Strengthening the West Texas Grid to Mitigate Widespread Inverter-Based Events – Operation Assessment Results

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Operations Support

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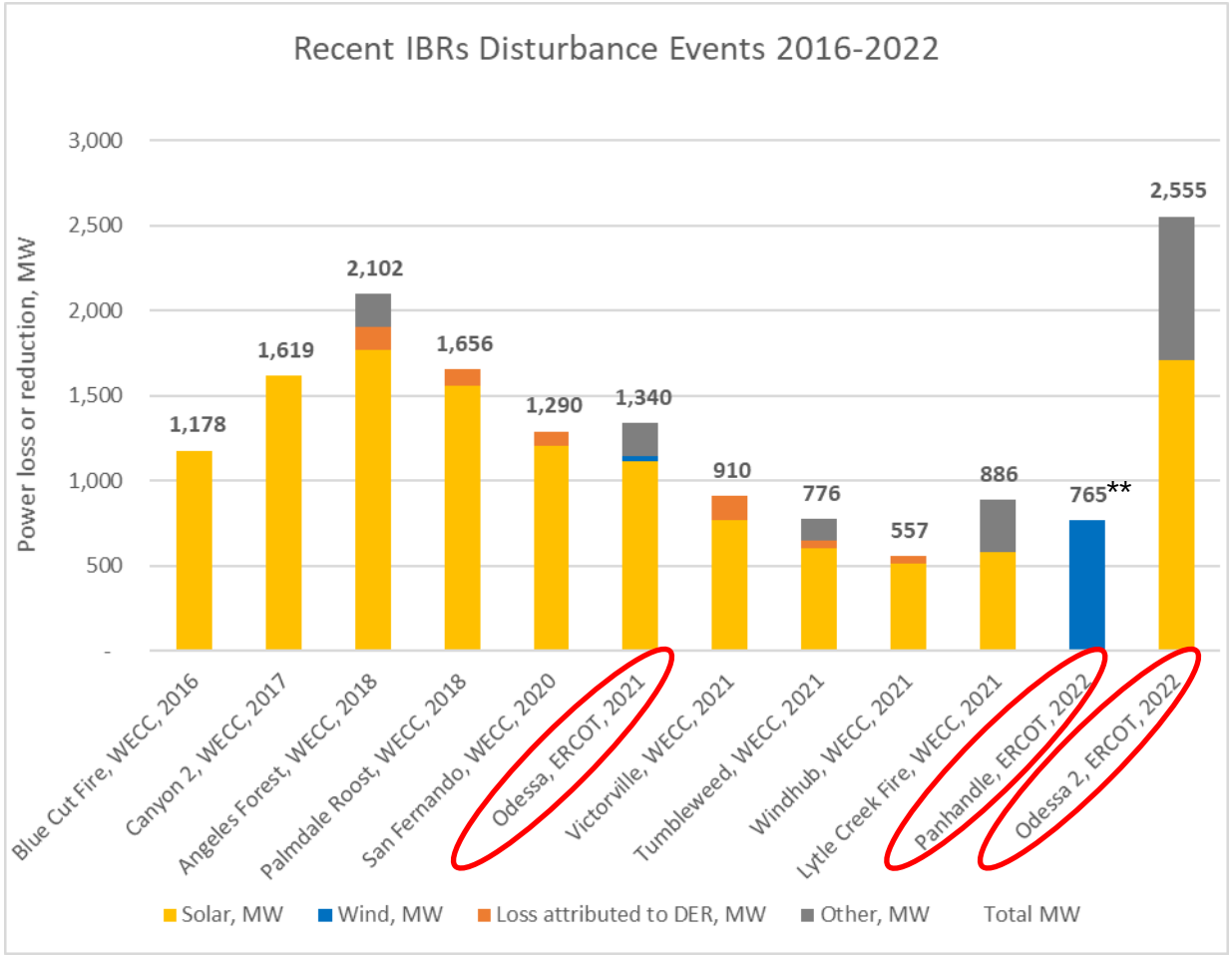
Recent IBR Disturbance Events in North America*



- In addition to these events, a load reduction event of ~1,560 MW occurred on December 7, 2022 in West Texas after a fault; the event is still under investigation
- The MW impact of these events is likely to increase as more IBRs and voltage-sensitive load are added in West Texas

- * Source: NERC Major Event Analysis Reports, https://www.nerc.com/pa/rrm/ea/Pages/Major-Event-Reports.aspx, and Julia Matevosyan, ESIG
- ** Two disturbances occurred in Panhandle on the same day in 2022. 765MW was the highest wind generation impact between these two disturbances.

Initiatives to mitigate IBR events

- Operational issues/concerns
  - Unexpected loss of generation and or load during the disturbances poses an increasing and significant reliability risk to the ERCOT system
  - Resource capability and performance deficiency, and the need to improve models when compared to actual performance and as-built control settings and parameters

- Mitigation Initiatives include both:
  - Improved Capabilities, Modeling and Performance of IBRs (primary)

    AND
  - Improve transmission grid strength to support the overall system reliability and resiliency (backstop)

- The assessment and results described in this presentation focus on the second of these mitigation initiatives
  - But does not lessen the need to get the first initiative as right as possible

Transmission Improvements – Synchronous Condensers

- A synchronous condenser is basically a large motor that has the ability to reinforce the transmission grid through: (1) dynamic voltage support; (2) inertia; and (3) system strength support, similar to a synchronous generator
  - Synchronous condensers are being considered and implemented globally by the utility and grid operators with high penetration of IBRs, e.g. Australia and UK.

- Two synchronous condensers were installed in 2018 at ERCOT Panhandle to provide the required voltage and system strength support
  - With the amount of existing and projected growth of IBRs, the need for the same improvement has been identified for the broader WTX region

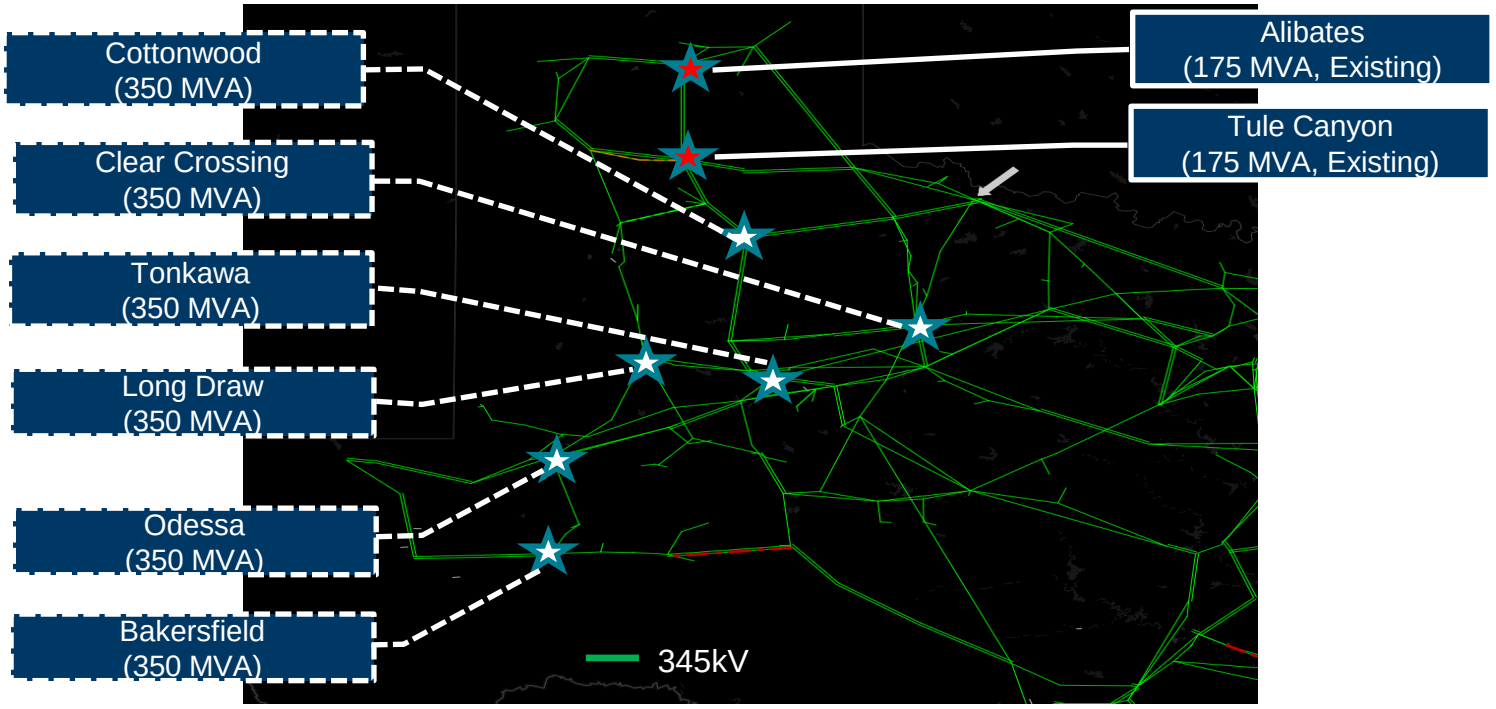
Study Overview

- ERCOT conducted an assessment, based on the 2022 system conditions, to identify the needs and options to improve the WTX reliability and resiliency
  - High renewable low load scenario
  - 35.4 GW IBRs in WTX
  - All synchronous generators in WTX were turned off
  - Consider synchronous condensers to strengthen WTX grid

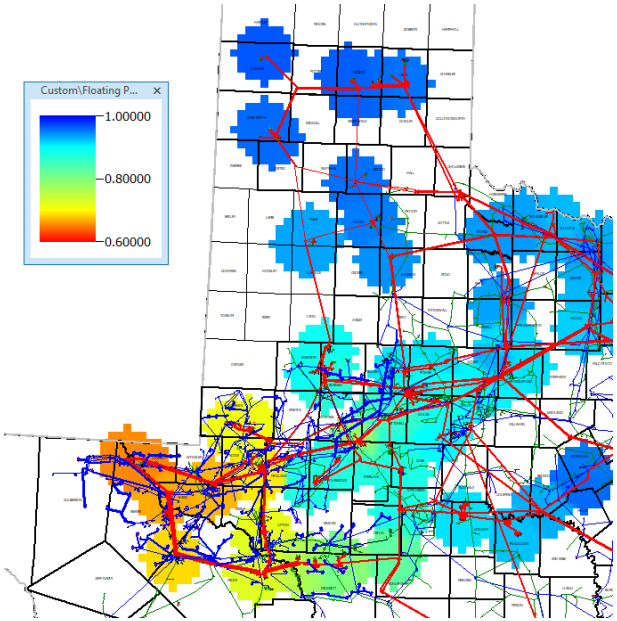
- Include both dynamic and short circuit studies
  - Short circuit study was used to screen and evaluate the preliminary impact of new synchronous condensers and its benefit to the system
  - Dynamic simulations were performed to assess dynamic benefits based on the identified synchronous condensers

Assessment Findings

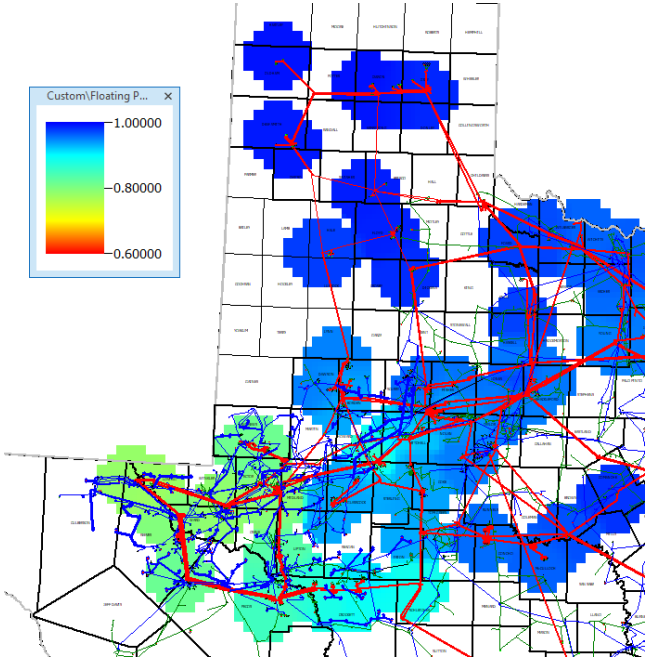
- Additional six synchronous condensers with total of 2,100 MVA were identified that will provide effective improvement to WTX.



An example of system improvement with synchronous condensers for a single fault location



Existing system



With additional 6 Synchronous Condensers

- Reduce widespread voltage dips across WTX during the fault
- Similar results for faults at other locations

Quantitative Benefits

- Reduces widespread impacts from transmission faults across WTX
  - In an average of 21% reduction in numbers of 345 and 138 kV buses that experience severe voltage dips (less than .85 p.u.) for major WTX transmission faults
  - In an average of 16% reduction in IBR capacity that experiences severe voltage dip at generator terminals (less than .85 p.u.) for major WTX faults
  - 16% increases in the system strength (voltage stiffness, measured in the WTX short circuit current level) compared to the study base case without new synchronous condensers

- Improves the stability and GTCs in WTX

- Additional synchronous condensers may provide additional improvement, but with diminished reliability benefit based on the study results

Conclusions

- Additional six synchronous condensers in WTX would improve the reliability and resilience of the existing system

- Continued focus on improving IBRs' capability and performance **AND** these improvements on the transmission system are **BOTH** needed to maintain the reliable operation of the ERCOT grid

- Additional system improvements will be required to support the continued growth of IBRs in the ERCOT grid; ERCOT will continue evaluate the most effective system improvement options to support ERCOT reliability
  - New technologies, such as Grid Forming Inverters, are being proactively discussed and proposed by regions and grid operators with high IBR penetration and may be recommended in the future to support the continuing growth of IBRs

Planning Consideration and Next Steps

- 2022 Regional Transmission Plan (RTP) identified the need of reactive support in the Far West Texas.

- ERCOT will conduct a study considering the recent IBR events, findings in this operation assessment, and the reactive support needs identified in the 2022 RTP

- ERCOT will provide status updates at the future RPG meetings, in addition to tentative timeline

Question