Performance Indicators and Texas RE 2014 Assessment of Reliability Performance

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Objectives

Review performance indicators

Outline observations

- Texas Reliability Entity, Inc. (Texas RE) Assessment of Reliability Performance report
- North American Electric Reliability Corporation (NERC) State of Reliability report

Overview protection misoperation trends and goals

Discuss data sources

- Transmission Availability Data Systems (TADS)
- Generation Availability Data Systems (GADS)
- Misoperation outage data (PRC-004)
- Electric Reliability Council of Texas (ERCOT) PI system
Performance Indicators Background

- Pulse points for system, not compliance measures
- Historical data review – seek trends
- Complement long term assessments future outlook and events analysis
- Varied data sources – none created especially for these indicators
- Work in progress

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2014 Assessment of Reliability Performance

Third Annual Report

Covers MRC metrics over the year with additional observations

Specific to the Texas RE footprint

Complements NERC “State of Reliability Report”
2014 Assessment of Reliability Performance

- Transmission availability consistent with NERC-wide performance
- Generation availability compares well with NERC-wide averages
- Frequency control metrics – continued high levels
- Primary frequency response shows continued improvements
- Protection system misoperation rates remain stable
- Human performance issues warrant further improvements
System Events

Key 2014 Events

- 1/6/2014 Polar Vortex
- 1/18/2014 EEA1
- 10/8/2014 Valley load shed
Green dashed lines are the Epsilon-1 (ε1) value of 0.030 Hz used for calculation of the CPS-1.

Red dashed lines show governor dead-band settings of 0.036 Hz.

Purple dashed lines show governor dead-band settings of 0.017 Hz.

Shape of frequency bell curve continues to narrow due to number of generators implementing reduced governor dead-band settings.
- 2012 Median value was 470 MW per 0.1 Hz for 54 events evaluated
- 2013 Median value was 763 MW per 0.1 Hz for 56 events evaluated
- 2014 Median value was 882 MW per 0.1 Hz for 44 events evaluated
Transmission Outage Rate Trends (> 200kV)

- 345kV Transmission outage rates in-line with NERC averages and showing downward trend
One-minute PI data from 52 generation buses (138kV and 345kV). Includes both fossil and wind generation.
Boxes represent the 25%/75% percentiles. Leader lines show the min/max voltage during the period.
Data is normalized so that the 1.0 per-unit value represents the control point from the seasonal voltage profile.
Transmission Limits

- Lines represent the total number of lines which are a constraint during the month (i.e., a post-contingency overload >100%)
- Bars represent the average hours per circuit during the month that the line constraints occurred
Equivalent Forced Outage Rate Demand (EFORd) measures the probability that a unit will not meet its demand periods for generating requirements because of forced outages or derates.

ERCOT units only, based on GADS submittal data (no wind, or units under 50 MW in 2012).
Protection system misoperation reporting required by ERCOT Operating Guides and NERC Standard PRC-004

Registered Entities submit misoperation reports quarterly to ERCOT and Texas RE

Since January 2011, a total of 776 misoperations reported (16 per month average)

Texas RE provides summaries of quarterly misoperation report to the ERCOT System Protection Working Group (SPWG)
Protection System Misoperations – Key Observations

Overall misoperation rate relatively flat since Jan 2011

Main causes similar to NERC-wide trend
- Incorrect settings/logic (42%),
- Relay failure (20%), and
- Communications failure (10%)

Relay failures evenly split between electromechanical and microprocessor-based systems

Main facilities affected
- Transmission lines (61%)
- Transformers (11%)
- Generators (10%)
  - 83% of generator misoperations occur with no system fault

“Human performance” factor in 52% of misoperations
- Field errors, engineering errors and incorrect settings

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Protection System Misoperations

- Failure to Reclose removed from historical misoperation data.
- Lines show percentage of protection system operations that are misoperations.
- Percent Misoperation Rate is normalized based on number of system events.
ERCOT Region Protection System Misoperation Statistics

- Security-based misoperations >94% (vs. dependability-based).

- Microprocessor-based relays continue to dominate misoperations, with large installed base and complexity in applying and setting these devices.
Protection System Misoperations

Protection System Misoperations – Human Error %

- Percentage of Protection System Misoperations due to human factors (i.e., settings errors, wiring errors, design errors, etc.)
Incorrect Settings – Details

Breaking down of cause of incorrect settings and logic errors since 1/1/2011

- Ground overcurrent: 39%
- Phase overcurrent: 6%
- Phase/Zero sequence compensation: 3%
- Phase/ground distance: 13%
- Zone/phase/ground/BF timers: 5%
- Carrier coordination timers: 6%
- Directional logic: 5%
- Not Enough info: 6%
- Weak in feed: 1%
- Other: 8%
- Switch on to fault: 3%
- 87 Tap settings: 5%
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Infrastructure Protection

Intrusion/Copper Theft

Physical/Cyber Security

Q1-11 Q2-11 Q3-11 Q4-11 Q1-12 Q2-12 Q3-12 Q4-12 Q1-13 Q2-13 Q3-13 Q4-13 Q1-14 Q2-14 Q3-14 Q4-14

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Annual summary

• Metrics
• Performance

Review of past year events and initiatives

Key findings

• Sustained high performance for bulk power system (BPS) reliability
• No load loss due to physical or cyber security events
• Continued decline in average transmission outage severity
• Significant decrease in unplanned transmission outages resulting in loss of load during 2012 to 2014
• Frequency response trend remained stable
• Protection system misoperations began trending toward reduced incidences, but they continue to escalate risk in Qualified Events
• Use of Energy Emergency Alert Level 3 continued to decline

Compliance metric in development

Actionable Items – new and past years
NERC Annual Severity Risk Index (SRI)

Ten Highest Stress Days with 2014 marked:
- 1/7 Polar Vortex
- 1/6 Polar Vortex
- 7/8 Thunderstorms
- 1/24 Winterstorm
- 12/11 Extreme Windstorms

Descending day of the year

2010 2011 2012 2013 2014

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References

- Texas RE Assessment of Reliability Performance

- NERC Protection System Misoperation Task Force

- NERC System Protection and Control Subcommittee
Questions?