NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

2016 State of Reliability

Summary of Findings

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RELIABILITY | ACCOUNTABILITY




Key Finding #1: Misoperations

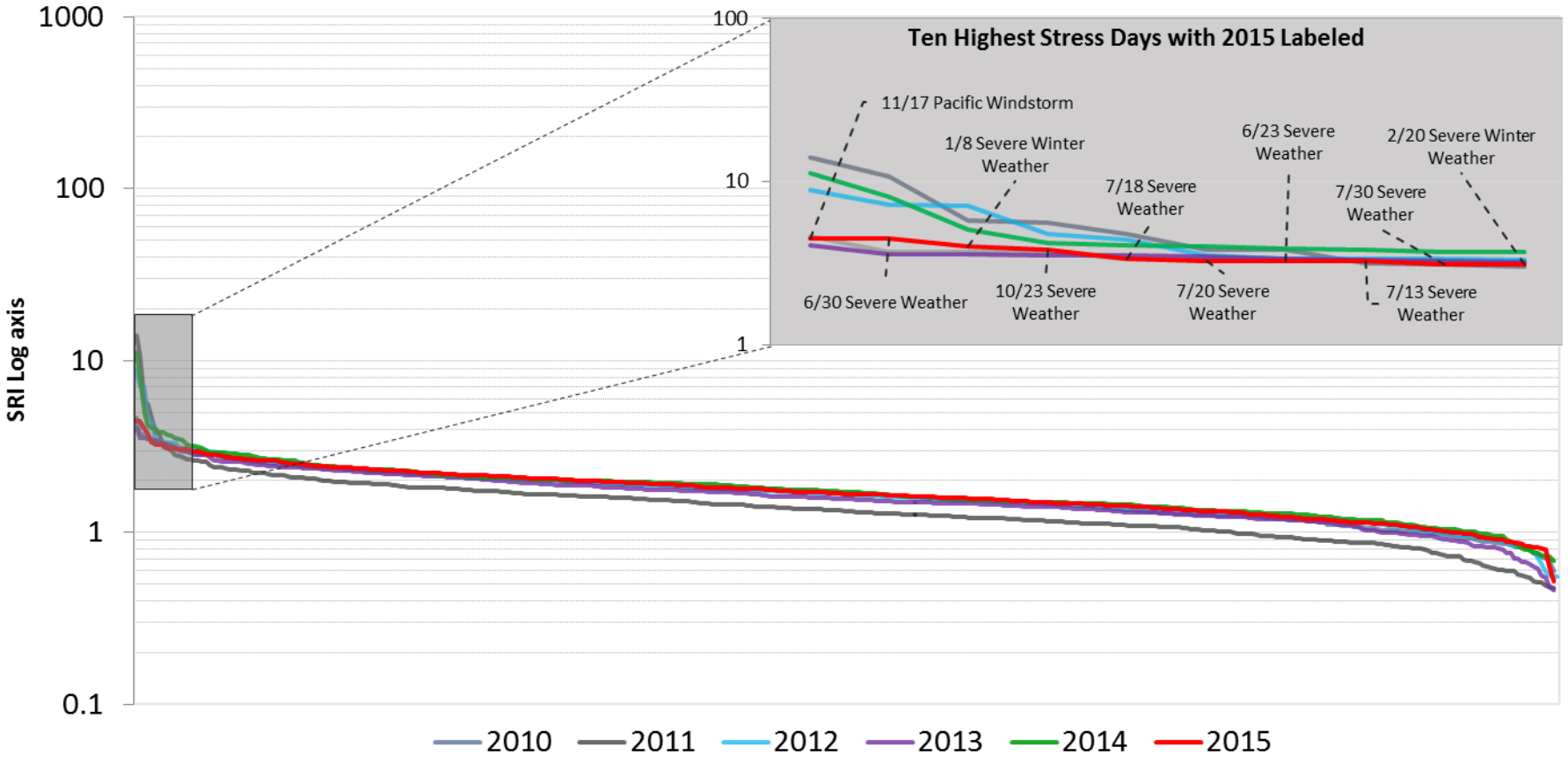
- **Reduced Protection System Misoperations**
  - Total misoperation rate (CY14 to CY15) - 10.4% to 9.4%
  - Early 2017 SOR results indicate further improvement in CY16
- **Recommendation**
  - Target the top three causes of misoperations
  - Focus on education on instantaneous ground overcurrent protection and relay system commissioning tests
- **Aggressive CY17 target(s)**
  - Threshold – less than 9%
  - (Stretch) Target – less than 8%

Key Finding #2: BPS Resiliency

- **Improved Severity Risk Index (SRI) - resiliency to severe weather**
  - No 2015 SRI days in the Top 10 (Winter 2014 has two days in the Top 10)
  - Extreme winter weather similar to 2014 in parts of the Eastern Interconnection (see 2015 Winter Review Report)[1]
- **Recommendation**
  - Consider performing daily SRI calculations on a Regional basis
  - Investigate the feasibility of correlating performance with weather data

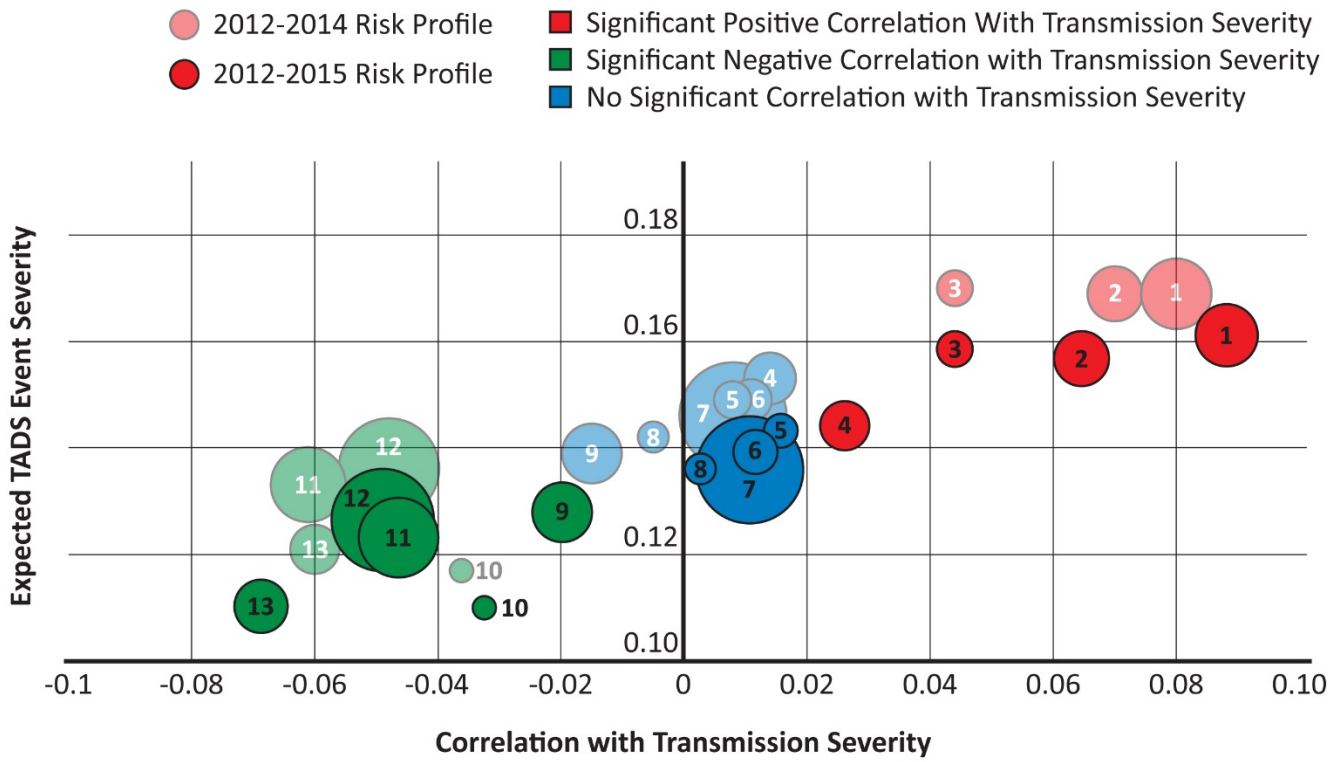
[1] http://www.nerc.com/pa/rrm/ea/ColdWeatherTrainingMaterials/2015_Winter_Review_December_2015_FINAL.pdf

BPS Resiliency to Severe Weather Improved



NERC Annual Daily Severity Risk Index (SRI) Sorted Descending

Risk Profile of Transmission Events



Misoperation	1	Lightning	7
Failed ac Substation Equipment	2	Other	8
Power System Condition	3	Failed AC Circuit Equipment	9
Human Error	4	Combined Smaller ICC Groups	10
Fire	5	Weather, Excluding Lightning	11
Contamination	6	Unknown	12
		Foreign Interference	13

Key Finding #3: Transmission Outages

- **Reduction in human error initiated outages**
  - Automatic Alternating Current (AC) Circuit Outages initiated by Human Error
    - 2015 = 0.028 per circuit
    - 2014 = 0.039 per circuit
    - 2013 = 0.047 per circuit
- **Recommendation**
  - Continue HP training and education focus
- **Enhanced CY17 activity**
  - NERC and North American Transmission Forum (NATF) to co-sponsor Sixth Annual HP Conference

Key Finding #4: Event Analysis

- **Event Analysis**
  - No Category 4 or 5 events
  - Only one Category 3 event
  - Reduction in total events of Category 2 or higher
  - Published 16 Lessons Learned
  - Significant number of registered entities that contribute to lessons learned

Key Finding #5: Modeling Improvements

- **Modeling improvements - improved blackout risk assessments**
  - Supports accurate assessment of blackout risk and other threats
  - Deploy of synchrophasor technology for dynamic model verification
  - Develop load models for dynamic studies, such as fault induced delayed voltage recovery (FIDVR)
- **Recommendation**
  - Improve system models using synchrophasors and other technologies

Key Finding #6: Essential Reliability Services (ERS)

- **ERS – Frequency Response (FR)**
  - Eastern Interconnection – Increasing trend but continued withdrawal[2]
  - Western Interconnection – Inconclusive; Insufficient candidate events
  - ERCOT Interconnection – Increasing trend
  - Québec Interconnection – Slight decreasing trend
- **Measure frequency response with changing resource mix**
- **Monitor the size of resources providing frequency response**

[2] Withdrawal of primary frequency response is an undesirable characteristic associated with certain generator control systems that negate the primary frequency response prematurely

Key Finding #6: Essential Reliability Services (ERS)

- **ERS – Voltage Support**
  - Impacts of a changing resource mix on voltage support
  - Increase in reactive-only generators for voltage support
  - Retirement of conventional generators
  - Increase in variable energy resources
- **Recommendations**
  - Monitor generator reliability that provide voltage support, including low voltage ride-through
  - Work with North American Generator Forum (NAGF) to monitor and improve ERS

Key Finding #7: BPS Security

- **BPS cyber and physical security events**
  - No load loss due to reported cyber security events
  - One physical attack that resulted in loss of approximately 20 MW
  - Increase in global cyber security vulnerabilities and incidents
  - Increase in reportable physical security events
- **Strengthen situational awareness for cyber and physical security**
- **Providing timely and coordinated information to industry**

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Summary

- Instances of protection system misoperations have decreased
  - Remains a key focus area for improvement
- Improved BPS resiliency to severe weather
  - Weather has biggest impact on grid
- Human error has decreased
  - Industry focus on Human Performance (HP) showing dividends
- No Category 4 or 5 events in 2015
  - Event severity reduced in 2015
- Frequency and voltage remained stable
  - ERS managed during resource changes
- Physical and cyber security maintained under increasing threats
  - Constant vigilance required in both areas

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Questions and Answers