



Performance Indicators and Texas RE 2015 Assessment of Reliability Performance

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Objectives

Review performance indicators

Outline observations

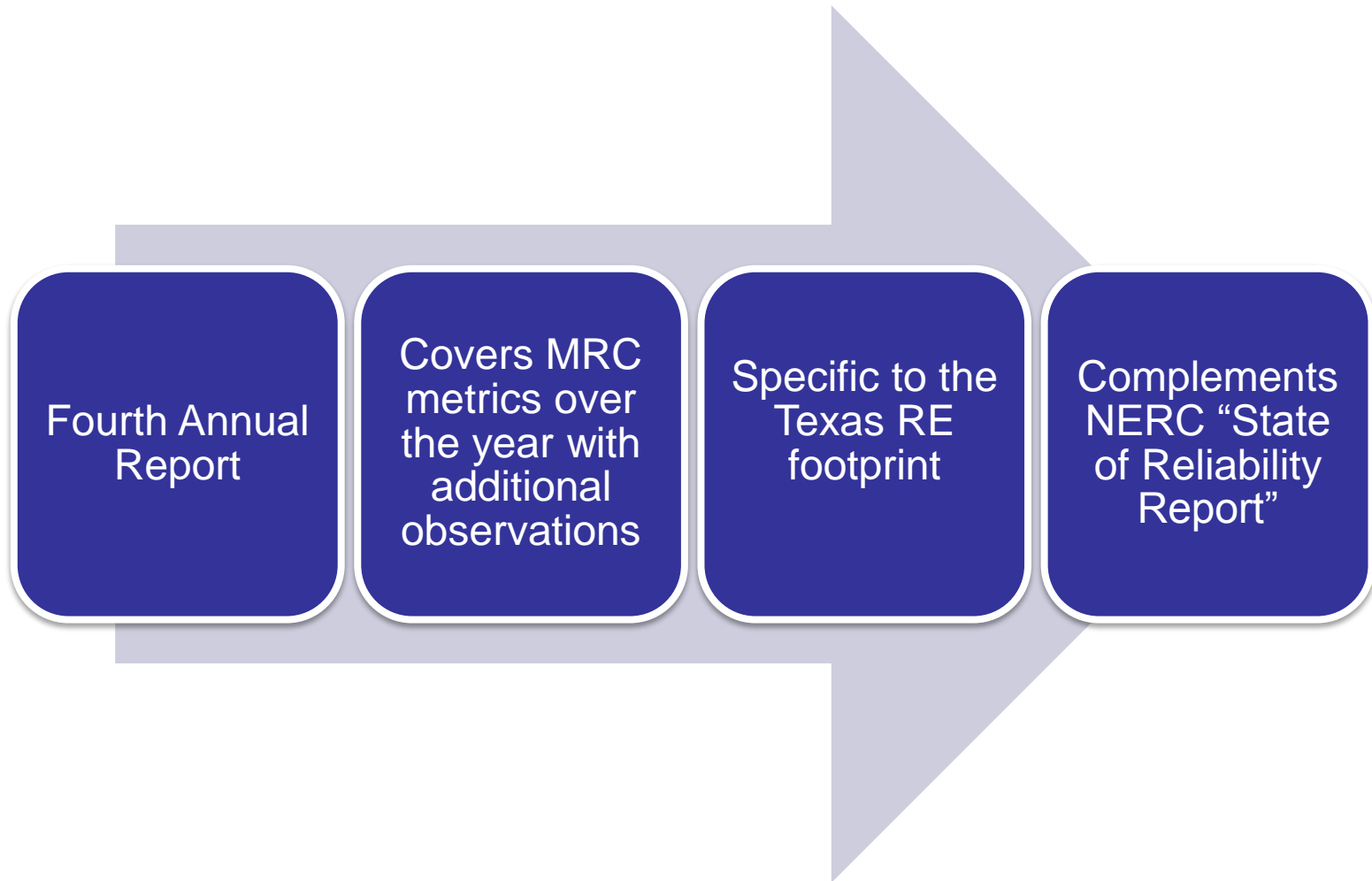
- **Texas Reliability Entity, Inc. (Texas RE) Assessment of Reliability Performance report**
- **North American Electric Reliability Corporation (NERC) State of Reliability report**

Overview follow-up activities and emerging issues

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**
- **ERCOT Market Information System (MIS) historical data**

2015 Assessment of Reliability Performance



2015 Assessment of Reliability Performance

Transmission outage rates increased in 2015 due to increase in lightning-related outages

Generation availability compares well with NERC-wide averages

Frequency control metrics – continued high levels

Primary frequency response – continued high levels

Protection system misoperation rates remain stable. However, misoperations due to incorrect settings remain an issue.

Initial data trending started for emerging reliability issues, i.e., system reactive performance, inertia, short circuit strength, ramping variability, etc.

2015 At A Glance

Record peak demand: 69,877 MW on August 10, 2015

Record wind generation: 13,883 MW on December 20, 2015

Record wind penetration: 44.7% of total energy on December 20, 2015

Control Performance Standard 1 (CPS1): 174.3 for calendar year 2015 vs. 163.3 for calendar year 2014

Frequency Response: 720.43 MW/0.1 Hz vs. NERC obligation of 471 MW/0.1 Hz

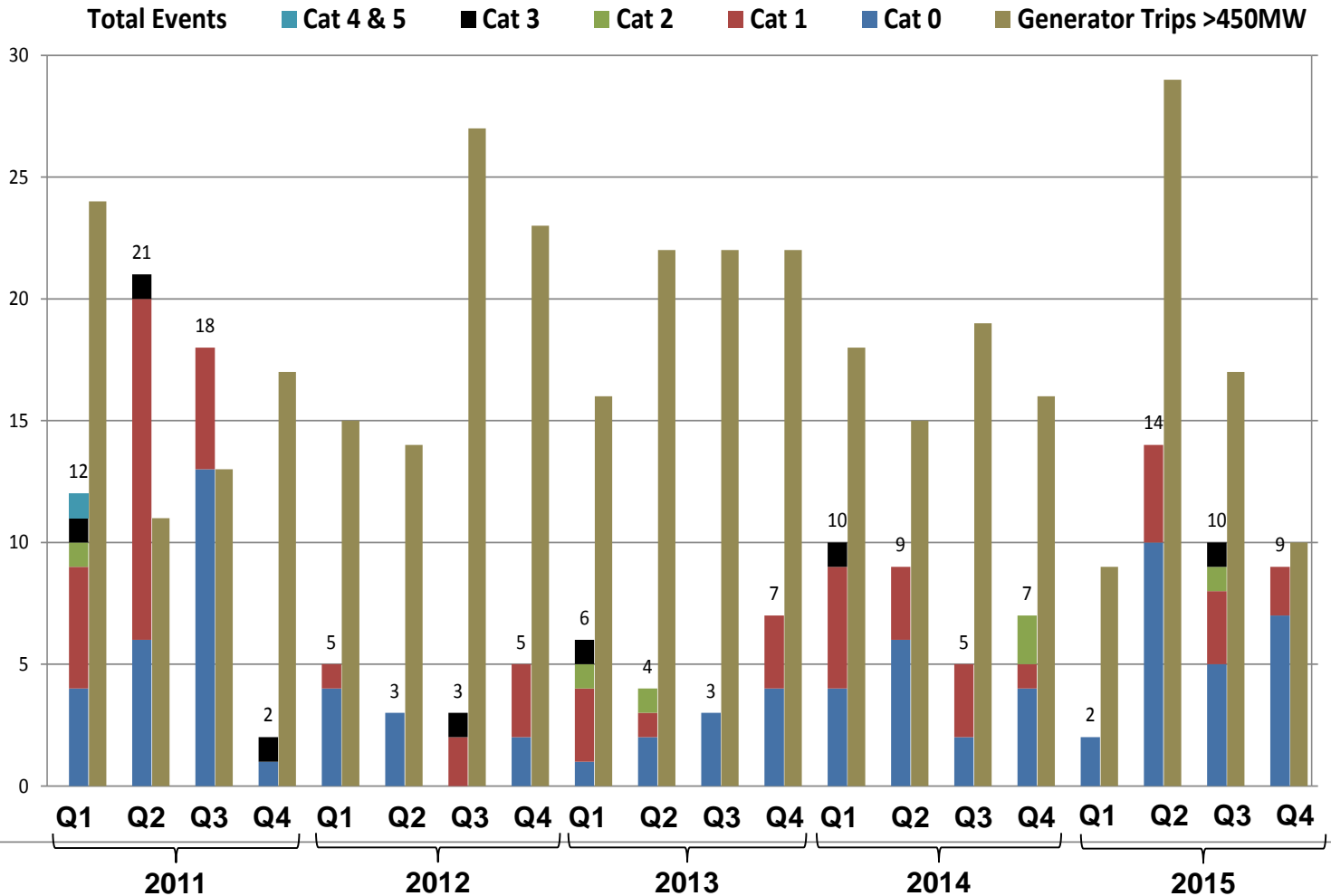
Protection system misoperation rate: 7.2% for 2015 vs. 8.7% for 2014

TADS 345 kV automatic outage rate per 100 miles: 2.99 for 2015 vs. 1.97 for 2014

GADS EFORd: 5.5% for 2015 vs. 5.4 % for 2014

System Events

Events



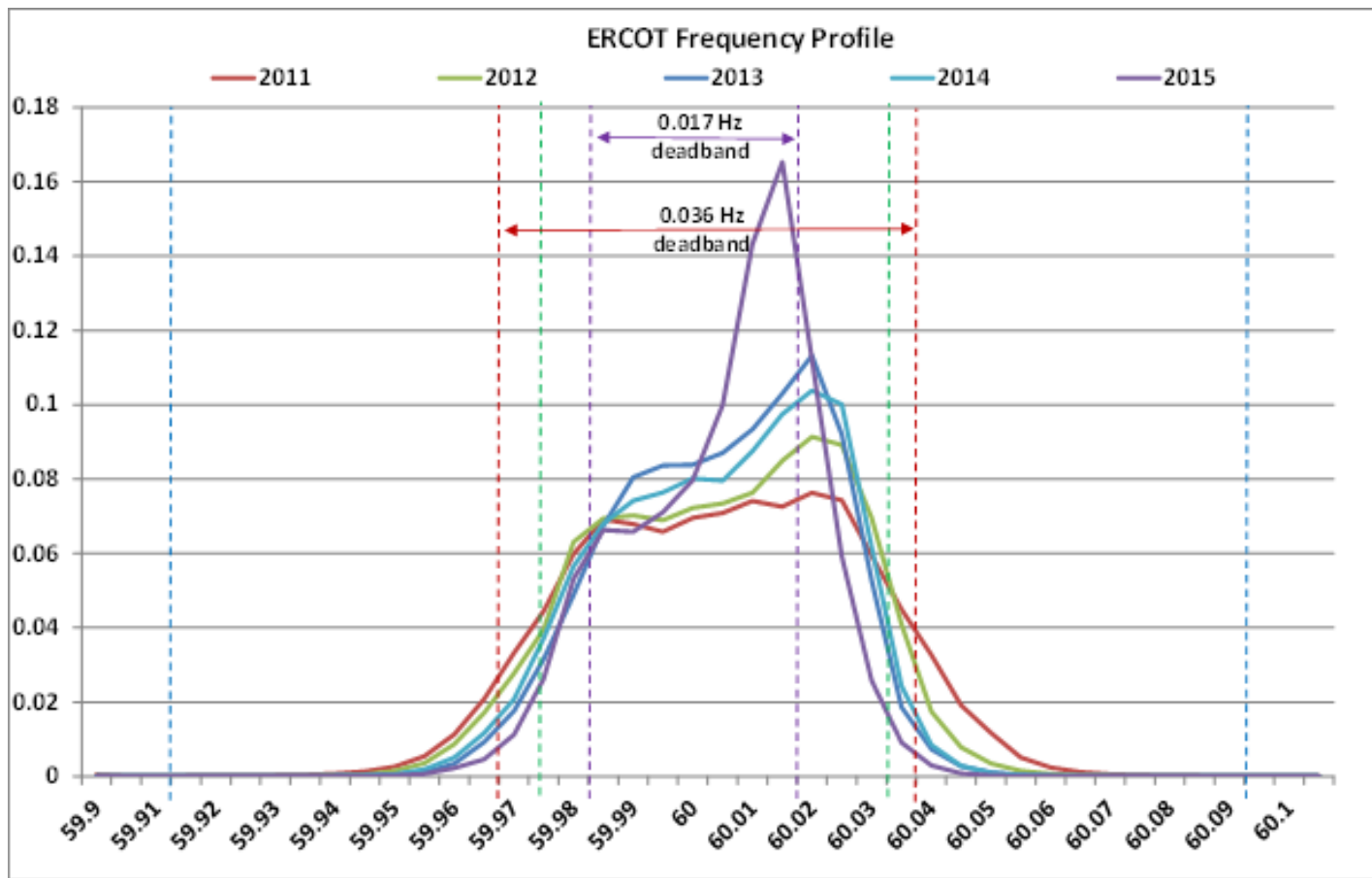
2015 Events in Brief

- Events Reported: 101
- Protection System Misoperations: 179
- Generation Forced Outages: 1,856
- 345 kV Transmission Automatic Outages: 477

Key 2015 System Events

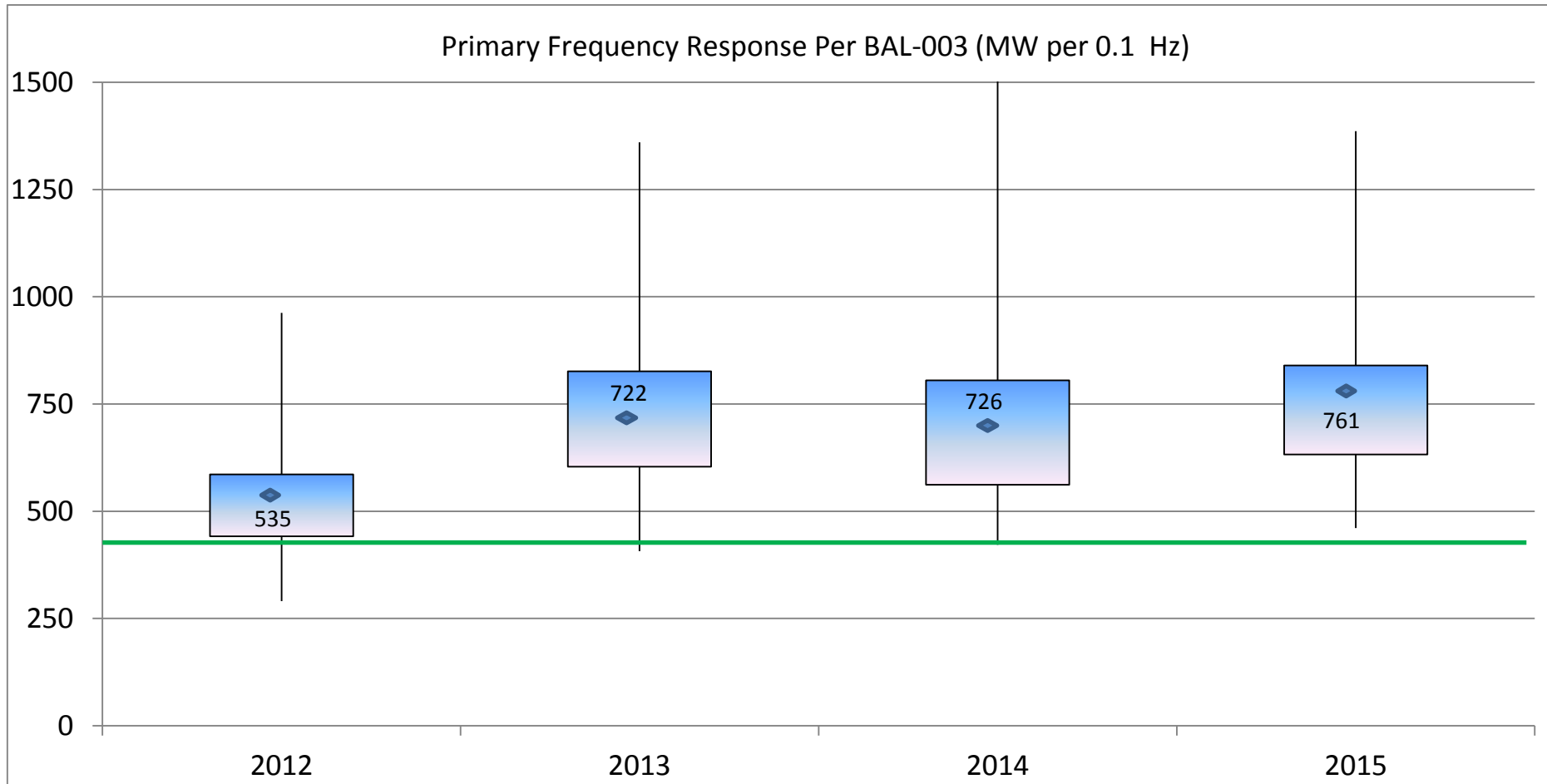
- 7/3/2015 Lower Rio Grande Valley
- 7/29/2015 Multiple generator loss > 1,500 MW

Frequency Control



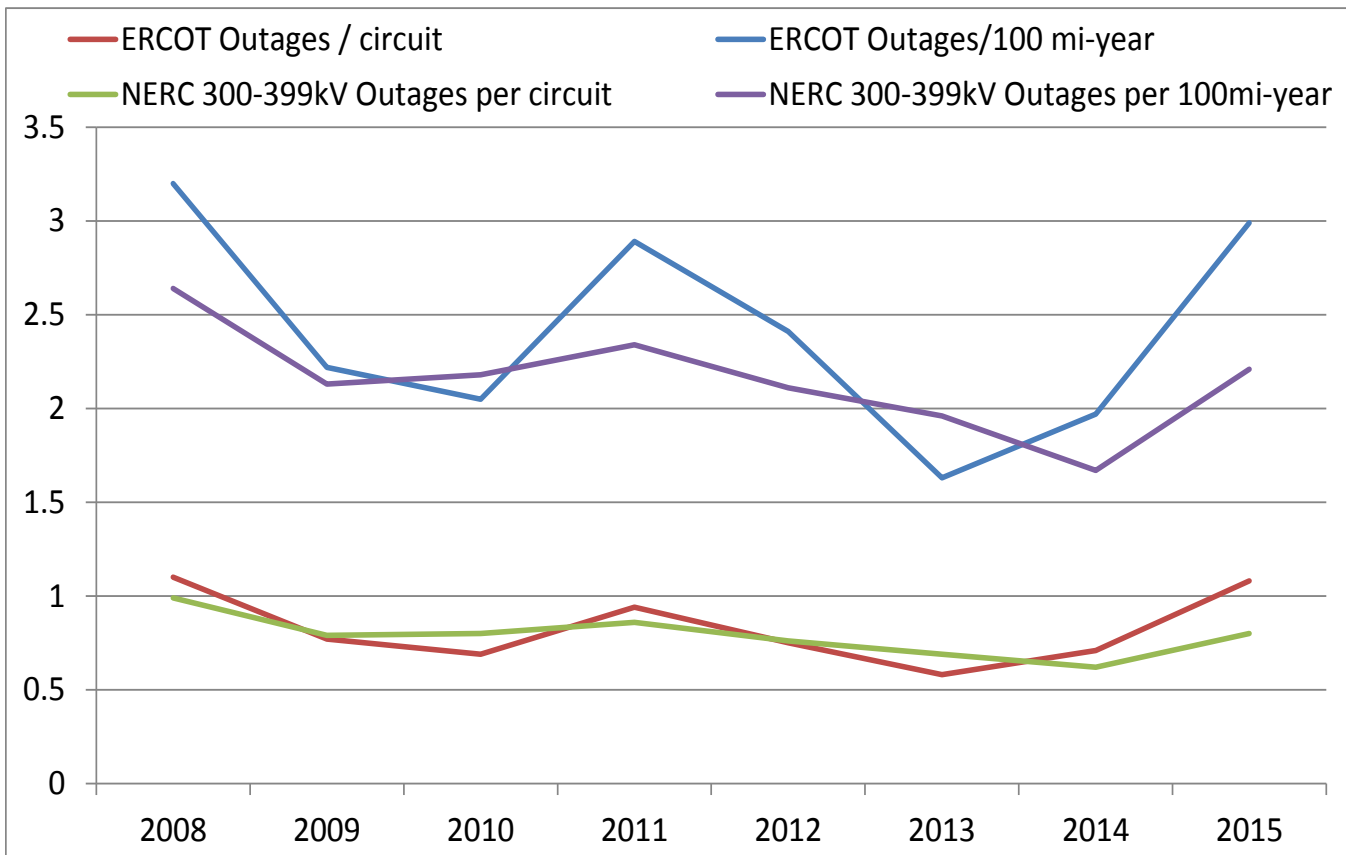
- Green dashed lines are the Epsilon-1 (ϵ_1) value of 0.030 Hz used for calculation of the CPS-1.
- Red dashed lines show governor dead-band settings of 0.036 Hz.
- Purple dashed lines show governor dead-band settings of 0.017 Hz.
- Shape of frequency bell curve continues to narrow due to number of generators implementing reduced governor dead-band settings.

Primary Frequency Response



- **2015 Average Recovery time from a generation loss event was 4.8 minutes**

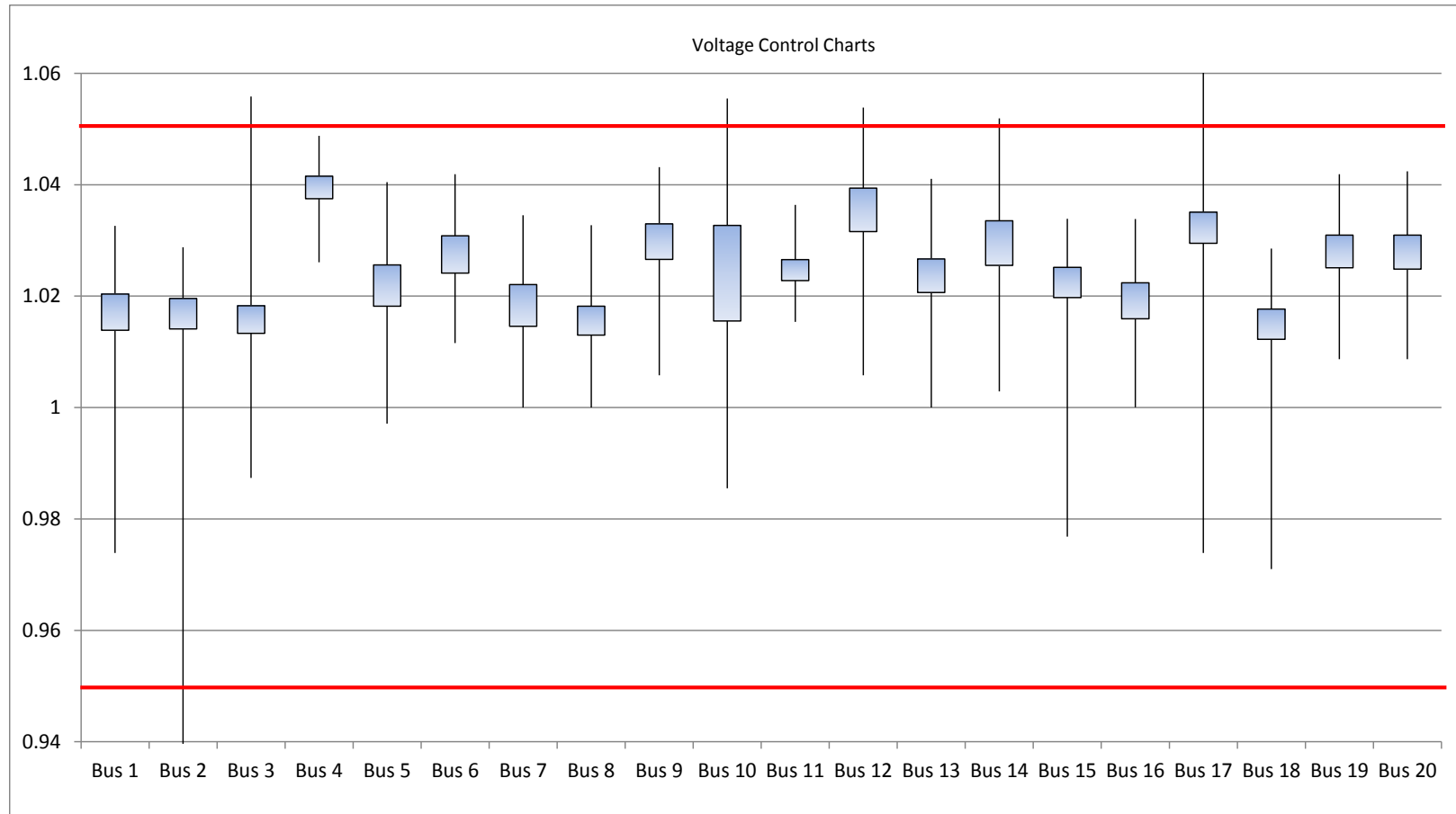
Transmission Outage Rate Trends (>200 kV)



2015 Transmission Performance in Brief

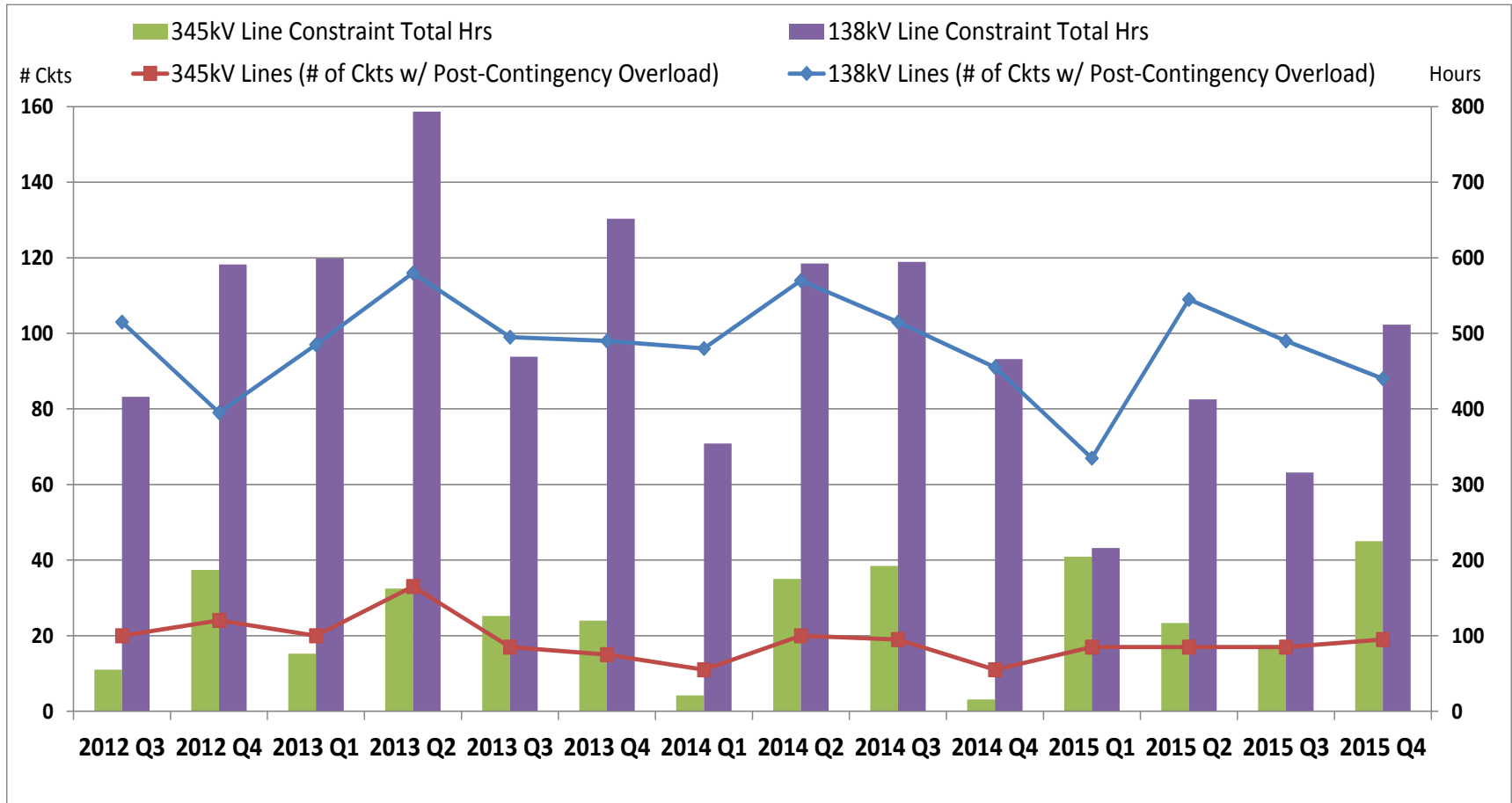
- 345 kV circuits: 413
- 345 kV circuit miles: 14,832
- 345 kV circuit Outages: 440
- 345 kV outage duration: 8,617 hrs
- 138 kV circuits: 1,705
- 138 kV circuit miles: 20,217
- 138 kV circuit Sustained Outages: 424
- 138 kV outage duration: 13,273 hrs

Voltage Control (345 kV Buses) – 2015



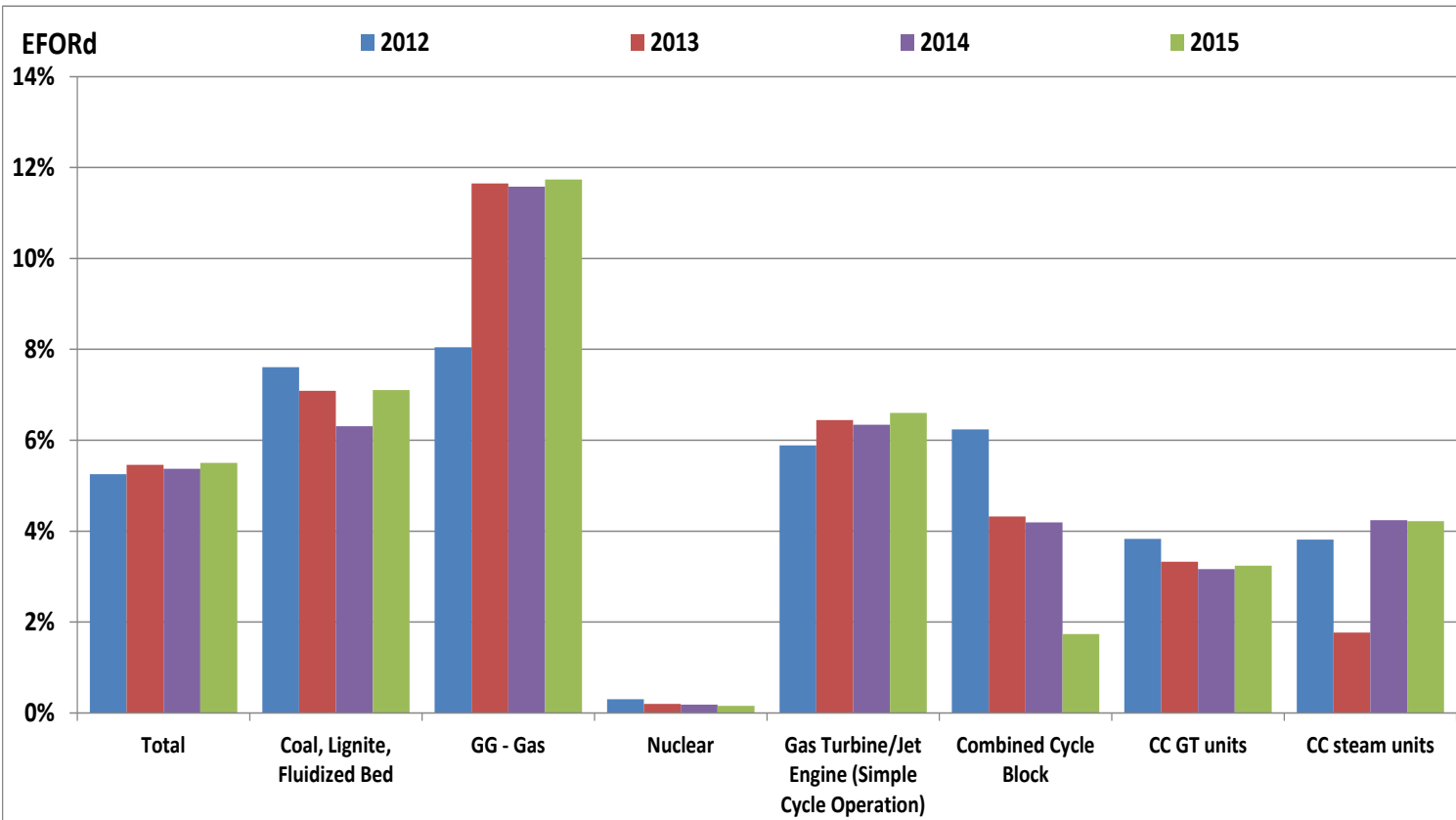
- One-hour average PI data from 20 345 kV buses important for State Estimator
- Boxes represent the 25%/75% percentiles. Leader lines show the min/max voltage during the period

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

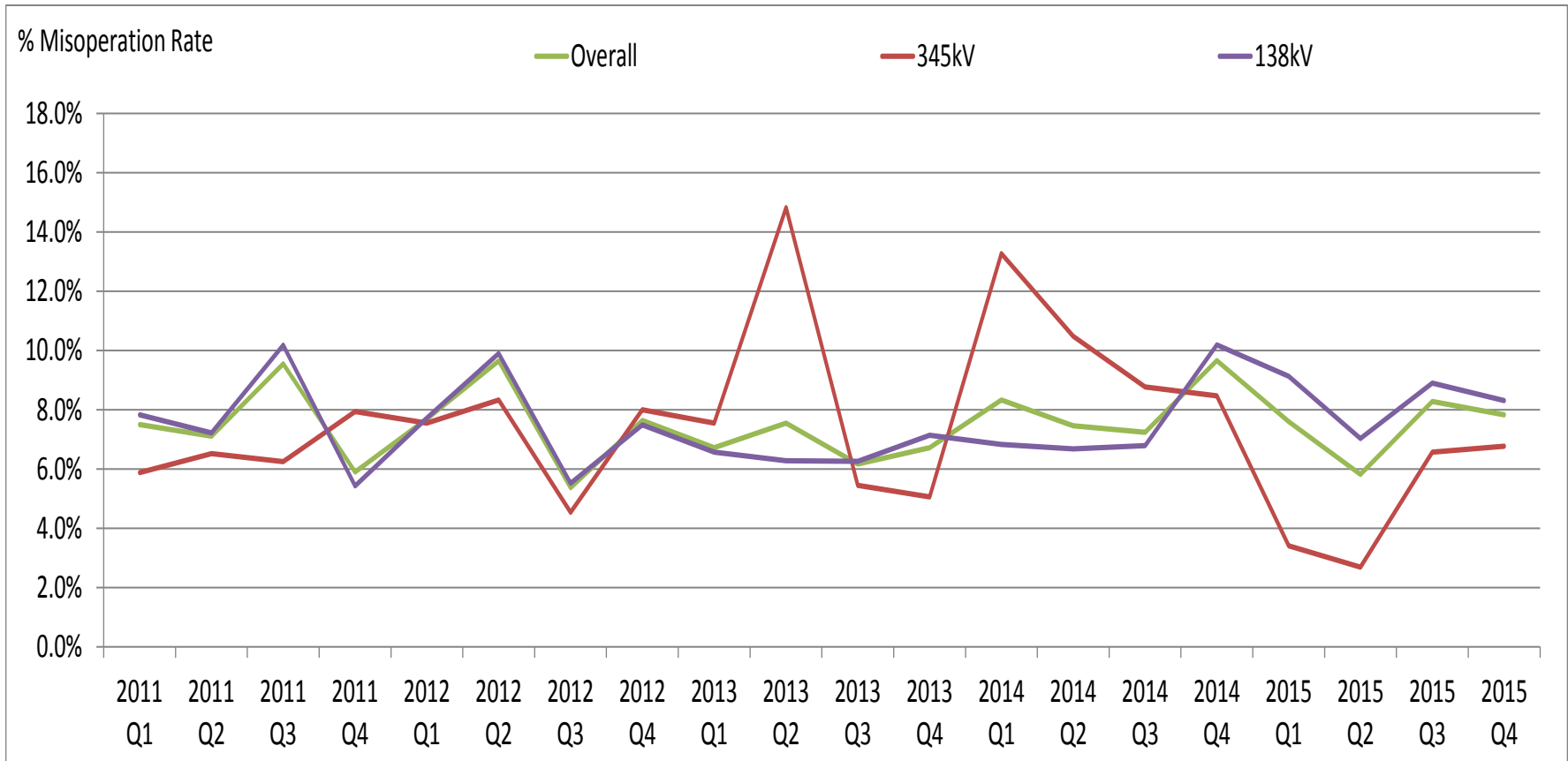


NERC 2009-2013 Fleet Avg EFORd

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

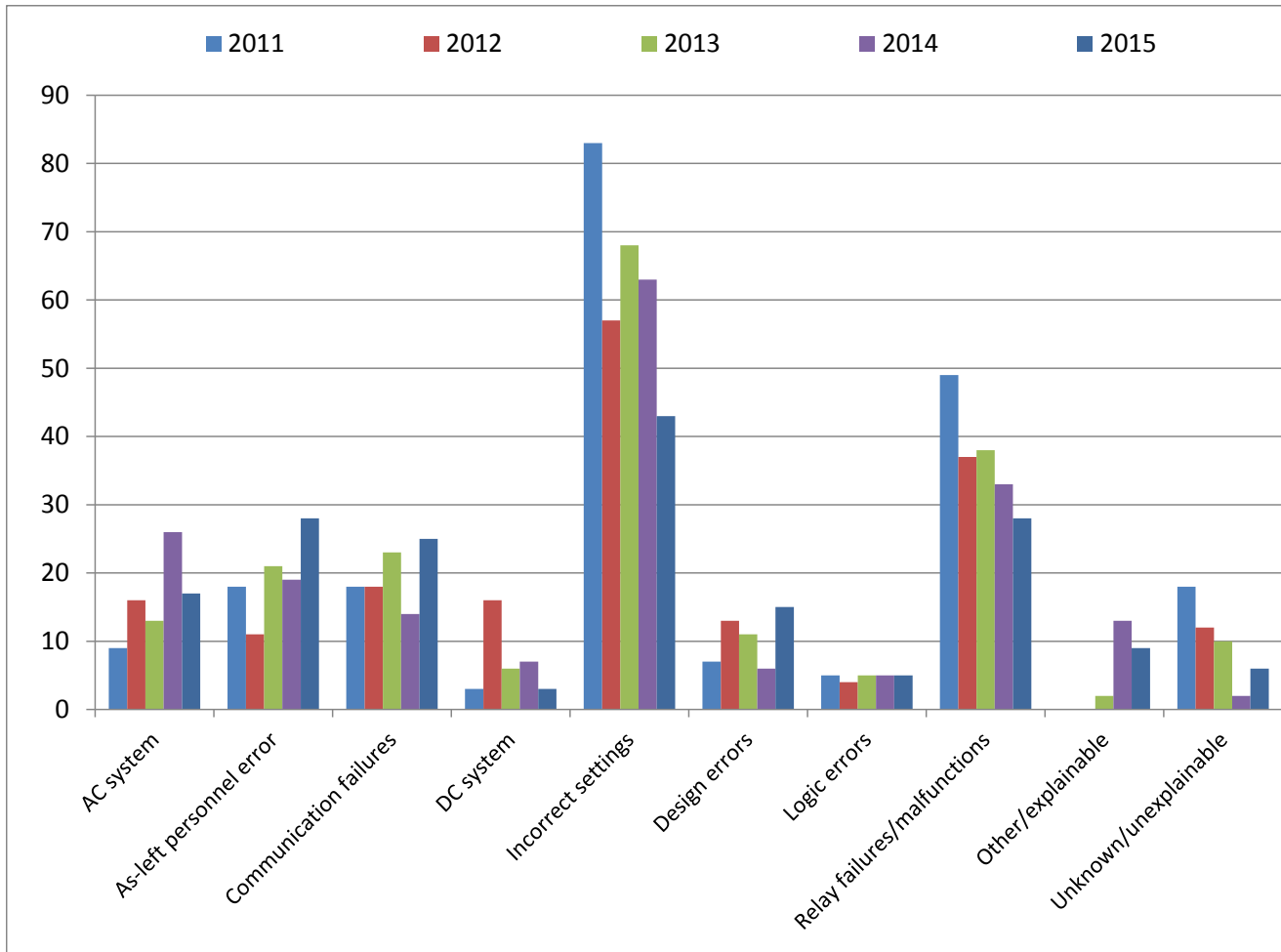
- **Equivalent Forced Outage Rate Demand (EFORd) measures the probability that a unit will not meet its demand periods for generating requirements because of forced outages or derates**
- **ERCOT units only, based on GADS submittal data (no wind, or units under 50 MW in 2012)**

Protection System Misoperations



- **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



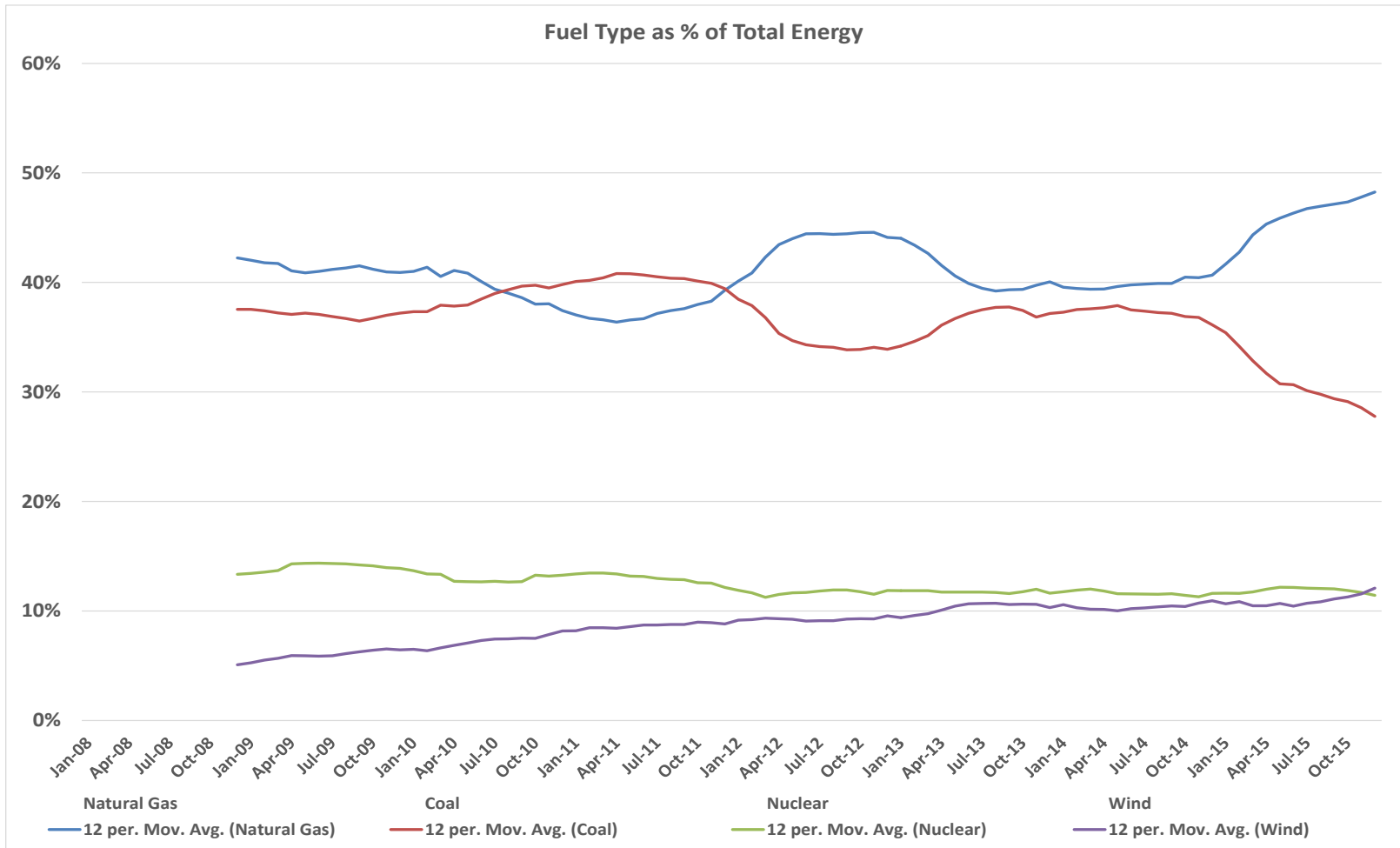
- Overall decrease in number of misoperations from incorrect settings and relay failures in 2015

Emerging Reliability Issues

NERC Essential Reliability Service Task Force's Final Measures Framework Report, December 2015:

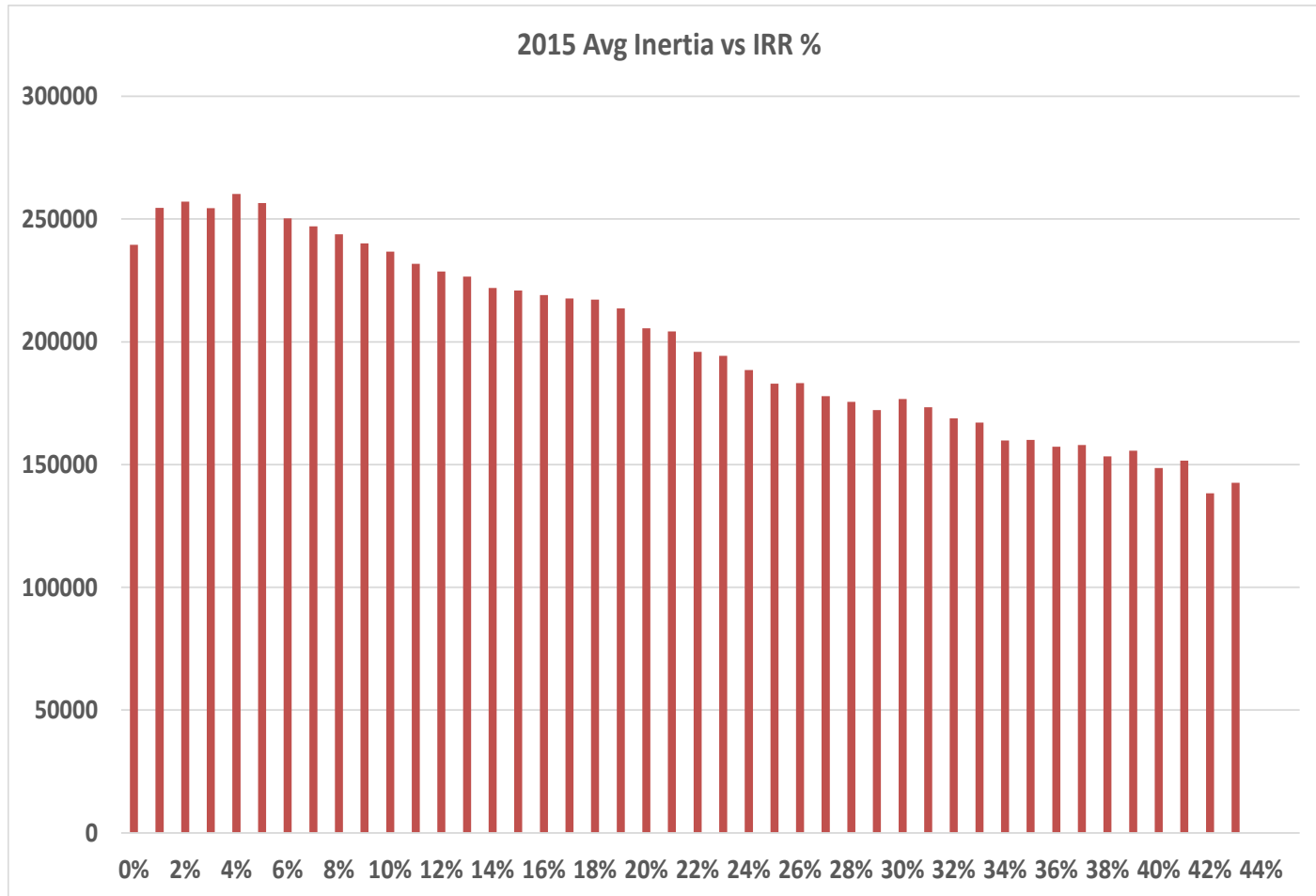
- **Measures or industry practices for:**
 - Synchronous inertial response at BA and Interconnection level
 - Initial frequency deviation following largest contingency
 - Frequency response at the Interconnection level
 - Real time inertial models
 - Net demand ramping variability
 - System reactive capability and overall reactive performance
 - System short circuit strength
- **Further examination of Distributed Energy Resources reliability coordination and contribution**

Energy by Fuel Type – Long-Term Trend



- **Wind surpassed nuclear in 2015 in total energy**

System Inertia vs. Load Served by Renewables



- Calculated from one hour average PI data

References

Texas RE 2015 Assessment of Reliability Performance

- <http://www.texasre.org/CPDL/2015%20Texas%20RE%20State%20of%20Reliability%20Report.pdf>

NERC Essential Reliability Services Task Force Final Measures Framework Report

- <http://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/ERSTF%20Framework%20Report%20-%20Final.pdf>

Questions?

