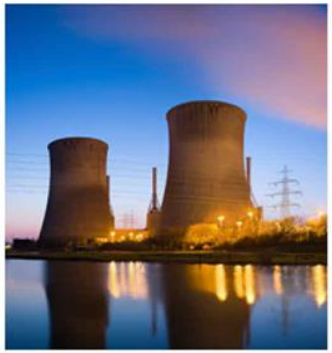
NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

State of Reliability

Summary of Findings

Mark Lauby, Senior Vice President and Chief Reliability Officer
FERC and NRC Joint Commission Meeting
June 7, 2018

RELIABILITY | ACCOUNTABILITY

Overview

- State of Reliability report measures past performance, identifies emerging risks, and success of mitigation activities
  - First report completed in 2012; 2018 report expected to be published June 24
- Essential Reliability Services
- Distributed Energy Resource integration and NERC activities

Summary of 2017 Report

- Decreased instances of protection system misoperations
- Improved BPS resiliency to severe weather
- Decreased human error
- No Category 4 or 5 events in 2016
- Stability of frequency and voltage
- Maintained physical and cyber security under increasing threats

Overview of 2018 Report

- Previous trend findings continue with some new findings:
  - Improved BPS resiliency to severe weather
    - Two Category 5 events – Hurricanes Harvey and Irma
  - Maintained physical and cyber security reliability under increasing threats
    - No loss of load
  - Decreased instances of protection system misoperations
    - 7.1 percent vs. 8.3 percent last year; has trended down over past five years
  - Decreased human error
  - Frequency and voltage remained stable
    - However, results varied by interconnection
  - Inverter disconnects during transmission disturbances present an emerging risk

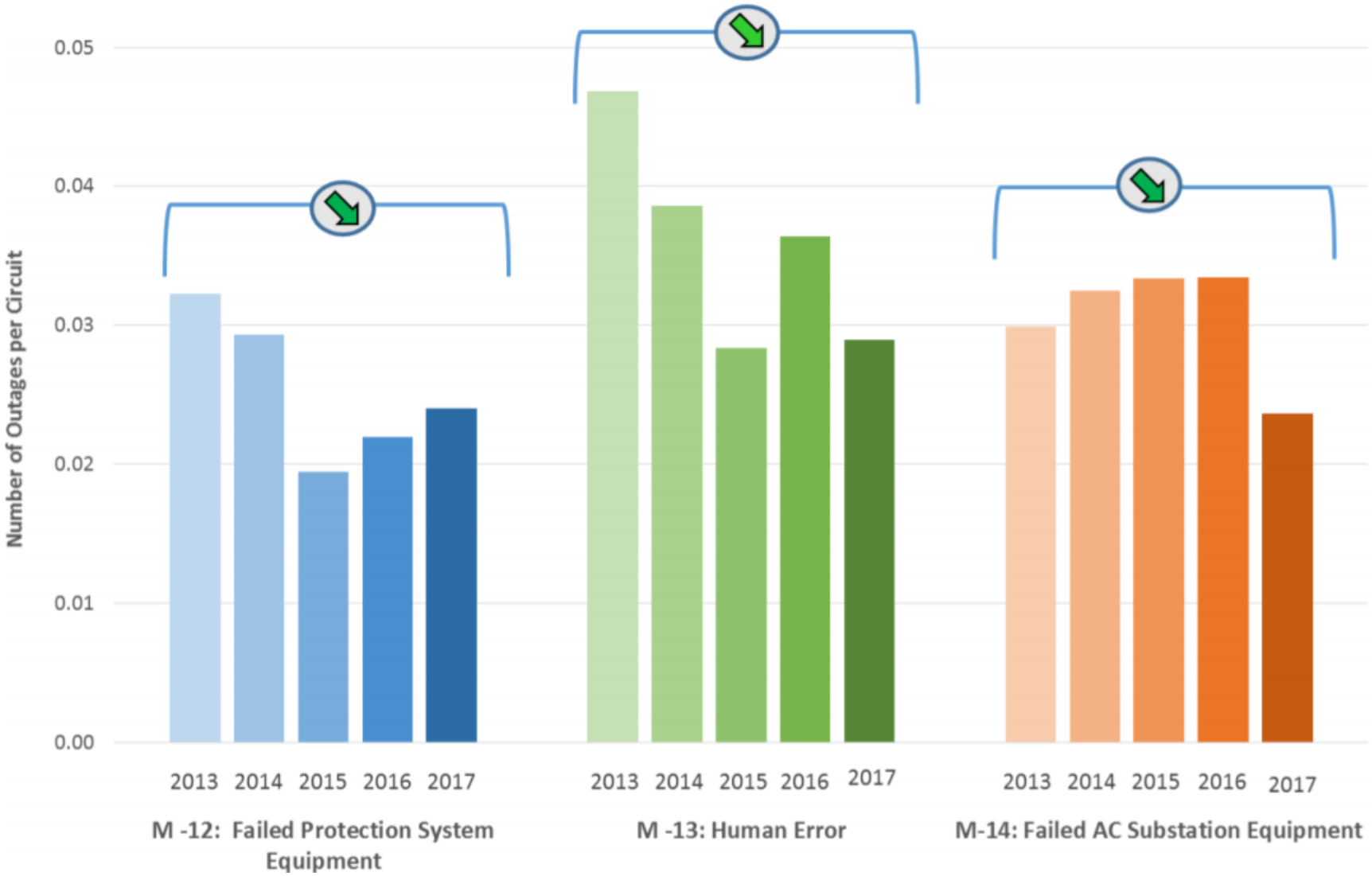
Two Category 5 Events

- Water and wind were key in Texas during Hurricane Harvey
  - 85 substations damaged
  - 225 transmission line outages
  - More than 850 transmission line structures downed/damaged
  - More than 6,000 distribution poles downed/damaged
- Hurricane Irma was the largest impact storm to ever hit Florida
  - 4.45 million customers out of service for Florida Power & Light
  - (Previous record was 3.24 million in 2005 during Hurricane Wilma)
  - Irma restoration took 10 days vs. 18 days during Wilma

Event Analysis Key Findings

- Drones hastened restoration following both Harvey and Irma with unexpected versatility
- Mutual Assistance agreements provided essential equipment and material for both Harvey and Irma restorations
- Florida and its utilities shortened Irma restoration time with strong, prior investment in system hardening

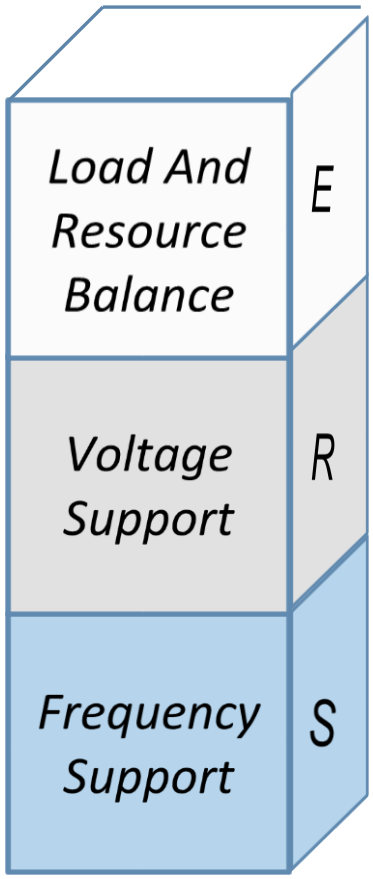
200 kV+ Outages by Cause Code



New Finding in 2018

- Inverter disconnects during transmission disturbances present an emerging risk
  - NERC 1,200 MW Fault Induced Solar Photovoltaic Resource Interruption Disturbance Report, Southern California August, 16, 2016 Event
    - Use of instantaneous frequency measurements can erroneous tripping during transients generated by faults on the power system
    - Cease current injection for voltages > 1.1 per unit or < 0.9 per unit, and return to pre-disturbance levels at a slow ramp rate
    - Two industry alerts issued providing guidance to reduce or eliminate impacts from these characteristics. Reviewing Standards.
  - CAISO Market Notice Effective Trade Day (TD) 6/14/17
    - The California ISO temporarily increased daily procurement of operating reserves to mitigate reliability risk against potential loss of solar resources

Essential Reliability Services



- Retirements of conventional generation and the rapid addition of inverter-based resources altering the operating characteristics of the grid
- In 2014, framework developed with building blocks of a reliable system: “Essential Reliability Services”
- NERC supports efforts to understand contributions to reliability from all forms of generation
- Change in planning and operations needed to manage future Transmission & Distribution systems

Link to: ERS Framework Report *Link to : Reliability Assessments*

DER Task Force

- Report published in February 2017

  DER Connection, Modeling, and Reliability Considerations

Working definition of DER:

- *Any resource on the distribution system that produces electricity and is not otherwise included in the formal NERC definition of the Bulk Electric System.*

Examples:

- *Residential rooftop solar*
- *Microgrids*
- *Cogeneration projects*
- *Any other distribution resource*

Accommodating Large Amounts of DER

- **DERTF:**
  - 2018 Technical Brief: DER Data Collection for Transmission System Entities
  - 2018 DER Educational Video
- **Load Modeling Task Force**
  - 2016 Report: Dynamic Load Modeling Technical Reference Document
  - 2016 Reliability Guideline : Modeling DER in Dynamic Load Models
  - 2017 Reliability Guideline : Developing Load Model Composition Data
- **Industry and Research Partnerships**
  - IEEE Standards Participation and NERC - IEEE Joint Task Force (IEEE 1547)
  - Argonne National Laboratory : Impact of DERs on the Bulk Electric System – Combined Modeling of T&D Systems & Benchmark Case Studies

Assessing BPS Impacts

- DER impacts on UFLS or under frequency load shedding (PRC-006-3) and under voltage load shedding or UVLS (PRC-010-2)
  - NERC Planning Committee: Region Studies on DER Impacts to UFLS/UVLS Programs
    - Unexpected loss of DER can contribute to frequency and voltage instability for high penetrations (e.g. NPCC study).
- IEEE 1547-2018 implement and coordinate with System Operators reliability
  - Mod-032-1 : Data for Power System Modeling and Analysis
- In the future aggregate DER may be the most severe contingency. TPL-001-4 requires study and planning for the potential impacts

Questions and Answers