NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

FERC Reliability Technical Conference

Panel II: Emerging Issues

Remarks of Mark G. Lauby, Senior Vice President and Chief Reliability Officer and John Moura, Director, Reliability Assessment and System Analysis

June 4, 2015

Good afternoon, Chairman Bay, Commissioners, Staff, and fellow panelists. My name is Mark Lauby and I am the Senior Vice President and Chief Reliability Officer at the North American Electric Reliability Corporation (NERC). I, and my colleague John Moura, Director, Reliability Assessment of System Analysis are delighted to be here to discuss emerging issues that can affect the risk to reliability, and NERC's activities to identify, assesses, and provide action-oriented recommendations for their remedy. Some of the key strategic emerging issues NERC include:

- **Changing nature of reliability:** Along with the current set of responsibilities, more and more emphasis is being placed on the resilience of an organization to respond to extreme events. Resiliency is becoming the yardstick of reliability. NERC is reviewing how it supports industry in addressing this challenge. For example, NERC continues to provide industry information on lessons learned from extreme weather events and is developing analytical methods to identify potential interdependencies between extreme weather and resiliency performance. Additionally, NERC continues to study and develop analytical approaches to address Geomagnetic Disturbances (GMD). You will hear more about this activity on the next panel.
- **Security:** NERC is dedicating a significant amount of resources to security topics. On the physical side, NERC and industry are just beginning. On cyber, the enormity and speed of change requires continued and elevated NERC engagement to assure reliability. You will hear more about this area from NERC in the next panel.
- **Changing nature of the grid:** With the addition of distributed generation, demand response, and micro-grids, the basic grid paradigm is shifting. As this transition occurs, the essential reliability services of the grid are impacted. NERC continues to study this transition, and you will hear more from this panel about the challenges of this transition and the need to maintain essential reliability services.

From a more granular view, NERC facilitates the ERO's statutory requirements of Section 215 of the Federal Power Act to perform periodic reliability assessments through the following activities:

- Annual Long-Term Reliability Assessments (Ten-year)
- Annual Summer and Winter Reliability Assessments (Seasonal)
- Special and Scenario Reliability Assessments (as needed)

Reliability assessments provide a technical platform for important policy discussions on challenges facing the interconnected North American bulk power system. Each year, NERC is responsible for independently assessing and reporting on the overall reliability resource adequacy, and associated risks that could impact the upcoming summer and winter seasons and the long term, ten year period – with the objectives to identify areas of concern regarding the reliability of the North American BPS and to make recommendations for remedial actions as needed.

NERC's unbiased judgment of the industry's plans for maintaining electric reliability in the future are grounded on solid engineering through collaborative and consensus-bases assessments. NERC continually scans the horizon to identify and attempt to quantify risks to reliability of the bulk-power system. These emerging risks and their potential impacts are often identified in NERC's annual *Long-Term Reliability Assessment* and key areas are also amplified in special assessments conducted to provide a technical framework and insights about the range, and specific aspects to guide steps to manage their impacts.

By identifying and quantifying emerging reliability issues, NERC is able to provide risk-informed recommendations that drive NERC's activities 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.

Question (a): What emerging issues are going to challenge NERC and industry? How are these issues being considered in long-term, seasonal and operational planning studies?

In the annual *Long-Term Reliability Assessment*, NERC independently examines data and information collected from industry through the eight Regional Entities. Additionally, NERC depends on a wide range of stakeholder and subject-matter experts to identify and assess both standing and emerging reliability risks. It is within this periodic assessment activity that key emerging reliability issues are identified.

In NERC's most recent *Long-Term Reliability Assessment* (2014),[1] NERC identified three key findings:

1. Reserve Margins in several Assessment Areas are trending downward, despite low load growth.
2. Environmental regulations create uncertainty and require deeper assessment.
3. Assessing reliability with the changing resource mix requires new analytical approaches

I will discuss each of these findings in more detail.

1. **Reserve Margins in several Assessment Areas are trending downward, despite low load growth**
   A primary objective of the *Long-Term Reliability Assessment* is to assess resource adequacy. Planning Reserve Margin is a metric used in NERC's assessment to consistently examine future

[1] *2014 Long-Term Reliability Assessment*: http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/2014LTRA_ERATTA.pdf

resource adequacy and raise industry awareness of potential resource adequacy concerns should Planning Reserve Margins fall below a specified target — the NERC Reference Margin Level. From this analysis, NERC highlights resource adequacy concerns, particularly in ERCOT, NPCC-New York, and MISO, as projections continued to reflect declining Planning Reserve Margins that are below their Reference Margin Level in the short-term outlook (1-5 years). Specifically:

- Resources adequacy has recently improved in ERCOT, as new capacity additions elevate Planning Margins through 2018.
- MISO drops below their Reference Margin Level as soon as 2016, as resources additions are unable to keep pace with continued load growth and ongoing retirements.
- Essential The NYISO faces a similar situation, below their Reference Margin Level in 2017.

The remaining areas assessed met their reference levels, though several areas have declining trends in the amount of planning reserves.

1. **Environmental regulations create uncertainty and require deeper assessment**

   In the *Long Term Reliability Assessment*, NERC identified several market and regulatory uncertainties in the near future that can have significant impacts on long-term resource adequacy. While the near-term impacts of the Mercury and Air Toxics Standard (MATS), recently finalized by the US EPA, are factored into this assessment, significant uncertainty remains for a large amount of existing conventional generation that may be vulnerable to retirement resulting from additional pending regulations—particularly EPA's recently proposed Clean Power Plan (section 111(d) of the Clean Air Act).

   Environmental regulations at the state, provincial, and federal levels continue to be a key driver of ongoing retirements — primarily fossil-fired capacity. System planners are responding by aligning generation portfolios to comply with limits on cross-state air emissions. Concurrent increases in the operating costs of coal plants are often related to the required installation of environmental control technologies. Before these capital investments are made, plant owners must consider the future life of the unit(s), current and future fuel costs and revenues compared to other fuel types, and the impacts of additional environmental regulations.

   According to the *Long Term Reliability Assessment's* reference case, an additional 44.2 GW of fossil-fired and nuclear capacity is projected to retire between 2014 and 2024. These projections are based on the assumption that current environmental regulations will remain unchanged; it does not include potential impacts of EPA's recently proposed Clean Power Plan (section 111(d) of the Clean Air Act). My colleague, John Moura, will cover these impacts more thoroughly based on the draft rule in more detail.

2. **Assessing reliability with the changing resource mix requires new analytical approaches**
   North America's resource mix is undergoing a significant transformation at an accelerated pace with ongoing retirements of fossil-fired and nuclear capacity and growth in natural gas, wind, and solar resources. This shift is caused by several drivers, primarily existing and proposed federal, state, and provincial environmental regulations. Other drivers include lower natural gas prices due to abundant supply, along with policies incentivizing the movement from conventional energy resources toward ongoing integration of both distributed and utility-scale renewable resources.

   The convergence of these resource mix changes is directly impacting the behavior of the North American bulk-power system. For example, assessments methods will need to recognize the energy limitations and the need to ensure sufficient essential reliability services will be available to maintain reliability. These developments will have important implications on industry planning and operations, as well as how NERC assesses reliability. There are several important facets of the changing resource mix and how this transformation can impact bulk-power system reliability:

   - Higher reliance on natural gas further exposes the bulk-power system to impacts from fuel transportation disruptions;
   - Ongoing growth in wind and solar resources requires more system flexibility;
   - Essential reliability services must be maintained as the resource base shifts from predominately coal-fired base-load generation, to a combination of natural gas-fired generation, energy efficiency, demand response and variable energy resources;
   - Transmission enhancements and reinforcements are needed to support reliability with ongoing unit retirements and increased penetration of variable energy resources.

Further, NERC continues to track standing issues (i.e., issues that have been previously identified in NERC reliability assessments). These issues include:

- Increasing load forecast uncertainty and flexibility needs due to the integration of large amounts of distributed energy resources,
- Changes to system behavior characteristics due to changing load compositions,
- Potential operational risks associated with the interaction of Special Protection Systems and Remedial Action Schemes,
- Regional/Interconnection-wide model validation and model representation,
- Transmission siting, permitting, and other right-of-way issues,
- Workforce transformation,
- Aging infrastructure.

NERC's assessments provide an independent platform to conduct a variety of analytical sensitivities and scenarios of potential reliability issues. Scenario and sensitivity analysis is critical in determining a range of potential outcomes around a particular issue. NERC has been very successful in collecting and maintaining key performance data on power system resources and transmission equipment. This data is instrumental for developing special reliability assessments designed to help inform policy makers, industry leaders, and the general public.

Question (b): What progress has been made by NERC's Essential Reliability Services Task Force in developing new approaches to the "reliability building blocks" (voltage support, ramping capability, and frequency support) needed for reliability and for ensuring their provision as the resource mix changes? Are any changes in reliability standards or other regulatory requirements needed or appropriate?

Giving the transformation of North America's resource mix, NERC is more closely examining corresponding impacts on frequency response, ramping capabilities, and other important operational characteristics. The Essential Reliability Services Task Force (ERSTF), established last year, continues to examine these issues and develop new metrics that will help measure and ensure the BPS continues to maintain an adequate levels of ERS.

The changing generation mix due to the addition of wind and solar, the retirement of conventional generation, increasing DR, and distributed resources warrants the study of Essential Reliability Services (ERS) at both the micro and macro levels. All of these trends in the utility operational model require an analysis of "essential" services, and NERC has commissioned the Essential Reliability Services Task Force (ERSTF) to refine what services are needed to maintain bulk power system (BPS) reliability.

The mission of the ERSTF is to provide a roadmap for the North American BPS for the transition to a generation mix with a high penetration of renewables and reduced conventional and synchronous generation. Conventional generation (steam, hydro, and combustion turbine technologies) inherently provides ERS needed to reliably operate the North American BPS. NERC has identified the building blocks of these ERS, which includes voltage support, ramping capability and frequency support. Generators must be able to continuously balance load and demand throughout the BPS to support transmission voltage and frequency response. Wind, solar and other variable energy resources that are an increasingly greater share of the BPS provide a significantly lower level of ERS than conventional generation. Recognition of differing requirements and preparing for this transition are a key focus for the task force.

Progress to Date

- ERSTF Concept Paper – The ERSTF developed a concept paper in order to inform the regulators and industry of various essential services affected by the integration of renewable resources and retirements of base load plants. As recognized in the report, policy makers must consider the technical aspects of ERS when making decisions related to interconnecting new resources or market

and tariff oversight. Federal, state, provincial and local jurisdictional policy decisions have a direct influence on changes in the resource mix, and thus can also affect the reliability of the BPS. As such, the NERC recommendations will assist in informing policy makers of the implications of the changing resource mix and how industry can evolve the system in a reliable manner.

- ERSTF Measures Framework Report – The task force then developed four subgroups to review and develop measures for various services affected by the changing nature of resource mix. The four subgroups are:
    - Load and Resources Balance,
    - Frequency Support,
    - Voltage Support,
    - Policy and Advisory.

As part of the subgroups' efforts the task force endorsed five measures to pilot by data gathering and analysis:

- Synchronous Inertial Response at an Interconnection Level,
- Synchronous Inertial Response at the Balancing Authority Level,
- Initial Frequency Deviation following largest contingency,
- Ramping Variability needs,
- System Reactive and Voltage Support.

The ERSTF believes that these measures are useful benchmarks for long-term assessment; however, in order to ensure and verify these measures are indicative of BPS reliability trends, a pilot assessment is warranted. In addition, several other measures are being evaluated by the task force. The overall plan endorsed by the Planning and Operating Committees in December 2014 includes data gathering and conducting a pilot assessment in the first half of 2015. The aforementioned pilot assessment includes conducting various analyses using this framework to assess long-term and emerging trends. This will lead to an overall assessment that will validate or refine the measures, and result in recommendations by the end of 2015. In addition, major entities across North America will be providing feedback and insights from their preliminary evaluations on the effectiveness and practical adoption of such measures in assessing the status of ERS.

In conclusion, through NERC's numerous analysis and assessments, the change in resource mix is expected to raise reliability concerns within the industry. As the task force evaluates the results of various analyses done through the measures, there could be some changes to requirements in NERC Reliability Standards as well as recommendations to enhance NERC's *Long-Term Reliability Assessment*.

Question (c): What approaches are being developed to address recent declines in reserve margins in several regions as described in the 2014 NERC Long Term Reliability Assessment report? What connection, if any, does this trend have with resource mix changes? Should reserve margin targets be altered or rethought as the overall resource mix changes?

Several Assessment Areas report declining Reserve Margins in recent years, as capacity additions fail to keep pace with ongoing retirements among modest demand growth rates. Specifically, ERCOT continues to address resource adequacy issues by incentivizing additional participation in Demand Response (DR) and energy efficiency programs. More recently, additional capacity – particularly four new gas-fired units totaling over 2 GW – were added in 2014. ERCOT's Anticipated Reserve Margin is now above the state target through 2018.

Since 2013, MISO's Planning Reserve Margins are also nearing its Reference Margin Level, with contributing factors including: (1) increased retirements and suspensions (temporary mothballing) due to Environmental Protection Agency (EPA); (2) regulations and market forces and low natural gas prices; (3) exclusion of low-certainty resources that were identified in a Resource Adequacy survey conducted by the RTO; and (4) the exclusion of transmission-limited resources in MISO-South for planning purposes.

NERC continues to raise awareness of resource adequacy issues in MISO and ERCOT by coordinating regularly with involved parties (state regulators and public utility commissions), and support ongoing initiatives to effectively address declining reserve margins.

NERC is also adopting new approaches beyond a deterministic Planning Reserve Margin metric to examine reliability as the resource mix continues to change. Specifically, more regular probabilistic analyses will provide further insights on the resource adequacy as well as energy adequacy across all hours. This approach offering a more in-depth understanding of the interplay between resource availability (with considerations for transmission constraints) and projected hourly demand.

NERC remains concerned that current reserve margin targets may not fully account for risks that might impact BPS reliability given the changing characteristics of the resources available on the system. The North American generation mix is primarily comprised of conventional generation (hydroelectric, coal, petroleum, nuclear, and natural gas). With this generation mix, the use of a Reserve Margin continues to be an effective approach for assessing resource adequacy. Reserve Margins measure the amount of generation capacity available to meet expected demand during the planning horizon and have been a surrogate metric for examining and planning for resource adequacy and system reliability. Based on the premise of this metric, a system should be able to supply resources to meet the projected normal weather electricity demand (given some explicit amount of reserve capacity), with a high degree of certainty that the system can manage generator outages and modest deviations from the annual demand forecast. The Reference Margin Level guideline does not evaluate the effects of unit size or performance, the size of the system, or the

strength of its interconnections in each Assessment Area. In North America, given the static measure of generation reliability, Reference Margin Levels are reviewed and, if necessary, revised as significant system changes occur.

The one-event-in-ten-year (0.1 events per year) Loss of Load Expectation (LOLE) is produced from this type of analysis—that is, a given electric system should maintain sufficient generation and demand-side resources such that system peak load is likely to exceed available supply once in a ten-year period. Utilities, System Operators, and regulators across North America rely on variations of the one-event-in-ten-year guideline for ensuring and maintaining resource adequacy. In many cases, system operators require a certain reserve level (e.g., many ISO/RTOs have reserve targets and/or requirements). Some state public utility commissions also set reserve targets within their jurisdiction.

Although Reserve Margins offer insight into the relative ability of a system to serve load based on existing and planned resources, this metric does not fully capture important reliability attributes essential for ensuring BPS reliability. Reserve Margins assume that generator fuel availability is not correlated with load levels or weather. However, recent extreme weather events have caused an increased number of forced outages due to fuel unavailability, particularly natural gas. Assumptions of the Reserve Margin metric may be understating these risks. For VERs, a proxy for fuel availability is used to adjust installed or seasonally rated capacity values — with installed or nameplate capacity derated in Reserve Margin calculations. This approach lacks in providing an evaluation of the reliability of VERs during off-peak hours or during extreme weather events.

Probabilistic measures, such as Loss of Load Hours (LOLH) and Expected Unserved Energy (EUE), provide greater fidelity as a reliability measure due to the consideration of energy contributions from resources compared to a distribution of load levels throughout a given year. EUE, for example, is a measure of the generation and transmission system's capability to continuously serve all loads at all delivery points while satisfying planning criteria. EUE is energy-centric and analyzes all hours of a particular year. Results are calculated in megawatt hours (MWh) and is the summation of the expected number of megawatt hours of load that will not be served in a given year as a result of demand exceeding the available capacity across all hours. LOLH, on the other hand, provides the number of hours per year where system demand will exceed the generating capacity. LOLH is usually expressed in hours per year. Any outage caused by inadequate resources regardless of geographic extent or load interrupted (it could be 1 MW for a single customer or the loss of the whole area load) counts as a LOLH. An LOLH of 0.1 means that an hour of loss of load is expected for every 10 years.

As the industry continues to change its resource mix, probabilistic measures will better capture the stochastic behaviors of variable and energy-limited resources that are being integrated into the bulk power system. While the Planning Reserve Margin metric is a fundamental and useful measure when considering

capacity-based planning, probabilistic indices offer a more applicable approach to assessing resource adequacy in areas that have significant variable and energy-limited resources.

Question (d): Are additional efforts needed to maintain reliability as the growth of natural gas-fired generation continues? What specific additional improvements still need to be made?

NERC released two special assessments focused on gas-electric coordination and continues to examine this issue within our seasonal and long-term assessments. FERC has also held numerous conferences on this topic. Natural-gas-fired capacity continues to be the replacement capacity of choice for resource planners as other fossil-fired units are retired. As natural gas prices continue to be at very low relative prices, natural gas will continue to be on the margin for new generating facilities. Over 44.6 GW of natural gas-fired capacity additions are expected during the next decade.

The electricity sector's growing reliance on natural gas raises concerns regarding the electricity infrastructure's ability to maintain BPS reliability when facing constraints on the natural gas pipeline system. The extent of these concerns from Independent System Operators (ISOs), Regional Transmission Organizations (RTOs), electricity market participants, industrial consumers, national and regional regulatory bodies, and other government officials varies throughout North America; however, concerns are most acute in areas where power generators rely on non-firm pipeline transportation as natural gas used for power generation continues to rapidly grow.

Natural gas supply and transportation infrastructure adequacy concerns, particularly in certain parts of North America, are causing NERC, industry, and policymakers to refocus attention on the interdependency between natural gas and electricity industries. System Operators and resource planners continue to make considerable progress to consider fuel supply and transportation adequacy as a formal part of reliability assessment. Under average annual operating conditions, most pipelines have some level of capacity that is not used by Firm customers and is therefore available for non-Firm (interruptible) loads, including natural gas generators with non-Firm contracts. If the requirements for non-Firm deliveries are communicated to the pipeline within the nomination cycle timeline, the pipeline can use facilities to enable delivery of natural gas requested up to its allowed physical capabilities. This is the normal procedure for interruptible transportation service or capacity release from Firm shippers. In some power markets or areas where there is excess natural gas pipeline capacity available, these low-capacity-factor units can rely upon interruptible service with a reasonable degree of certainty that service will be available.

However, as growth in natural gas demand continues to increase, pipeline transportation constraints will have a greater impact on natural-gas-fired generation, making units with non-Firm service vulnerable to more frequent interruption. If a generator served by interruptible service has no secondary fuel source, then that generating capacity could be unavailable during peak periods. While coordination efforts between the gas and electric industries continue to improve, the potential still exists for a mismatch between the availability of natural gas delivery and natural gas demand for electricity generation. This can be particularly

challenging in areas where a significant amount of the capacity — or more importantly, reserve capacity — is susceptible to natural gas transportation interruptions, potentially resulting in more frequent generator outages.

The gas and electric industries have recently made substantial progress to enhance coordination and develop new strategies to address system reliability due to fuel supply and transportation concerns. These efforts – documented in the 2014 LTRA – helped to reduce the severity of impacts experienced during the 2014 polar vortex event.

While recent strides have been made in addressing gas-electric coordination, additional areas need attention. Specifically, system planners in areas where natural gas constitutes a large portion of the generation mix, planners need to more thoroughly examine system reliability needs to determine if more Firm fuel transportation or units with dual-fuel capability are needed. Additionally, fuel availability and deliverability should be specifically considered and integrated into resource adequacy and other planning assessments.

More attention is also needed regarding operational coordination strategies between gas and electric industries. System operators should develop or enhance coordination strategies to address potential fuel interruptions – especially prior to anticipated extreme weather events. Generator owners should consider securing on-site secondary fuel in the event that non-Firm gas service is curtailed.

Question (e): In March of this year, the Commission completed a series of conferences on EPA's proposed Clean Power Plan. Since that time, is there new or updated information that warrants consideration on this issue?

On April 21, 2015 NERC released its report titled Potential Reliability Impacts of EPS's proposed Clean Power Plan. The report highlights four key findings as a result of the proposed CPP. Those key findings are:

1. Consistent with NERC's Initial Reliability Review, the proposed CPP is expected to accelerate a fundamental change in electricity generation mix in the United States and transform grid-level reliability services, diversity, and flexibility.
2. Industry needs more time to develop coordinated plans to address shifts in generation and corresponding transmission reinforcements to address proposed CPP CO_2 interim and other emission targets.
3. Implementation plans may change the use of the remaining coal-fired generating fleet from base load to seasonal peaking, potentially eroding plant economics and operating feasibility.
4. Energy and capacity will shift to gas fired generation, requiring additional infrastructure and pipeline capacity.

As a result of the key findings that NERC highlighted in its report, NERC made the following recommendations:

1. NERC should continue to update and expand the assessments of the reliability implications of the proposed CPP and provide independent evaluations to stakeholders, states, regulators, and policy makers. NERC should continue to conduct a phased assessment strategy recognizing that the proposed rule is not yet final and may change. These assessments will continue to provide insight and guidance as the CPP rule is finalized and states, regional and federal implementation plans begin to materialize.
2. Coordinated regional and multi-regional industry planning and analysis groups should continue to conduct detailed system evaluations to identify areas of reliability concern and work in partnership with states, regions, and policy makers to provide clear guidance of the complex interdependencies resulting from the CPP rule's implementation.
3. Policy makers, states, regions, and regulators (including the EPA) should develop implementation plans that allow for more time to address potential BPS reliability risks and infrastructure deployment requirements during the transition period.
4. The EPA should include a formal reliability assurance mechanism in the final rule that provides the regulatory certainty and explicit recognition of the need to ensure reliability during both the plan development and the implementation period through 2030 – and potentially beyond. NERC has outlined a specific series of roles for providing reliability guidance and independent assessments, in the form of a reliability assurance mechanism.
5. State and regional plans should be developed in consultation with reliability authorities – Planning Coordinators and Transmission Planners – to review plans and demonstrate reliability through established planning analyses and processes.

EPA's final rule is anticipated later this summer on the Clean Power Plan. NERC will continue to monitor this progress and plans additional assessments. In addition, on May 15, 2015, FERC issued a letter outlining its views on its role with respect to a Reliability Safety Valve and Reliability Monitoring and Assistance. NERC looks forward to working with the Commission and with EPA in assessing how the Clean Power Plan may affect the reliability of the Bulk-Power System.

Conclusion

NERC's RASA organization and associated stakeholders serve to provide a solid technical foundation for understanding the reliability and performance across North America. Those insights provide unique perspective that shapes directional efforts and guidance to assure the reliable operation and planning of the bulk power system to address emerging issues as identified for this panel discussion. We appreciate the Commission's focus on these issues and look forward to working together to address these topics.