Written Statement by

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Good morning, everyone. It is a pleasure to participate in this technical conference on the state of electric reliability today, and I appreciate the opportunity to express the views of the U.S. Department of Energy (Department, or DOE).

I congratulate the Commission on the timing of this conference. It is no secret that the U.S. electricity sector is in the midst of major changes. Looking ahead, I see little reason to expect that this process will slow down or that we will reach some new equilibrium anytime soon – on the contrary, the process of change we are experiencing today may last indefinitely, and the pace of change may even accelerate. Accordingly, I think the fundamental challenge now is to *understand this process and manage it*, so that our Nation's electric infrastructure remains reliable, affordable, and resilient.

Turning now to the key topics identified for this panel:

I. Trends and Risks Warranting Particular Attention and Effort

I have three such items on my list:

1. *Physical and Cyber Security.* On the physical side, utilities and system operators need to continue the efforts to identify facilities that are essential to the system and take reasonable steps to harden them.

   The cyber security of the Nation's electric grid is of paramount importance to the Department of Energy. Just last week, news broke about the first malware specifically designed to target the industrial control systems that govern the operations of electricity grids. We know about this malware because it was used in December 2016 to target the electricity sector in Ukraine. In the cyber realm, we certainly live in interesting times.

   While this malware may be new, the Department has been working to prepare the Nation for these types of threats for some time. The Department of Energy has collaborated with the energy sector for nearly two decades in voluntary public-private partnerships that engage energy owners and operators at all levels—technical, operational, and executive, along with state and local governments—to identify and mitigate physical and cyber risks to energy systems.

   These partnerships are built on a foundation of earned trust that promotes the mutual exchange of information and resources to improve the security and resilience of critical energy infrastructures. These relationships acknowledge the special security challenges of energy delivery systems and leverage the distinct technical expertise within industry and government to develop solutions.

   The security and integrity of energy infrastructure is both a state and Federal government concern because energy underpins the operations of every other type of critical infrastructure; the economy; and public health and safety. The owners and operators of energy infrastructure, however, have the primary responsibility for the full spectrum of cybersecurity risk management: identify assets, protect critical systems, detect incidents, respond to incidents, and recover to normal operations.

In the energy sector, the core of critical infrastructure partners consists of the Electricity Subsector Coordinating Council (ESCC), the Oil and Natural Gas Subsector Coordinating Council (ONG SCC), and the Energy Government Coordinating Council (EGCC). The ESCC and ONG SCC represent the interests of their respective industries. The EGCC, led by DOE and co-chaired with the Department of Homeland Security, is where interagency, state, and international partners meet to discuss the important security and resilience issues for the energy sector.

In addition to working closely with our private sector partners through the aforementioned organizations, the Department is also closely aligned with our Federal partners to ensure a rapid, whole-of-government response to urgent cyber threats. As the "Sector Specific Agency" for the energy sector, DOE will play an integral role in responding to significant cyber events in the energy sector. We stand ready to assist our law enforcement, intelligence, and rapid response teams to ensure that any response is properly coordinated, informed, and executed.

I'll also note that the Secretary of Energy was granted statutory authority in 2015 to undertake certain actions if the President declares a "Grid Security Emergency." In the event of such a declaration, the Department will work to execute a swift and coordinated response in collaboration with industry partners to secure critical energy infrastructure and to support response and restoration efforts.

2. *Mitigating the Reliability Risks Associated with Rising Gas/Electric Interdependence.* The Aliso Canyon event involved the functional loss of a major underground natural gas storage facility northwest of Los Angeles, which led to increased electric reliability risk to the Los Angeles area. Its implications, however, are much broader than gas storage. I commend the North American Electric Reliability Corporation (NERC) for its special assessment gauging the reliability impacts associated with the possible loss of any of the major components of the gas delivery system, including pipelines, compressor stations, storage facilities, and LNG terminals.

   An old lesson was demonstrated anew by Aliso Canyon, which is that local conditions must be taken into account to assess and mitigate risk. A team at Argonne National Laboratory screened the nation's 400+ operational underground gas storage facilities and found that an abrupt loss of functionality from 63 such facilities could potentially disrupt gas-fired generation. Only 12 of the 63 facilities, however, had the potential to disrupt 2 GW or more of generation capacity. In the special assessment mentioned above, NERC is now taking a closer look at those 12 facilities to learn whether the affected utilities have already mitigated their risk through measures such as onsite storage of backup fuel.

   More generally, the growing dependence on natural gas as generation fuel brings increasing concern over the variety of ways in which the delivery of natural gas could be disrupted and how best to mitigate such risks at specific locations. However, as Aliso Canyon also demonstrated, a mix of new technologies, including demand response and energy storage, helped to mitigate the risk and protect against future service loss. A range of potential solutions exists, and more work is needed to estimate their costs and applicability.

3. *The Need for Planners to Build More Flexibility and Optionality into their Systems – both Short-Term and Long-Term.* The uncertainties that system planners must take into account have multiplied in recent years, and this condition is not expected to change anytime soon. These uncertainties include the likely costs and penetration rates of many new technologies, the extent to which electricity consumers will become "prosumers," the shape and level of future electricity demand, the direction of future Federal and state regulatory requirements, and more. Flexibility and optionality contrast sharply with the industry's traditional practice of relying heavily on large, long-lived capital-intensive generation units with low operating costs but little operating flexibility.

II. Data, Data Analysis, and Capability Gaps

I began by saying that the fundamental challenge we face is the need to manage the process of ceaseless change, and I believe in the old adage that you can't manage what you don't measure. So, I am pleased at the prominence you are giving today to data and data analytics.

1. *New Bulk Power System Metrics.* In Year 2 of the Grid Modernization Laboratory Consortium Project 1.1, the reliability team will work with NERC on new ways to enhance the usefulness of information that NERC has collected for many years, housed in the Transmission Availability Data System (TADS) and the Generation Availability Data System (GADS). Currently, this information is invaluable for understanding the availability of key power system components and the causes that lead to outages of them. However, to have a better understanding of the impact or severity of individual outages from the standpoint of overall bulk power system reliability, information about the condition or state of the bulk power system at the time when an outage occurs is necessary. Without adding such supporting, contextual information, it is difficult to judge whether overall bulk power system reliability, as a whole, is getting better or worse.

2. *Distinguishing Between Bulk Power System Reliability and Distribution System Reliability.* EIA's annual collection of reliability data now identifies "loss of supply" as one cause of outages experienced by customers. Thus far, 4-5% of customers' annual average minutes of service interruptions are attributable to loss of supply.

III. Diversity of Generation and Reliability

The electric grid is undergoing a transformation as new technologies, changing economics, shifting customer behaviors, and government policies are driving change.

1. *Distributed Energy Resources (DERs).* The transformation is especially prevalent at the distribution system level, where distributed energy resources (DERs) such as solar energy systems, energy storage technology, electric vehicles, and energy management systems are becoming more widely adopted as prices decrease and the technologies become more commercially available.

The result is a trend toward a more decentralized electric grid and a greater variety of resources providing power in ways that today, at least, are much less predictable. Hence, these DERs are challenging our traditional approaches to planning and operations, and raising new questions, for which our National Labs are actively pursuing answers, about how to control and coordinate much larger numbers of diverse devices. The new grid also requires a larger proportion of flexible resources that can act within short time frames (such as gas turbines, demand response, and energy storage) to handle the variability in operating conditions.

2. *Reliability Study.* Earlier this spring, Secretary Perry asked DOE staff—led by my office—to initiate an internal study to explore issues central to protecting the long-term reliability of the electric grid. This study was the first to be requested by the Secretary since his confirmation and is due later this month. That it focuses on reliability and is to be completed in a short time frame is quite deliberate. Ensuring the reliability, security, and resiliency of the electric grid is a top priority for Secretary Perry and the Department.

   As a Nation, we are blessed to have an abundance of domestic energy resources to meet our baseload needs. Over the last few years, however, some grid experts have expressed concern about the erosion of critical baseload resources, specifically, how these controllable, reliable resources are dispatched and compensated. Other grid experts and operators believe the evolving grid requires fewer traditional baseload resources.

   Secretary Perry asked DOE staff to explore three issues:

   - the evolution of wholesale electricity markets, including the extent to which federal policy and the changing electricity fuel mix challenge grid reliability;
   - whether wholesale and capacity markets are adequately compensating attributes, such as on-site fuel supply and other factors that strengthen grid resilience; and,
   - the extent to which regulations and legislation affect early retirement of baseload generation plants.

   This study is not a conclusion, but rather a beginning. While recommendations are expected from the final report, it is likely that several areas related to reliability will be identified for further research and study. Further, our efforts in the area of electricity markets and reliability are meant to provide some additional perspective and to complement existing processes.

Thank you, and I look forward to your questions.