Bulk Power System Reliability under a New Energy Paradigm

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Mission: To efficiently and effectively reduce risks to the reliability and security of the Bulk Power System in North America

- Certified as the Electric Reliability Organization by FERC (pursuant to the Federal Power Act and recognized as such by Canada and Mexico)
- Many programs executed through regional entities with delegated authority across North America
- Develop and enforce mandatory Reliability Standards
  - Over 100 mandatory standards (1,500 requirements) in place
  - Developed and voted on by technical experts
  - Approved and Enforced by NERC and FERC
- Assess current and future reliability
  - Develop reports to assess resource adequacy and identify reliability issues
  - Analyze system events and recommend improved practices
  - Manage technical committees and stakeholder groups
• Resource mix shifting
  • Variable Energy Resources (wind and solar) with very different generation characteristics and stochastic production profiles
  • Demand side resources (roof top solar and demand response) “invisible” to system operators
  • Coal and nuclear in decline
  • Storage becoming viable option
• BPS load growth flattening
  • Pricing (rate) pressures
  • Business model challenges for utilities
• Reliability and security requirements increasing
  • Electricity is “fundamental” to modern society
  • Persistent security threat with sophisticated actors
What’s Changing on the Bulk Power System?

- Replenishment of Essential Reliability Services
  - Reduced inertia
  - Frequency Responses
  - Voltage Support
  - Ramping and flexibility needs

- Rapid penetration of new loads, variable speed drives, EVs, LED Lighting

- System controls and relay protection coordination

- Modeling and simulation constraints

- Increasing interface with distribution-centric resources
Findings From Previous NERC Assessments

- Natural gas expected to increase
  - Replace retiring generation
  - Offset variable resources
  - Meet increasing electricity demand
- Fuel not easily stored on-site
- Widely used outside the power sector
- Historically, disruptions are rare
- Interdependencies have larger effect with increased reliance
Resilience is a Characteristic of a Reliable System

NERC Reliability Assessments and Performance Analysis
- Reliability Assessments
- System Analysis
- Events Analysis
- Performance Analysis
- Situational Awareness

Operator Training

NERC Reliability Assurance
- Standards
- Compliance
- Enforcement
- Registration
- Certification

* Solely the Bulk Power System. Does not include local distribution systems.
Increased dependence on natural gas for generating capacity can amplify the bulk power system’s vulnerability to disruptions in fuel supply, transportation, and delivery.
Top-20 Gas Pipelines by Peak-Day Delivery Arrangement

- Red pipelines mean there were no interruptible flows on peak pipeline day and virtually no “Firm” capacity available for sale.

- Some electric generation customers can buy “Firm” from secondary market, if available.

Source: ANL
Gas infrastructure adequacy
- To meet volumetric needs as industry shifts to gas/renewables mix
- To meet flexibility as ramp rates “steepen and deepen”
  - Pack and draft availability/utility as pipeline utilization rates increase
  - In-market storage to serve as a shock absorber
- “N-1” conditions on the natural gas system
  - Single point of failure/ability of electric system to compensate
    - Loss of pipeline
    - Loss of major compressor station
    - Loss of storage facility (e.g., Aliso Canyon)
- Operational alignment
  - Situation awareness/information sharing/transparency
  - Scheduling and balancing (“5 minute electric market” versus “natural gas day”)
- Regulatory policy/curtailment queue
- Security (physical and cyber)
Mitigation options are few

• Dual Fuel capability
  ▪ Environmentally challenging, though some successes with critical LADWP units
  ▪ Liquid fuel infrastructure limitations limit effectiveness to shorter term disruptions

• Electric Storage
  ▪ Promising technologies
  ▪ Scalability
Hot spots

- New England
- Southern California/Desert Southwest
- PJM
- Other?
• Over 100 GW of conventional generation retired Since 2011 (2017 LTRA)
• LTRA future projections do not account for unannounced retirements
Questions and Answers