Assessing Reliability for an Evolving Bulk Power System

Thomas Coleman, Director of Reliability Assessment
Member Representatives Committee Meeting
May 4, 2016
• NERC’s Capability
  ▪ Probabilistic Assessment
  ▪ Interconnection-Wide Assessment
  ▪ Essential Reliability Services (ERS)

• Robust and Independent Reliability Assessments
  ▪ Resource Mix Change/Clean Power Plan
  ▪ Increasing Dependency on Natural Gas
  ▪ Accommodating Large Amounts of Distributed Resources

• Integration of New Technologies and Resources
  ▪ Reliability Guidelines for Planning and Operations
  ▪ Sufficiency Guidelines for ERS
  ▪ Support for Standards Development
Analyses to Address Emerging Risks to the Bulk Power System

- Increased statistical analysis to identify and recognize ongoing trends and risks to reliability
- Advancement of interconnection-wide analysis and development of technical studies and practices to use them
- Analysis of cyber and physical considerations on electric system planning and operation
• Incorporating probabilistic, scenario analysis, and transmission adequacy assessment techniques to measure evolving system characteristics

• Using tools for assessing reliability risks of natural gas infrastructure, including gas storage and pipeline delivery

• Increased analytical understanding of distribution systems and the interface to bulk power system reliability
• Whether proposed enhancements reflect an appropriate approach for assessing reliability given the evolving bulk power system
• Additional emerging risks to be considered for enhancing reliability assessments
Short-Term Deliverables
2016 Annual Reliability Assessments

- **2016 Long-Term Reliability Assessment**
  - MRC review – November
  - Board approval and publish – December

- **2016 Summer Reliability Assessment** – condensed report
  - Publish – May

- **2016/17 Winter Reliability Assessment** – condensed report
  - Publish – November

- **2016 Probabilistic Reliability Assessment**
  - Results published in 2016 Long-Term Reliability Assessment
  - Final report published in Q1 2017
2016 Special Reliability Assessments

- **2016 Special Reliability Assessment on the Clean Power Plan, Phase II**
  - MRC review – Late April
  - Board approval and publish – May

- **2016 Short-Term Reliability Assessment: Increased Reliance on Natural Gas for Electric Power**
  - MRC review – Late April
  - Board approval and publish – May

- **2016 Short-Term Reliability Assessment**
  - Topic yet to be selected by ERO-RAPA
• Distributed Energy Resources Task Force Final Report
  ▪ MRC review – Late November
  ▪ Board approval and publish – December

• Frequency Response for the Eastern Interconnection: A Scenario Analysis of the Changing Resource Mix
  ▪ Stemming from ERSTF recommendations
  ▪ First forward-looking study for the ERO on this topic
  ▪ Complete reference and scenario case analysis by end of year
• **Short-Circuit Strength**
  - Stemming from ERS Task Force recommendations
  - Evaluate short circuit current and ratios
  - Developing framework for continued assessment

• **Inter-Area Oscillation Baselining Analysis**
  - Utilizes phasor measurements to enhance model validation and understand operating limits
  - Developing framework for continued assessment

• **Probabilistic Assessment of Severe Impact to Natural Gas Supply and Transportation**
  - Coordinated analysis with NPCC
Questions and Answers
ERO Enterprise Strategic Planning Framework

Mark Lauby, Senior Vice President and Chief Reliability Officer
Member Representatives Committee Meeting
May 4, 2016
Current Strategic Planning Documents

- Three-year ERO Enterprise Strategic Plan
- Annual ERO Enterprise and Corporate Metrics
- ERO Enterprise Longer-term Strategic Planning Considerations
Proposed Strategic Plan and Framework

• Consolidates the three documents
• Aligns:
  ▪ Goals
  ▪ Metrics
  ▪ ERO Reliability Risk Priorities Report recommendations
  ▪ Longer-term strategic planning considerations
• 2017 metrics will be reduced and refined to be outcome-based
2016 Strategic Planning Timeline

- **April 2016**: policy input on framework document format
- **July 2016**: policy input on strategic plan content
- **August 2016**: strategic planning sessions for NERC Board of Trustees (Board) and ERO Enterprise
- **October 2016**: policy input on draft strategic plan
- **November 2016**: strategic plan to Board for approval
Questions and Answers
Cost-Effectiveness Approach and Pilot

Brian Murphy, Standards Committee Chair
Howard Gugel, Director of Standards
Member Representatives Committee Meeting
May 4, 2016
• Initiated by NPCC Board in 2011
• Concentrated on implementation costs
• Implemented as a result of development of PRC-002-NPCC-01
• Lessons learned
• Based on NPCC process
• Two phases
  ▪ Cost Impact Analysis (CIA)
  ▪ Cost Effectiveness Analysis (CEA)
• Pilot used in development of PRC-025-1 and PRC-002-2
• Lessons learned
• Process development
• Enhanced periodic reviews
• Standards metric
• Pilot of proposed method
Cost Effectiveness Pilot Update

- TPL-001-4 selected for Phase 1
- Survey posted late April for 30 days
- Results will be posted
- Will be provided to SDT
- Phase 2 questions to be developed
Questions and Answers
Clean Power Plan: Phase II Assessment

Thomas Coleman, Director of Reliability Assessment
Member Representatives Committee Meeting
May 4, 2016
• Provide an independent assessment of reliability
• Provide a range of resource adequacy evaluations
• Provide an additional framework for further analysis
# CPP Phase II Scenarios

## Reference Case
- Conditions if CPP were not implemented

## CPP Base Case
- Intrastate trading develops; Regional Green House Gas Initiative trading continues

## National Trading Case
- Full intrastate and interstate trading

## High Renewable Penetration Case
- Assumes lower costs for renewable generation technology

## Accelerated Nuclear Retirements Case
- Assumes accelerated retirement of nuclear units
Wind and Solar Experience Large Increases in Capacity

Wind Capacity - Reference Case

- IPM Model
- Aurora Model

- GW
- 2016: 70
- 2018: 80
- 2020: 100
- 2022: 120
- 2025: 150
- 2030: 180
Wind and Solar Experience Large Increases in Capacity
Wind and Solar Capacity Increase as a Result of the CPP

- **Wind**
  - Reference Case
  - CPP Base Case

- **Solar**
  - Reference Case
  - CPP Base Case

<table>
<thead>
<tr>
<th>Year</th>
<th>Reference Case</th>
<th>CPP Base Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GW
Coal Declines from 270 GWs to 220 GWs in Reference Case (2016 – 2030)

Coal Capacity - Reference Case

- IPM Model
- Aurora Model

GW

2016 | 2018 | 2020 | 2022 | 2025 | 2030
---|---|---|---|---|---
270 | 250 | 240 | 230 | 220 | 210
Natural Gas Prices Increase over Time

$/mmbtu

- NYMEX
- EIA: AEO2015 REF
- Modeling Assumption
Energy Efficiency is Increased through Demand Side Programs

Annual US Electricity Energy Efficiency Savings (GWh)

- No Carbon
- Clean Power Plan

Year: 2015, 2020, 2025, 2030, 2035, 2040

Savings (GWh): 0, 100,000, 200,000, 300,000, 400,000, 500,000, 600,000
Natural Gas Capacity Increases from 235 GWs to 280 GWs

Natural Gas Capacity - Reference Case

- IPM Model
- Aurora Model

GW

230 240 250 260 270 280 290 300

2016 2018 2020 2022 2025 2030
• Due to lead times planning process should already be underway
• Planning coordinators should conduct system reliability evaluations using NERC report as framework
• *Reliability Considerations for CPP Development* should be used
• Agencies must continue to work together to ensure reliability
• Planners must ensure adequate levels of ERS
• NERC should continue its work around sufficiency guidelines for ERS
<table>
<thead>
<tr>
<th>May 6</th>
<th>Embargoed report to Board of Trustees (Board) and MRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 13</td>
<td>Board to consider report for approval of publication</td>
</tr>
<tr>
<td>May 17</td>
<td>Target release</td>
</tr>
</tbody>
</table>
Questions and Answers
What is the new “Short-Term Special Assessment”? 

- Topic-oriented reliability evaluations
- Identify potential reliability risks over the next 18-24 months
- Provide an independent review of potential reliability issues, studies, policies, and initiatives
- NERC and the Regions select assessment topics
- Potential areas of assessment
  - Emerging drought conditions
  - Impacts from environmental conditions
  - Potential fuel availability concerns
  - Examination of operational challenges during shoulder periods
• Generation Availability Risk Assessment
• Assessment Period: Peak periods for Summer 2016, 2017; Winter 2016/17, 2017/18
• Short-term challenges related to natural gas infrastructure
• Leverage existing studies from industry and Regions

Areas Highly-Dependent on Natural Gas-Fired Capacity

- ISO-NE
- NYISO
- ERCOT
- CAISO

Gas-fired   Other
Gas Availability Risk Assessment

Overview

Based on GADS Performance Data

- **Firm Import Capability**
- **Gas-Fired Capacity**
- **Dual-Fuel Capacity**
- **Non-Gas-Fired Capacity**

- **Average Forced Non-Gas Outages**
- **Average Forced Gas Outages**
- **Maximum Forced Gas Outages (in excess of average)**

- **Separate Area-Specific NG Scenario**
  - Refers to loss of a major pipelines during the peak

- **Extreme (90/10)**
  - Peak Load Forecast

- **Normal (50/50)**
  - Peak Load Forecast

**Graphs and Data**

- **Anticipated Capacity**
- **Net Imports (Firm)**
- **At-Risk Capacity**
- **Extreme Scenario**
• Aliso Canyon is a critical element of the Los Angeles (LA) Basin natural gas delivery system
  ▪ Supports winter peak heating demand
  ▪ Maintains pressure in gas distribution system (More challenging with rapid power plant ramping)
• Aliso Canyon currently has about 15 Bcf of working gas out of a total capacity of 86 Bcf
• Injections will not resume until safety testing or isolation of remaining 114 wells is completed
Aliso Canyon: LA Basin Power Supply

- **Midway-Vincent (Path 26)**
  - 4,000 MW
- **Pacific DC Intertie (Path 65)**
  - 3,100 MW
- **Intermountain (Path 27)**
  - 2,400 MW
- **Aliso Canyon Delivery Area**
- **East of River (Path 49)**
  - 10,100 MW

**Potential Impacted Generation**
- **LA Basin:**
  - 9,800 MW natural gas generation
  - ~95% of total local capacity
- **Rest of Southern California:**
  - >15,000 MW natural gas generation

**Maximum Import Capacity**
- **SDGE-CFE Import (Path 45)**
  - 800 MW
- **5,500 MW DC capacity**
- **14,900 MW AC capacity**
- **20,400 MW total***

* Typically limited to 17,000 - 18,000 MW
Aliso Canyon: BPS Reliability Concerns

- Fuel availability for local generation
  - Gas system deliverability without Aliso Canyon
  - Gas system outages (SoCal or on interstate pipelines)
  - Exogenous factors affecting supply (e.g., cold weather)
  - Curtailment priorities

- Generation resource adequacy
  - 95% of in-basin generation vulnerable to gas curtailment
  - Adequate generation resources exist to supply imports into the LA Basin, but this does not take into account local deliverability issues
• Electric import capacity (transmission)
  ▪ 20.4 GW gross import capacity on five major transmission paths to LA Basin
  ▪ Capacity is typically limited to 17-18 GW (stability limitation)

• Operational realities
  ▪ Gas system pressure during electric generation ramping without storage support
  ▪ Voltage support/stability if in-basin power plants curtailed below acceptable minimum load
  ▪ Local gas generation is relied on to manage pre- and post-contingency flows
• Single-fuel dependency increases risk of BPS-impairing common-mode failures
• Risks to natural gas generation during summer season
• Expand gas-electric planning and coordination
  ▪ A planning-based Reliability Standard should be considered
• Operational coordination between gas and electric industries decrease likelihood of wide-spread outage
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 6</td>
<td>Embargoed report to Board of Trustees (Board) and MRC</td>
</tr>
<tr>
<td>May 13</td>
<td>Board to consider report for approval of publication</td>
</tr>
<tr>
<td>May 17</td>
<td>Target release</td>
</tr>
</tbody>
</table>
Questions and Answers
State of Reliability Report
Preview of Key Findings

James Merlo, Senior Director Reliability Risk Management
Member Representatives Committee Meeting
May 4, 2016
BPS Resiliency to Severe Weather Improved

NERC Annual Daily Severity Risk Index (SRI) Sorted Descending

Ten Highest Stress Days with 2015 Labeled:
- 11/17 Pacific Windstorm
- 1/8 Severe Winter Weather
- 7/18 Severe Weather
- 6/23 Severe Weather
- 2/20 Severe Winter Weather
- 6/30 Severe Weather
- 10/23 Severe Weather
- 7/20 Severe Weather
- 7/30 Severe Weather
- 7/13 Severe Weather
Event Severity on Good Glideslope

SAS-calculated Baseline Trend Line Slope = -0.00000765, with 95% confidence values between -0.00002365 and +0.00000835
Events Analysis Process Capturing Lessons Learned

All Qualified Events (CAT 1 – CAT 5)

Event Count

- Monthly Counts
- UCL
- Average
- LCL

Year:
- 2011
- 2012
- 2013
- 2014
- 2015
Continued Decline in Average Transmission Outage Severity

- Red: Significant Positive Correlation With Transmission Severity
- Green: Significant Negative Correlation with Transmission Severity
- Blue: No Significant Correlation with Transmission Severity

- Expected TADS Event Severity
- Correlation with Transmission Severity

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

- FRCC: Year 1 (Q4 2012–Q3 2013)
- MRO: Year 2 (Q4 2013–Q3 2014)
- NPCC: Year 3 (Q4 2014–Q3 2015)
- RF: Statistically Significant Increase between Connected Years
- SERC: Statistically Significant Decrease between Connected Years
- SPP: Year 1
- TRE: Year 2
- NERC: Year 3

NERC - North American Electric Reliability Corporation
Frequency Response Trend Varies by Interconnection

Western Interconnection

Eastern Interconnection
Frequency Response Trend Varies by Interconnection

ERCOT Interconnection

Québec Interconnection
<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 6</td>
<td>Report Sent to Board of Trustees (Board) for Review</td>
</tr>
<tr>
<td>May 13</td>
<td>Board Teleconference and Vote to Accept Report</td>
</tr>
<tr>
<td>May 19</td>
<td>Target Release</td>
</tr>
</tbody>
</table>
Recent and Current FERC Activity

Presented by:

Michael Bardee
Director, Office of Electric Reliability

Federal Energy Regulatory Commission
Essential Reliability Services

- Exemption for Wind Generators from Providing Reactive Power
- Docket No. RM16-1, November 2015
- Proposal to Eliminate Exemption for New Wind Generators
- Comments filed in January
Essential Reliability Services (cont.)

- Provision and Compensation of Primary Frequency Response
- Docket No. RM16-6, February 2016
- Notice of Inquiry
- - Obligation to provide: New Resources? Existing Resources?
- - Compensation?
- Comments filed in April
Ride-Through Requirements for Small Generators

- Docket No. RM16-8, March 2016
- Proposal to Match Requirements for Large Generators
- Comments due May 23
• NERC filed proposed Reliability Standard in January 2015
• FERC proposed to accept but require change to benchmark
• Docket No. RM15-11, May 2015
• Comments: Wide range of views
• Technical conference held on March 1
Supply Chain Risk Management

- FERC proposed directive for new requirements
- Docket No. RM15-14, July 2015
- For risks to hardware, software and services at BES operations
- Comments generally opposed this proposal
- Technical conference held on January 28
Restoration and Recovery Report

- Issued January 2016
- Joint effort of FERC, NERC and Regional Entity staff
- Reviewed restoration/recovery plans of nine utilities
- Plans were generally thorough and highly-detailed
- Report recommended additional actions and studies
Availability of Certain Databases

- TADS, GADS, and Misops
- FERC proposed non-public access for Commission staff
- Docket No. RM15-25, September 2015
- Most comments opposed; some supported
- Determine Need for New/Modified Standards
- Better Understand NERC’s Periodic Reliability and Adequacy Assessments