Department of Energy
Washington, DC 20585

June 10, 2014

MEMORANDUM TO THE DEPARTMENT OF ENERGY
ELECTRICITY ADVISORY COMMITTEE

From: **Patricia A. Hoffman** PH
Assistant Secretary
Office of Electricity Delivery and Energy Reliability

Subject: **DOE Responses to EAC Work Products**

I want to thank all members of the Department of Energy's (DOE) Electricity Advisory Committee (EAC) for your hard work during the second half of 2013.

The work products delivered by the Committee during this period are listed below. The purpose of this memo and its attachments is to provide you with the Department's responses to your analyses and recommendations in a systematic and inclusive form.

EAC 2013 Fall and Winter Work Products

1. Recommendations for DOE Action regarding Resiliency, October 2013
2. Recommendations for DOE Action regarding the Implementing Effective Enterprise Security Governance, October 2013
3. Recommendations for DOE Action regarding a National Grid Energy Storage Strategy, December 2013

The attachments that follow summarize DOE's actions and responses to these 2013 work products.

I continue to look forward to the future efforts of the EAC and am committed to ensuring a strong and fruitful working relationship between the Committee and DOE.

Electricity Advisory Committee (EAC} Recommendations
Resiliency
October, 2013

1. **Determine grid vulnerabilities, including sparing gaps, and develop grid component hardening guidance/best practices.**

   DOE should work with stakeholders to determine grid vulnerabilities (including sparing gaps) and to develop grid resiliency and component hardening guidance/best practices. These should be applied as assets are replaced in natural order as they reach end of life, or in some cases they might drive an accelerated schedule when benefits warrant. It is assumed that a risk-based approach will not generally result in aggressive time lines or material cost premiums. The EAC believes that a reasonable approach to grid hardening as assets are replaced will be as effective as similar programs such as the guidance/best practices applied to achieve energy efficiency.

The Department of Energy (DOE) appreciates the EAC's positive assessment of the NERC, New York State, and EPRI work in assessing recommendations on resiliency, and it agrees with the committee that DOE actions should be complementary to actions taken by industry and other government agencies to the extent which its resources permit.

The White House has provided leadership on this issue through its paper "Economic Benefits of Increasing Electric Grid Resilience to Weather Outages" which establishes priorities, suggests avenues for increasing resilience, and discusses the value of a smarter, more resilient electric grid.

DOE continues to work with, and to complement the activities of utility industry participants in:

- *the EEI STEP program.*
- *NERC Spare Equipment Database program.*
- *DOE has examined "Threats and Risks to the Electricity Sector" April 10, 2014 DRAFT as viewed in industry reports and as reported in company annual reports to the Securities Exchange Commission.*
- *DOE has produced a report on "Large Power Transformers and the U.S. Electric Grid- 2014 Update", March 2014. The report examines issues impacting large power transformer supply chains including the design, manufacture and transport as well as materials pricing and availability.*
- *DOE has engaged in discussions with insurance companies to identify opportunities where insurance companies can help identify grid vulnerabilities and the role that insurance companies might play in helping to mitigate risk. A report entitled "Insurance as a Risk Management Instrument for Energy Infrastructure Security and Resilience" was produced, March 2013.*

Electricity Advisory Committee (EAC} Recommendations
Resiliency
October, 2013

DOE will continue to assess its coordination efforts and consider initiating additional grid resiliency and grid hardening "best practices" efforts. DOE's ongoing internal coordination effort led by the Grid Tech Team is already evaluating gaps in existing programs affecting grid modernization and is seeking resources to fill these gaps.

2. **Use available R&D funds to support projects that fill gaps in the resiliency work of EPRI, NERC, and other organizations.**

   Important research areas include dynamic load flow control, grid level storage in conjunction with renewables, micro-grid implementation using storage with solar, smart invertors, innovative pole and line designs, structural reinforcement to existing lines, and non-wires solutions.

   DOE should coordinate with electric utilities and the Federal Energy Regulatory Commission (FERC) to ensure adequate support for the demonstration, commercialization, and resulting deployment of advanced transmission technologies. FERC is directed by statute, 42 USC §16422, in carrying out the Federal Power Act and Public Utilities Regulatory Policy Act, to "encourage ... the deployment of advanced transmission technologies." Additionally, the Federal Power Act, 16 USC §824s, mandates that, "Commission shall establish, by rule, incentive-based (including performance-based) rate treatments" that shall " ...encourage deployment of transmission technologies and other measures to increase the capacity and efficiency ... and improve the operation of [transmission facilities]..."

   DOE should explore with transmission utilities opportunities to support the commercialization, and thereby encourage the deployment, of advanced transmission technologies through appropriate recognition in transmission rates of costs associated with the demonstration and further development of these technologies. Appropriate rate recognition could leverage and help realize the economic benefits of DOE funded research and development.

   Likewise, DOE should encourage advanced technologies at the distribution level with utilities to support resiliency and work with entities such as the National Association of Regulatory Utility Commissioners (NARUC) to facilitate communication on resiliency needs to support funding.

Electricity Advisory Committee (EAC} Recommendations
Resiliency
October, 2013

DOE agrees with the EAC's recommendations that we utilize available funds to fill gaps in resiliency work of EPRI, NERC, and other organizations. Work that DOE is already doing to address these gaps includes:

- *DOE has been coordinating with NERC, EPRI and DHS on R&D relating to the threat of space weather on large power transformers. This continuing work seeks to much better understand ground electrical conductivity and potential impacts of geomagnetic inducted currents on transformers.*

- *Beginning with the DHS S&T funded recovery transformer program with EPRI and ABB DOE has worked closely with DHS on transformer related questions including use of advanced transformer insulating materials.*

- *DOE participates with other government agencies on a White House Geomagnetic Currents Interagency Working Group where government agencies share information on their ongoing efforts.*

DOE supports programs to commercialize advanced transmission technologies, and advanced distribution technologies, and intends to continue such support.

NARUC is a regular member of the Government Energy Coordinating Council. DOE has met with them many times to discuss energy security and resiliency issues. Discussions have begun with NARUC related to utility cost recovery for resilience investments and approaches to encourage utilities to make investments.

3. **Convene meetings and technical workshops with EPRI, NERC, and others to integrate system performance modeling and utility best practices for resiliency.**

DOE supports the EAC recommendation to convene workshops with EPRI, NERC and others to develop utility best practices for resiliency.

In its Guide to Using Combined Heat and Power for Enhancing Reliability and Resiliency in Buildings, DOE provided guidance on improving resiliency during rebuilding in a cost effective manner.

Specific actions however will be subject to budgeting constraints and program approvals.

4. **Develop presentations (based on results of the preceding recommendations) for industry and regulatory leaders that provide sensible and affordable "blueprints" for actions (based on cost/benefit risks) and regulatory cost recovery authorization.**

Electricity Advisory Committee (EAC} Recommendations
Resiliency
October, 2013

These presentations should include best practices for enhancing maintenance, spare component, and capital replacement programs to increase grid resiliency, for non-wires solutions to ensure lowest cost and risk planning as well as best practices.

DOE supports the concept of developing presentations for industry and regulatory leaders containing a recommendation of sensible and affordable "blueprints" for actions to improve resiliency in a sensible and cost-effective manner. However, creation and delivery of such presentations is conditional upon our success in developing the cost/ risk analysis to support such "blueprints".

5. **Support the incremental investments to demonstrate how systems that already have distribution automation, smart meters and distributed generation can be designed to sustain critical social services in the event of large scale power outages of long duration. By conducting and publicizing two or three such demonstrations, DOE might provide utilities, regions, and regulators the confidence for similar investments using local resources.**

DOE supports programs to demonstrate how systems can be designed to sustain critical social services in the event of large power outages. The "Microgrid Research, Development, and System Design" Funding Opportunity Announcement (FOA) supports the goal of "building stronger and safer communities and infrastructure" as set forth in the President's Climate Action Plan and supports implementation of Executive Order 13653 by making climate-resilient investments in States, local communities, and tribes. The FOA targets teams of communities, technology developers and providers, and utilities to develop advanced microgrid controllers and system designs that will help communities take an innovative and comprehensive approach to microgrid design and implementation. Each applicant will be required to work with an entity or community to design microgrid systems of ≤10 MW which is enough to power a small community. Additionally, applicants will be encouraged to design systems that protect critical infrastructure such as hospitals and water treatment plants.

Subject to budget constraints, DOE will remain alert to opportunities to facilitate such demonstrations.

Electricity Advisory Committee (EAC} Recommendations
Implementing Effective Enterprise Security Governance
October 3, 2013

1. **Champion Enterprise Security Governance with the Electricity and the Oil and natural Gas Subsector Coordinating Councils.**

DOE intends to continue championing Enterprise Security Governance.

DOE, DHS, FBI and the Electricity Subsector Coordinating Council developed a combined CEO checklist to support security conversations between CEOs and their staff. These questions were intended to trigger more in-depth discussions to identify strengths and weaknesses. The enterprise security governance concept was ingrained in several checklist items, such as "Do you routinely assess the resources available to govern and implement your security strategy?"

Upon completion of the DOE project to identify enterprise security governance best practices based on case studies, DOE will share the work with government and industry partners and collaboratively develop educational and communications ***materials*** *to champion the adoption of enterprise security governance to the Electricity and Oil and Natural Gas Subsector Coordinating Councils.*

2. **Establish Chief Executive Officer security awareness opportunities in coordination with the Department of Homeland Security, Trade Associations, Nuclear Energy Institute, North American Electric Reliability Corporation, and the Federal Energy Regulatory Commission.**

Talking points on enterprise security governance have been incorporated into several presentations by DOE leaders. These points include the importance of enterprise security governance, such as the responsibility for security belonging not solely to technical, risk, or compliance specialists, but rather to the entire organization, and the need to begin with senior leadership and continue throughout the enterprise to foster a more security-aware culture. For example, Assistant Secretary Patricia Hoffman spoke at EnergyBiz in February 2014 and Deputy Secretary Poneman spoke at the March 2014 EEI Board of Directors meeting.

Upon completion of the DOE project to identify enterprise security governance best practices, DOE will share the work with government and industry partners and collaboratively develop appropriate educational and communications materials. In conjunction with the sector coordinating councils, the government and industry partners will be able to champion the adoption of enterprise security governance to a much wider energy sector audience.

3. **Leverage the ES-C2M2 security governance areas to emphasize CEO and Board-level engagement.**

Measurement of key indicators helps to increase awareness and drive improvement for enterprise security governance. The cyber program management domain highlights strategy that defines the organization's approach to provide program oversight and governance for cybersecurity activities. A higher maturity level indicates that the cybersecurity program strategy is updated to reflect business changes, changes in the operating environment, and changes in the threat profile. This is an indicator of effective enterprise security governance. For all domains, a maturity indicator level of 3, the activities in the domain have been institutionalized and are being managed. Activities are guided by policies (or other organizational directives) and governance.

The C2M2 tool kit is available by request. To date, 128 utilities have requested the ES-C2M2. In addition, there have been 113 non-utility and 29 international requests. DOE has facilitated approximately 50 self-evaluations by utilities with nearly 39 million consumers.

DOE appreciates the EAC recognizing the value of the C2M2 tool kit. DOE will consider updates to the C2M2 facilitator guide and other instruments in the tool to emphasize education of CEO's and Board level individuals about their enterprises security and opportunities to improve it.

4. **Continue classified-level threat briefings targeted for the CEO and Board-level audience.**

DOE, DHS, and FBI are continuing classified and unclassified briefings that are specifically targeted for the CEO and Board-level audience. The most recent classified-level threat briefing was conducted for the ESCC in conjunction with their January 2014 meeting. DOE, DHS, and FBI also meet or teleconference with individual executives on specific threats as the need arises.

In addition, the government partners also provide classified briefings to the staff and technical professionals. The North American Energy Threats Workshop was conducted in April 2014 for both the electricity and oil and natural gas subsectors at the staff level. The threat briefings were focused on the energy sector.

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5. **Identify industry best practices for engaging CEO and Board-level audience.**

OE is currently working on a seed project to help DOE gain an understanding of the most successful current approaches to security governance in a utility/ONG company context. The goal is to develop a body of knowledge on enterprise security governance that is useful to utilities and companies of all sizes, types, and levels of organizational security maturity.

The end products will create a view of some of the most effective security governance and practices in the US. The findings and recommendations will form the basis for education materials that DOE will be able to share with energy sector stakeholders and owners/operators.

Electricity Advisory Committee (EAC} Recommendations
A National Grid Energy Storage Strategy
December, 2013

PHASE 1

1. **Review of existing studies to validate/quantify known and unknown needs for performance (flexibility and resiliency), storage valuation, and storage.**

Through the release of the Strategic Plan for Energy Storage Safety, DOE-OE will address the need of the community for scientifically based, standardized safety validation techniques, documented safety and incident preparedness. To address these needs, this document will compile current safety validation techniques, which will include known and unknown needs for performance of a storage system. The information in the document will be presented to ensure validation standardization through the common understanding of the broad range of validation techniques that are currently in use industry-wide.

DOE-OE has led an effort to engage stakeholders from across the storage industry to identify use cases of greatest value and develop test profiles. The goal of this effort is to bring uniform testing methodologies to the industry for evaluating the performance of storage. The initial report was released, a first revision is under way to add additional use cases, and future revisions are planned to expand the protocol document. All interested parties have been invited to use and report back comments from the first protocol to ensure wide applicability and acceptance of the testing plans identified.

2. **Development and implementation of Funding Opportunity Announcement Requests for Proposal (FOA RFPs) for regional performance (flexibility and resiliency) assessment and needs as described above. Such FOA RFPs should be "technology neutral" and allow alternative technological solutions.**

DOE-OE is working with States to develop joint local or regional Storage Initiatives. This will comprise two main areas of interest:

- *Energy Storage Integration for states with sizable penetration of renewable will involve not only highly leveraged cost shares, technical assistance, and monitoring of field performance but also development of a set of tools to enable energy storage selection, evaluation, and deployment for utilities. Also included will be establishment of living databases for commissioning processes and energy storage codes, standards, regulations and policy.*

- *Disaster preparedness will involve working with states to educate and identify opportunities for energy storage to harden their grids to all hazards, developing leveraged partnerships to establish model installations, and developing an advanced decision framework for power grid resiliency.*

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DOE-OE is actively partnering with states to realize storage as a vital grid asset and to enhance resilience and disaster mitigation, particularly in coastal regions. Current DOE partnerships include Pennsylvania, Connecticut, Massachusetts, New York, New Jersey, Maryland, New Mexico, Oregon, Alaska, and Vermont. Additionally, new collaborations are being pursued, and one avenue could be the development of new FOA RFPs if there is budget to do so.

3. **Development and implementation of FOA RFPs for analyzing storage investment decisions and incentive designs so as to inform policy makers responsible for and empowered to enact such policies.**

DOE-OE is working with regulators, federal and state policy makers to encourage the integration of energy storage systems into electric utility planning. For example, a few of DOE-OE activities include:

- *California has a mandate of 1.325GW of new grid energy storage in the next 10 years, and DOE is working with CEC and utilities, such as Southern California Edison, in cost-shared evaluation of storage for integrating distributed PV, other renewable generation and demand response.*

- *Washington Clean Energy Fund cost-shared investment of over $30M in coordinated storage field test and evaluation of grid storage. DOE, through PNNL, will work with Washington State, utilities and storage providers in evaluation of storage technology and benefits.*

- *Oregon Department of Energy and Oregon Public Utilities Commission, assisted by DOE, recently held an energy storage workshop for the local utilities, storage system manufacturers and other interested parties. A new collaborative demonstration project is under consideration.*

DOE-OE is currently working on the modeling and analysis of Storage Systems to assess the use, costs and benefits of energy storage, identify institutional and policy barriers, and develop tools for utilities and users planning to introduce and use energy storage. This could be leveraged into the development of a FOA for analyzing storage investment decisions and incentive designs if there is a budget to do so.

4. **Collection and assessment of ongoing regulatory frameworks established (as an example, the CPUC storage use cases) for categorizing and valuing storage in different applications.**

A result of DOE-OE's active engagement in the effort to collect and assess regulatory frameworks is the DOE/EPRI Electricity Storage Handbook in collaboration with NRECA.

Electricity Advisory Committee (EAC} Recommendations
A National Grid Energy Storage Strategy
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This Handbook was issued as a how-to guide for utility and rural cooperative engineers, planners, and decision makers to plan and implement electricity storage projects. The Handbook is an information resource for investors and venture capitalists on the latest developments in technologies and tools to guide their evaluations of electricity storage opportunities. It includes a comprehensive database of the cost of current electricity storage systems in a wide variety of popular electric utility and consumer applications, along with interconnection schematics. This Handbook is intended to be living document that will be updated regularly to continue to provide the industry with a valuable tool that contains current information.

DOE will take an action item to consider different regulator frameworks in categorizing and valuing storage when consulting with its partners on updating of the Handbook.

Phase 2

5. **Review of manufacturing cost issues and volume/scale factors as well as quality assurance (QA) and manufacturability issues; identification of materials science and manufacturing technology/testing gaps that DOE can address.**

DOE-OE has developed new cost models that identify significant cost contributors for a few technologies, and help guide research investments. This model information is used with industry and component developers, to develop new materials, such as membranes, that are less expensive, more durable, and/or have higher performance. DOE-OE has also established a detailed manufacturing model for redox flow stacks that included production volume effects. While these activities are a good start, DOE-OE acknowledges the need for greater effort to address manufacturability, degradation mechanisms, and alternative material sets, for many promising storage technologies.

6. **Review of holistic systems design and installation issues, as well as performance experience and lessons learned.**

DOE-OE's Energy Storage Program has engaged the energy storage industry in a number of ways to ensure a common understanding of holistic system design, installation issues, performance experiences and lessons learned. The most recent method of engaging the energy storage community was the DOE-OE Energy Storage Safety Workshop, which was hosted in Albuquerque, NM in February 2014. The goals of this workshop were to bring together key stakeholders in the energy storage industry, share knowledge on current safety validation, commissioning and operations. The result of the workshop was the identification of the current gaps in understanding, validating, standardizing and regulating the safety of energy storage systems.

The DOE Global Energy Storage Database is another way in which DOE-OE is engaged in gathering and publicizing information on current energy storage installations worldwide. This tool was designed to be accessible to a wide variety of stakeholders and has tremendous potential to help grow the energy storage industry, ultimately making the electricity grid more sustainable, reliable, robust, and secure. The GESDB was the first and is currently the only freely accessible database of this information.

Additionally, DOE-OE is funding an Energy Storage Installation Commissioning Manual to provide guidance to the industry in the commissioning of an energy storage system and to ensure safety and reliability. The DOE-OE Energy Storage Demonstrations project also works with industry to deploy systems in the field. These deployments lead to a greater understanding of actual system performance and lessons learned which enable more effective and efficient deployments. The DOE-OE Energy Storage Test Pad enables the testing of system scale energy storage for pre-demonstration evaluation and troubleshooting.

7. **Development of FOA RFPs to address manufacturability and design/installation issues identified above.**

Given availability of sufficient funding, DOE-OE is working to spur energy storage and its component manufacturing and supply chain companies in the U.S. by aiding the development of innovative cost-reducing and/or efficiency-increasing technology into useable manufacturing equipment and processes.

DOE-OE will continue to work with various stakeholders, through multiple programmatic means that may include FOA's, to address deployment challenges including safety issues, performance standards, siting, grid integration and benefits analysis tools. It also intends to pursue the development of manufacturing process models and exploration of

materials processing approaches that dramatically improve storage system cost, cycle life, and robustness.

8. **Collation of volume/scale cost factors for use in incentive design (whether subsidies, investment tax credits or other incentive structures).**

DOE-OE has funded two reports to assist in the valuation of energy storage: "New Wholesale Power Market Design Using Linked Forward Markets" and "Market and Policy Barriers to Energy Storage Deployment". The first report identified the market structures and the resulting cost factors. It also proposed a reformulation of the current market for improved reliability and efficiency of system operations. The second report identified barriers to energy storage development and deployment, and included a discussion of possible solutions to address these barriers.

Phase 3

9. **Completion of regional performance (flexibility and resiliency) requirement studies.**

The ESS program, through various research projects, such as the development of Control Systems to Manage Grid Stability, is currently working with tools such as PSLF (Positive Sequence Load Flow), to conduct power flow modeling for grid stability, reliability, and other studies. This process will help identify gaps in available modeling software when considering scenarios that include high renewables penetration, distributed generation resources, and energy storage resource implementation.

Existing work that PNNL has performed with Nevada Power and on the National Assessment has revealed the methodological optimization issues of currently available production cost models to appropriately optimize energy storage. Current models perform optimal dispatch of all grid assets for one point in time. Further testing will be performed to evaluate the adequacy of the heuristics or whether or not new algorithms must be developed to model and represent energy storage assets appropriately. DOE-OE plans to begin additional projects to develop planning tools that address these gaps in 2015 and beyond.

10. Completion of investment decision economics

Through the ARRA Technical report: "Estimating the Maximum Potential Revenue for Grid Connected Electricity Storage: Arbitrage and Regulation," DOE-OE evaluated methods to maximize the value of energy storage technology through arbitrage and frequency regulation. DOE-OE additionally funded a report which evaluated the value of storage for the Nevada grid.

DOE-OE is working with utilities, states, and storage providers to facilitate economic analysis of storage for various use cases. Working with state officials in Washington, for instance, utilities will be evaluating a common set of use cases and optimized storage operations to deliver maximum value.

Phase 4

11. Development of policy and incentive analyses and alternatives by state and federal authorities based on information gained and lessons learned. These potentially involve multiple regulatory bodies and legislation across various levels. DOE can play a critical role in education, analysis, and information dissemination.

DOE-OE is leading the way in addressing broad stakeholder challenges such as uniform performance test protocols, conducting a seminal workshop to address safety issues including codes and standards, grid storage cost-benefit valuation, storage siting and grid integration. The program also maintains a global data base of energy storage projects with some 850 projects from 50 countries.

DOE-OE is actively partnering with states to realize storage as a vital grid asset and to enhance resilience and disaster mitigation, particularly in coastal regions.

DOE-OE will continue to expand its efforts in modeling and analysis focused on the development of market characterization tools, system integration studies, regulatory assessments, and standards development.