West Texas Project (FWTP) endorsed by ERCOT Board of Directors in June, 2017.

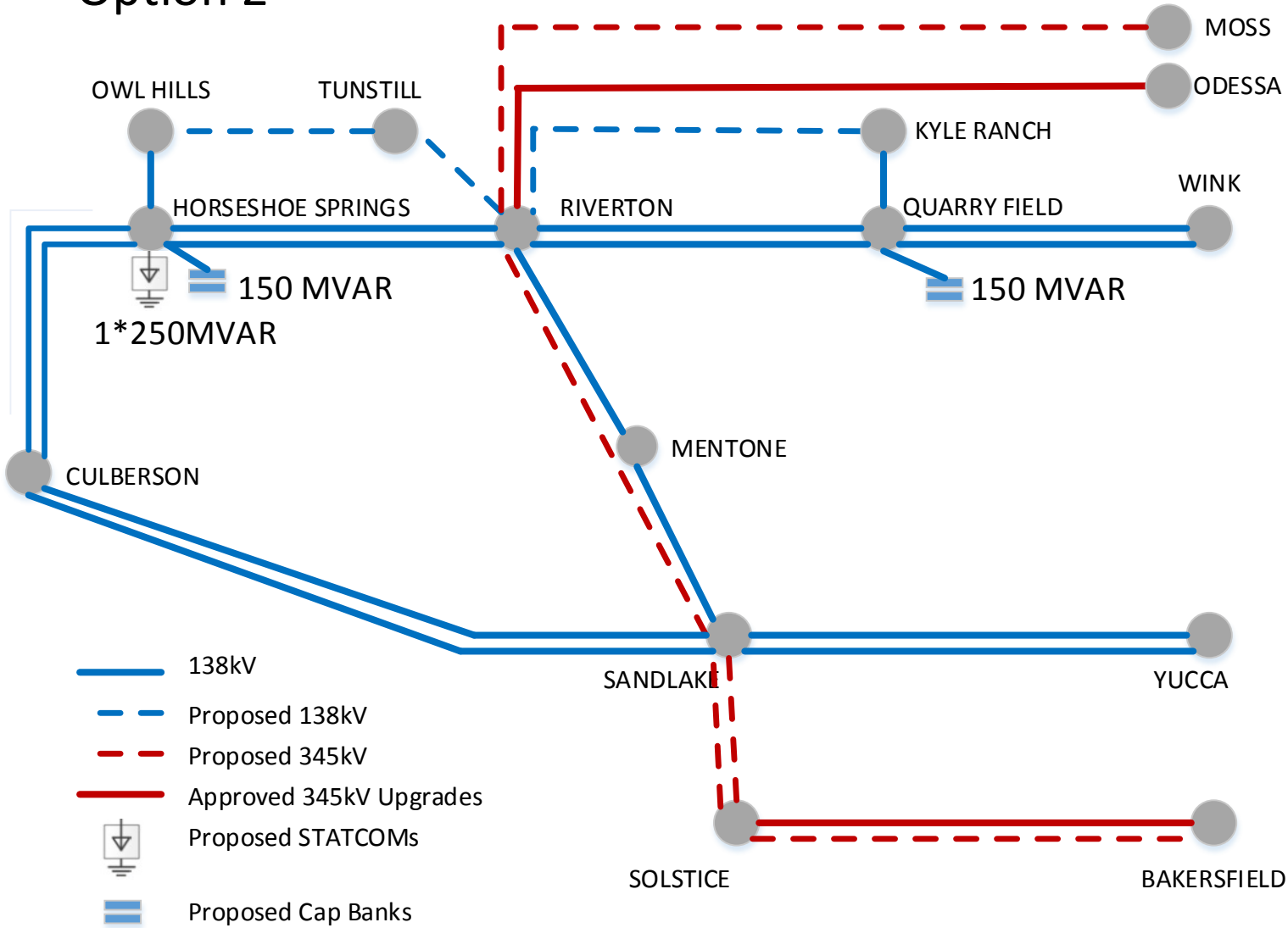
Options Considerations

- ERCOT short-listed only options that included a second 345 kV circuit to the Odessa EHV-Riverton (between Moss and Riverton), Sand Lake-Solstice, and Solstice-Bakersfield 345 kV lines for the following reasons:
 - Significant load growth in the Culberson loop
 - Operational flexibility
 - Cost saving, ~50% less than the cost of coming back to install the second circuit at a later time
- The new 138 kV lines proposed in the FWTP2 are necessary to strengthen the Culberson Loop and provide operational flexibility under normal and outage conditions.
- Reactive support needs for both near term and long term load growth.
- Three options were selected for detailed analysis.

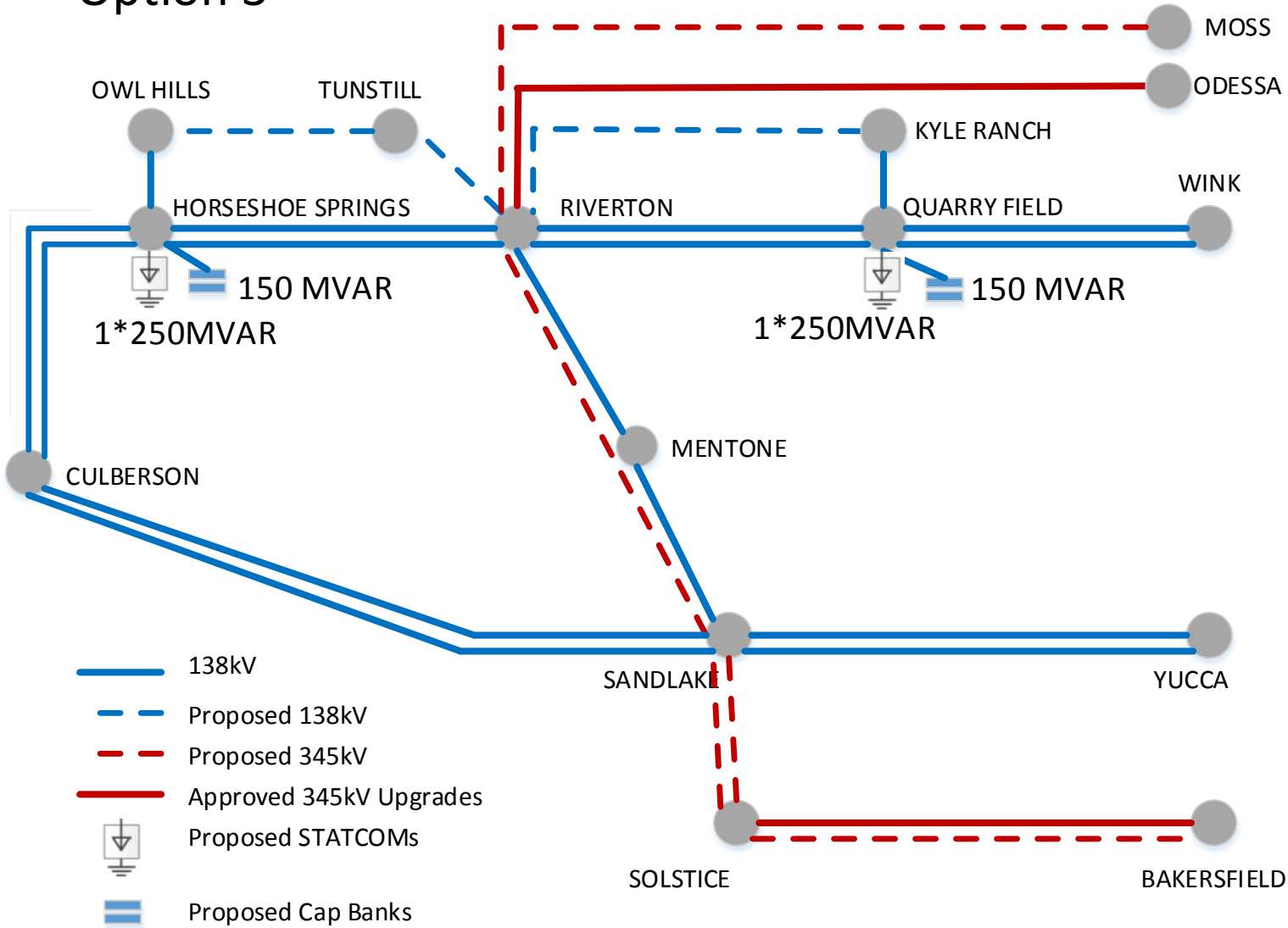
Option 1



Option 2



Option 3



Comparison of Project Options

Description	Culberson Loop Load Served (MW)		
	Option 1	Option 2	Option 3
PV Voltage Collapse Results (NERC P1, P6, P7, ERCOT Events)	1608	1568	1688
PV Voltage Collapse Results (without PBSES Units) (NERC P1, P6, P7, ERCOT Events)	1508	1468	1648
Dynamic Stability Result (without PBSES Units) (NERC P1, P6, P7, ERCOT Events) ⁽¹⁾	Acceptable	Acceptable	Acceptable
Estimated Capital Cost (\$M)	300	292.5	327.5
PV Voltage Collapse Results (reactive devices only ⁽²⁾) (NERC P1, P6, P7, ERCOT Events)	801	821	1001
PV Voltage Collapse Results (without PBSES units) (reactive devices only ⁽²⁾) (NERC P1, P6, P7, ERCOT Events)	721	741	880 ⁽³⁾

Note:

(1). Dynamic stability was conducted at the Culberson load level identified in the PV voltage collapse results.

(2). Assuming reactive devices will be in service before new transmission lines.

(3). Oncor indicated that the reactive devices identified to be located at Quarry Field 138 kV Switch Station may not be in service by summer 2019. ERCOT performed a PV analysis considering only the reactive devices located at Horseshoe Springs from Option 3. The results showed that without the Quarry Field reactive devices in service, Option 3 would have a load serving capability of 721 MW..

Subsynchronous Resonance (SSR) Vulnerability Assessment – Protocol Section 3.22.1.3(2)

- All three short-listed options strengthen the transmission network and increase the required transmission circuit outages to have a Generation Resource become radial to series capacitors.
- The SSR assessment results showed no SSR vulnerability for any existing Generation Resources or Generation Resources satisfying Planning Guide Section 6.9 conditions for inclusion in the planning models at the time of this study.

Additional Economic and Steady State Analysis for Option 3

- ERCOT conducted an economic analysis to identify any potential impact on system congestion related to Option 3:
 - The annual production analysis showed no measurable congestion impact on the ERCOT System with the addition of the transmission upgrades related to Option 3
- ERCOT also conducted a detail steady state analysis to identify any potential reliability issues (outside the Culberson loop) related to Option 3:
 - The analysis showed no additional reliability issues (thermal & voltage) with the addition of the transmission upgrades related to Option 3

Sensitivity Analysis – PG Section 3.1.3 (4)

- **Generation Sensitivity Studies**
 - No solar generation in the Culberson loop is assumed the most stressed system condition considering the oil and gas industry load.
 - The proposed Generation Resources in the Culberson loop area are all solar projects and will have no impact on the recommended transmission project.
- **Load Scaling Impact Analysis**
 - Because the voltage violations were observed at load serving buses inside the Culberson loop, ERCOT assumed that the load scaling in the outside weather zones did not have a material impact on the observed need.

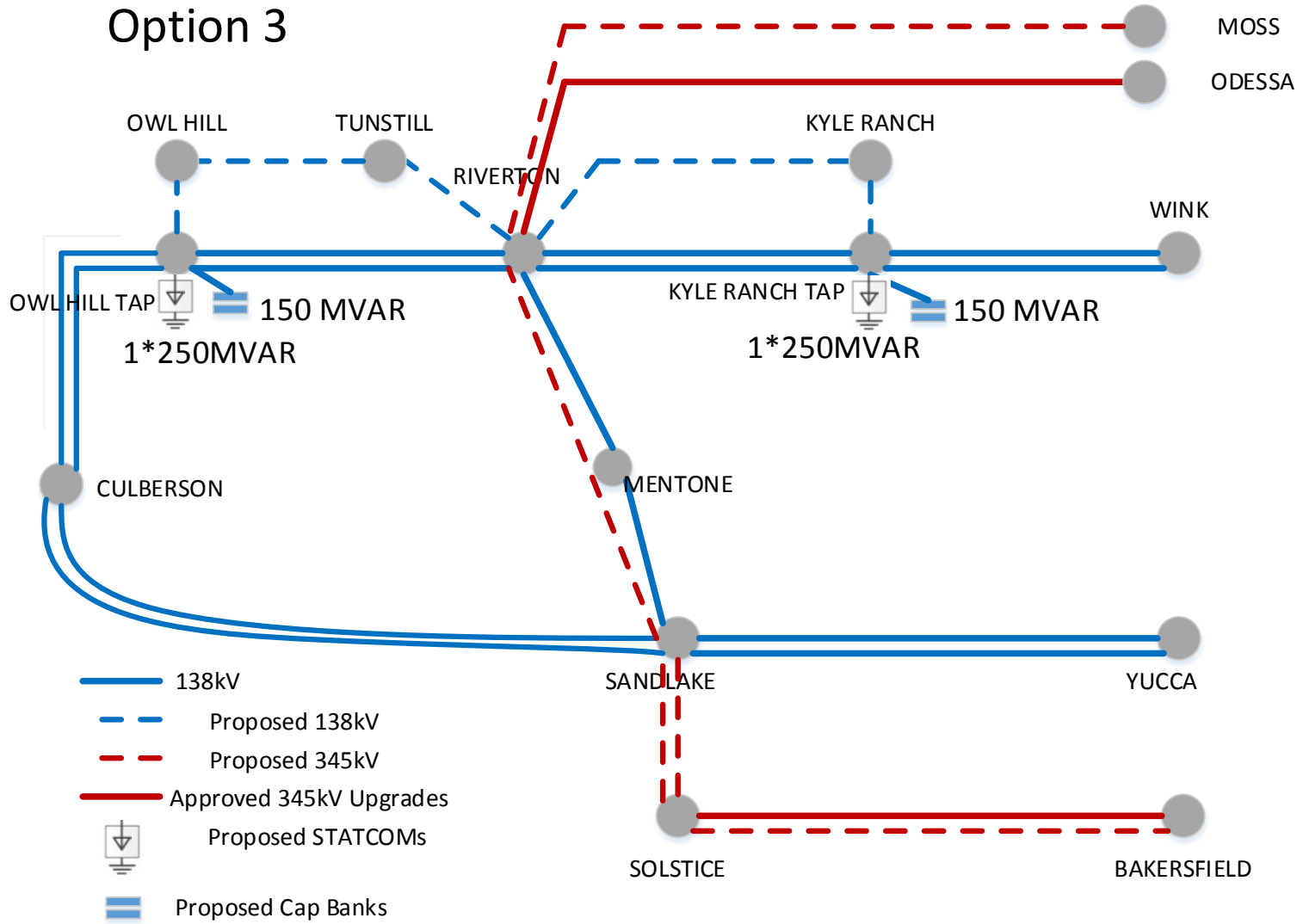
ERCOT Recommendation

- Based on the review, ERCOT will recommend the Board endorse Option 3 (listed in the next slide) to address the reliability need in the study region
- Estimated Capital Cost: \$327.5 million
- ERCOT will recommend that the Board deems the Riverton – Sand Lake 345 kV line, the Sand Lake – Solstice 345 kV line, and the Bakersfield – Solstice 345 kV line project critical to reliability

ERCOT Recommendation: Option 3

- Construct a new approximately 40-mile 345 kV line on double-circuit structures with two circuits in place from Sand Lake 345 kV Switch Station to Solstice 345 kV Switch Station
- Add two new 600 MVA, 345/138 kV autotransformers at Sand Lake 345 kV Switch Station
- Install a new 345 kV circuit on the planned Riverton – Sand Lake double circuit structures
- Install the second 345 kV circuit on the Odessa EHV – Riverton 345 kV line double circuit structures between Moss and Riverton (creating a Moss – Riverton 345 kV circuit)
- Construct a new Quarry Field 138 kV Switch Station in the Wink – Riverton double-circuit 138 kV line
- Construct a new approximately 20-mile Kyle Ranch – Riverton 138 kV line on double-circuit structures with one circuit in place from Kyle Ranch 138 kV Substation to Riverton 138 kV Switch Station
- Construct a new approximately 20-mile Owl Hills – Tunstill – Riverton 138 kV line on double circuit structures with one circuit in place from Owl Hills 138 kV Switch Substation to Riverton 138 kV Switch Station
- Install the second 345 kV circuit on the planned Solstice 345 kV Switch Station – Bakersfield 345 kV Switch Station double circuit structures
- Install one 250 MVAR STATCOM at Horseshoe Springs 138 kV Switch Station
- Install one 250 MVAR STATCOM at Quarry Field 138 kV Switch Station
- Install 150 MVAR static capacitors at Horseshoe Springs 138 kV Switch Station
- Install 150 MVAR static capacitors at Quarry Field 138 kV Switch Station

ERCOT Recommendation – Option 3



Nest Steps

- ERCOT will present the project recommendation to
 - TAC on May 24th
 - BOD on June 12th

Appendix

Study Assumptions

Steady-State Study Case

- Constructed from latest 17RTP reliability case 17RTP_2020_SUM_WFW
- Study Region will consist of Far-West and West Weather Zones
- Generator additions that meet Planning Guide Section 6.9 criteria in study region at time of study will be added to the case.
- Transmission Projects expected to be in-service within the study region by 2020 at the time of the study will be added to the case

Dynamic Study Case

- Start from DWG 2020 Summer Peak Flat Start Case
- The Dynamic Study case was updated to reflect the 2019 and 2023 load projects in the Culberson loop

Contingencies and Criteria

□ Initial Steady-State Reliability Analysis

○ Contingencies for Study Region

▪ NERC TPL-001-4 and ERCOT Planning Criteria):

- P0
- P1-1, P1-2, P1-3, P1-4,
- P2-1, P2-2, P2-3 (All EHV only)
- P3-1, P3-2, P3-3, P3-4, G-1+P7 {G-1 worst case only}
- P4-1, P4-2, P4-3, P4-4, P4-5 (All EHV only)
- P5-1, P5-2, P5-3, P5-4, P5-5 (All EHV only)
- P6-2: X-1 + (P1-1, P1-2, P1-3, P1-4, P7-1) {X-1 is 345 kV Auto outages}
- P7-1

○ Criteria:

▪ Thermal

- Monitor all transmission lines and transformers in study region (excluding GSU)
- Use Rate A for Normal Conditions
- Use Rate B for Emergency Conditions

▪ Voltages

- Monitor all busses 100 kV and above
- $0.95 < 1.05$ Normal
- $0.90 < 1.05$ Emergency
- Voltage deviations exceeding 8% on non-radial load busses