NERC

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

# NASPI Work Group

## Virtual Meeting

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November 3, 2020

RELIABILITY | RESILIENCE | SECURITY




# About NERC: Mission

**To assure the effective and efficient reduction of risks to the reliability and security of the North American bulk power system**

- Develop and enforce reliability standards
- Assess current and future reliability
- Analyze system events and recommend improved practices
- Encourage active participation by all stakeholders
- Accountable as ERO to regulators in the United States (FERC) and Canada (NEB and provincial governments)

# The Golden Circle

# Key Issues 2020 and Beyond

- Pandemic Preparedness
  - At this time, NERC has not identified any specific threat or degradation to the reliable operation of the bulk power system (BPS)
  - However, risks are elevated with emergence of COVID-19
- Supply Chain Risks
  - Three NERC Alerts related to Supply Chain issued
  - Standards and Industry Partnership activity underway
- Batteries/Storage
  - Battery Energy Storage Systems (BESSs) growing at increasing pace
- Distributed Energy Resources (DER)
  - DER penetration impacts the Bulk Electric System (BES) in numerous ways
  - Accurate modeling/measurement will be critical

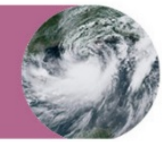
# Consolidation of Risks into Key Functional Areas

Further review and consolidation has resulted in four high level risk profiles:

## Grid Transformation

A. Bulk Power System Planning
B. Resource Adequacy and Performance
C. Increased Complexity in Protection and Control Systems
D. Situational Awareness Challenges
E. Human Performance and Skilled Workforce
F. Changing Resource Mix

## Extreme Natural Events



A. Extreme Natural Events, Widespread Impact
- GMD

B. Other Extreme Natural Events

## Security Risks

A. Physical
B. Cyber
C. Electromagnetic Pulse

## Critical Infrastructure Interdependencies

A. Communications
B. Water/Wastewater
C. Oil
D. Natural Gas

# What's Changing?

- Higher penetration of renewables – variable resources
  - Most are inverter-connected
  - Ramping needs increase for load following
  - Capacity value
- Retirement of large fossil-fired generation plants
- Changing System Inertia
  - Trade-offs between inertia and Fast Frequency Response
- Emergence of distributed energy
- Changing sources of reactive support for voltage control
  - Lower levels of synchronizing torque
  - Increasing use of power electronics
- Increasing energy constraints from the generation fleet

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# Rapid Evolution of "Edge" Technologies

| Generation | Transmission | Distribution |
|---|---|---|
| Inverter-based, variable resources | New market constructs | Distributed energy resources |
| Hybrid power plants and batteries | Changing policies and incentives | Aggregators |
| Decentralized generation | Updating requirements and standards | Advanced distribution management |
| Digitization and connectivity | Advanced and automated applications | Internet of Things (IoT) |
| New control strategies | Big data tools | Transportation electrification |
| | Intelligent dispatch concepts | Sustainability initiatives |
| | | Microgrids |

# Rapid Evolution of the Energy Sector

**Inverter-Based Resources**

**Distributed Energy Resources**

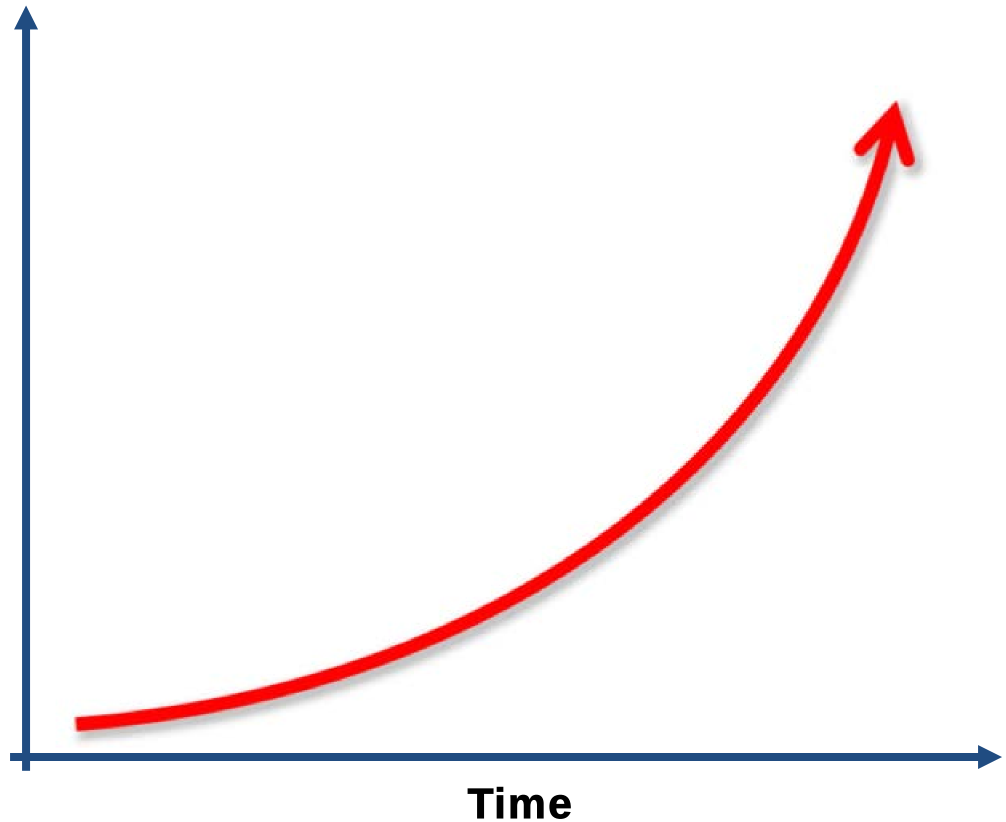
**Hybrid Plants**

**Cyber Attacks**

**Internet-Connected Devices**

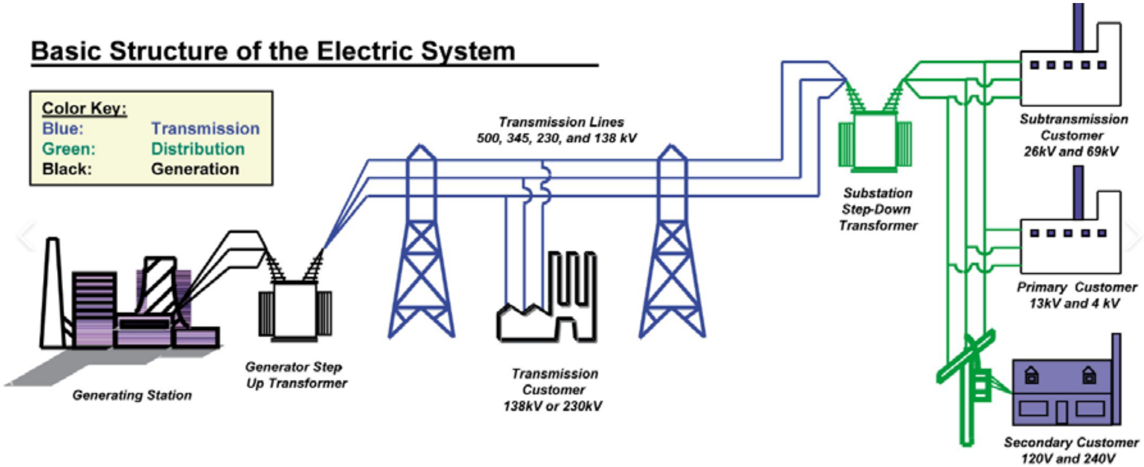
**Electric Vehicles**

**...**



# Planning challenges

- Traditional model out the window
  - Historically Generation → Transmission → Distribution
  - Emerging Generation → Transmission ↔ Distribution ← Generation
- System protection with fault levels ≈ load levels
- Adequate reactive resources
- Under frequency load shedding settings



# Operating challenges

- Operator visibility into distributed energy resources
- Inverter-based resources
- Distribution impacts on transmission system
- Voltage regulation
- Under frequency load shedding
- Regulating reserves
- Cyber security of distributed energy resources

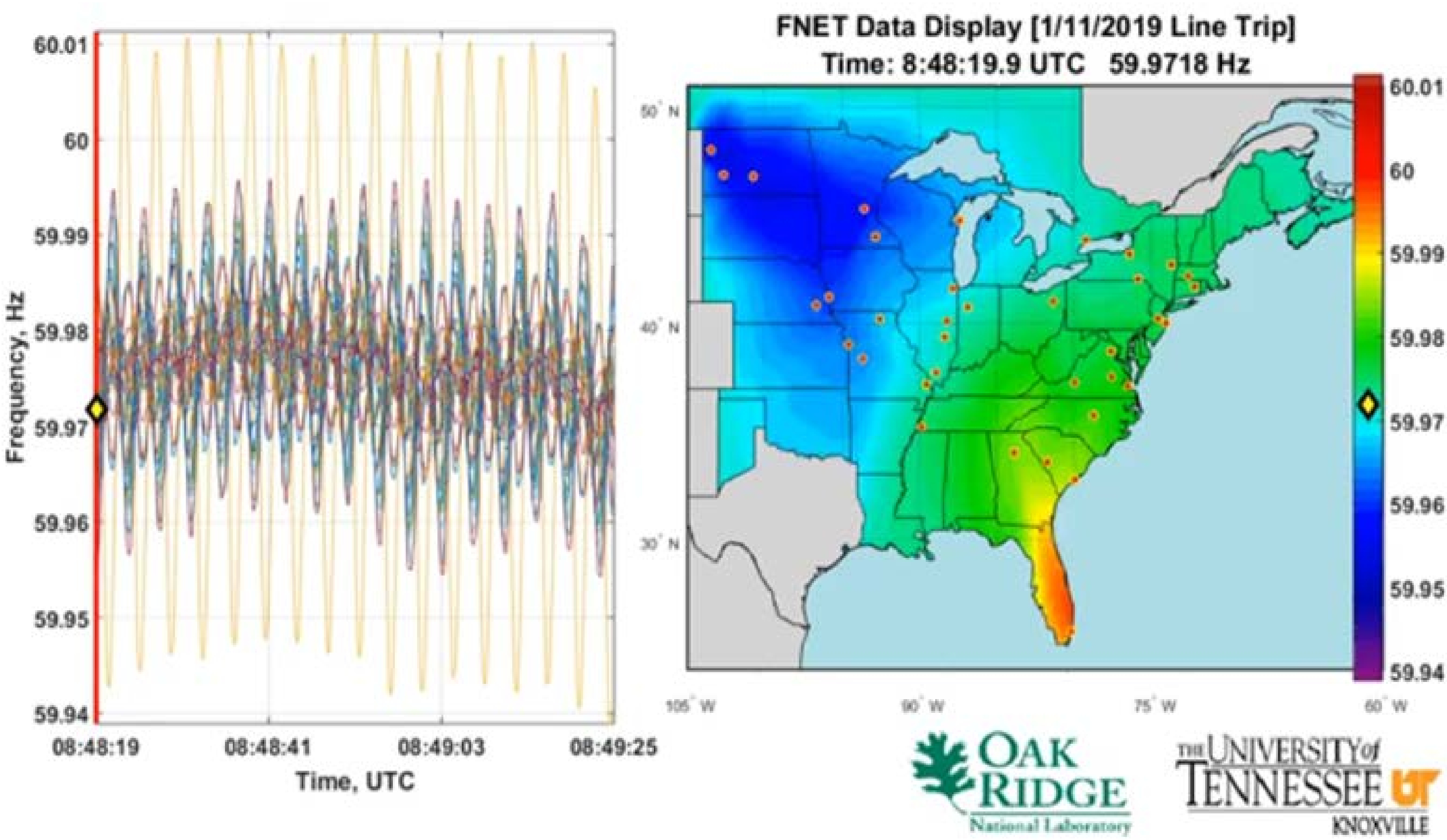
# What is Limiting Wider Use of PMU Data

- Historical practices has data quality at its core
  - SCADA data used widely, highly redundant, easy to flag bad data
  - State estimation used to filter out bad data
  - Advanced applications (e.g., contingency analysis) use filtered measurements
  - Bad data is thrown out
- Synchrophasor technology used for complex use cases
  - Raw measurements used in early days with less attention to data quality than maybe was needed
  - Additional data quality considerations (e.g., time synchronization)

# Future Application of PMUs

- Oscillation tools have had success on the BPS
  - Advanced applications are using wide-area measurements to detect (and identify the source of) oscillations.
  - PMUs were able to pick this up and determine an oscillation was occurring
  - Tools should be able to identify the source (or close to it) in real-time and to inform operators of relevant and applicable actions to take.
  - This requires a wide-area view across all RCs within an interconnection.
  - Fortunately, there are projects underway to make that a reality, even in the Eastern Interconnection
  - Example includes the June 2016 and January 2019 disturbances that both resulted in the unit coming offline

## January 2019 Sustained Oscillation Event

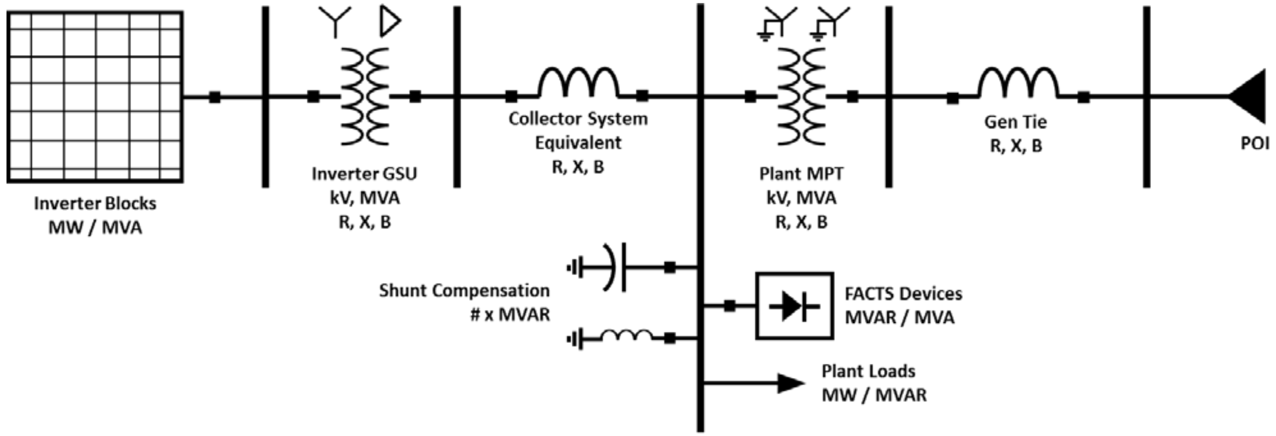


# Future Application of PMUs

- Data quality is critical
  - High data quality data for the control room needed, else operators will "not trust" the tools that leverage PMU
  - Having trust in the measurement source is key to a successful advanced application
- Synchrophasor data quality needs attention & improvement
  - Data availability should be near 100% (unless planned)
  - Data accuracy understood and documented (used appropriately)
  - Data quality tools on front end of all applications (screening)
  - Data quality flags/alarms built into all applications (warning)
  - Operational decisions made when data quality is high (reliable)
  - Data quality institutionalized (business processes)

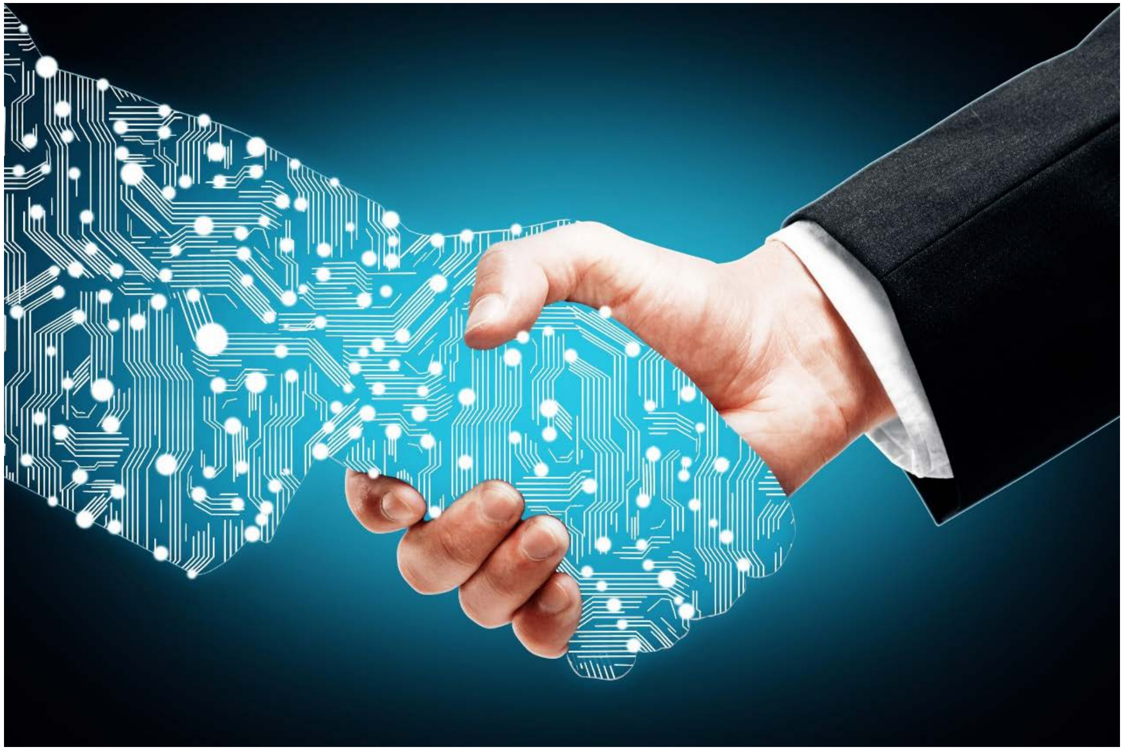
# Future Applications of PMUs

- High speed data is important to understand the behavior and performance of inverter-based resources
  - Data faster than PMUs is needed for point-on-wave behavior. DFRs or similar within the plant controller
  - Inverter-level oscillography is critical to understand individual inverters during severe disturbances



# Integration of Security and Engineering

*Today…*



*Source: Siemens*

# Questions and Answers