Status Updates: Effectiveness of Transmission Upgrades in terms of Loss of Load Reduction

Sun Wook Kang
Dynamic Studies, ERCOT

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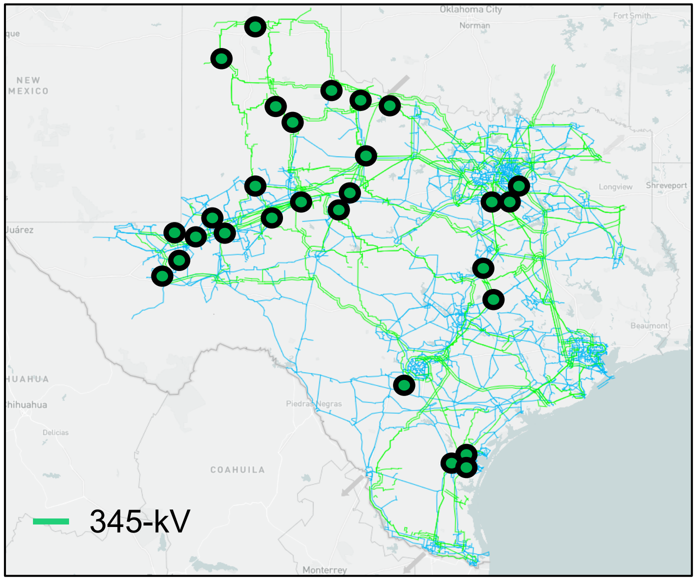
Recap – Study Scope Reminder

- ERCOT presented study scope at the [September LLWG meeting]
  - Objective: Evaluate transmission upgrades' effectiveness in mitigating potential load loss from Large Electronic Loads (LELs)
  - Study region: West, Far West, Panhandle, Nearby Panhandle
  - Study year: 2030/2031
  - Approximately 11.3 GW of the total 15.2 GW of LELs are located within the study region
  - Generation and transmission updates were made
  - Dynamic models were incorporated



Approximate, high-level LEL locations

Result of Contingency Screening

Contingency Screening

- Apply 3φ faults at all 345 kV buses within the study region
- Assumed no line tripping and no post-fault LEL reconnections (initially using the original load models for the LELs)
- Estimated the resulting load loss for each tested 345 kV bus

- Tested more than 370 buses within the study region. As a result of the screening, approximately 24 buses within the study region were found with load loss more than 2200 MW

Contingency Selection

- Identify critical locations based on the load loss ranking and 2,600 MW threshold
- Consider POI of planned LEL in contingency selection as needed

- Approximately 24 locations were selected within the study region to create fault events for more detailed study

Detailed Analysis

- Test planning events (e.g., P1 thru P7) relevant to the selected locations
- Use the load model with ITIC assumptions: trip at 0.7 pu for 20 ms, with no reconnection after recovery)

- Tested over 640 events in the base case and identified more than 170 that caused load loss. Among the 170 events, over 30 representative events were selected for further analysis.

Base Case Results and Follow-Up Scenarios

Study Base Case

Key Findings

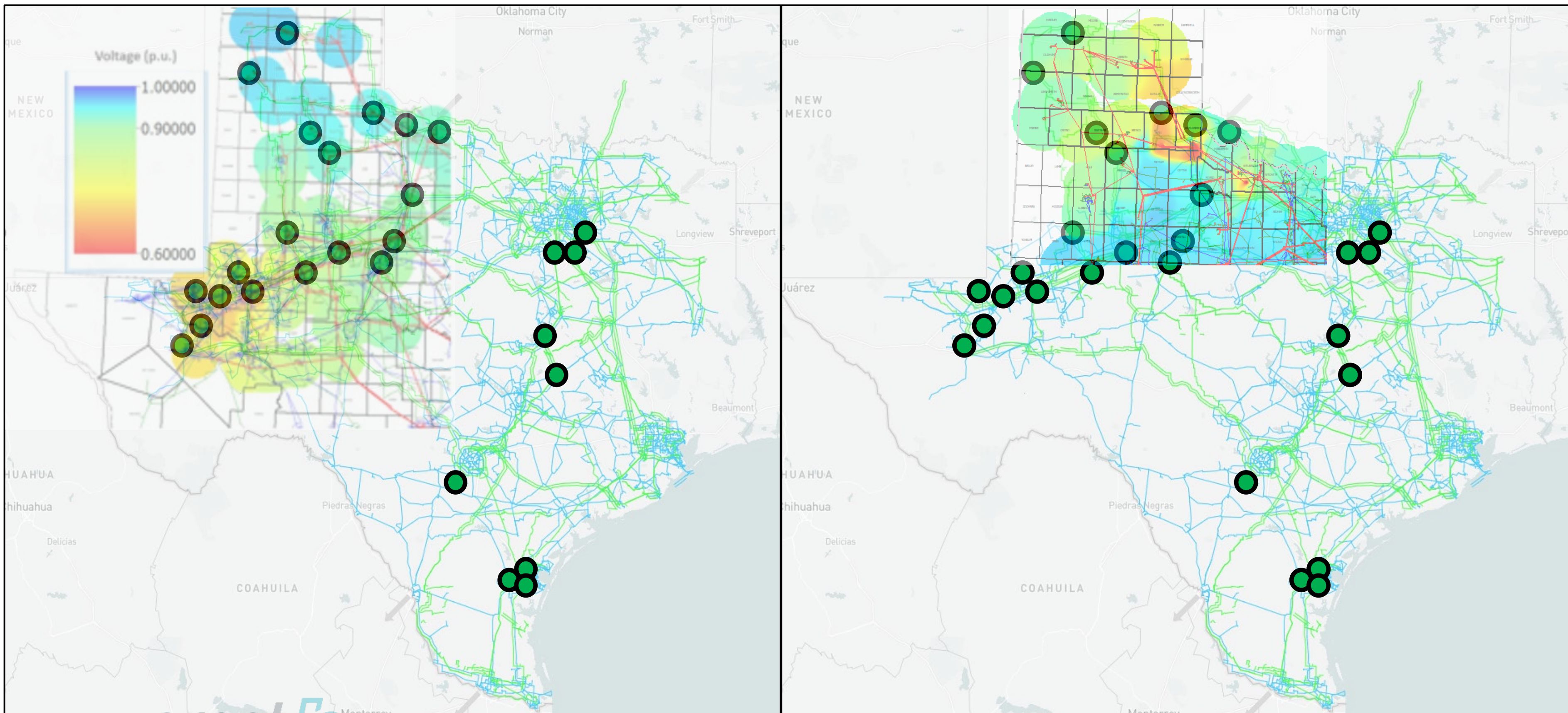
- Of the representative events, 15 resulted in load loss exceeding the 2,600 MW threshold.
- Highest load loss (~6,452 MW) occurred in Panhandle/Nearby Panhandle in North weather zone
- All other representative events caused load losses between 167 MW and 2,456 MW
- The impact of a transmission element trip on the grid is found to be less significant compared to a fault event without the tripping of a transmission element

Scenarios Considered

- **Scenario 1**: Removal of the six RPG-approved synchronous condensers in WFW Texas
- **Scenario 2**: Addition of five new synchronous condensers at Tesla, Oklaunion, Iris, Fr Corner, and Helios (total 1.75 Gvar)
- **Scenario 3**: Deployment of 152 E-STATCOMs (total 30.4 Gvar) at all buses within three buses from the faulted bus
- **Scenario 4**: Deployment of 387 E-STATCOMs (total 77.4 Gvar) at all 345 kV buses in the study area
- **Scenario 5**: Adjustment of LEL trip time delay to 70 ms

Example: Voltage Dips Under Certain Faults

Note: The voltage dip contour shown is a hypothetical illustration of potential wide-area voltage dips affecting LELs. It does not represent actual system conditions.



Key Findings – Transmission Upgrades

Event Category	MW Load Loss					
	Base Case	Scenario 1 (Remove RPG-approved Sync Cons 2.1 Gvar)	Scenario 2 (five new Sync Cons, 1.75 Gvar)	Scenario 3 (152 E-STATCOMs, 30.4 Gvar)	Scenario 4 (387 E-STATCOMs, 77.4 Gvar)	Scenario 5 (Adjustment of LEL trip time delay to 70 ms)
P1	6452	6544	6451	2428	2428	0
P1	5754	5755	5754	1917	1917	0
P6	5754	5755	5754	5150	2997	0
P1	5754	5755	5754	1917	1917	0
P1	5664	5755	5663	1917	1825	0
P1	5171	5366	5170	2428	1561	0
P1	5152	5152	5151	4844	2690	0
P7	5152	5152	5151	4844	2690	0
P1	5152	5152	5151	4844	2690	0
P1	3377	5152	2864	286	378	0
P1	4558	5150	4558	849	0	0
P1	3285	5079	3285	744	745	0
P1	3285	5079	3285	744	745	0
P1	4969	4969	4968	1980	1980	0
P1	4093	4185	2111	1917	1825	0
P1	2294	3098	2294	924	463	0
P1	1345	3070	1255	194	194	0
P1	2373	2994	2373	552	116	0
P1	1345	2864	1345	183	184	0

more than 2600

500 ~ 1500

less than 20

1500 ~ 2600

20 ~ 500

Key Findings – Transmission Upgrades (Cont.)

- Transmission options (e.g., E-STATCOM, Synchronous Condenser) showed varying levels of ability to mitigate load loss for the critical events tested, i.e., for some events transmission improvements were able to lower the load loss while for other events transmission improvements showed negligible benefits, even with absurd amounts of added devices
- For most events, transmission improvements will not be an effective option to mitigate the risk of loss of load due to lack of voltage ride-through capability
- Testing with LEL trip delay adjustment (i.e., Scenario 5) suggests that enhancing fault ride-through capability is the most effective option to reduce load loss
- In general, adding transmission line(s) reduces the overall system impedance, increasing fault currents and making the system stronger. However, it also brings the network electrically closer to the fault location, so voltage dips at nearby buses can still be significant immediately after the fault

Key Findings – Transmission Upgrades (Cont.)

- Why does a particular region experience more severe load loss compared to others?
  - Size of individual LELs,
  - High local concentration of LELs,
  - Ride-through capability,
  - Electrical proximity to major faults,
  - Fault clearing times, etc.

Key Takeaway and Next Steps

- As more LELs connect to the ERCOT grid, both the risk and magnitude of load loss are expected to increase continuously

- Enhancing fault ride-through capability proved far more effective

- ERCOT is currently conducting an assessment considering the ride through performance requirements proposed by ERCOT. Status updates will be provided at the future LLWG meeting(s)

Questions?

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Ehsan Rehman, ehsan.rehman@ercot.com
Christian Danielson, christian.danielson@ercot.com
Sun Wook Kang, Sunwook.Kang@ercot.com