West Texas Export Stability Assessment

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West Texas Export(1)

Competitive Renewable Energy Zone reactive compensation plan was designed to accommodate **14 GW** of West Texas renewable generation*

2013

>25 GW of renewable generation is expected to be connected in West Texas

2021

2012	10 MW
2014	32 MW
2016	296 MW
2018	1,325 MW
2020	4,246 MW
2021	7,010 MW

West Solar

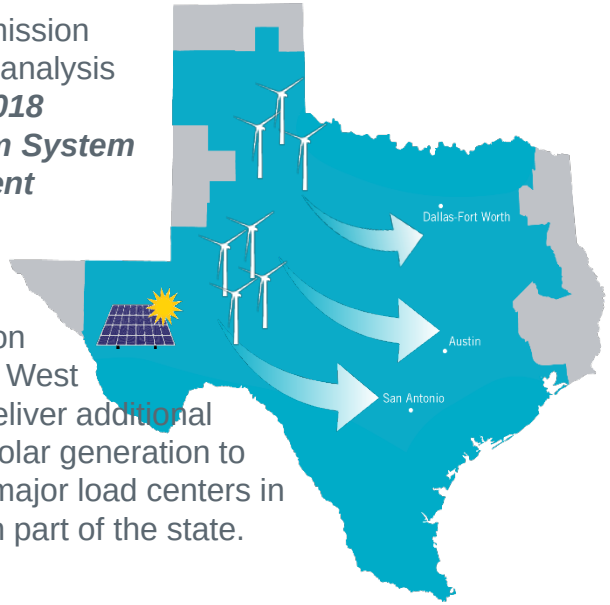
2012	8,220 MW
2014	8,634 MW
2016	9,842 MW
2018	11,606 MW
2020	13,335 MW
2021	18,687 MW

West Wind

*http://www.ercot.com/content/news/presentations/2011/CREZ%20Reactive%20Power%20Compensation%20Study.pdf

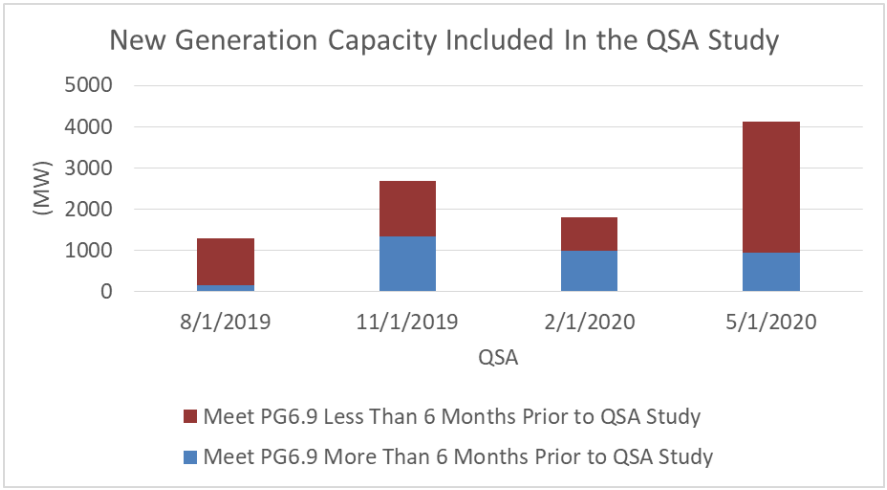
(1). http://www.ercot.com/content/wcm/lists/172485/2019_Constraints_and_Needs.pdf

- Several recent studies have indicated the potential for West Texas export constraints and the need to improve West Texas transmission to accommodate the increasing addition of renewable generation:
  - The ***2018 Dynamic Stability Assessment of High Penetration of Renewable Generation in the ERCOT Grid*** indicated that an additional transfer path between West Texas and Central Texas can be beneficial from a stability perspective.
  - The ***2019 Regional Transmission Plan*** identified high amounts of congestion on the Kendall – Cagnon and Kendall – Bergheim 345 kV circuits. This congestion primarily resulted from an increase in wind and solar generation in the west and north regions of ERCOT.
  - The transmission expansion analysis from the ***2018 Long-Term System Assessment*** identified a need for additional transmission paths from West Texas to deliver additional wind and solar generation to ERCOT's major load centers in the eastern part of the state.



Recent New Generation

- New generation projects increasingly meet PG6.9 within 6 months of QSA.



- Planning studies may not fully capture the impact of these new generators and associated stability issues that may be need to be addressed in the Operations horizon.

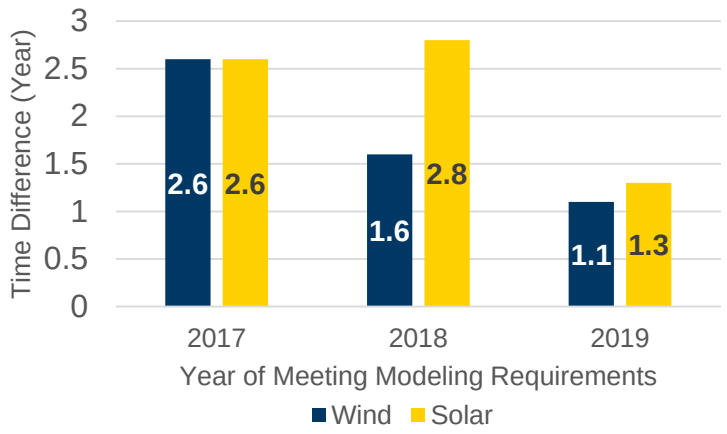
18-24 Months

Typical time for IBRs from initial planning to physical interconnection

0

Number of IBRs currently planned beyond 2022

Average duration of planned projects between meeting modeling requirements and projected commercial operation date



West Texas Export Stability Assessment Recap

- To analyze the stability of the ERCOT transmission system, with the year 2022 transmission topology, for high wind and solar generation dispatch conditions, including the existing and planned wind and solar generation projects which met Planning Guide 6.9 requirements at the time this study was conducted.

	Wind and Solar Capacity (MW)	Wind and Solar Output (MW)
ERCOT Total	31,214	25,781
West Texas	24,373	20,166 (1)

(1). known existing GTCs in the study areas were not enforced in the case dispatch

Assessment Results

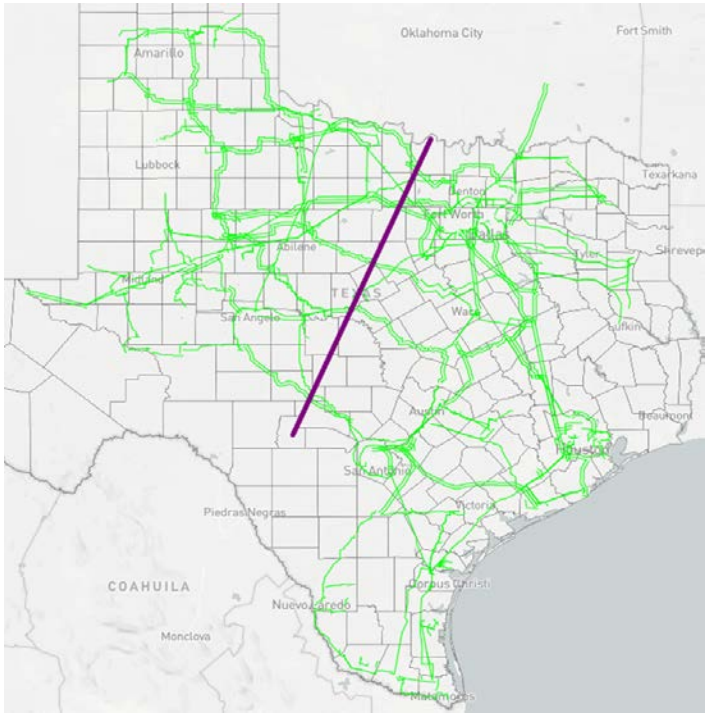
West Texas Export for Acceptable Stability Response(2)

Contingency Type	VSAT (GW)	Dynamic (GW)
P7-P7(1)	10.9	10.1
P7	12.2	11.5

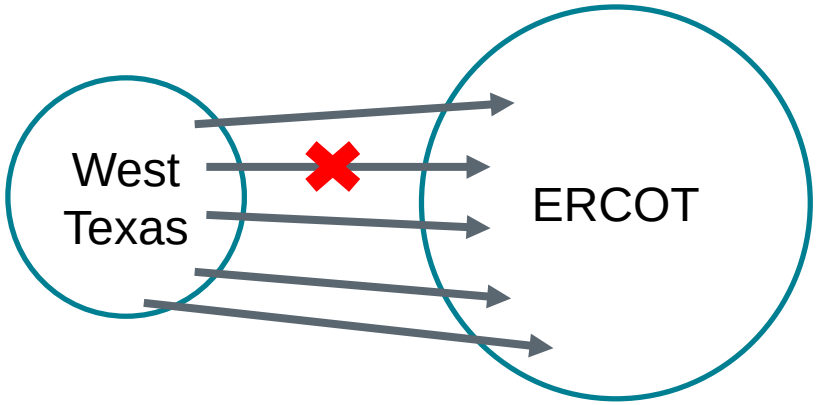
(1). P7: double circuit outage
(2). based on maximum power flow on the monitored sixteen 345 kV lines where an acceptable stable response was observed

Consideration of sixteen 345 kV lines:

- The transmission lines comprising the critical contingencies and the transmission lines exhibiting the largest increases in reactive losses
- To monitor flows from West Texas to the rest of ERCOT
- Further studies should examine whether all sixteen lines should be monitored or subsets of these lines



Reactive Losses



- Reactive losses on a transmission line are a function of the square of the current flowing on the line
- Thus, as more power flows, the reactive losses increase exponentially
- Same principle holds for multiple lines exporting power from a region
- Under contingency during high transfers across an interface, voltage will sag along the transfer path

Findings and Observations

- Large power long distance transfer -> significant reactive losses -> voltage stressed -> voltage stability issues
  - Further stressed under outage conditions

Total for 16 Monitored 345 kV Lines	9.9 GW Transfer	12.5 GW Transfer
Reactive Losses (GVAr)	2.3	5.1

- Fast voltage instability is more binding than steady state voltage stability
  - Accurate dynamic models are important to properly assess West Texas export capability
- No-fault outage/contingency may result in more binding transfer limits

Next Steps

- Per Protocol 3.10.7.6 (7), ERCOT will identify alternatives for exiting the W_to_C GTC
  - Schedule: December 2020
- Analyze transmission solutions to relieve West Texas Export congestion in the 2020 RTP economic analysis
  - Schedule: December 2020