
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

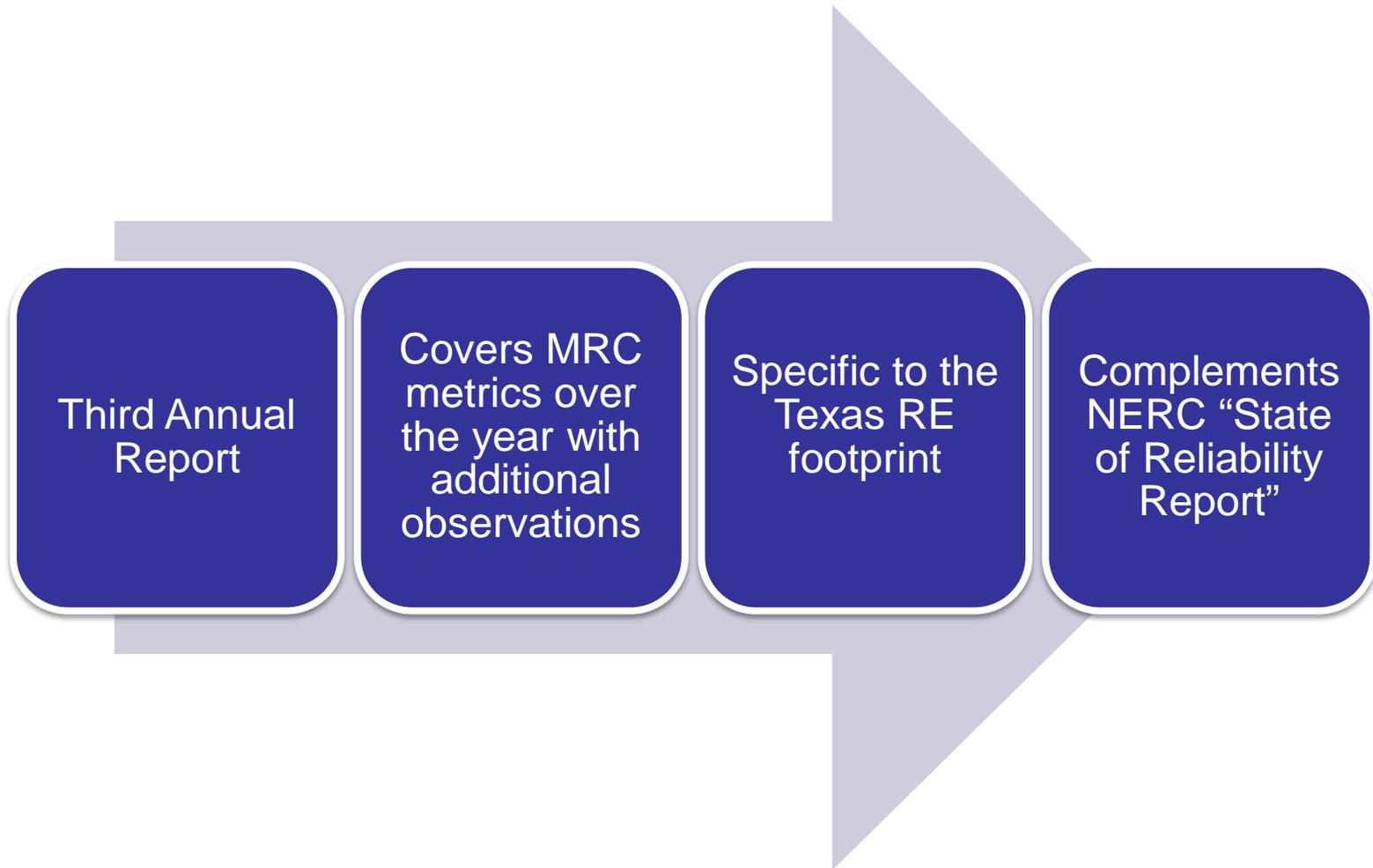


Varied data sources –
none created especially for
these indicators



Work in progress

2014 Assessment of Reliability Performance



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

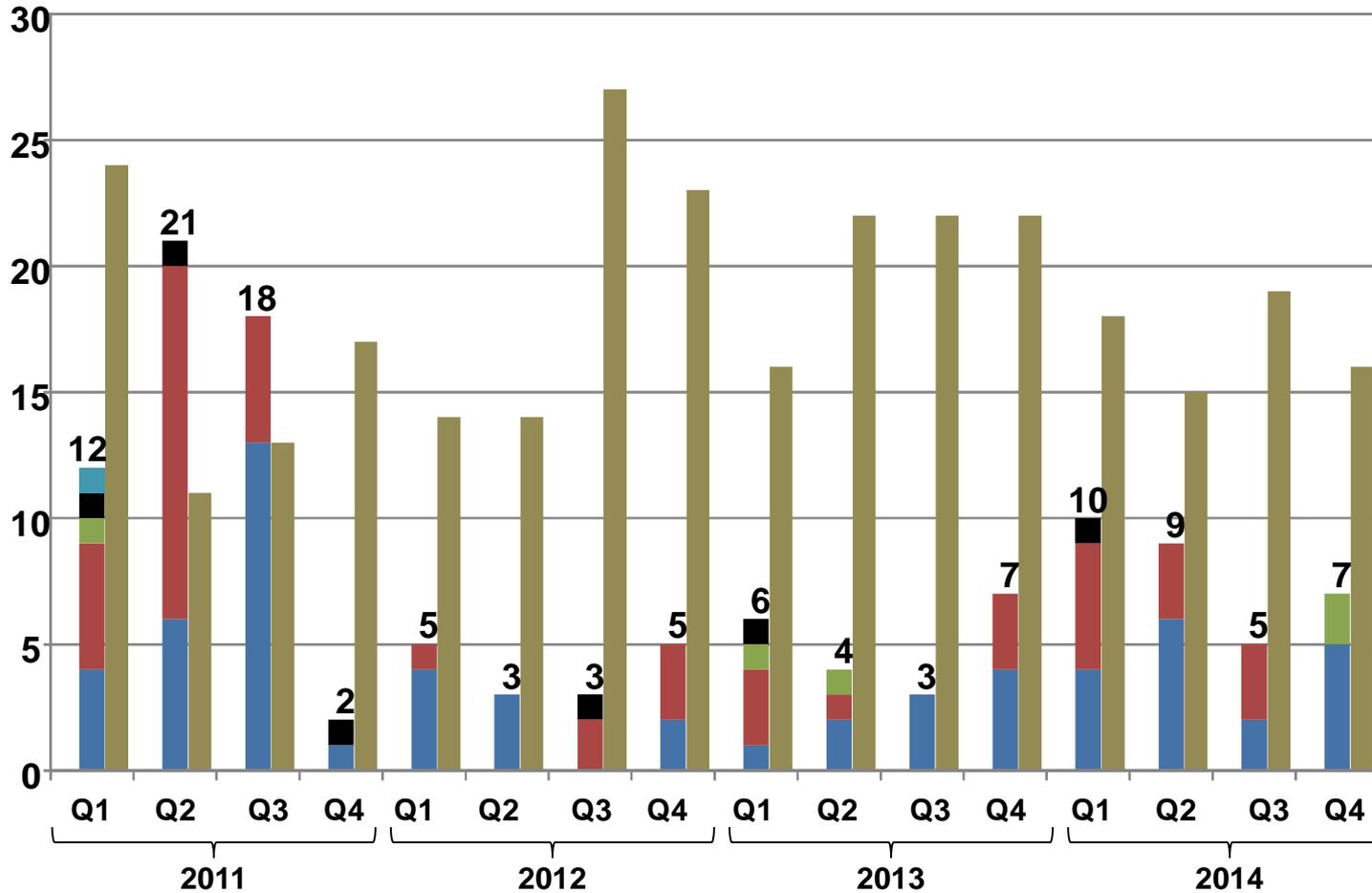
Protection system misoperation rates remain stable

Human performance issues warrant further improvements

System Events

Total Events

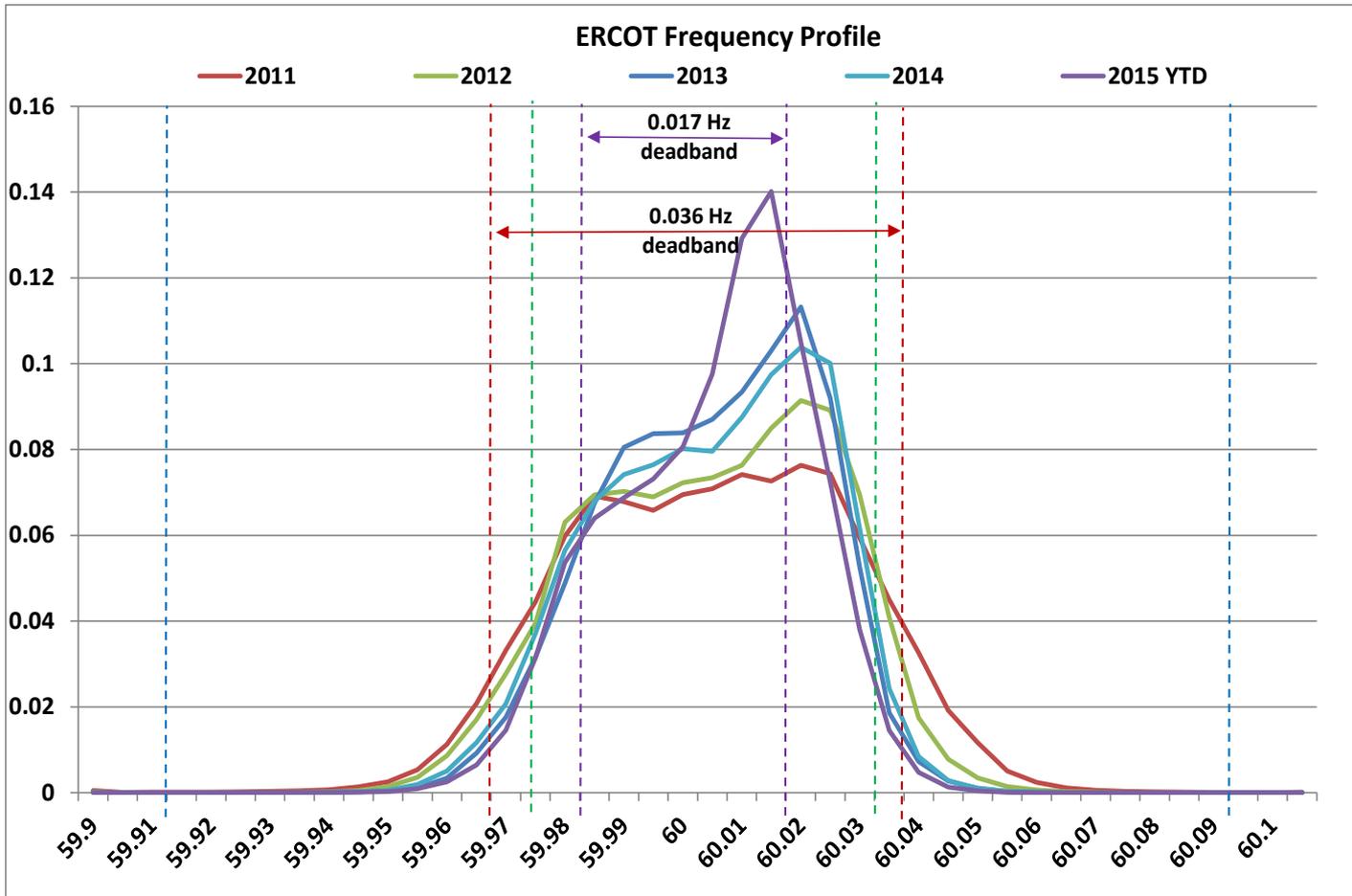
■ Cat 4 & 5
 ■ Cat 3
 ■ Cat 2
 ■ Cat 1
 ■ Cat 0
 ■ Generator Trips >450MW



Key 2014 Events

- 1/6/2014 Polar Vortex
- 1/18/2014 EEA1
- 10/8/2014 Valley load shed

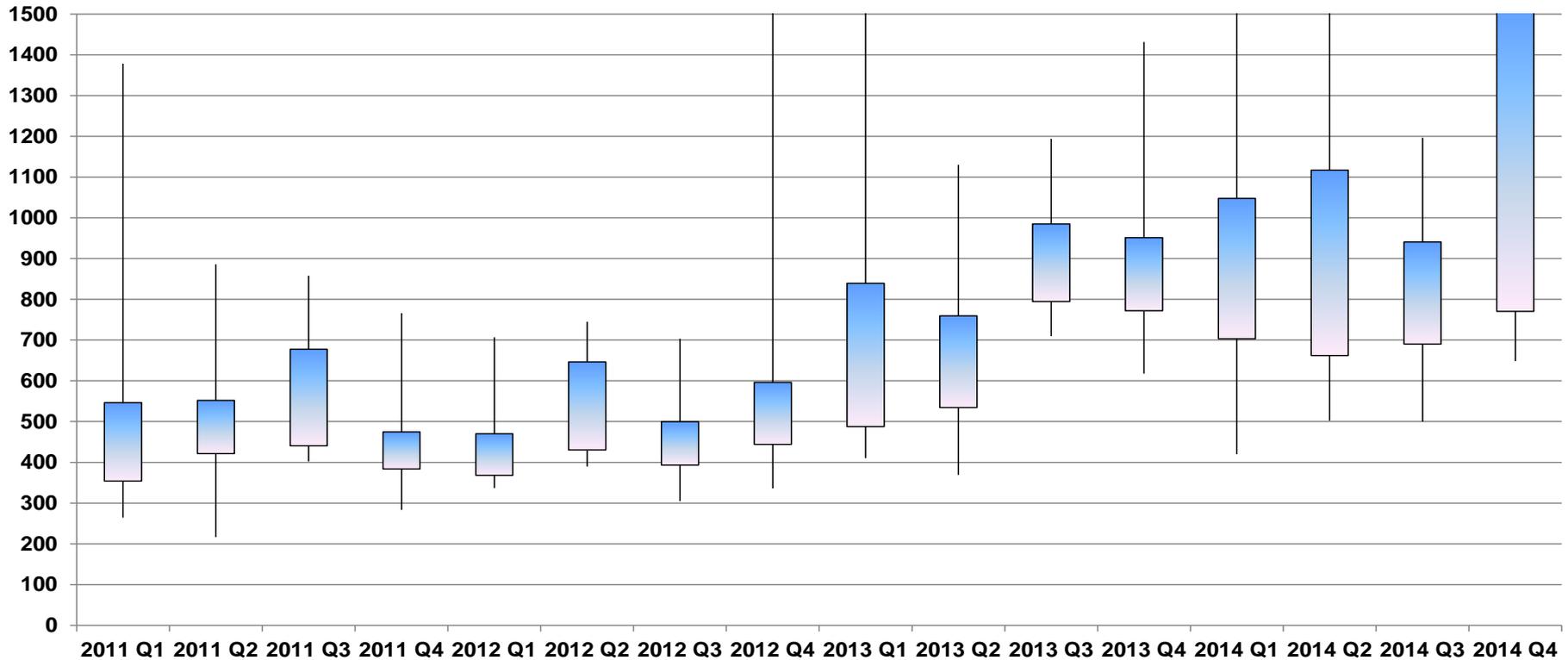
Frequency Control



- Green dashed lines are the Epsilon-1 (ϵ_1) 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.

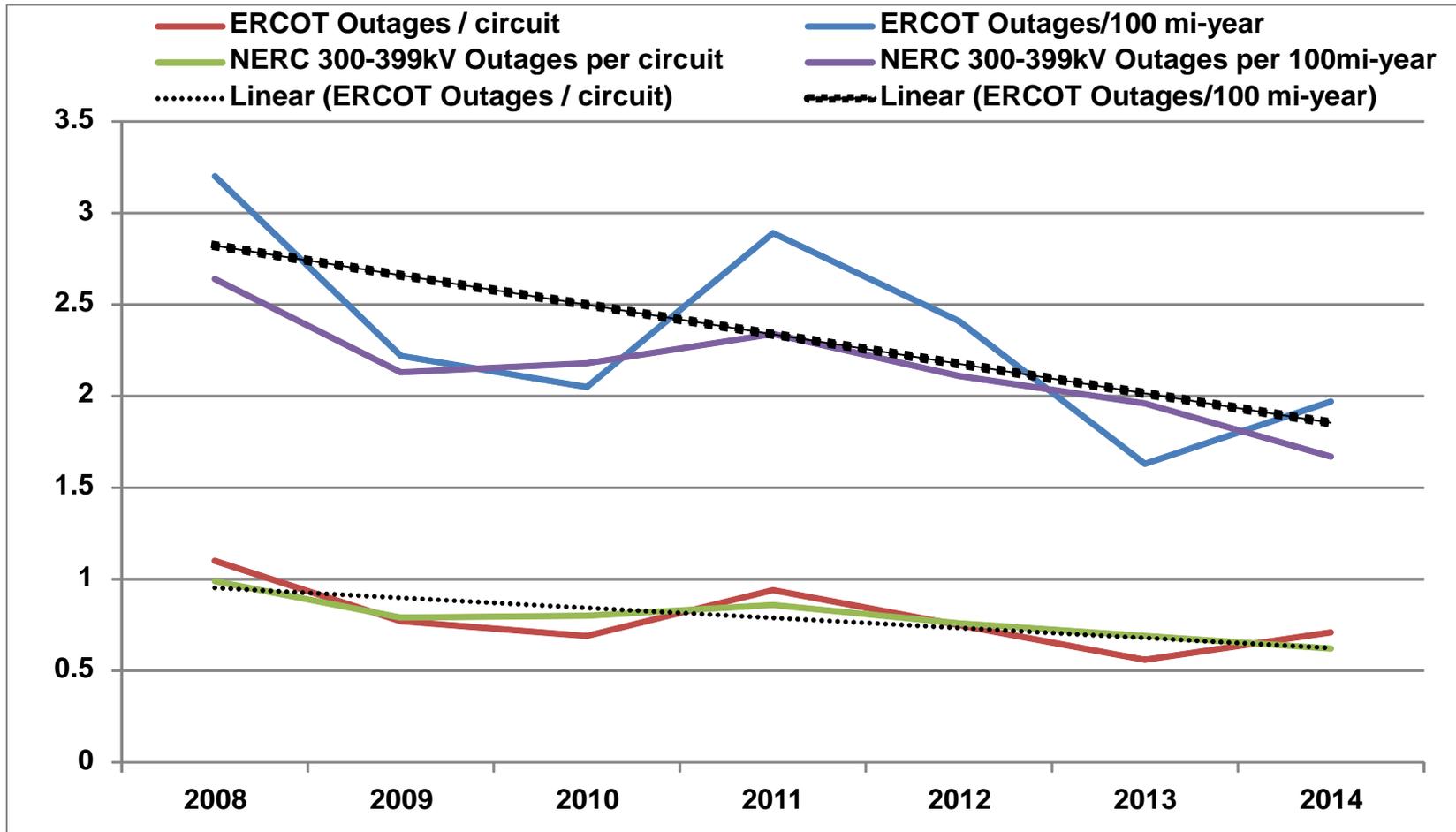
Primary Frequency Response

ERCOT REGION PRIMARY FREQUENCY RESPONSE (MW per 0.1 Hz at B-point)
Gen Unit Trips > 450 MW Analyzed by PDCWG



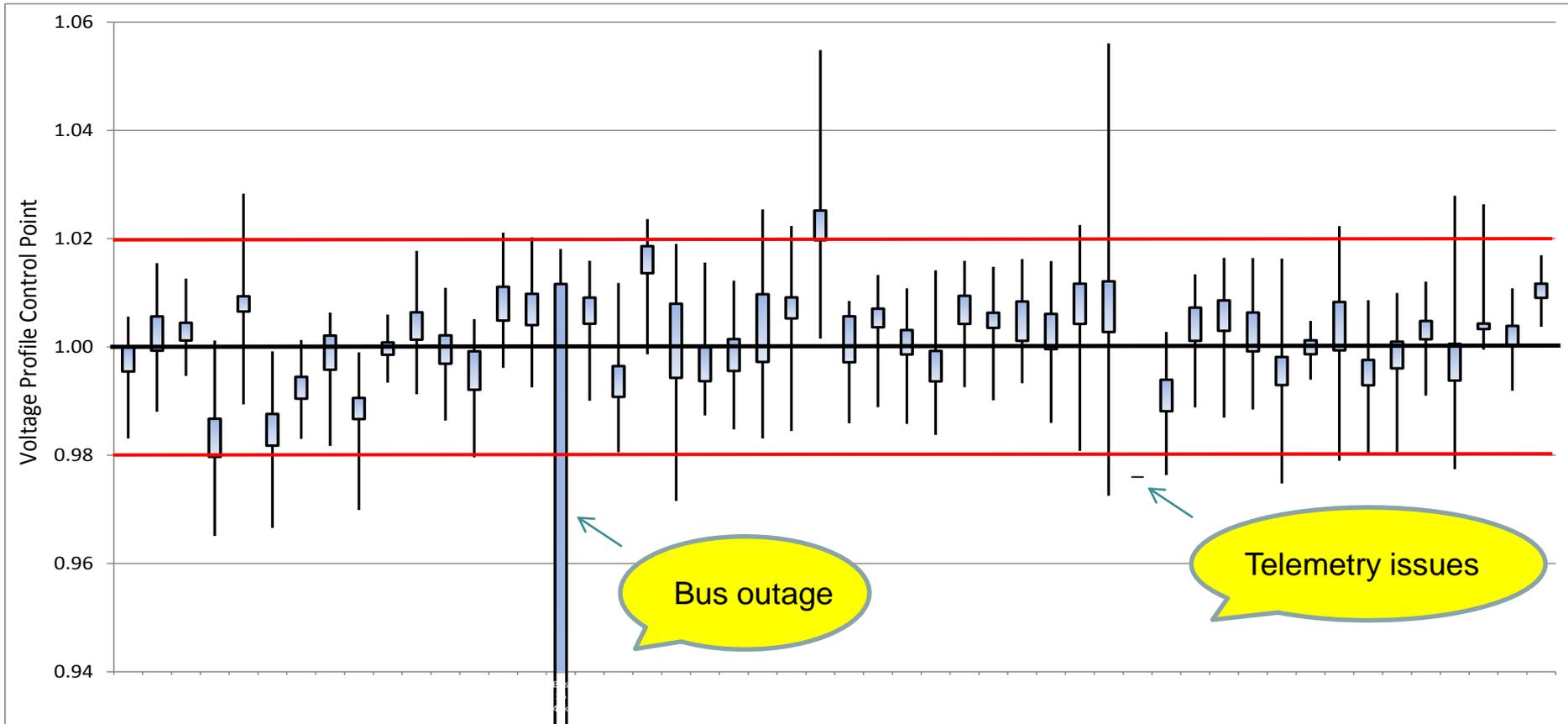
- 2012 Median value was 470 MW per 0.1 Hz for 54 events evaluated
- 2013 Median value was 763 MW per 0.1 Hz for 56 events evaluated
- 2014 Median value was 882 MW per 0.1 Hz for 44 events evaluated

Transmission Outage Rate Trends (> 200kV)



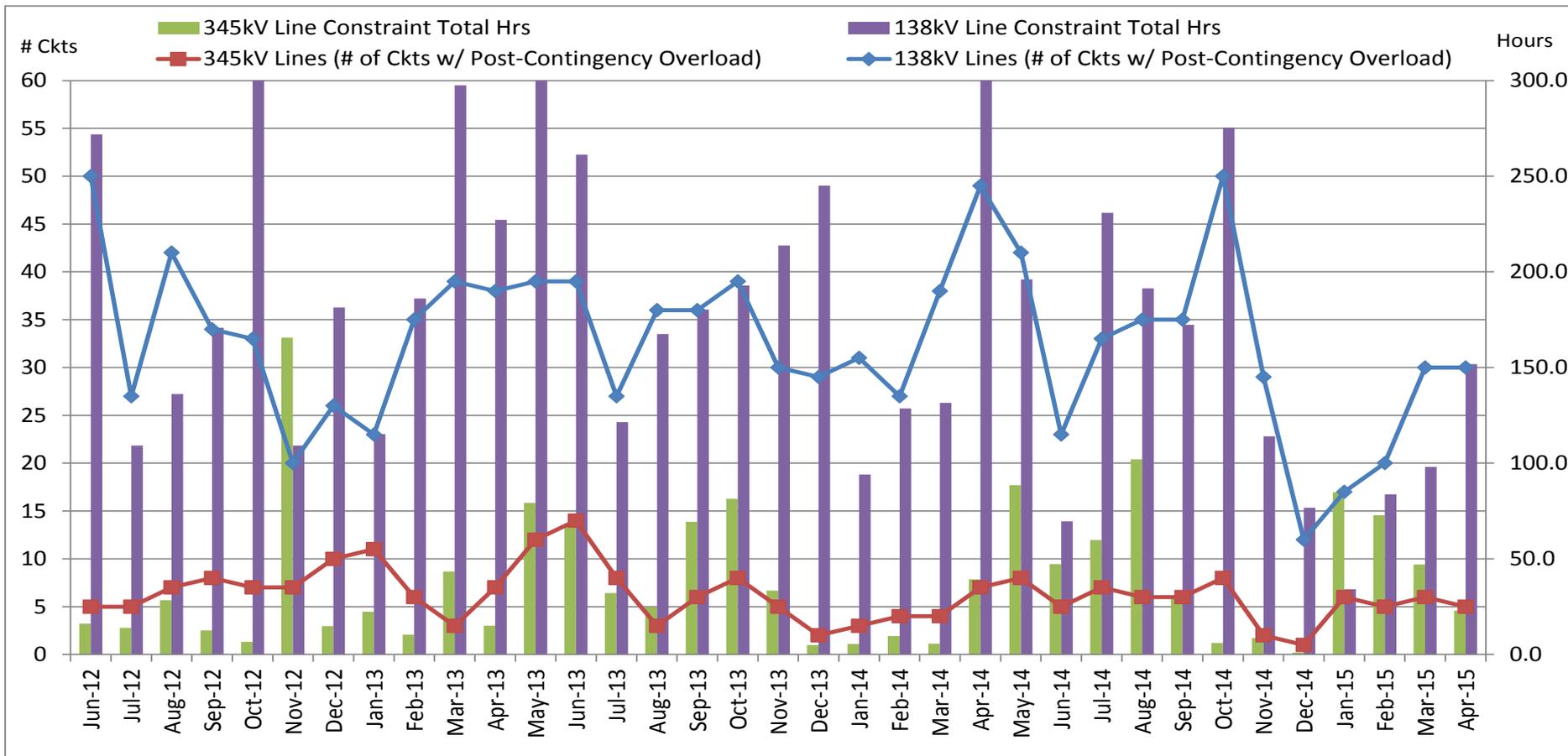
- 345kV Transmission outage rates in-line with NERC averages and showing downward trend

Voltage Control (Generation Buses) – March 2015



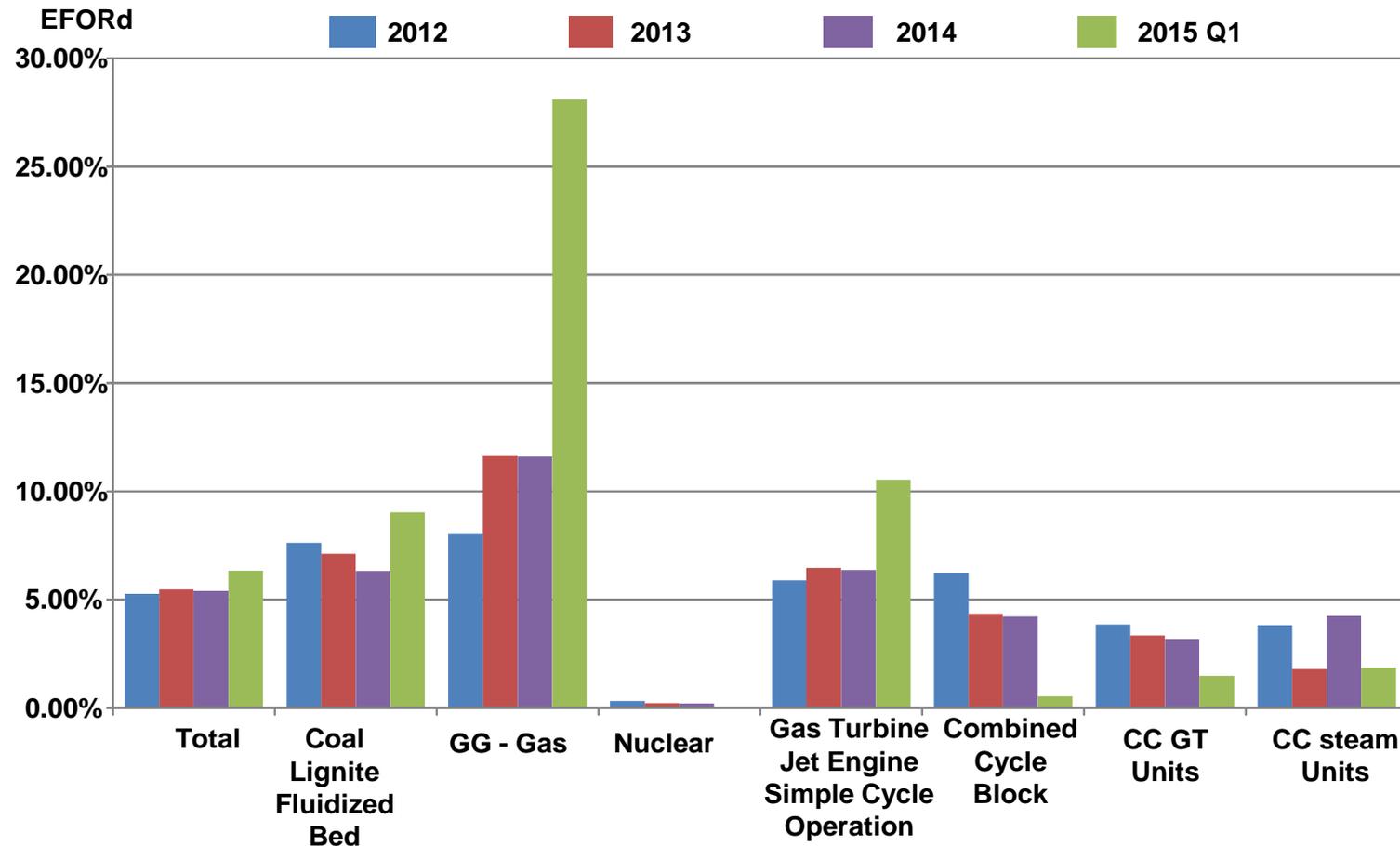
- One-minute PI data from 52 generation buses (138kV and 345kV). Includes both fossil and wind generation
- Boxes represent the 25%/75% percentiles. Leader lines show the min/max voltage during the period
- Data is normalized so that the 1.0 per-unit value represents the control point from the seasonal 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

Generation EFORd

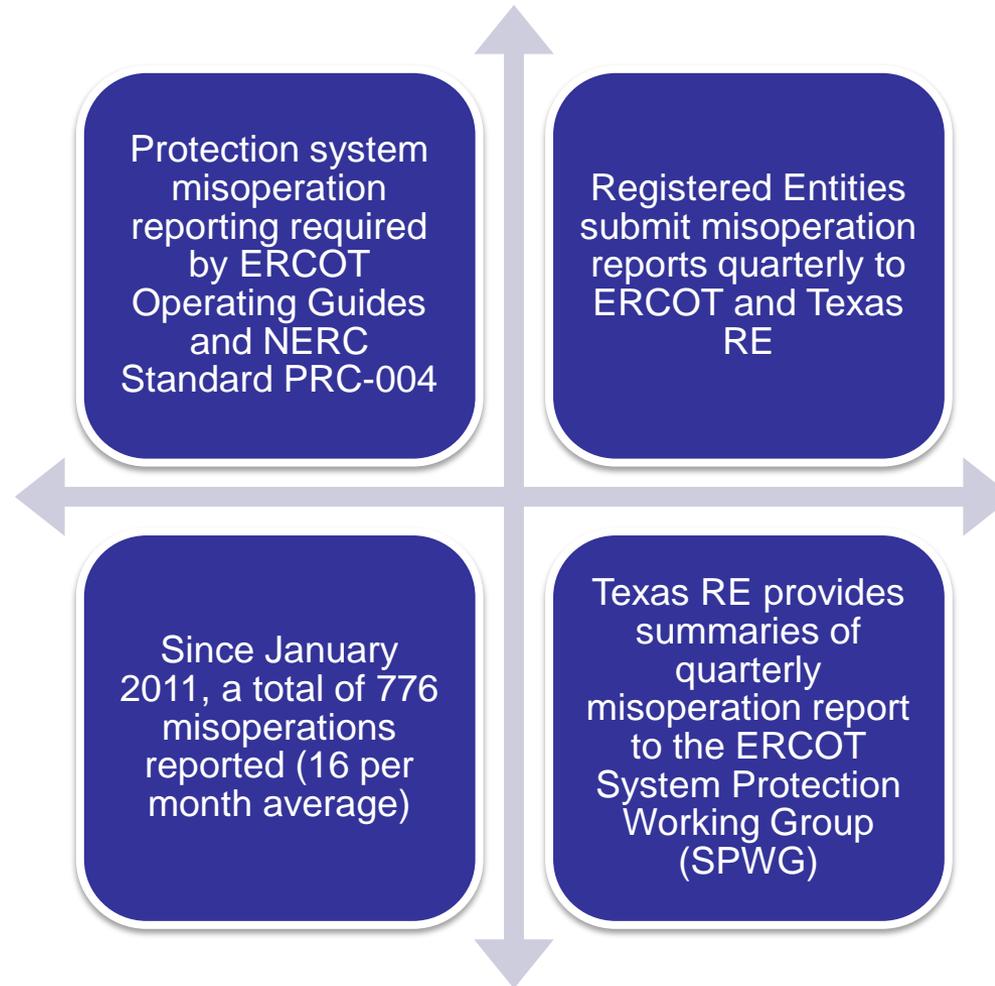


NERC 2009-2013 Fleet Avg EFORd

Fossil	8.27
Coal	7.50
Gas	10.17
Lignite	7.11
Nuclear	4.47
Jet Engine	10.78
Gas Turbine	11.40
CC Block	4.58

- 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 Misoperations – Reporting



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

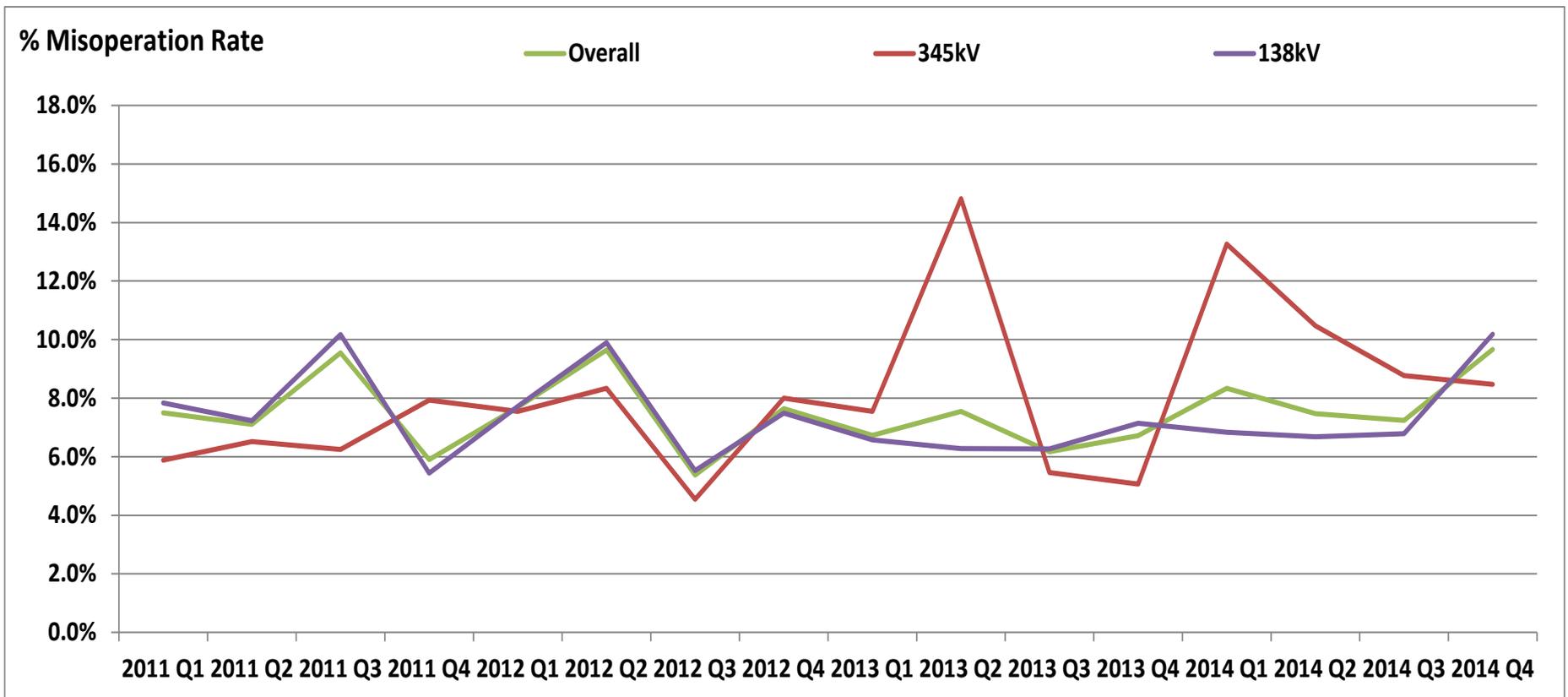
Main facilities affected

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

“Human performance” factor in 52% of misoperations

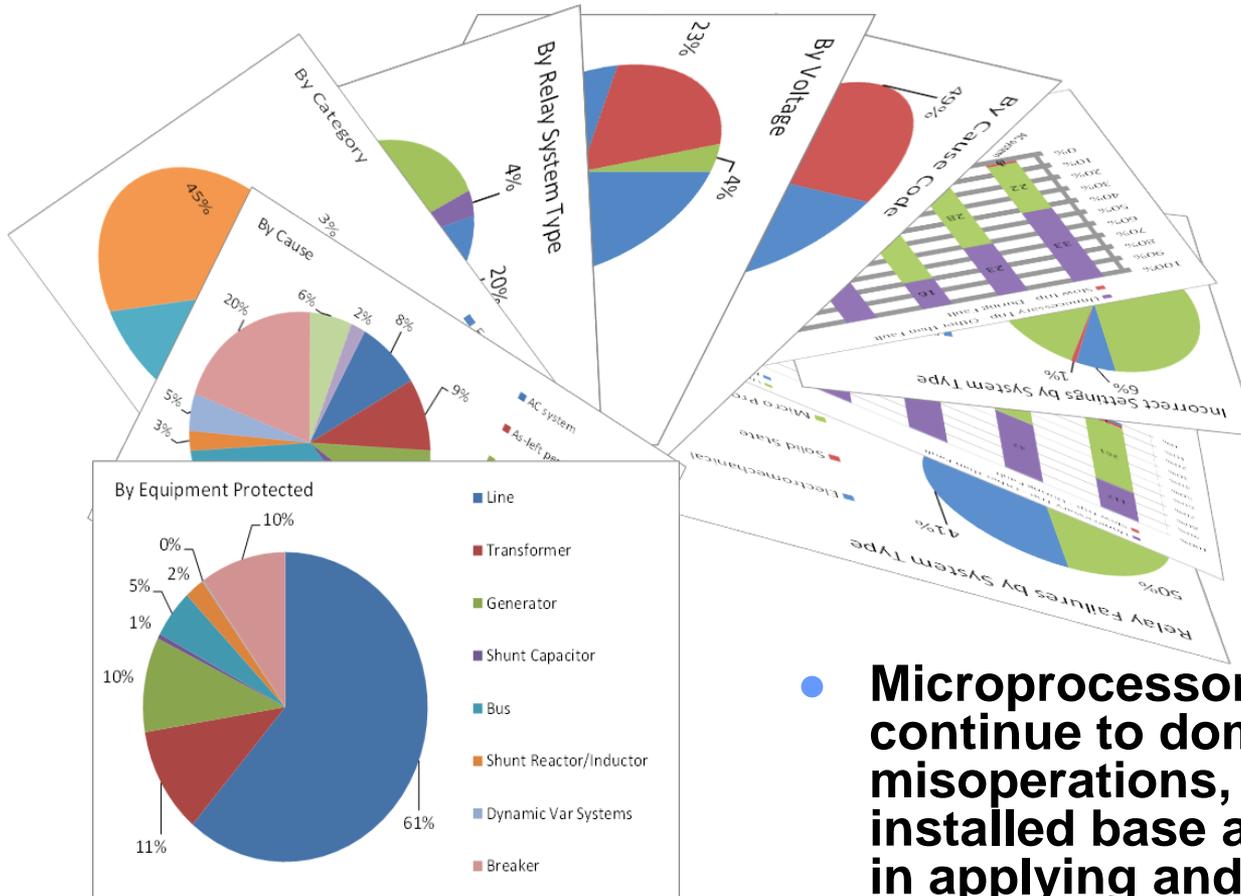
- **Field errors, engineering errors and incorrect settings**

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.

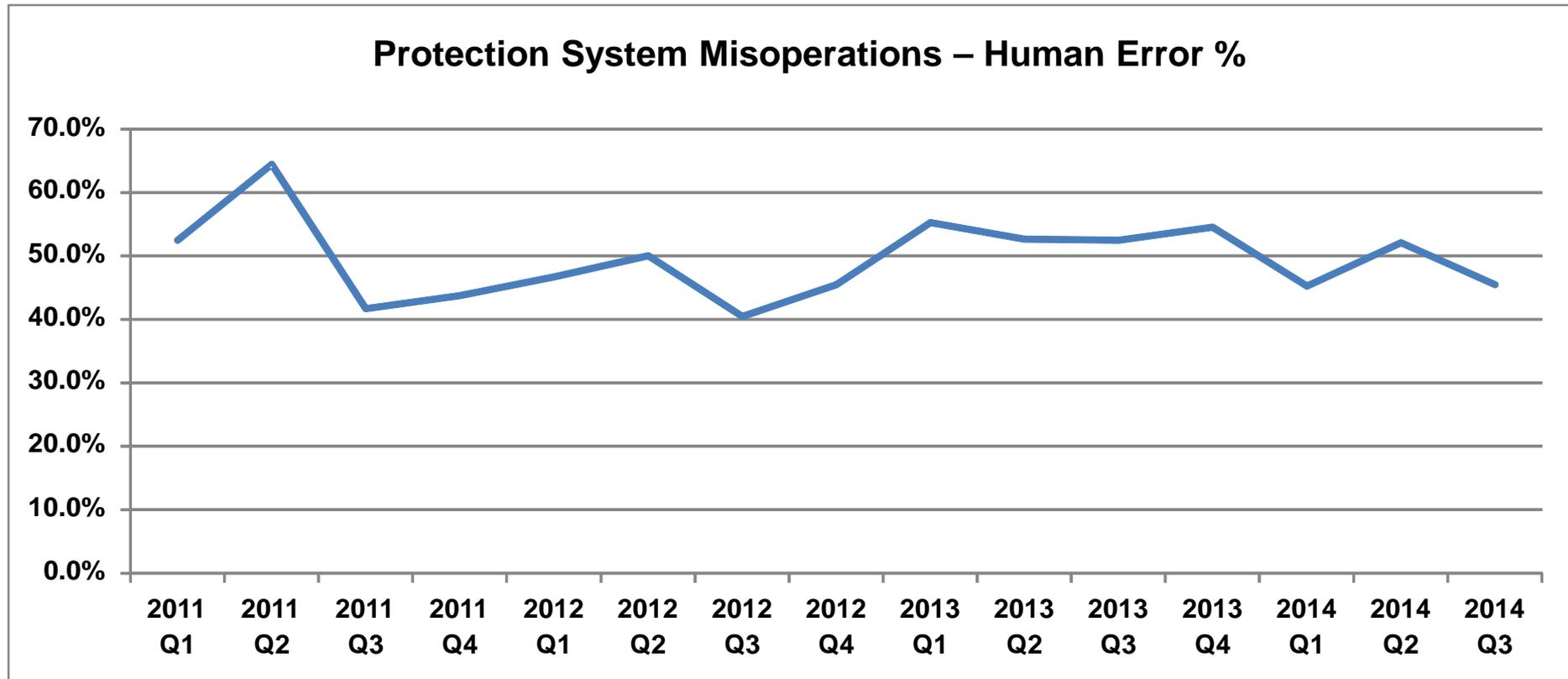
ERCOT Region Protection System Misoperation Statistics



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

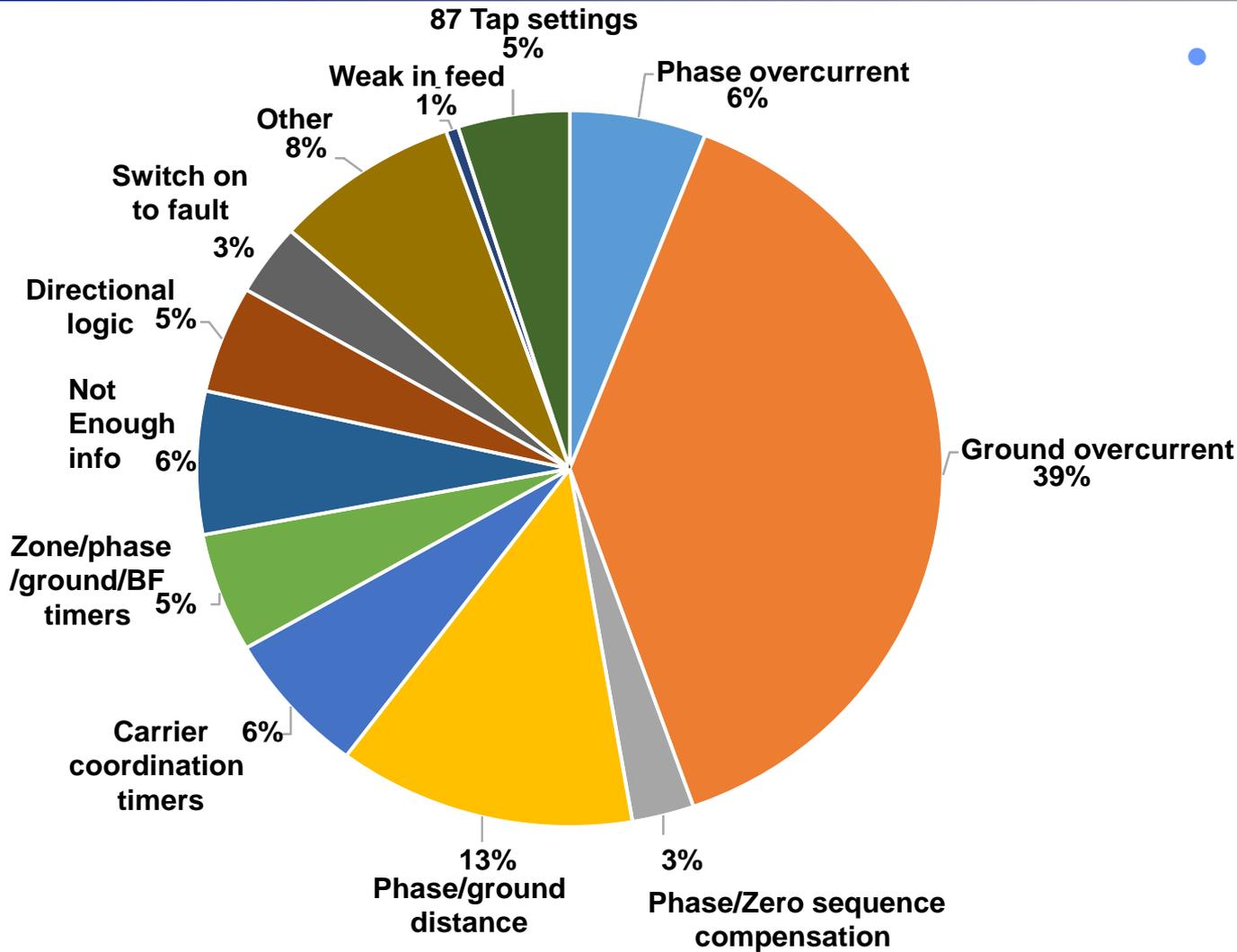
- **Microprocessor-based relays continue to dominate misoperations, with large installed base and complexity in applying and setting these devices.**

Protection System Misoperations



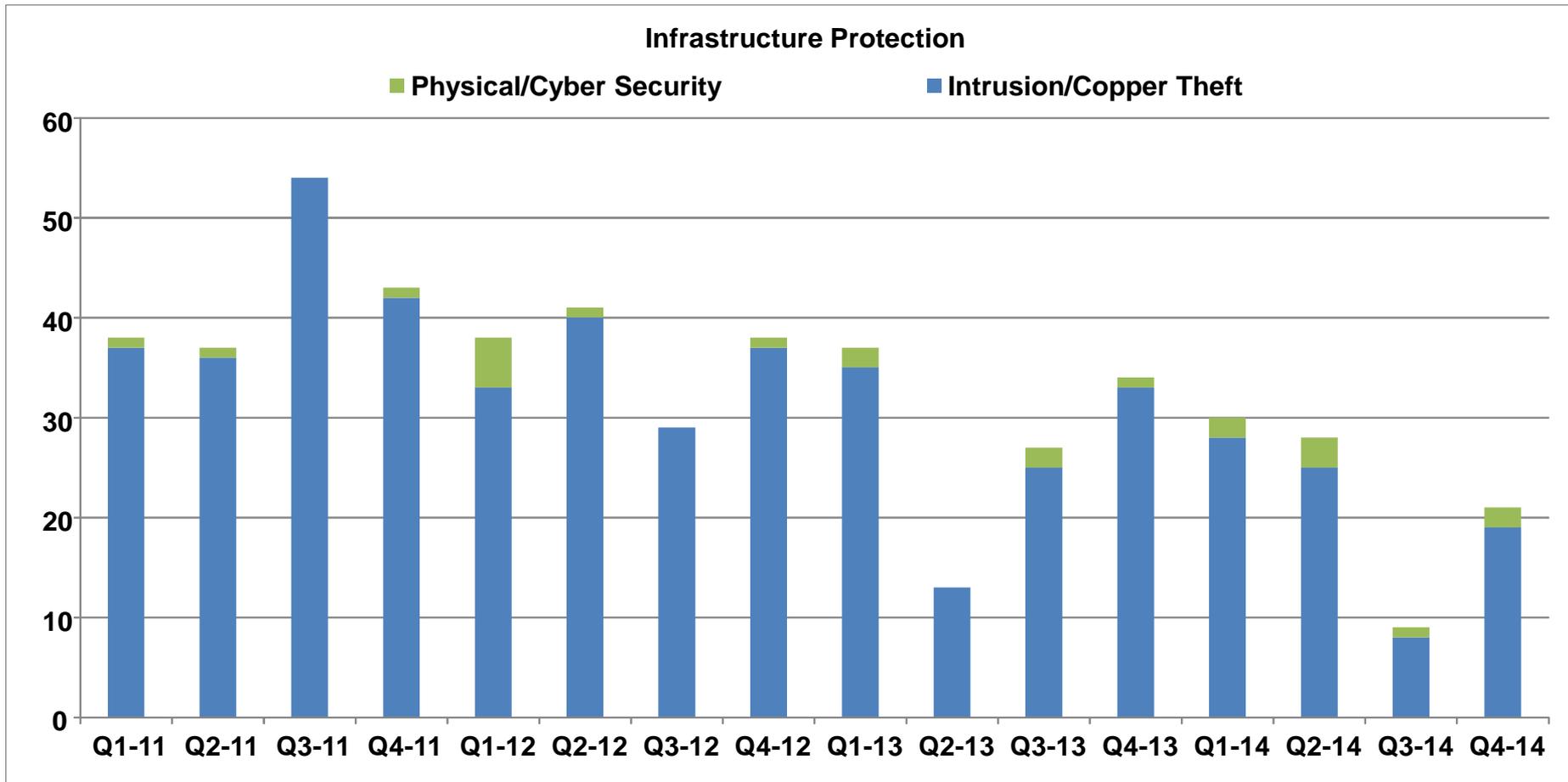
- **Percentage of Protection System Misoperations due to human factors (i.e., settings errors, wiring errors, design errors, etc.)**

Incorrect Settings - Details



- Breakdown of cause of Incorrect settings and Logic errors since 1/1/2011

Infrastructure Protection



NERC State of Reliability Report (SOR)

Annual summary

- Metrics
- Performance

Review of past year events and initiatives

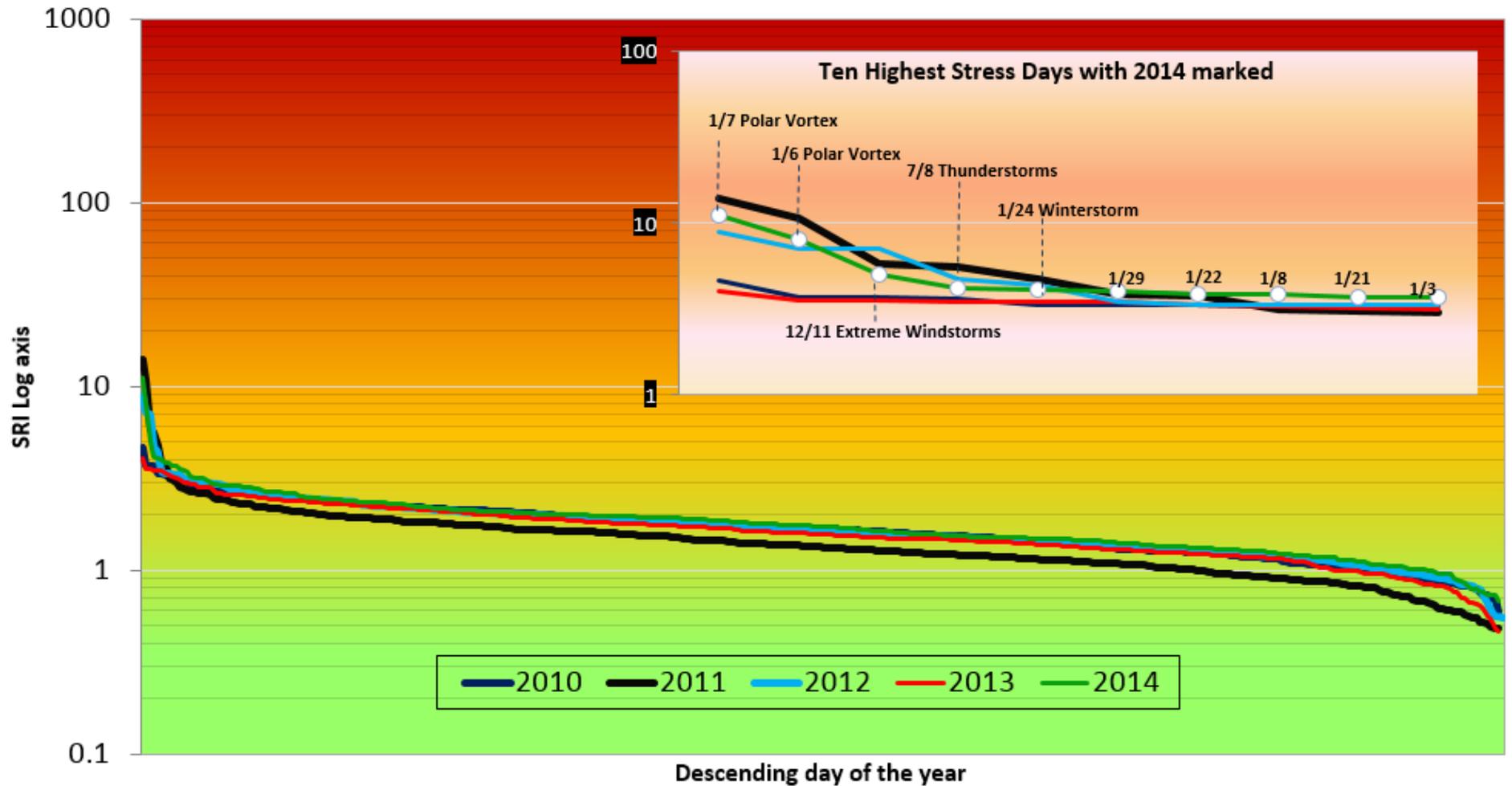
Key findings

- 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)



References

- **Texas RE Assessment of Reliability Performance**
 - <http://www.texasre.org/Reliability/Pages/Default.aspx>
- **NERC Protection System Misoperation Task Force**
 - http://www.nerc.com/comm/PC/Protection%20System%20Misoperations%20Task%20Force%20PSMTF%202/P_SMTF_Report.pdf
- **NERC System Protection and Control Subcommittee**
 - [http://www.nerc.com/comm/PC/Pages/System%20Protection%20and%20Control%20Subcommittee%20\(SPCS\)/System-Protection-and-Control-Subcommittee-SPCS.aspx](http://www.nerc.com/comm/PC/Pages/System%20Protection%20and%20Control%20Subcommittee%20(SPCS)/System-Protection-and-Control-Subcommittee-SPCS.aspx)

Questions?

