Texas RE 2019 Assessment of Reliability Performance

ERCOT Reliability and Operations Subcommittee
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Texas RE periodically assesses and reports on the reliability and adequacy of the bulk power system (BPS) within the Texas Interconnection.

The Assessment of Reliability Performance annually compiles analyses for the previous year.

Goals of this report are to paint the overall BPS reliability picture with historical context, identify current and future risk areas, and prioritize and create actionable results for reliability improvement.
Focus Areas

- Event Analysis Review
- Resource Adequacy and Performance
- System Resilience
- Changing Resource Mix
- Human Performance
- Bulk Power System Planning
- Loss of Situational Awareness
- Protection and Control Systems
- Physical and Cyber Security
## Summary of 2019 Performance Trends

<table>
<thead>
<tr>
<th>Key Performance Indicator</th>
<th>Watch/Action Trend</th>
<th>Stable Trend</th>
<th>Notable Positive Trend *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resource Adequacy</strong></td>
<td>Two EEA level events. Improved 2020 reserve margin, still below reference in future years.</td>
<td>Sufficient operating reserves maintained during summer and winter peaks</td>
<td>Natural gas curtailments reduced in 2019 due to milder winter</td>
</tr>
<tr>
<td><strong>Transmission Performance</strong></td>
<td></td>
<td>345 kV outage rates per circuit &amp; per 100 miles increased but are within 5-year average</td>
<td>0 IROL exceedances; transmission performance on extreme days improved significantly</td>
</tr>
<tr>
<td><strong>Resource Performance</strong></td>
<td>Gas generation EFOR rates increasing</td>
<td>No Balancing Contingency event failures</td>
<td>Primary frequency response</td>
</tr>
<tr>
<td><strong>System Inertia</strong></td>
<td>Increasing net load and solar ramping magnitudes</td>
<td>Stable inertia trends during all hours</td>
<td></td>
</tr>
<tr>
<td><strong>Misoperation Rate</strong></td>
<td>Multiple events with misoperations</td>
<td></td>
<td>Decreased rate and 5-year overall improving trend</td>
</tr>
<tr>
<td><strong>Human Performance (HP)</strong></td>
<td>HP errors remain primary causal factor in misoperations</td>
<td></td>
<td>2019 generator outages tied to HP decreased significantly</td>
</tr>
<tr>
<td><strong>Situational Awareness</strong></td>
<td>4 Loss of EMS events</td>
<td>State Estimator convergence rate</td>
<td></td>
</tr>
</tbody>
</table>
Event Analysis Review

2019 Highlights
• 31 OE-417 reports
• 6 EOP-004 reports
• 55 FNET (frequency-related) notifications
• 14 Event Analysis reports

2015-2019
• 433 Events Analyzed
• > 270 Event reports
• 302 root and contributing causes identified
• Qualified event attributes dominated by Generation Loss, Protection System Misoperations, and Loss of Situational Awareness
• Primary frequency response metrics continue to be maintained at high levels.
• Average recovery time from generation loss events was 5.1 minutes in 2019 versus 6.2 minutes for 2018; long-term gradual upward trend since 2012.
Fossil Generation
Performance Metrics

- From January 2019 through December 2019, there were 2,122 immediate forced outage events, totaling 122,471 hours.
- Total outage capacity was 405,724 MW.
- Median outage capacity was 171 MW per event.
System Resilience

For 345 kV circuits:
- 487 momentary and sustained forced outages reported on 16,382 circuit miles
- Failed transmission circuit equipment accounted for 20% of cause and 70% of duration.

For 138 kV circuits:
- 374 sustained forced outages reported on 23,224 circuit miles
- Failed substation or transmission circuit equipment accounted for 38% of cause and 75% of duration.
## System Resilience

### Transmission Extreme Day Analysis

<table>
<thead>
<tr>
<th>Date</th>
<th>Sustained Transmission Outage Events on Extreme Day</th>
<th>Leading Causes for Extreme Day</th>
<th>Average Sustained Outage Duration on Extreme Day</th>
<th>Longest Sustained Outage on Extreme Day</th>
<th>Average Sustained Outage Duration for Year</th>
<th>Longest Sustained Outage Duration for Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/26/2017</td>
<td>40</td>
<td>Weather</td>
<td>80 hours</td>
<td>257 hours</td>
<td>54 hours</td>
<td>7,594 hours</td>
</tr>
<tr>
<td>1/16/2018</td>
<td>50</td>
<td>Weather</td>
<td>10 Hours</td>
<td>72 hours</td>
<td>53 hours</td>
<td>6,403 hours</td>
</tr>
<tr>
<td>5/18/2019</td>
<td>19</td>
<td>Weather</td>
<td>85 hours</td>
<td>332 hours</td>
<td>31 hours</td>
<td>1,657 hours</td>
</tr>
</tbody>
</table>

### Generation Extreme Day Analysis

<table>
<thead>
<tr>
<th>Date</th>
<th>Generation Outage Events on Extreme Day</th>
<th>Leading Causes for Extreme Day</th>
<th>Cumulative Outage Duration on Extreme Day</th>
<th>Cumulative MW Impact on Extreme Day</th>
<th>Cumulative GWH Impact on Extreme Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/27/2017</td>
<td>41</td>
<td>Weather</td>
<td>22,798 hours</td>
<td>10,107 MW</td>
<td>2,917.5 GWH</td>
</tr>
<tr>
<td>1/16/2018</td>
<td>84</td>
<td>Balance of Plant/Fuel</td>
<td>2,891 hours</td>
<td>11,893 MW</td>
<td>517.8 GWH</td>
</tr>
<tr>
<td>5/11/2019</td>
<td>36</td>
<td>Turbine Generator</td>
<td>1,626 hours</td>
<td>6,449 MW</td>
<td>282.5 GWH</td>
</tr>
</tbody>
</table>

- Transmission and generation performance on extreme days improved compared to previous years
- From 2015-2019, 11% of sustained 345 kV outage events involved multiple elements
Inertia data shows risk of approaching critical inertia level less than 50 hours per year.
Changing Resource Mix

• Long-term increasing trend in maximum one-hour up-ramp magnitudes for net load and solar
Human Performance

- Protection system misoperations caused by human error show an improving downward trend
- Causal analysis of human errors in protection system misoperations shows continuing, repeated issues due to lack of adequate error-checking processes
- Since 2015, 462 ERCOT generator immediate forced outages had a human error cause.
- Generator forced outages caused by human error dropped significantly in 2019
Loss of Situational Awareness

Loss of EMS/SCADA events continue to be a focus point at the NERC and regional levels.

Event count in 2019 is about average for the past 7 years.
Loss of Situational Awareness

ERCOT telemetry performance criteria - 92% must achieve 80% quarterly availability.
• For 2019, points failing availability metric averaged 4,422 each month, or approximately 3.9% of total system telemetry points.

ERCOT’s goal for State Estimator convergence is 97% or higher.
• In 2019, convergence rate was 99.99%, continuing improvement since 2016.
Increasing Complexity in Protection and Control Systems

- Favorable multiyear trend in misoperations due to incorrect settings, communication failures and relay failures
- 2019 misoperation rate down to 6.3%, from 7.3% in 2018

- Incorrect settings, logic, and design errors remained as largest cause (32%)
- Misoperations magnified outages of transmission, generation and load in multiple 2019 events
Questions?

2019 Assessment of Reliability Performance – Summary

2019 Assessment of Reliability Performance – Full Report

Email information@texasre.org with any questions.