West Texas Export Analysis

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Background and Study Purpose

- Renewable generation levels (Inverter-based Resources, IBR) continuing to increase, especially in the Western part of ERCOT
- Increasing stability challenges associated with power transfer from West Texas to ERCOT load centers
- Investigate potential transfer limits and stability constraints associated with high IBR penetration in West Texas as identified in previous study:

http://www.ercot.com/content/wcm/lists/144927/Dynamic_Stability_Assessment_of_High_Penetration_of_Renewable_Generation_in_the_ERCOT_Grid.pdf

Study Case

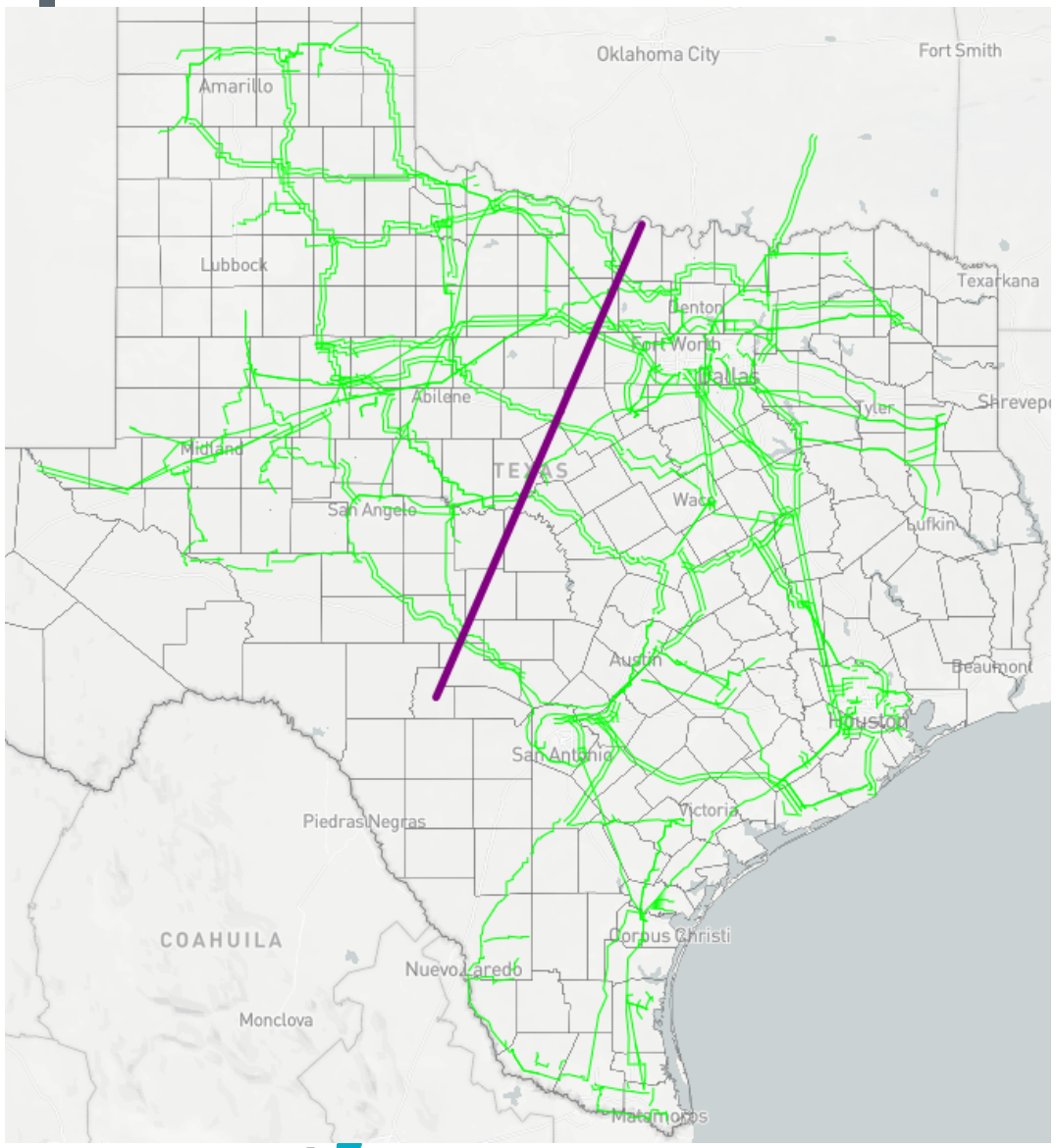
- DWG 2022 HWLL case was used - IBRs were re-dispatched to achieve higher renewable penetration
  - Synchronous generators in west Texas were turned off
  - Generation meeting PG 6.9 were added
  - Solar resources were turned on
  - Renewable dispatch averaged at 83% of capacity

	IBR Capacity (MW)	IBR Output (MW)
ERCOT Total	31,214	25,781
West Texas	24,373	20,166

- Study Case Totals:

	MW
Generation Output	48,312
Load (including PUN load)	45,545

Power Transfer Map



- Sixteen 345 kV circuits:
- Riley – WestKrum 2ckt
- Jacksboro – WestKrum ckt
- Jacksboro – WillowCreek 2ckt
- ClearCrossing – WillowCreek 2ckt
- Graham – Parker 2ckt
- WestShackelford – Sam/Navarro 2ckt
- Brown – Comanche ckt
- Brown – Killeen 2ckt
- BigHill – Kendall 2ckt
- Study case flow on the sixteen 345 kV circuits ≈ 12.5 GW

Study Scope

- Steady state voltage stability analysis: VSAT (Transfer analysis)
- Dynamic stability analysis: PSSE (Stability analysis)
  - Contingencies tested with both 3-phase fault and no fault condition
- Focused on the following NERC Planning Event 345 kV contingencies in West Texas:
  - P1 (single)
  - P6 (single + single)
  - P7 (double)
  - P1 + P7 (single + double)
  - P7 + P7 (double + double)

Observations

- MW flow comparison with study case and DWG base cases

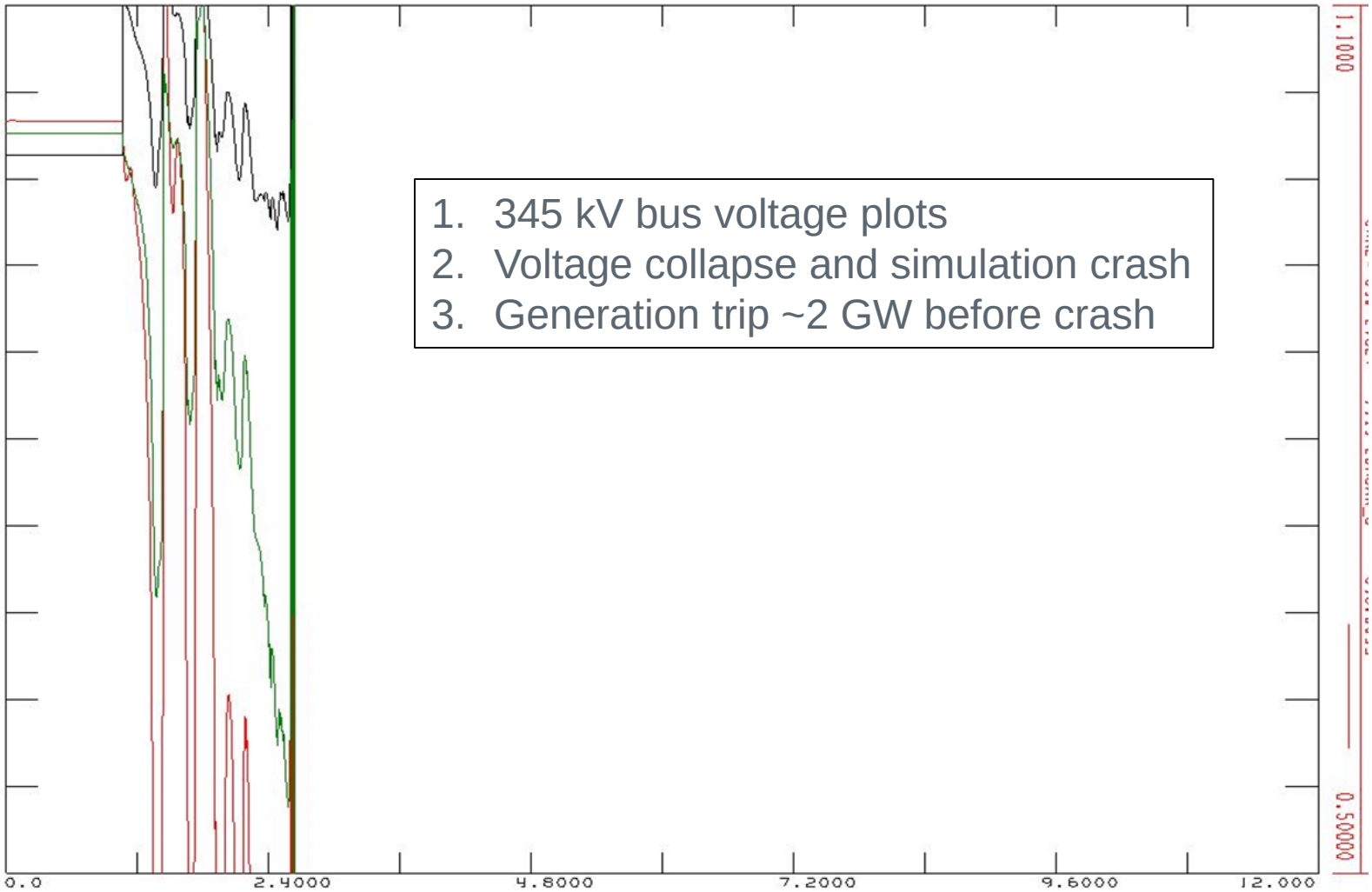
Segments	Power Flow (Study Case) (MW)	Power Flow (HWLL 2023) (MW)
BigHill - Kendall double ckt	1924	1224
West Shakelford - Sam Switch/Navarro double ckt	2232	1758
Brown - Killeen double ckt	1696	1338
16-Line export	12500	9900

- Large reactive power losses – comparison with DWG base cases

Segments	Reactive Losses (Study Case) (MVAR)	Reactive Losses (HWLL 2023) (MVAR)
BigHill - Kendall double ckt	1112	274
West Shakelford - Sam Switch/Navarro double ckt	2160	1132
Brown - Killeen double ckt	630	260
16-Line reactive losses	5093	2335

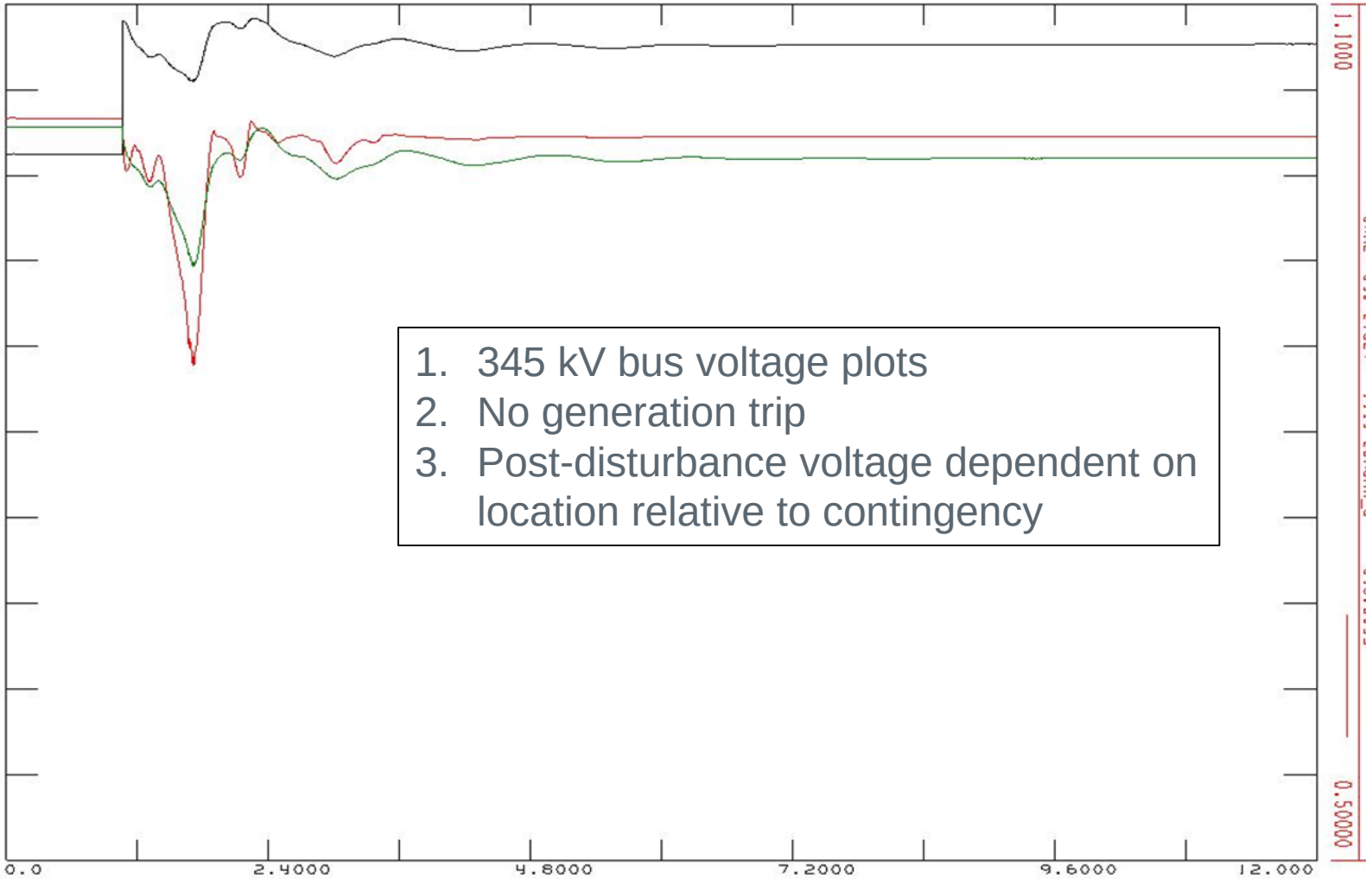
Observed Unstable Result

– System unstable at 11.8 GW transfer level under P7 contingency (no fault)



Observed Stable Result

– System stable at 11.5 GW transfer level under the same P7 contingency



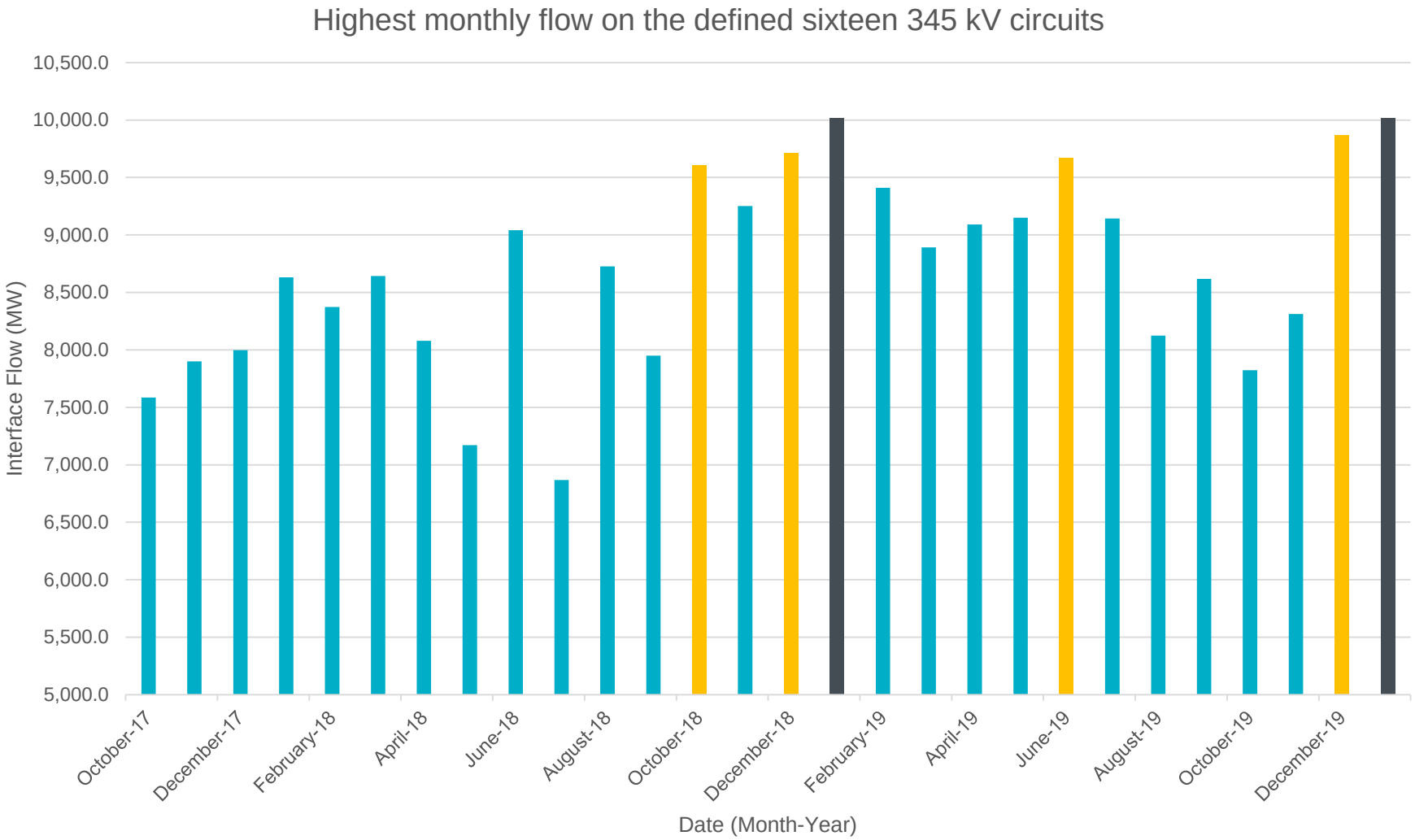
1. 345 kV bus voltage plots
2. No generation trip
3. Post-disturbance voltage dependent on location relative to contingency

Preliminary Results

- Scenario with 12.5 GW on interface was insecure for P7 events
- Steady state VSAT transfer analysis and dynamic simulations performed
  - The dynamics limits observed to be more binding than VSAT limits
- Summary of interface limits:

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

Recent Historical Data



- The highest monthly flow surpassed 10 GW twice

Next Steps

- Incorporate results into planning processes (RTP, LTSA, etc.)
- Tentative schedule: complete study and report in June 2020

Panhandle Study Update

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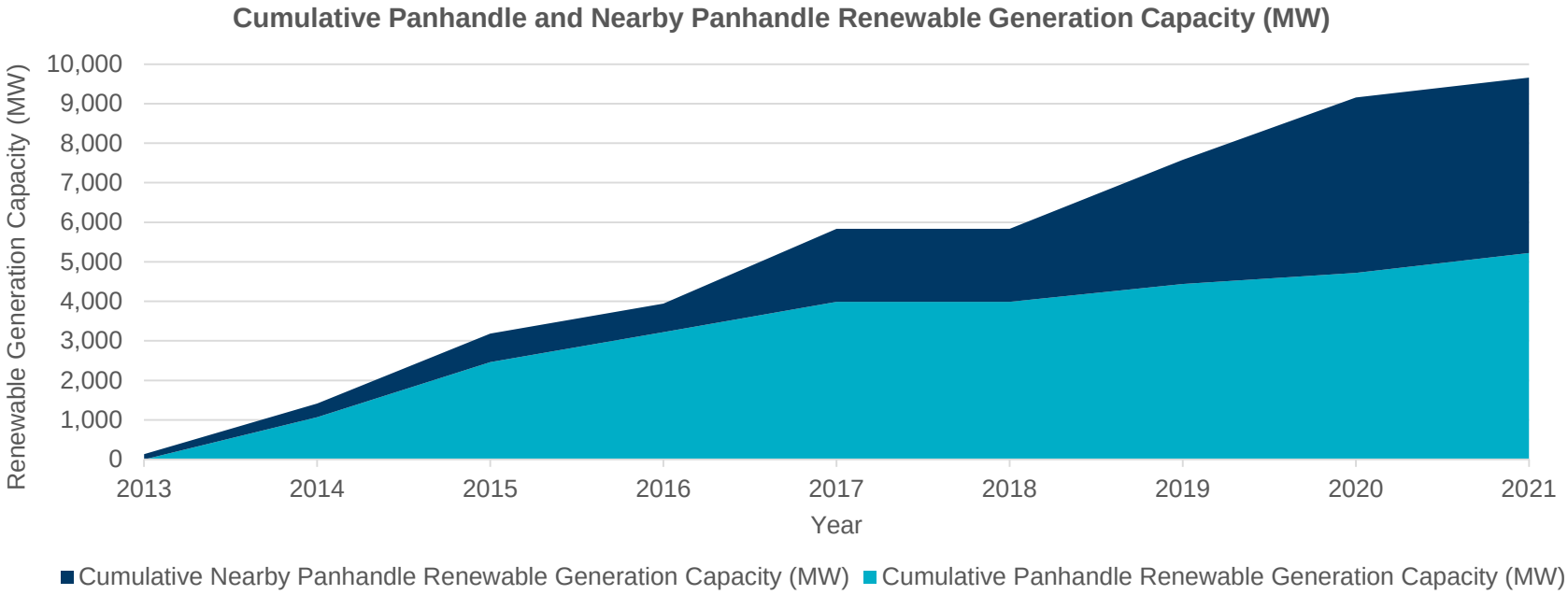
Background and Study Purpose

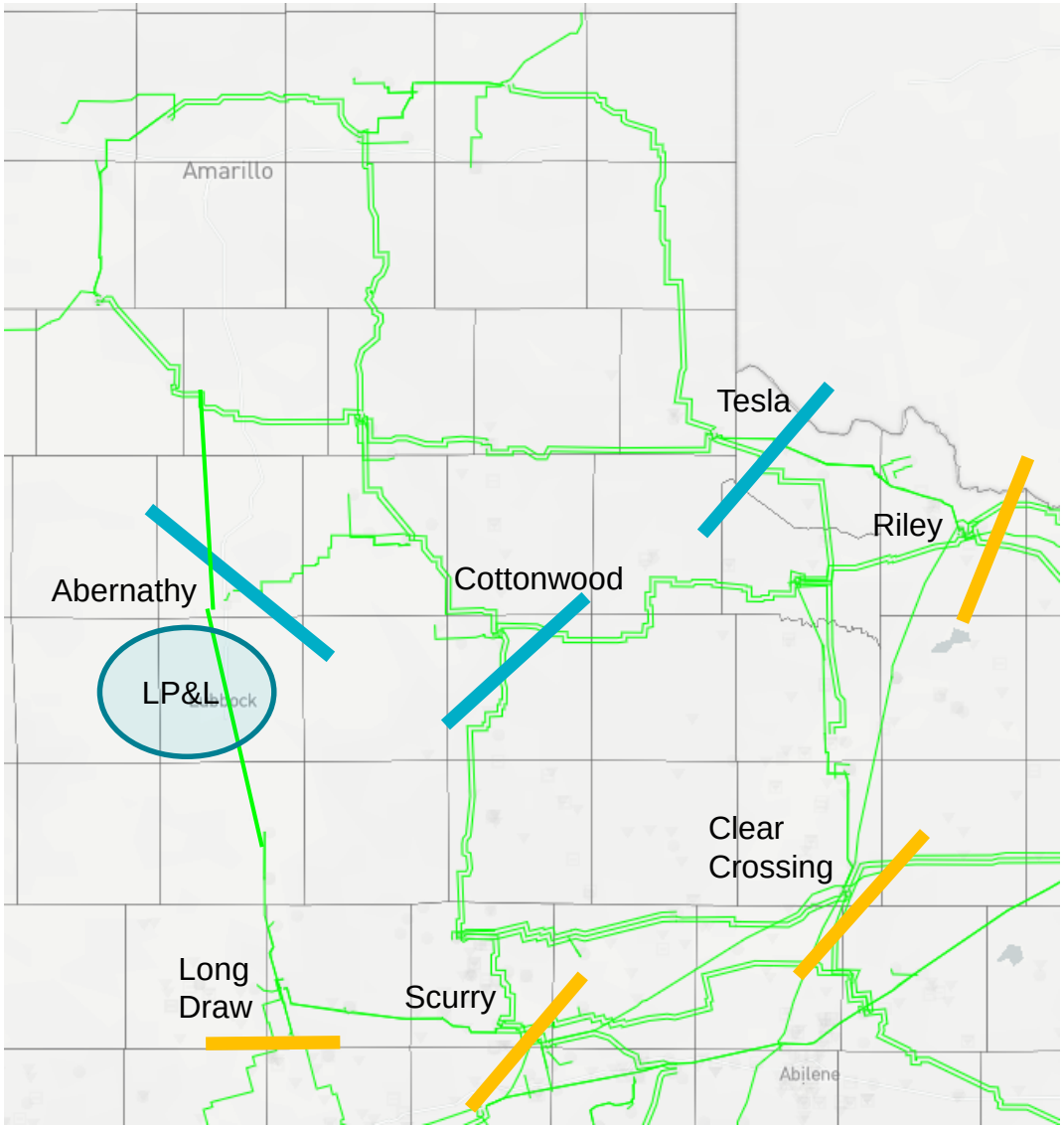
- Integration of Lubbock Power and Light
- Fast evolving interconnection situations in the Panhandle and Nearby Panhandle area require more frequent PSS/e and PSCAD analysis
- Nearby Panhandle capacity (meeting PG 6.9) increased from ~3.5 GW to ~5.3 GW since 2019 study



Base Case

- Modified DWG 2022 HWLL case
- Panhandle IBR Capacity: ~5200 MW
- Nearby Panhandle IBR Capacity: ~5300 MW
- Solar resources turned on
- Lubbock Load: 171 MW (~35% of Peak)
- West-to-East Transfer: ~11.2 GW
- West Texas Synchronous Machines off

Panhandle Boundary Assumptions*



Panhandle Boundary
Nearby PH Boundary

*Boundaries are defined for purposes of classifying generation capacity as Panhandle or Nearby Panhandle and not indicative of a defined constraint interface

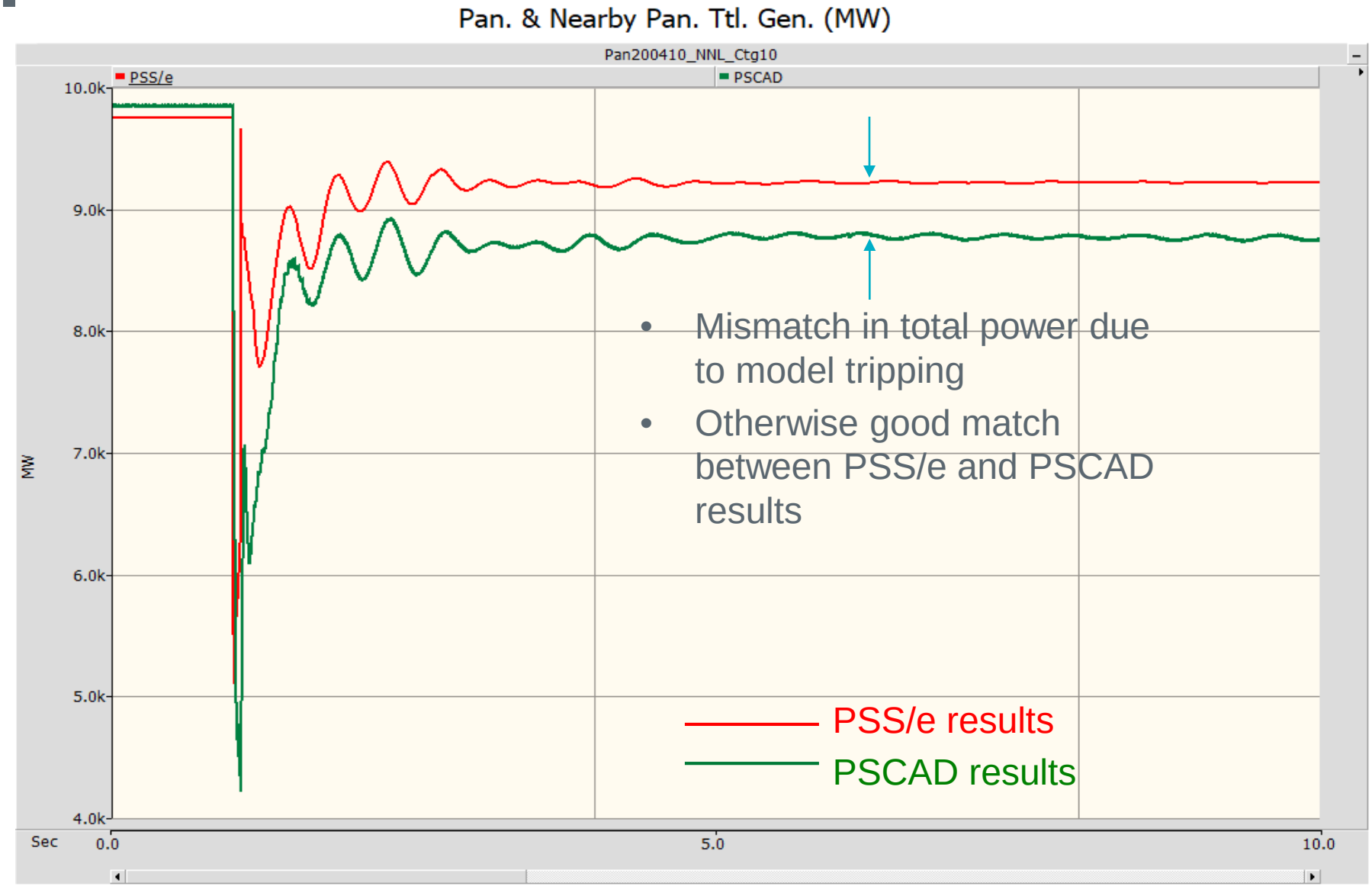
PSCAD Case Development

- Detailed PSCAD modeling for Panhandle and Nearby Panhandle
- Passive equivalent representation for the rest of ERCOT
- 43 parallel cases
- ~2.5 hours to run a single contingency
- 100% dispatch level
- Planned projects (454 MW) without PSCAD models are not included in the case
- Individual model performance reviews for both PSS/e and PSCAD were performed for selected projects

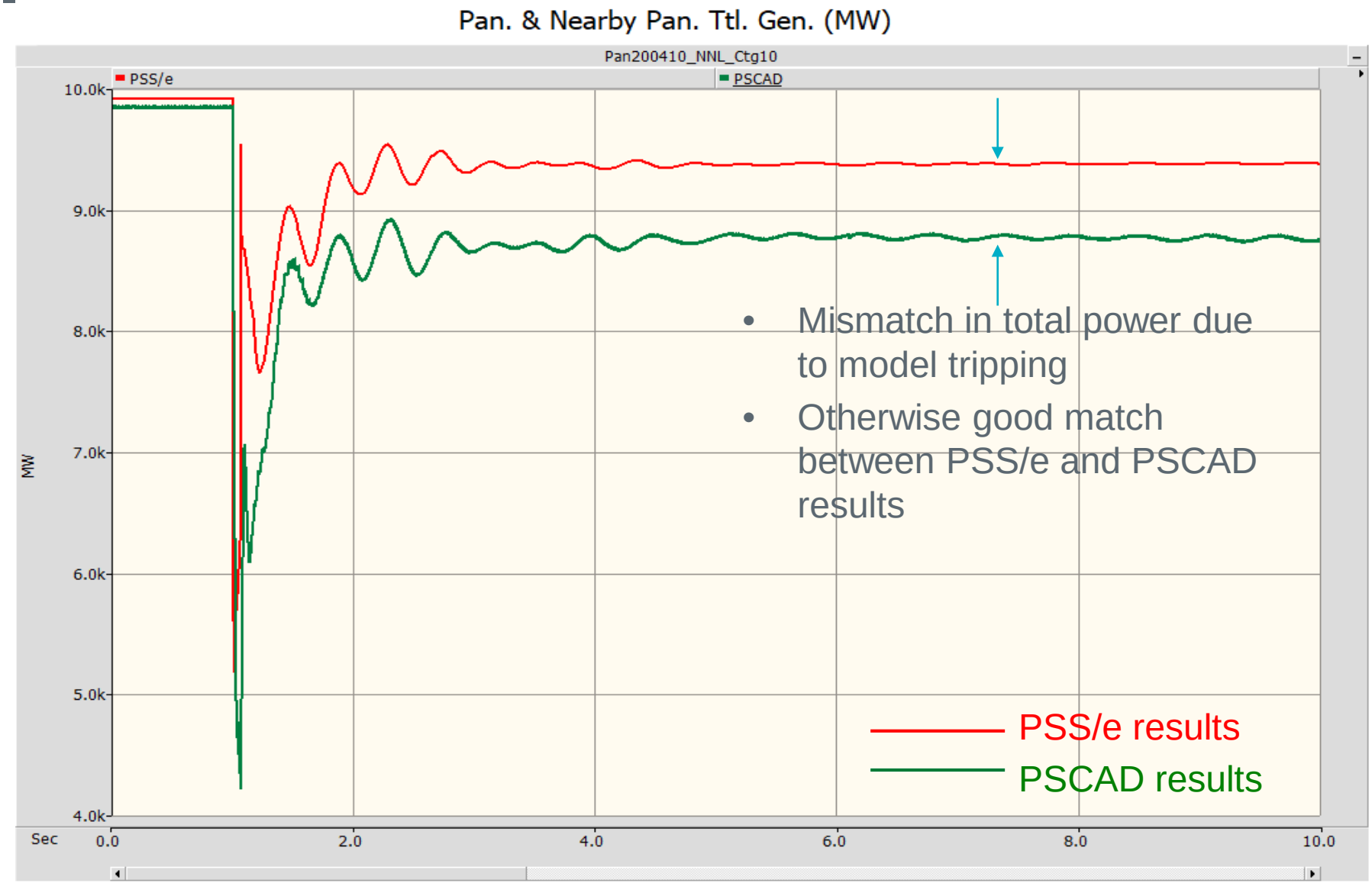
PSCAD Simulation Observations

- Inconsistent performance between PSCAD models and PSS/e models for individual projects
- Deficient PSCAD models for a few sites
- Challenges assessing performance for disturbances near the boundary of the equivalent network and detailed PSCAD models
- Some differences between PSCAD simulation results and PSS/e simulation results

PSCAD – PSS/e Comparison



PSCAD – PSS/e Comparison (OLD)



Preliminary Results

- 100% dispatch level is not acceptable
  - More than 1GW generation tripped in both PSS/e and PSCAD simulations
- The primary reason for generation trips in both PSS/e and PSCAD is overvoltage
- Increasing suspicious frequency trips in PSS/e need to be further checked

Next Steps

- Continue PSS/e and PSCAD analysis
- Review and further examine the PSS/e and PSCAD simulation results, including overvoltage trips, suspicious frequency trips
- Revise the interfaces with Lubbock integration
- Tentative schedule: complete study and report in June 2020