FEDERAL ENERGY REGULATORY COMMISSION

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2016 State of Reliability	)	**Docket No. AD16-15-000**
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RELIABILITY TECHNICAL CONFERENCE

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Thank you for the opportunity to express the views of the Department of Energy (DOE) on a range of important issues related to electric reliability – today and tomorrow. I note that you have divided today's agenda into three broad areas: 1) the state of reliability in 2016; 2) emerging issues, both internationally and domestically; and 3) grid security. In this written statement, I will address topics of particular interest or concern to DOE in all three areas, with particular attention to the first area.

I. 2016 State of Reliability

Reliability has become more important than ever before – major parts of our economy are now totally dependent on reliable electricity. Even momentary disruptions in power quality can result in major economic losses. Further, we are in the early stages of a grand transformation of our electricity supply system, and this process of change is likely to continue for many years, with no stable end-state in view. Keeping the lights on during this transformation will require unprecedented coordination and collaboration among many parties.

Success in managing this transformation will not be achievable without relevant metrics. One of the most important of the "foundational" projects in DOE's current 88-project Grid Modernization Lab Consortium (GMLC) portfolio is aimed at developing metrics for six key attributes a modern grid must have. Reliability is one of those attributes, and it is often the first one mentioned.[1]

The reliability metrics we use today will not be adequate for our future. For example:

1) We need to distinguish more clearly in our statistics and data between customer outages related to transmission-level events and those caused by distribution-level events. More than 90 percent of all interruptions are distribution-level events. We need to understand the latter category better in order to make them less frequent and reduce their impacts.

2) For any given utility, long-term trends in SAIDI and SAIFI[2] can vary significantly depending on whether "major events" (e.g., hurricanes and other

[1] The six attributes, in no particular order, are reliability, affordability, resilience, flexibility, sustainability, and security.
[2] SAIDI: System Average Interruption Duration Index, calculated as total duration of sustained customer interruptions (≥ 5 minutes each)/number of customers served; SAIFI: System Average Interruption Frequency Index, calculated as frequency of sustained customer interruptions (≥ 5 minutes each)/number of customers served.

large-scale storms, tsunami, etc.) are included. Exclusion of major events from the data can mask declines in reliability, particularly if – as now appears to be the case – both the frequency and severity of major events are increasing.

3) As presently defined, SAIDI and SAIFI do not distinguish among affected customers. Yet according to Lawrence Berkeley National Laboratory (LBNL) research, a 1-hour interruption costs an average residential customer $5, an average commercial customer $866, and an average industrial customer $7,688. [3] This lack of granularity makes it difficult, for example, for state regulators to decide how well their utilities are allocating reliability investment dollars.

In the GMLC project mentioned above, DOE will develop "event-based" reliability metrics, drawing on real-time interruption information posted on some utilities' websites. Events will be characterized by

1) Magnitude (number of customers interrupted)
2) Customer type
3) Geographic scope (zip codes, counties)
4) Affected critical facilities and infrastructures.

A number of utilities are now estimating the costs of power outages using a tool developed by LBNL called the Interruption Cost Estimate Calculator ("ICE Calculator").

[3] These averages were generated using the Interruption Cost Estimate (ICE) Calculator available at http://icecalculator.com/. ICE is an electric reliability planning tool developed by Nexant and Lawrence Berkeley National Laboratory. The ICE Calculator was funded by the Office of Electricity Delivery and Energy Reliability at the U.S. Department of Energy.

The ICE Calculator is based on utility-sponsored statistical surveys of the costs customers incur due to power interruptions. DOE is now mapping out plans to improve the survey data upon which the calculator is based, which will enable more accurate estimates of the costs of outages.

We also need better metrics at the transmission level for reliability planning. Current planning practices usually evaluate a limited number of scenarios, including a postulated "worst case." Focusing narrowly on a low-probability worst case can lead to unduly-conservative decisions and misallocation of resources. New methods and metrics are needed that take a probabilistic approach to the assessment of a wide range of possible contingencies or even combinations of them.

At the same time we develop concepts and proposals for new or refinements of existing metrics, we will need to take appropriate actions to ensure the availability of the relevant data. The Department of Energy looks forward to working with FERC, NERC, utilities, state regulators, and others to develop, test, and refine these reliability metrics (and any metrics that others may propose), and to work with the same organizations to ensure the availability of the pertinent data.

In DOE's 88-project GMLC portfolio, we are addressing a wide range of other important topics related to reliability at the bulk power level, including:

1) Improvements in system modeling that will enhance our ability to forecast load patterns and the availability of weather-dependent generation, and to design advanced protection schemes where appropriate.
2) Tools to accelerate the speed at which grid operators will be able to identify, analyze, and respond to unusual conditions or events –which will be made necessary by the likelihood of much more dynamic market conditions, as the mix of load-side and generation technologies changes.

II. Emerging Issues

It is no secret that we face a growing list of new issues in the electricity subsector, many of which have reliability implications, associated with the massive transformation of our electric supply system mentioned earlier. Here I want to add that the *entire* system is being affected, not just the bulk power facilities and markets, including distribution systems and important new system components that are being added on the customer's side of the meter.

In this section I want to give particular attention to several challenges. One is that the need for new metrics, new kinds of data, and new data-sharing protocols is just as important at the distribution level as at the bulk power level. In fact, this need is probably more challenging than at the bulk-power level, if only because we are starting from a less developed base. That is, with respect to bulk power reliability, we are able to build on decades of experience with the design and operation of these systems and with the development of pertinent reliability standards. By comparison, at the distribution level we are in the early stages of creating a cadre of professional distribution planners and a body of distribution-level reliability standards, metrics, and mechanisms for sharing data.

Further, with the continuing penetration of distributed energy resources (DERs), many of the reliability problems that we have dealt with in earlier times at the bulk power level are now appearing at the distribution level, such as the need to manage voltage fluctuations and control, frequency control, and provide VAR support. Dealing with the reliability aspects of these concerns will raise significant federal/state jurisdictional issues, but I think that it is important to first gain an understanding of the technical problems and the potential solutions; that understanding will then inform and assist the resolution of the jurisdictional questions. The Department is supporting several projects related to these distribution-level challenges, too numerous to mention in detail here, as part of our 88-project Grid Modernization Lab Consortium portfolio.

Other important "emerging issues" are related to the continuing growth in the interdependence of our generation capacity and the natural gas supply system. The significance of this interdependence was amply demonstrated over two years ago in the massive eastern cold weather event known as the Polar Vortex, when protracted cold weather rendered much coal-fired generation inoperable, increased electricity demand, and strained our ability to deliver timely and adequate amounts of natural gas to gas-fired generation plants. Despite that experience, we are still faced with difficulties in ensuring the timely development of additional gas pipeline capacity, coordination of the "market day" timing of the two industries, and determining in advance how available gas supplies would be allocated among wholesale customers in emergency situations. At the same time, our weather experts caution us not to remember the 2014 Polar Vortex as a one-time experience. I congratulate the Commission for its past and ongoing activities to explore concerns related to gas-electric interdependency, but I note that much work remains to be done.

Further, the significance of our growing gas-electric interdependence has been underscored recently in another way by the Aliso Canyon accident near Los Angeles and its continuing effects. The gas leak at Aliso Canyon has been closed, but the massive gas storage facility there is also shut down and is not likely to reopen for months, despite the dependence of much of the generation capacity that previously served Los Angeles on natural gas fuel drawn from that storage system. California's regulatory agencies and utilities have projected that without that storage capacity, rolling blackouts could be needed for up to 14 days during the summer of 2016, given conditions of extreme hot weather. Further, reliability problems could persist into the winter of 2016-17 if Aliso Canyon's storage system remains closed.[4]

In response to this accident, the Department of Energy and the Department of Transportation are co-leading the Administration's Interagency Task Force on Natural Gas Storage Safety. To support the Task Force, the Department has tasked analysts at Argonne National Laboratory to review safety conditions at the nation's 400 natural gas

[4] California Public Utilities Commission, California Energy Commission, the California Independent System Operator, and the Los Angeles Department of Water and Power. *Aliso Canyon Action Plan to Preserve Gas and Electric Reliability for the Los Angeles Basin* [April 2016]

storage facilities, and to gauge the strategic significance of these facilities for the regional or local electric industry or other important industrial sectors.

In further recognition of the growing importance of gas-electric interdependence, another project in our 88-project Grid Modernization Lab Consortium portfolio will address how to model in an integrated manner the dynamics of regional electricity markets and regional gas markets. These markets operate at very different time scales – electricity moves at near the speed of light, and natural gas moves through pipelines at about 30 mph. (This helps explain why gas storage facilities, located close to generation facilities and load centers, can be strategically important; and, if bulk storage is not an option in a given region for geologic reasons, as in New England, why ample pipeline capacity becomes important.) Improved understanding of the interaction of the two markets on a dynamic basis is essential to uncovering areas for potential improvement in their joint operations, and to identifying potential adverse contingencies and preparing for them before they arise in real time.

III. Grid Security

In this section, I will respond to the Commission's questions about implementation of the Fixing America's Surface Transportation (FAST) Act, DOE actions to increase the resilience of the grid, and matters related to the development of a transformer reserve.

FAST Act

Congress enacted several important new energy security measures in the FAST Act. The Secretary of Energy was provided new authority, upon declaration of a “Grid Security Emergency” by the President, to issue emergency orders to protect or restore critical electric infrastructure or defense-critical electric infrastructure. This authority will enable DOE to respond as needed to threats or cyber and physical attacks on the grid. DOE is developing proposed rules of procedure regarding this new authority and will continue its partnership with the energy sector to maximize the effectiveness of this authority.

The FAST Act requires DOE to submit a plan to Congress evaluating the feasibility of establishing a Strategic Transformer Reserve for the storage, in strategically-located facilities, of spare large power transformers in sufficient numbers to temporarily replace critically damaged large power transformers. In January 2016 DOE-OE assigned the technical component of this important analysis to a team led by the Oak Ridge National Laboratory. The project team is very strong, and includes researchers from the University of Tennessee-Knoxville, Sandia National Laboratory, the Electric Power Research Institute, and Dominion Virginia Power. The results, when available, will be subject to rigorous peer review.

The FAST Act also codifies DOE’s role as the lead Sector-Specific Agency (SSA) for energy sector cyber incident coordination. This will facilitate a coordinated response to such incidents and expedite recovery from them. The FAST Act’s protections regarding critical electric infrastructure information provide essential information-sharing tools to enhance the Federal Government's situational awareness, while ensuring the private sector that sensitive information on vulnerabilities will be safeguarded.

Cyber Security

Intentional, malicious challenges to our energy systems continue to increase in numbers and sophistication. In response, we have made cyber security one of our highest priorities at DOE. We work continually and closely with the energy sector to share cyber threat information. Since 2010, DOE's Office of Electricity Delivery and Energy Reliability (OE) has invested more than $210 million in cyber-security research, development and demonstration projects led by industry, universities and our national labs. More than 20 new technologies that our investments helped support are now being used to advance the resilience of the nation's energy delivery systems. For example, SecureSmart is a capability to identify bad actors on networks, and Hyperion is a capability to evaluate and expose malicious content and third-party software.

All of OE's cyber security research initiatives are based upon industry involvement, joint funding through matching funds, and development with practical application of the results as an end goal. For example, the Cyber-security Risk Information Sharing Program (CRISP) is a public-private partnership, co-funded by DOE-OE and industry. The purpose of CRISP is to collaborate with energy sector partners to facilitate the timely bi-directional sharing of unclassified and classified threat information and to develop situational awareness tools that enhance the sector's ability to identify, prioritize, and coordinate the protection of critical infrastructure and key resources. CRISP leverages advanced sensors and threat analysis techniques developed by DOE along with DOE’s expertise as part of the National Intelligence Community to better inform the energy sector of the high-level cyber risks. Current CRISP participants provide power to over 50 percent of the total number of continental U.S. electricity subsector customers.

As part of the Administration’s efforts to improve electricity subsector cyber security capabilities, DOE-OE and industry partners developed the Electricity Subsector Cyber-security Capability Maturity Model (C2M2) to improve cyber security capabilities and to help private sector owners and operators better assess their own cyber security posture. The C2M2 provides a self-evaluation tool that helps organizations evaluate, prioritize and improve their cyber security capabilities. Since the C2M2 program’s inception in June 2012, more than 750 organizations have requested and received the C2M2 toolkit, including more than 400 electricity subsector organizations, and the number of participants continues to grow. Further, this is a comprehensive and credible approach that all energy sector companies can use to improve their cyber-security posture. DOE-OE has also released versions of the C2M2 for the oil and natural gas subsector and for industry at large.

Resilience and Preparedness

We believe it is important to be proactive and cultivate an "ecosystem of resilience" -- a network of producers, distributors, regulators, vendors, and public partners, acting together to strengthen our combined ability to prepare, respond, and recover. We partner with industry, other Federal agencies, local governments, and other stakeholders to quickly identify threats, develop in-depth strategies to mitigate those threats, and rapidly respond to any disruptions.

Our model is partnerships first. We are all in this together. It is through working together that we continue to strengthen our ability to bounce back following an event. Toward this end, DOE leads preparedness exercises at the local, state, and national levels. In November 2015, for example, DOE led the federal participation in the North American Electric Reliability Corporation's Grid Ex III, the largest electricity subsector crisis response exercise ever. More than 350 government and industry organizations, as well as 4,500 participants played a role in testing and shaping the national response plan.

In April, DOE led Clear Path IV in Portland, Oregon and Washington, DC, an interagency exercise to test and evaluate energy sector roles and responsibilities in response plans developed for a Cascadia Subduction Zone (CSZ) 9.0 earthquake and tsunami. Clear Path IV included representation from 10 Federal agencies (including FERC), seven states, five local governments, 15 oil and natural gas companies, 18 electric utilities, six trade associations, and four state associations with more than 175 participants.

Concluding Statement

Threats to our electric infrastructure will continue to evolve, and DOE is working diligently to stay ahead of the curve. We must build and maintain an "ecosystem of resilience" that works in partnership with local, state and industry stakeholders to help provide the methods, strategies, and tools needed to help protect local communities through increased resilience and flexibility. We must determine whether a transformer reserve is needed, and if so, how it should be created and managed. We must also accelerate information sharing to inform better local investment decisions, encourage innovation and the use of best practices to help raise the sector's cyber security maturity, and strengthen local incident response and recovery capabilities, especially through participation in training programs and disaster and threat exercises.

Sustaining an ecosystem of resilience is – by definition – a shared endeavor, and focusing on local communities is an imperative. Because DOE has spent decades building and supporting partnerships at the local level, and investing in technologies to enhance resilience, the grid is better able to withstand and recover quickly from a disaster or attack.