

## FERC Reliability Technical Conference

### Panel II: Emerging Issues

Remarks of Thomas Burgess, Vice President and  
Director of Reliability Assessment and Performance Analysis and  
Gerry Cauley, President and CEO  
North American Electric Reliability Corporation  
June 10, 2014

#### Introduction

Acting Chairman LeFleur, Commissioners, staff, and fellow panelists. My name is Tom Burgess and I am the Vice President and Director, Reliability Assessment and Performance Analysis (RAPA) at the North American Electric Reliability Corporation (NERC). The development of reliability assessments is an integral part of NERC's mission as the Electric Reliability Organization (ERO) and fundamental to the Commission's responsibilities under Section 215 of the Federal Power Act. The overall objective in these assessments is to gather insights and formulate recommendations regarding anticipated reliability matters affecting bulk power supply; this includes assessments of long-term reliability, expected seasonal conditions, and special or scenario evaluations of unique or emerging risks to reliability.

First of all, I would like to highlight the uniqueness of NERC's position as the independent authority on reliability assessment. The RAPA organization and associated stakeholders serve to provide a solid technical foundation for understanding the multiple facets of reliability and performance across North America. Those insights provide unique perspectives that shape, guide, and give us directional efforts to ensure and enhance the reliable operation of the bulk power system (BPS). The independent integrity of the assessments and performance analyses are core strengths, clearly benefiting from wide industry engagement about reliability. The support, unique expertise, and engagement from industry are essential ingredients that support the overall reliability mission.

First and foremost, our reliability assessments provide a technical platform for important industry and policy discussions on challenges facing the interconnected North American BPS. Each year, NERC is responsible for independently assessing and reporting on the overall reliability and adequacy, as well as identifying potential associated risks that could impact the upcoming summer and winter seasons and the long-term, ten-year period. The RAPA leads an intensive effort to ensure that key emerging risks and important reliability conditions over the planning horizon are identified through collaboration with the technical committees, the Members Representative Committee, and the Reliability Issues Steering Committee. As specific priority emerging risks and potential impacts to reliability are identified, special assessments and scenario evaluations are conducted to provide more focused technical framework and insights about the range, and specific aspects of these to guide steps that may be warranted. Unbiased judgment of the industry's plans for maintaining electric reliability in the future are founded on solid engineering through these collaborative and consensus-based assessments, whose key findings and recommendations support informed decision makers and position the industry to respond to ensure reliability.

By identifying and quantifying emerging reliability issues, NERC is able to provide risk-informed recommendations and support a learning environment for industry to pursue improved reliability performance. These recommendations, along with the associated technical analysis, provide the basis for actionable enhancements to resource and transmission planning methods, planning and operating guidelines, and NERC Reliability Standards, and other significant steps to ensuring BPS reliability.

## Adaptation and Planning for Change

Among the key priorities identified as an emerging issue through the RISC stakeholder is the important need for enhancing the planning capabilities to provide sound insights as the industry rapidly changes and adapts operations and planning. As highlighted in numerous recent long-term reliability assessments, the BPS in North America is dramatically changing in many ways. NERC has observed incremental changes in the resource mix each year, which has trended toward a generation base that is now predominately gas-fired generation. However, the continued wide-scale retirement of coal, petroleum, and more recently nuclear, and other baseload generation has rapidly accelerated these changes, which are being compounded by the wide-scale addition of gas-fired and variable (e.g., wind, solar) resources. As a result, gas fired generation capacity has increased to now represent more than 40 percent of total capacity in North America, an increase from under 30 percent as recent as five years ago. As noted in NERC's *2013 Long-Term Reliability Assessment*, natural gas is the fastest growing new source for capacity in North America (notably in PJM, MISO, NYISO, NE-ISO, and IESO) representing additions of nearly 50 GW over the forecast horizon. While generation from renewable energy (wind, solar, biomass, and geothermal), accounts for about 7.5 GW of on-peak capacity additions [50 GW of nameplate capacity] during the next 10 years such that renewables resources represent about 2 percent overall. These represent significant changes in the resource mix over a relatively short period on a very macro-scale. The effects and reliability implications can manifest, in some cases, in more localized areas where renewable resources or gas facilities are readily integrated in the grid.

Understanding the reliability impacts of conventional generation retirements, managing a resource fleet with increasing reliance on natural gas, utilizing an increasing amount of demand resources, local area effects, and integrating higher levels of variable resources (wind, solar, and some forms of hydro) into the North American BPS will require significant changes to traditional methods used for system planning and operation. The resulting reliability behaviors within the resource supply, the transmission delivery system, and the demand characteristics will require more sophisticated analysis methods, integrated and more extensive data, probabilistic approaches, and other approaches to effectively plan and operate a reliable system. Power system planners must consider the impacts of all these changes in power system planning and design and develop the practices, tools, and methods necessary to maintain long-term BPS reliability. Operators will require new tools and practices, including potential enhancements to NERC Reliability Standards or guidelines to maintain BPS reliability.

In support of enhancing planning approaches and assessments, RAPA has promoted the evolution of probabilistic reliability assessment techniques for some time, and biennially produces a supplemental analysis to the LTRA using probabilistic indices. This has informed and provided a solid foundation for further risk-based approaches, which needs to be expanded on the generation resource, the load side, and the transport across transmission systems.

Overall, the swift resource mix changes being observed and forecasted, coupled with an increasing interdependency of resources creates a fertile landscape for reliability risks and operational challenges.

---

### Panel II

Remarks of Thomas Burgess, Vice President and Director of Reliability Assessment and Performance Analysis and

Gerry Cauley, President and CEO

North American Electric Reliability Corporation

FERC Reliability Technical Conference

June 10, 2014

Accordingly, it is essential to ensure long-term reliability of supply that can support the rapidly evolving characteristics of North America's electricity supply resources. Furthermore, development of complementary and appropriate models, data, tools, and high quality assessments will lead to better decisions in support of reliability.

## **NERC's Assessment on Emerging Environmental Regulation and Related Generation Retirement Impacts**

The first major source of focus of assessment is on environmental regulations and their impact on BPS reliability. We have done considerable work in evaluating a series of expanded environmental regulation impacts over the past several years. RAPA has continued its reviews of the impacts of environmental regulations on generation resources as a part of a comprehensive risk evaluation. NERC's October 2010 *Special Reliability Assessment: Resource Adequacy Impacts of Potential U.S. Environmental Regulations* is the most recent in a series of assessments that included a detailed analysis of the potential resource adequacy impacts likely to result from four pending and planned Environmental Protection Agency regulations.<sup>1</sup> NERC examined the individual and aggregated impacts of: (1) Clean Water Act – Section 316(b): Cooling Water Intake Structures; (2) Clean Air Act – Section 112, Utility Air Toxics; (3) Clean Air Transport Rule; and (4) Coal Combustion Residuals.

In 2010, NERC's initial analysis of these regulations indicated 78 GW of projected retirements and derates by 2018. Additional impacts to reliability were also projected due to reduced reserve margins, in some cases the localized area impacts, highlighting the need for additional resources and complementary transmission reinforcements.

NERC's latest projections are in line with the initial 2010 analysis. Since the release of the initial report, nearly 43 GW of fossil-fired generation has retired, which is consistent with RAPA's initial retirement projections.<sup>2</sup> The latest long-term assessment (2013)<sup>3</sup> projects 85 GW of total retirements between 2011 and 2023. These retirements have been largely attributed to the confluence of environmental regulations (final and proposed) and the continuation of low natural gas prices and other economic factors.

Additional policies and regulations on greenhouse gas emissions are being developed and implemented by federal and provincial authorities throughout North America. As these were initially being considered for potential implementation, RAPA released its assessment of the *Reliability Impacts of Climate Change Initiatives* in 2009 considering both the impacts on the fossil fired components of the resource mix, as well as effects of renewable portfolio standards. As these policies and regulations become more certain, it is anticipated that an updated assessment will be warranted.

NERC continues to monitor and report on the impacts of environmental regulations on generation in the United States and Canada, as industry responds to state, federal, and provincial requirements. This is achieved through ongoing coordination with the NERC Regions, the EPA, and industry at large. NERC is also monitoring ongoing retirements and impacts to both resource adequacy and operations (e.g., deliverability, stability, localized issues,

---

<sup>1</sup> 2010 Special Reliability Scenario Assessment: Resource Adequacy Impacts of Potential U.S. Environmental Regulations.  
[http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/EPA\\_Scenario\\_Final\\_v2.pdf](http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/EPA_Scenario_Final_v2.pdf)

<sup>2</sup> <http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/2014SRA.pdf>

<sup>3</sup> [http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/2013\\_LTRA\\_FINAL.pdf](http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/2013_LTRA_FINAL.pdf)

---

### Panel II

Remarks of Thomas Burgess, Vice President and Director of Reliability Assessment and Performance Analysis and

Gerry Cauley, President and CEO

North American Electric Reliability Corporation

FERC Reliability Technical Conference

June 10, 2014

outage scheduling, operating procedures, and industry coordination). This information is released regularly by NERC in both seasonal and long-term assessments.

## **NERC Assessment of the Increasing Dependency on Natural Gas for Electric Power**

The next aspect of focus is on the continuing trend of increasing natural gas-fired generation. In recent years, many policies, discoveries, and economic factors have led to a shift toward gas fueled supply becoming the dominate component of the resource mix, and potentially affecting both the resource fueled supply, base-mid-merit composition and overall resource reliability behavior. A combination of factors, including environmental regulations and the emergence of widely available shale gas, coupled with environmental policies and coal-fired generation retirements, more natural gas generators are being built to replace traditional forms of generation and support future demand growth. Over the same period, renewable portfolio standards, state requirements, production incentives and other factors have driven the deployment of variable energy renewable resources. In North America, natural gas is anticipated to continue to become the dominant source of new capacity during the next 10 years. Based on the findings of recent special assessments, these convergences and potential localized area impacts continues to represent a potential risk with the growing dependence on gas-fired generation, coupled with recognition of the change in the supply and pipeline industry necessary to supply these plants. As highlighted in NERC assessments, increased dependency on natural gas can increase the BPS's exposure to disruptions in fuel supply, transportation, and delivery, and these risks can emerge jointly across the sectors and across different seasons. While extremely rare, disruptions in natural gas supply and transportation to power generators have prompted industry to seek an understanding of the reliability implications associated with increasing gas-fired generation.

NERC explicitly incorporated gas-electric interdependencies into its periodic reliability assessment, addressed in the in-depth special assessment *Accommodating an Increased Dependence on Natural Gas for Electric Power*<sup>4</sup>. This report examined the gas supply and transportation vulnerabilities as a prevalent risk in some areas that could lead to bulk power supply risks, causing industry and policymakers to refocus attention on gas-electric interaction and how these risks should be accounted for in planning. Generally, reserve margin projections include gas-fired capacity at its projected seasonal rating. While there are differences across the assessment areas, resource planning and adequacy assessments do not fully account for the risk of common-mode forced outages of gas-fired capacity that occur due to natural gas supply or transportation disruptions. NERC recommended that system planners consider implementing similar probabilistic techniques currently applied to energy-limited resources (e.g., wind, hydro) for evaluating fuel and supply risks associated with natural gas-fired generation. Further recommendations pointed to enhanced cross-sector coordination, planning, and operations, as well as undertaking readiness preparations for contingency constrained conditions. These approaches, in combination with an institutionalized cross-sector planning processes, can help pinpoint the risk exposure as well as specific reliability needs of individual systems.

In the *2014 Summer Reliability Assessment*, NERC indicated that although gas-electric coordination is more likely to be a key factor during the winter period, issues can also arise during the summer period when all areas in the United

---

<sup>4</sup> 2013 Special Reliability Assessment: Accommodating an Increased Dependence on Natural Gas for Electric Power – Phase II: A Vulnerability and Scenario Assessment for the North American Bulk Power System  
[http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC\\_PhaseII\\_FINAL.pdf](http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_PhaseII_FINAL.pdf)

### Panel II

Remarks of Thomas Burgess, Vice President and Director of Reliability Assessment and Performance Analysis and

Gerry Cauley, President and CEO

North American Electric Reliability Corporation

FERC Reliability Technical Conference

June 10, 2014

States peak. A separate set of concerns during the summer season regarding gas availability, specifically; natural gas storage facilities that are refilled during the summer season while several pipelines and pipeline compressor stations undergoing planned maintenance, all can contribute to constraints for interruptible gas-fired generation. The NERC *2014 Summer Reliability Assessment*, therefore, recommends that the electricity industry increase awareness of pipeline maintenance schedules and promote ongoing coordination to ensure individual generators do not face supply shortages—principally those that can be resolved through coordination—during peak summer or winter conditions.<sup>5</sup>

The industries – both electric and gas supply -- have recognized these risks and a number of regions are performing more detailed risk assessments. This work is promising and will be critical as it relates to further planning efforts. The increased coordination with the natural gas industry and the extensive risk analysis are important to enrich the planning processes and ensure reliability. For example, on an operational planning basis, New England coordinates with the gas industry and has knowledge about gas pipelines maintenance and outage schedules. In April 2013, PJM formed a Gas Electric Senior Task Force to identify and examine gas electric issues and develop solutions. MISO's Electric and Natural Gas coordination Taskforce also performs numerous studies to resolve the gas-electric issues in the region.<sup>6</sup> From a broader perspective, wider-area planning studies, such as those coordinated by EIPC and EISPC are helping better understand the risks to the natural gas generator fleet and how to incorporate these risks into resource planning.

## **NERC Assessment on Integrating Large Amounts of Variable Resources**

The final area of assessment focuses on accommodating large amounts of variable generation. During the past four years, the NERC Integration of Variable Generation Task Force (IVGTF) developed a number of recommendations that support the reliability considerations for accommodating large amounts of variable generation. These recommendations spurred significant action across the electric industry, including the identification of potential gaps and enhancements to NERC Reliability Standards. NERC IVGTF recommendations have provided industry with guidance on developing new operating procedures and planning considerations, including specifics on unique regional challenges, differing market structures, and regulatory policies. Among the key assessments produced by the extensive task force efforts include:

- *Variable Generation Power Forecasting for Operations* (May 2010)
- *Standard Model for Variable Generation* (May 2010)
- *Flexibility Requirements and Potential Metrics for Variable Generation*
- *Potential Reliability Impacts of Emerging Flexible Resources* (November 2010)
- *Operating Practices, Procedures, and Tools* (March 2011)
- *Ancillary Service and Balancing Authority Area Solutions to Integrate Variable Generation* (March 2011)
- *Methods to Model and Calculate Capacity Contributions of Variable Generation for Resource Adequacy Planning* (March 2011)

<sup>5</sup> Summer Reliability Assessment, May 2014 <http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/2014SRA.pdf>

<sup>6</sup> MISO's gas-electric reports can be found on the Electric and Natural Gas coordination Taskforce website:

<https://www.misoenergy.org/StakeholderCenter/CommitteesWorkGroupsTaskForces/ENGCTF/Pages/home.aspx>

---

### Panel II

Remarks of Thomas Burgess, Vice President and Director of Reliability Assessment and Performance Analysis and

Gerry Cauley, President and CEO

North American Electric Reliability Corporation

FERC Reliability Technical Conference

June 10, 2014

- *Potential Bulk System Reliability Impacts of Distributed Resources* (August 2011)
- *Interconnection Requirements for Variable Generation* (September 2012)
- *Performance of Distributed Energy Resources During and After System Disturbance* (December 2013)

Accommodating higher levels of variable resources requires cooperation and coordination within each interconnection—especially between BPS and non-BPS entities. Frequency stability, frequency response, energy imbalance, and increased and dynamic transfers must be addressed at all levels. Specifically, increasing amounts of solar photovoltaic (PV) generation leads to decreased system inertia and frequency response capabilities, as well as limited observability or dispatch controls that could potentially result in reliability impacts on the BPS.<sup>7</sup>

In November 2013, NERC published a joint report with the California ISO, which concluded that, when resource mix reaches 20 percent to 30 percent of the total supply met by non-dispatchable resources, such as renewable and distributed resources, reliability of BPS operation can be diminished as the essential reliability services become insufficient or constrained. Further, the initial work recognizes that the unique area resource mix, and corresponding changes, can couple with the large additions of variable energy resources to aggravate gaps in available essential reliability service, impacting reliability. The availability of essential reliability services that have always been inherently available on the BPS are being diminished by non-dispatchable renewable and distributed generation that connect to the grid without replacing the essential reliability services lost when larger, dispatchable generating units are retired. These services include demand and resource balancing, voltage and frequency support, inertial response, ramp management, and active controls.<sup>8</sup>

California recently raised its renewable portfolio target for utilities to 33 percent by 2020. Potential operating challenges presented by a 33-percent mix of renewables will make it challenging, e.g. ramping capability, for system operators to balance supply and demand in real time. Changes to existing practices are necessary to alleviate these challenges.

The electricity supply resource mix in California is distinctly different from that of other states or regions of the country and is projected to continue to include an increasingly large proportion of variable energy resources with limited control and dispatchability coupled with a continued retirements of conventional resources. By 2020, an additional 11,000 MW of variable energy resources are expected to be connected to the CAISO grid, which is anticipated to add to the uncertainty and variability of the future resource mix.

CAISO projects that more flexibility in accessing essential reliability services will be needed to reliably meet net load, manage approximately 3,000 MW of intra-hour load-following needs, and provide nearly 13,000 MW of continuous up-ramping capability within a three-hour time period.

At a high level, the assessment concluded that as an electric system approaches a significant penetration in variable resources:

---

<sup>7</sup> [NERC IVGTF Reports](#).

<sup>8</sup> 2013 Special Reliability Assessment: Maintaining Bulk Power System Reliability While Integrating Variable Energy Resources – CAISO Approach , A joint Report by NERC and CAISO [http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC-CAISO\\_VG\\_Assessment\\_Final.pdf](http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC-CAISO_VG_Assessment_Final.pdf)

---

## Panel II

Remarks of Thomas Burgess, Vice President and Director of Reliability Assessment and Performance Analysis and

Gerry Cauley, President and CEO

North American Electric Reliability Corporation

FERC Reliability Technical Conference

June 10, 2014

- Essential reliability services will be strained
- Technical aspects of the evolving resource mix must be given due consideration at state, federal, and provincial levels
- Solution sets for maintaining reliability can come from:
  - Market tools and rules
  - New technology integration
  - Standards or requirements
- Unresolved cost implications can impede solutions from materializing.

In summary, NERC recommended:

- NERC, state and provincial regulators, and industry should use an analytical basis for understanding potential reliability impacts as a result of increasing variable energy resources coupled with a changing resource mix and how those impacts can affect system configuration, composition, and essential reliability services.
- Based on analytical results and the broad experience of NERC stakeholders, specific recommendations for changes to operating and planning practices, state and provincial programs, and pertinent NERC Reliability Standards should be developed.
- VER expansion coupled with a changing resource mix can be addressed through many non-NERC avenues (e.g., market rules; vertically integrated operations; or federal, state, and provincial programs). However, it is recommended that NERC work with affected entities in the different NERC Regions, including state and provincial agencies that have jurisdiction over VERs, wholesale market areas, and vertically integrated utilities, to develop appropriate guidelines, practices, and requirements to address variable energy resource integration issues to ensure reliability of the BPS.

Based on these recommendations, NERC initiated its work on essential reliability services.

## **NERC's Essential Reliability Services Initiative**

As large quantities of variable energy resources—predominately wind and solar photovoltaic—are integrated into the BPS a greater proportion of the systems total resource mix will have limited inertial rotating mass capability and operator flexibility. These new types of resources will displace electric generation provided by large rotating machines and the operating characteristics those machines provided. The operating characteristics of electronically coupled variable energy resources (primarily wind and solar) differ from those of large synchronous generators. As these trends continue to unfold, it is increasingly important for regulators and policy makers to understand how the resource mix change affects the planning and operation of the BPS. Therefore, it is necessary that in addition to the energy and capacity needs of a given system, a solid technical foundation for assessing essential reliability services is needed. Consideration of these essential components of reliability are needed in both BPS planning and state, federal, and provincial policy implementation. NERC continues to assess these challenges and is developing proactive measures to address any potential issues through a suite of tools available to NERC, including but not limited

---

### **Panel II**

**Remarks of Thomas Burgess, Vice President and Director of Reliability Assessment and Performance Analysis and**

**Gerry Cauley, President and CEO**

**North American Electric Reliability Corporation**

**FERC Reliability Technical Conference**

**June 10, 2014**

to Reliability Standards. Importantly, there are certain lessons that have emerged [e.g. Germany and Hawaii] where essential reliability services were constrained, that these insights will help to avoid and prevent.

The changing generation mix due to the addition of wind and solar, the retirement of conventional generation, increasing demand response, and distributed resources warrants the study of essential reliability services at both the micro and macro levels. These trends in the utility planning and operational model require an analysis of “essential” services. In order to assist policy and decision-makers in understanding the role that these essential reliability services play in supporting BPS reliability, NERC has posted a white paper tutorial that outlines the major characteristics and reliability attributes of essential reliability services. Policy makers (federal, state, and provincial) need to thoroughly understand these issues and their own roles in finding solutions, leveraging a comprehensive technical analysis of the issues. To that end, NERC has commissioned the Essential Reliability Services Task Force (ERSTF) to refine what services are needed to maintain BPS reliability. The task force will soon begin its work, which includes developing an analytical approach for evaluating essential reliability services.<sup>9</sup>

NERC intends to build on the work of the ERSTF to develop an assessment that will identify metrics, procedures, and methodologies to determine the need for, provide, and maintain essential reliability services for an electric system.

The next step for the ERSTF (to be completed by the end of 2014) is to develop an approach and framework for the long-term assessment of essential reliability services to supplement existing resource adequacy assessments. The approach should include a series of metrics that can be continually measured for further evaluation. NERC’s objective on this next step is to:

- Develop technical reference for each essential reliability service
- Identify parameters and performance expectations for each essential reliability service
- Identify current initiatives, standards and other on-going work in support of maintaining essential reliability service
- Identify any gaps and recommendations for NERC

Final takeaways:

- Physics of the Bulk Electric System remain constant—voltage, frequency and load/resource balance require essential reliability services to be supported at all times
- Not all MWs are equal—having adequate resources does not equate to the right type of resources with functional capabilities and characteristics
- Changing resource mix requires evaluation of essential reliability services —“Reliability building blocks” are integral to a reliable bulk electric system and must be maintained regardless of the resource mix

---

<sup>9</sup> *Essential Reliability Services: A Tutorial for Maintaining Bulk Power System Reliability and Adapting to a Changing Resource Mix:*  
<http://www.nerc.com/comm/Other/essntlrbltysrvctskfrcdl/ERS%20Draft%20Concept%20Report.pdf>

---

#### Panel II

Remarks of Thomas Burgess, Vice President and Director of Reliability Assessment and Performance Analysis and

Gerry Cauley, President and CEO

North American Electric Reliability Corporation

FERC Reliability Technical Conference

June 10, 2014

## **Conclusion**

In conclusion, the ability to adapt to a changing resource mix is expected to raise new concerns across the electricity industry. These issues need to be assessed and evaluated in order to have a better understanding of how to accommodate and adapt to a paradigm shift of resource utilization. While some of these challenges are more regional than others, the cumulative impacts can affect both planning and operating fundamentals that can extend to the entire interconnection. NERC has a unique role in its ability to assess reliability in terms of both performance and preparations. A solid analytic foundation demonstrated in our assessment efforts is continuing to deepen the insights and guidance that enables sound actions within industry and among policy makers. These approaches are continuing to mature, and though there is still work to be done, an established solid foundation is in place to identify and develop effective measures commensurate with the risk. This framework for independent risk-informed decisions ensures progress and measures continued reliability success.