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2019 State of Reliability Report

Mark G. Lauby
Senior Vice President and Chief Engineer

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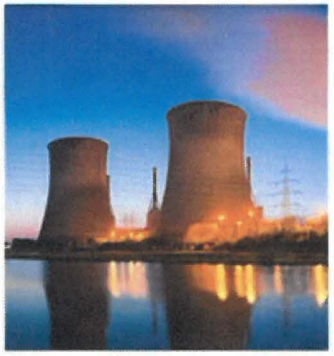

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Key Findings and Recommendations

- High Reliability in 2018, No Non-Weather Category 3, 4, or 5 events
  - Hurricane Michael and Florence Category 3
- Extreme weather events continue to be leading contributor to the largest generation and distribution outages
- Better than expected performance from Texas generation fleet helped meet 2018 summer peak demand; reliability risk in 2019 due to continued capacity deficit
- Continued downward misoperation rate trend
- Improving or stable frequency response performance in all interconnections
- Emerging reliability challenges identified as more inverter-based generation is added

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By The Numbers

4,353,740,908 MWh
2018 Actual Energy

1,028,629 MW
2018 Summer Peak Capacity

469,842 mi
Total Transmission Circuit Miles > 100kV

5,816
Number of Conventional Generating Units > 20MW

99.92%
Time with no operator-controlled load shedding

0
Category 3, 4, or 5 Events (non-weather related)

The ERO Enterprise: NERC and 7 Regional Entities

FRCC · MRO · NPCC · NERC · RELIABILITY FIRST · SERC · TEXAS RE · WECC

15	Reliability Coordinators	**4**	Interconnections
184	Transmission Operators	**991**	Generator Owners
73	Balancing Authorities	**398**	Distribution Providers

Bulk Power System Situation Awareness Inputs and Products in 2018

2,963 Intelligent Alarms

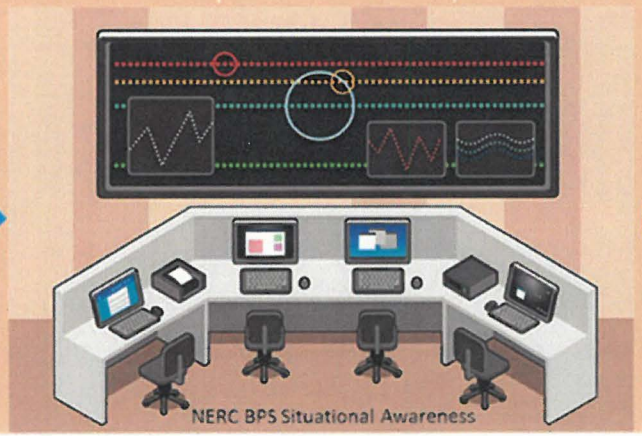
4,239 FNet Notifications

1,855 RCIS Messages

233 DOE OE-417 Reports

459 EOP-004-3 Reports

2 EOP-002-3 Reports



255 Daily Reports

5 Special Reports

0 Level 1 Alert

1 Level 2 Alerts

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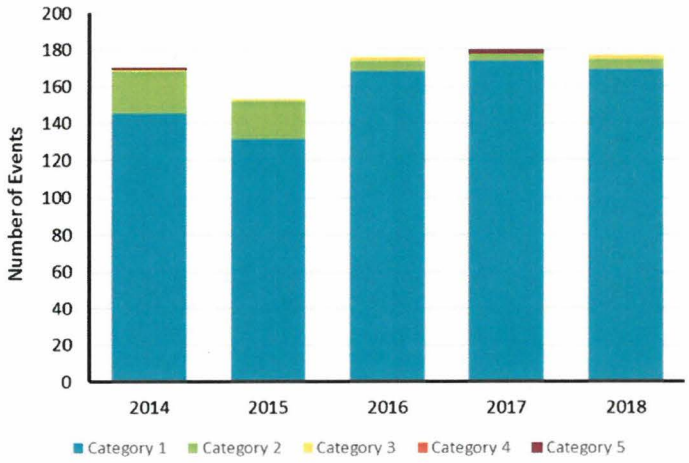
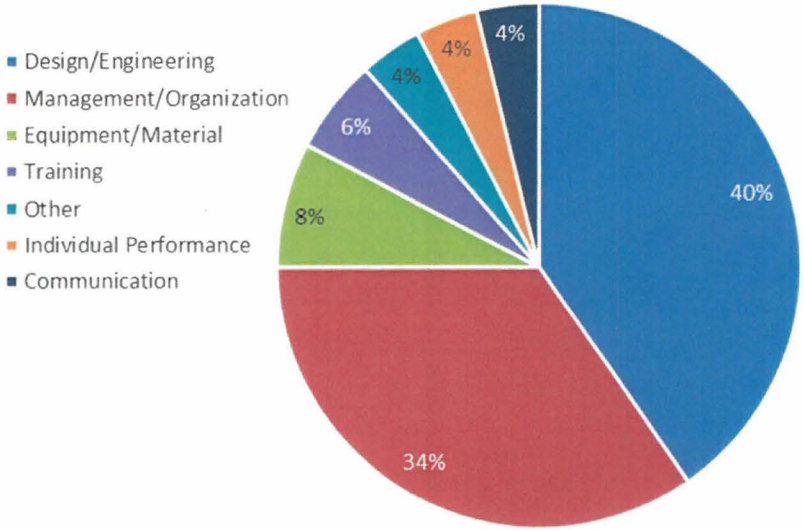
Event Analysis (2018, Trends, Causes)

Category 1	169	56 — 3 or more BPS facilities lost (1a) 7 — BPS SPS/RAS Misoperation (1c) 1 — Voltage reduction > 3% (1d) 3 — Unintended loss 1,000-1,999MW in ERCOT (1g) 102 — EMS (1h)
Category 2	6	4 — Unintended loss of load (2f) 2 — IROL Violation
Category 3	2	Hurricane Michael Hurricane Florence
Category 4	0	
Category 5	0	





2014-2018 Event Analysis Trends

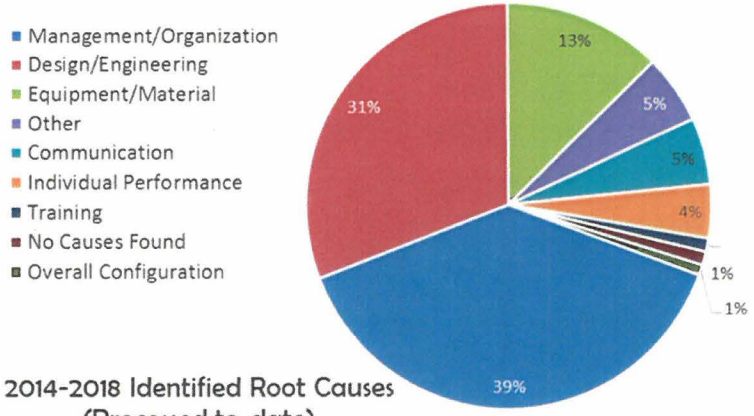
2014-2018 Event Analysis Trends

856 Event Reports

378 Identified Root Causes

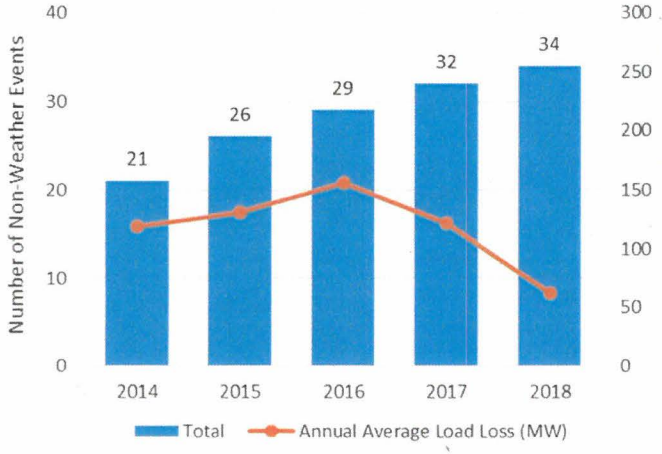
116 MW

Overall (Five-Year) Average Load Loss of Non-Weather Driven Events with Load Loss

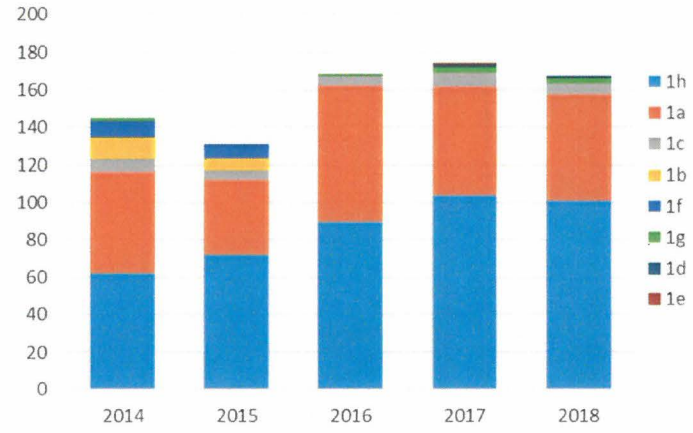


2014-2018 Identified Root Causes (Processed to-date)

Number of Non-Weather Events with Load Loss and Annual Average Load Loss



Total Category 1 Events by Year and Subcategory



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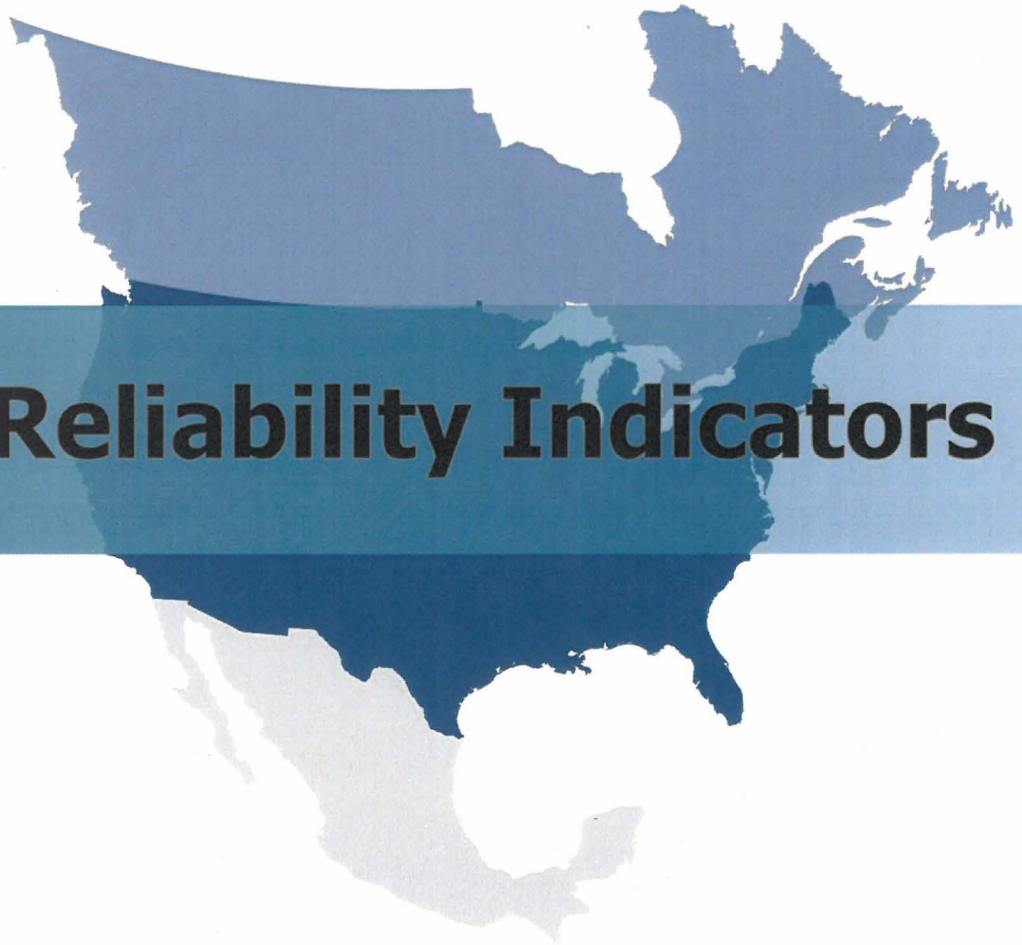

Reliability Indicators

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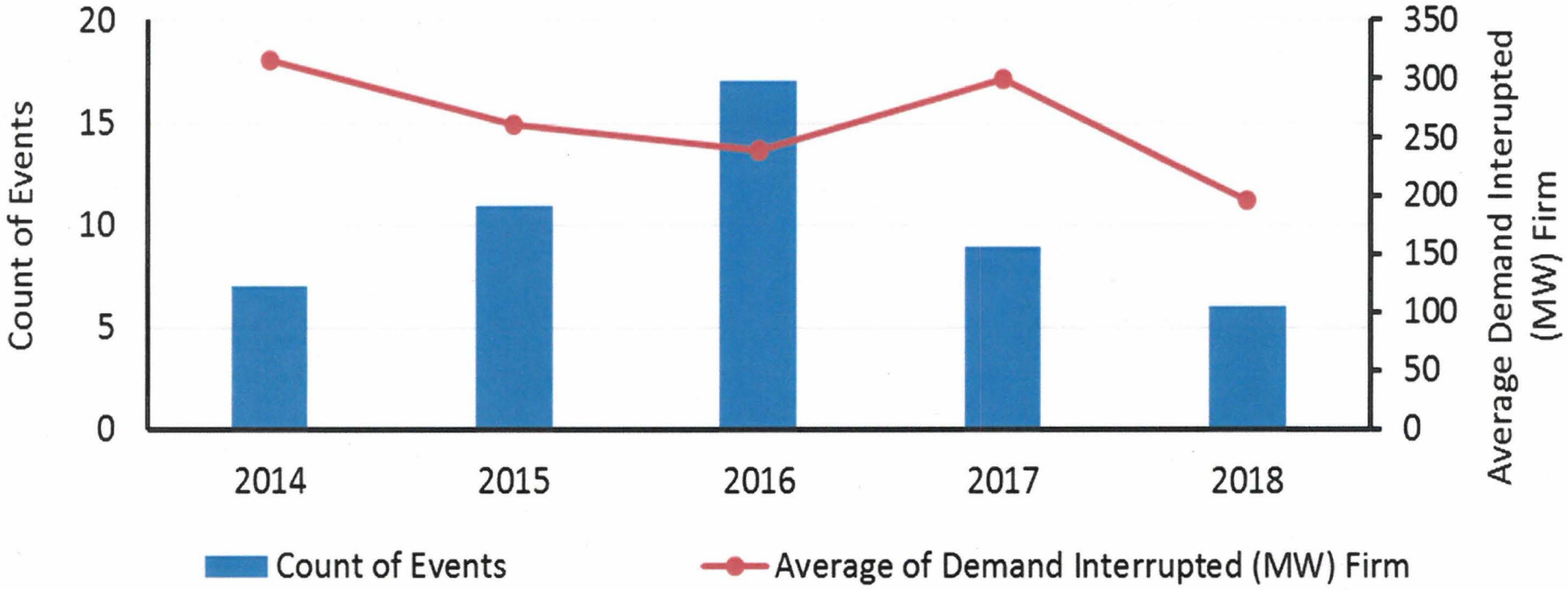
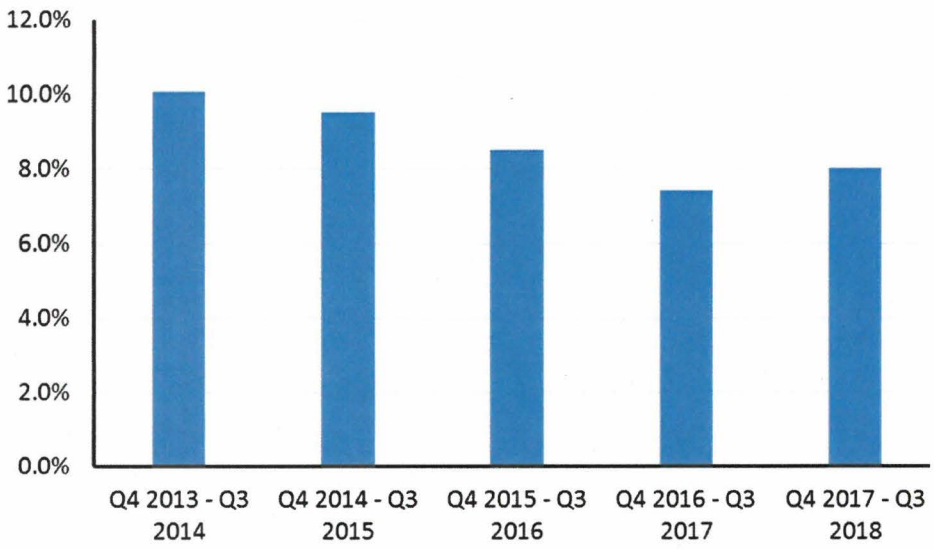
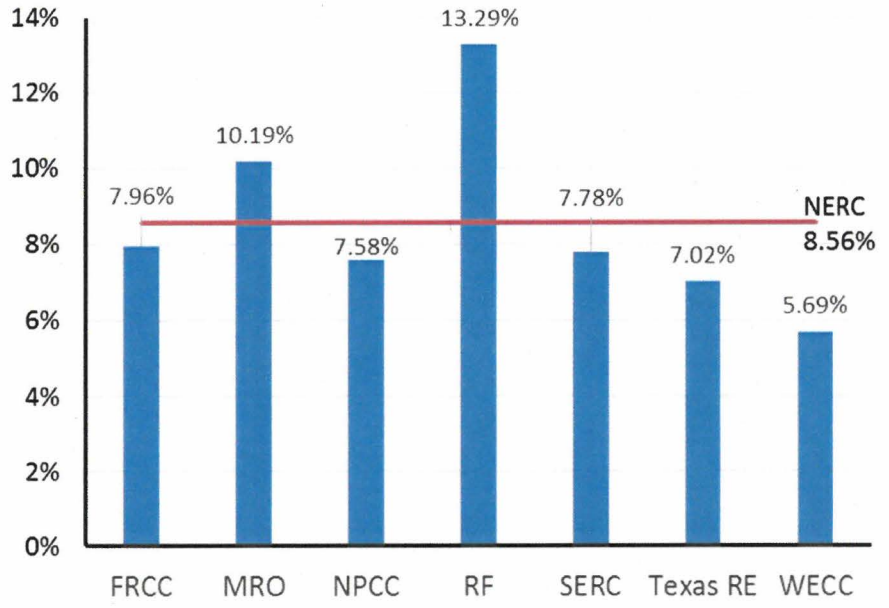
Reliability Indicator – Transmission Related Events Results in Loss of Load



Reliability Indicator – Protection System Misoperation Rate



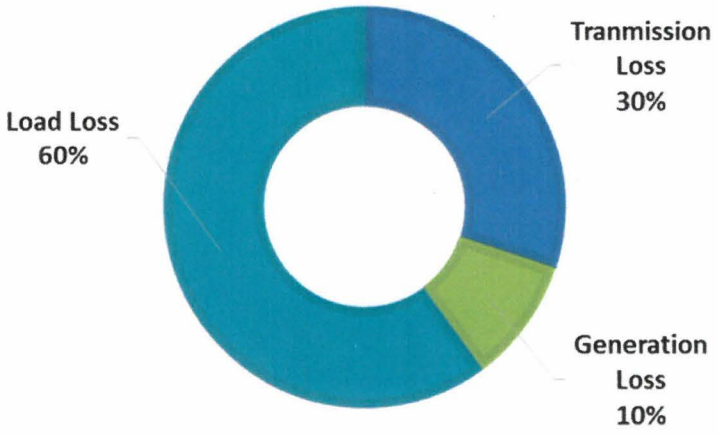
Annual Protection System Misoperation Rate



Five-Year Protection System Misoperation Rate by Region

Q4 2013 through Q3 2018

Severity Risk Index



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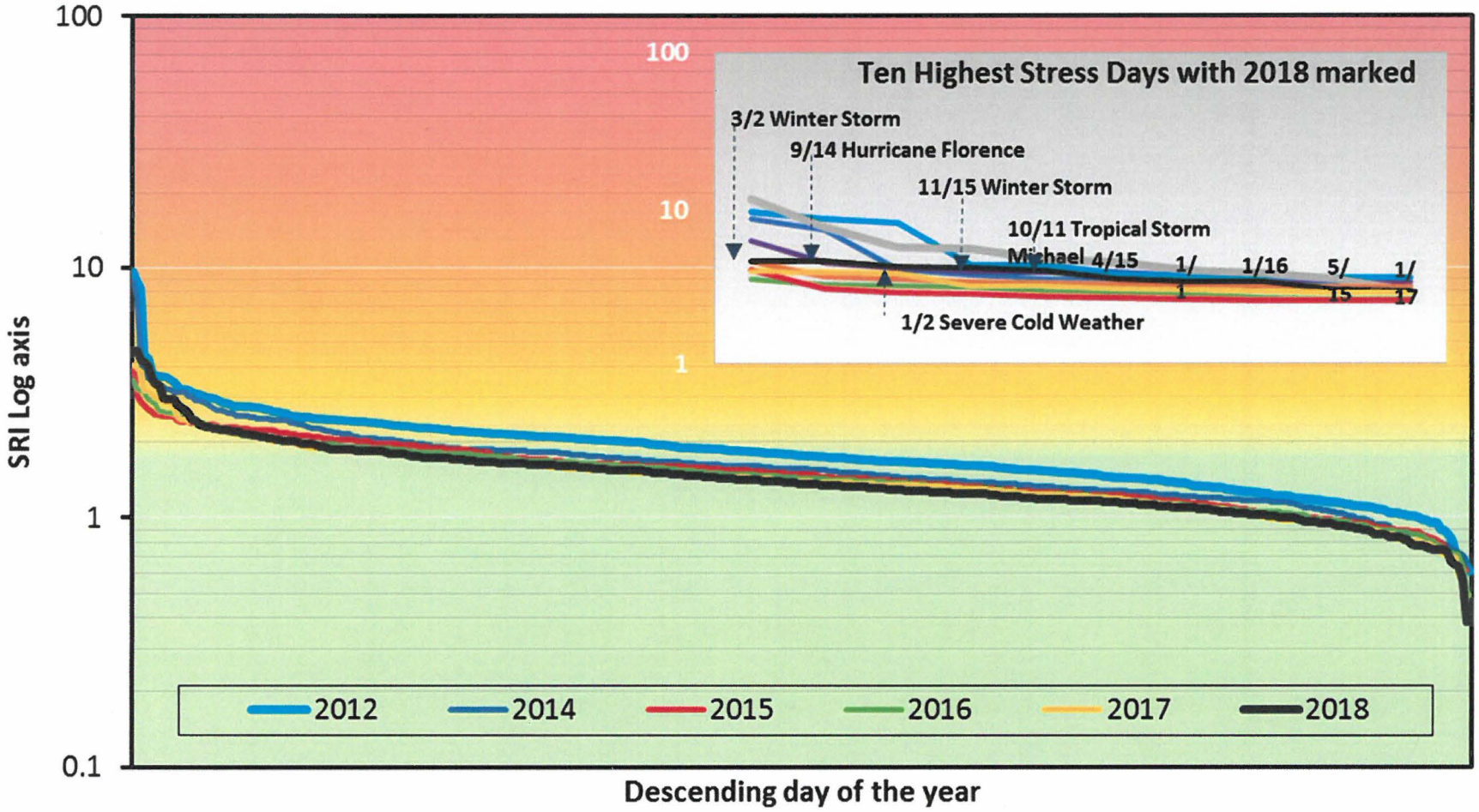
Severity Risk Index (SRI) - Sorted



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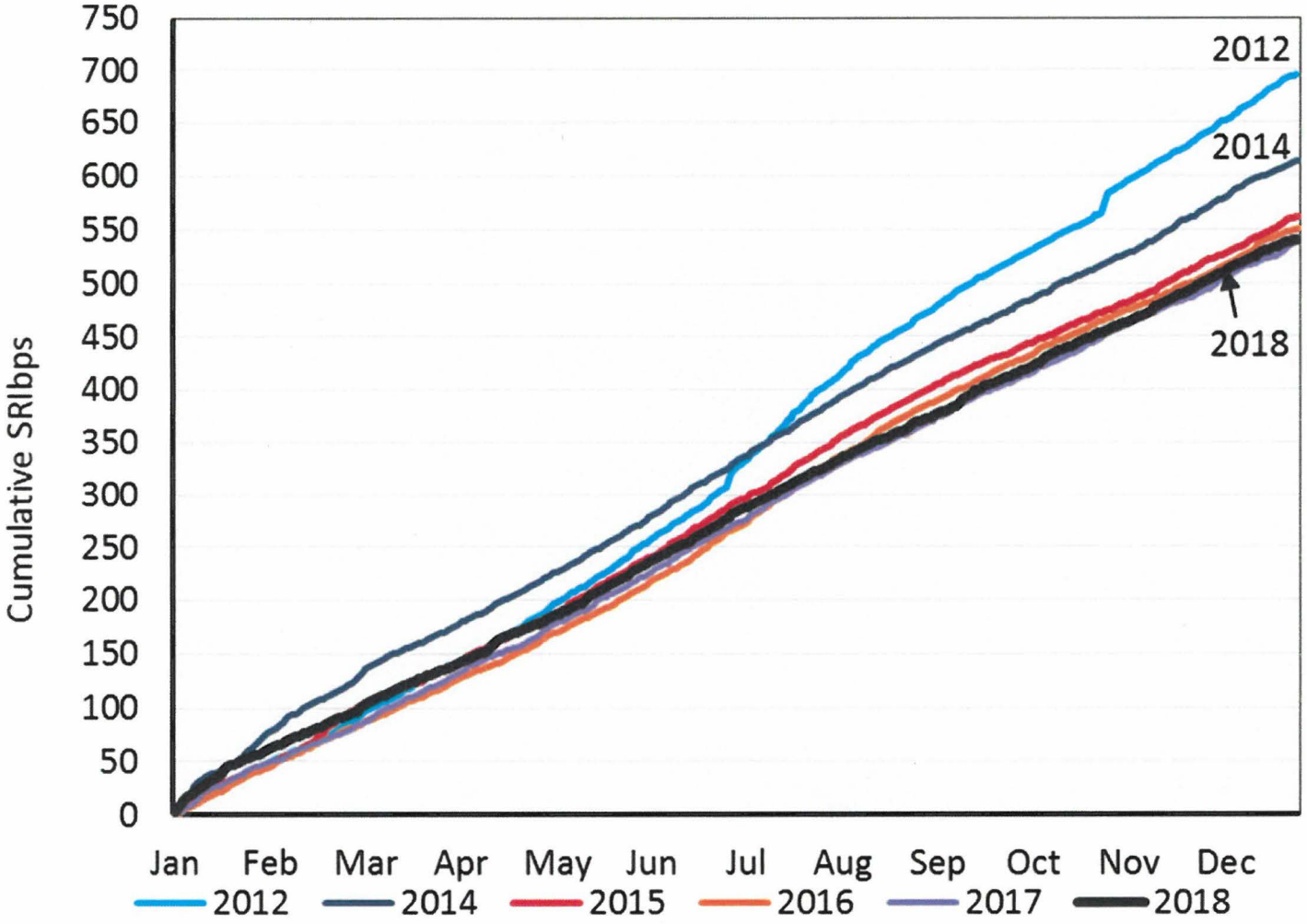
Severity Risk Index (SRI) – Cumulative



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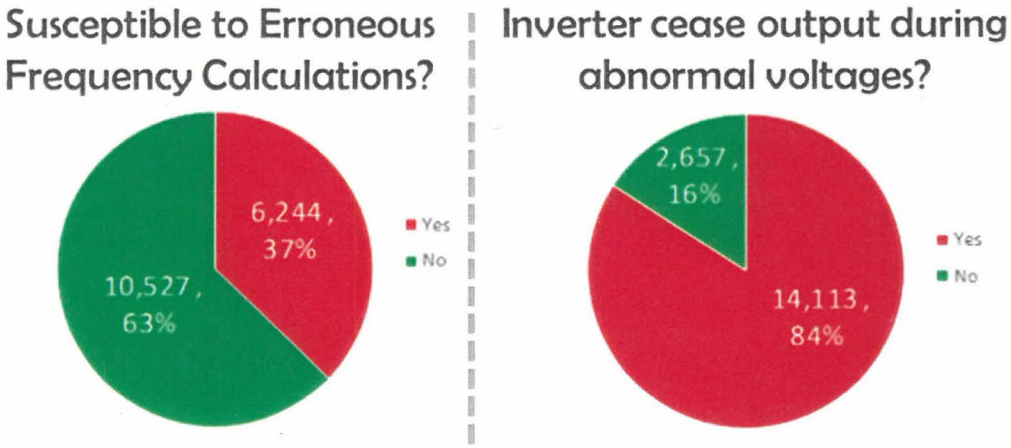
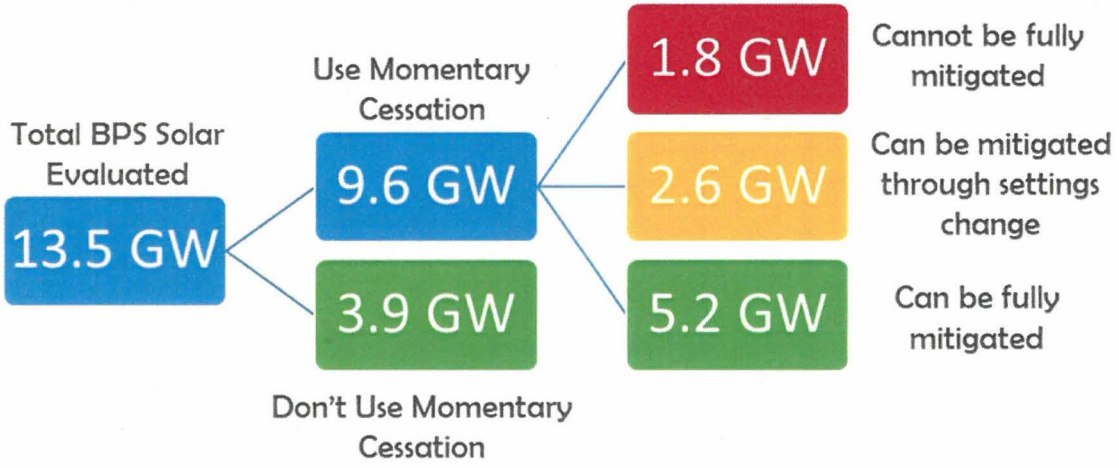
BPS Planning and Adapting to a Changing Resource Mix

- Concerns with inverter-based resource persist and mitigation strategies are being developed by the NERC Inverter-Based Resources Task Force.
- NERC Alert helped inform industry of the vulnerabilities associated with momentary cessation.

NERC Alert 1



NERC Alert II



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Recommendations
The ERO and Industry should:

1 - Continue improving their ability to understand, model, and plan for a system with a significantly different resource mix. Priority should be given to:

- Frequency response under low inertia conditions
- Contributions of inverter-based resources to essential reliability services
- Increasing protection system and restoration complexities with increased inverter-based resources
- Resource adequacy with increasing energy constraints

2 - Develop comparative metrics to understand the different dimensions of resilience during extreme events and system performance changes over time.

3 - Better understand and share information on cyber and physical security threats and mitigate the risks through a variety of approaches, including resilient system design, consequence-informed planning and operation, and practicing response and recovery processes.

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EMP Task Force Status Update

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Mark Lauby, Senior Vice President and Chief Engineer

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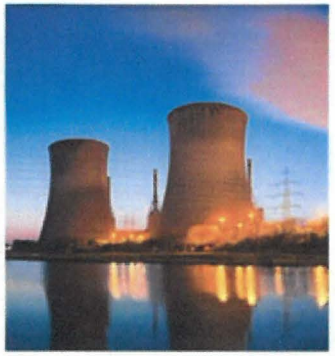

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Purpose

- **May 2019:** NERC launched a Task Force to identify reliability concerns associated with EMPs and potential methods for promoting resilience
- The Task Force advises NERC, regulators, Regional Entities, and industry stakeholders to establish a common understanding of the scope, priority, and goals for the development of next-steps to address resilience to HEMP events

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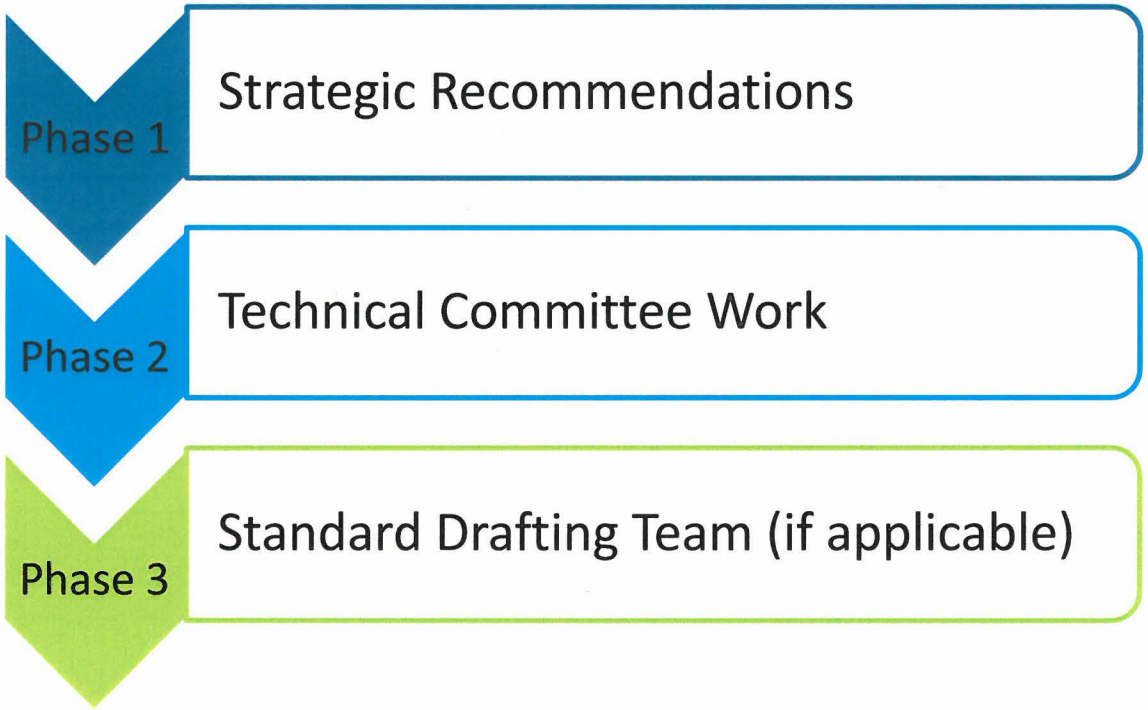
EMP Task Force: Phased Approach



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EMP Task Force: Report Structure

- The Task Force has broken up the topic of EMP as it relates to the utility industry in the following categories:
  - **Policy** – What needs to be clearly defined by industry and federal government
  - **Research** – What research is needed to prudently inform utilities that need to make decisions
  - **Vulnerability Assessments** – How does the utility industry take the policy and research to understand its vulnerability
  - **Mitigation Guidelines** – Fundamental suggestions and guidelines on prudent mitigation strategies
  - **Response and Recovery** – Based on the vulnerability assessments and any mitigation guidelines, for any impacted facilities, how does a utility respond and recover

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Questions and Answers