

ELECTRIC GRID RELIABILITY

HEARING BEFORE THE COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED THIRTEENTH CONGRESS

SECOND SESSION

ON

KEEPING THE LIGHTS ON—ARE WE DOING ENOUGH TO ENSURE THE
RELIABILITY AND SECURITY OF THE U.S. ELECTRIC GRID?

APRIL 10, 2014



Printed for the use of the
Committee on Energy and Natural Resources

U.S. GOVERNMENT PRINTING OFFICE

87–851 PDF

WASHINGTON : 2014

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
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ELECTRIC GRID RELIABILITY

THURSDAY, APRIL 10, 2014

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 9:36 a.m. in room SD-366, Dirksen Senate Office Building, Hon. Mary Landrieu, chairman, presiding.

OPENING STATEMENT OF HON. MARY LANDRIEU, U.S. SENATOR FROM LOUISIANA

The CHAIRMAN. Good morning.

Thank everyone for joining us for this important hearing this morning entitled, “Keeping the lights on—are we doing enough to ensure the reliability and security of the electric grid?”

I’m pleased to chair the first oversight hearing that this committee has had in quite some time on this important subject. This subject is important to many members of the Senate as recently indicated by letters sent on a variety of different issues, as well as to members of this committee. I thank the members for joining us this morning.

Affordability and reliability of the electric grid is so commonplace in America today that most people spend little time even thinking about it. Except, of course, when the power goes out and when the lights go off. Whether for a few minutes, a few days or a few weeks, it can be inconvenient. It can be maddening. It can also be life threatening.

In a small neighborhood just a few blocks from the New York Stock Exchange in 1882 Thomas Edison’s Pearl Street Station in lower Manhattan illuminated 400 lamps in homes, offices and businesses for the first time for 85 customers. It was indeed a glimmer of how electricity would come to dramatically change and improve and strengthen our country and make our daily lives more convenient and more prosperous.

The U.S. electrification rate steadily increased from there from a few percentage points in the early 1900s to about 70 percent in the early 1930s. But at that point only 10 percent of rural households in America had electricity compared to 90 percent of urban homes. With government action and great effort on the part of many parties, rural electrification ramped up and was near 100 percent by 1960.

During the 20th century electricity production in the U.S. shifted from being produced primarily from coal and hydropower to a diverse mix of coal, natural gas, nuclear, petroleum and recently,

other renewables. With the rapid development of new technologies, 50 years from now, we can be certain that there will be even more diversity in electric energy sources that power our country.

However, as the economy and technology rapidly evolve our dependence on electricity only grows. Think about your average day and how much we all rely on electricity.

The alarm clock or charged cell phone that wakes you up in the morning.

The coffee pot that brews your morning coffee, the toaster that warms a bagel or refrigerators that keep fruit fresh.

Traffic lights that make your commute to work safer or the phone that you use to stay in contact with friends and family to conduct important business.

That's just to mention a few.

These are just a few of the ways we rely on electricity in our daily lives. A power outage of even a few minutes can be a terrible inconvenience. It can be a costly occurrence or it could be a real threat to public health, particularly when temperatures are very high or very low or in the aftermath of storms, disasters, hurricanes, floods, tornadoes, mudslides, or fires.

In Louisiana we felt the impacts of long term power outages after natural disasters which while understandable, were still extremely difficult to deal with.

Today our committee is here to receive testimony about what both the public and private organizations that have responsibility for the electric grid are doing to maintain it and to prevent brown outs or black outs. Can this grid be made smarter, safer, more secure? Can we do so in a cost effective way?

Our first panel will focus on new and emerging cyber threats as well as long standing physical threats to the electricity grid.

This committee has already taken steps to address this issue by including in the Energy Policy Act of 2005 a first of its kind provision to establish reliability standards, including ones to address cyber threats to the Nation's electric grid. In fact the electricity sector is still the only part of our national, critical infrastructure that is subject to binding cyber threat standards.

We will discuss some of that today.

As far as the physical threat to the electric grid is concerned, the attack last year on the Metcalf substation in California's Silicon Valley was the most serious attack ever on the U.S. electric system. Fortunately Metcalf did not result in a blackout in Silicon Valley, the horrors of which could only be imagined. But the incident, as it's been reported, came very close to causing the shutdown of a large portion of the Western grid.

I commend the electricity industry and its Federal and State partners involved for the significant improvements they've made to reduce risk of a physical attack since that took place.

I also know that last month FERC voted to direct NERC, the North American Electricity Reliability Corporation, to direct some additional standards and gave it 90 days to do so.

Grid reliability is a responsibility of the electricity industry, as well as State and Federal agency partners. Each of us has a role to play. In my view it is essential that information regarding an

attack or a threat of an attack be transmitted to others that need that information in a timely, secure and actionable fashion.

I'd like at this time to submit a letter regarding Senator Feinstein's letter to the record and the response by Chairman LaFleur on this subject that we will go into in more detail.

Without objection it will be submitted.

I believe that we must take, very seriously, these issues and develop appropriate responses to these threats. But the response must fit the size and nature of the threat. One size does not fit all.

In Louisiana we have two large utility companies, Entergy and CLECO, as well as a number of relatively small rural co-ops and of course, municipal utilities. It just doesn't make sense for small co-ops with minimal critical infrastructure to be subject to the same requirements as larger suppliers. We must keep that in mind.

Our second panel will focus on different aspects of the reliability challenge, such as whether or not there's sufficient generation and unfettered transmission to keep the lights on when electricity demands peak throughout the country.

Senator Manchin and Senator Franken have been particularly focused on this issue. The adequacy of power generation differs a great deal from region to region. So rather than tackling the entire issue at once, at the request of Senator Manchin, who is here today, we'll look at the impact of coal fired generation requirements in the PGM system reliability during the Polar Vortex earlier this year.

I appreciate all of the Senator's concerns regarding the threat to reliability from coal fired plant retirements caused by new environmental standards as well as competition from the gas market. The question of coal retirement is multifaceted. There are different perspectives that will be shared today. I look forward to a lively discussion on this question with the second panel.

So in closing, we have a panel of expert witnesses here today to discuss these issues.

Senator Murkowski, I thank you for your help in planning this hearing today and for your cooperation, from you and your staff. I want to thank all of you who traveled a great distance to be with us today.

I'll now turn it over to Senator Murkowski for her opening statement.

**STATEMENT OF HON. LISA MURKOWSKI, U.S. SENATOR
FROM ALASKA**

Senator MURKOWSKI. Thank you, Madame Chairman.

I appreciate the opportunity to discuss, not only an important and critical issue, but really very, very timely. The hearing title, "Are we doing enough to ensure the reliability and security of the U.S. grid?" is a central question that is posed today. But really everybody in this room already knows the answer to this question. We can always do more.

The next and more important question then is how should we prioritize those efforts?

We can judge, I think, Madame Chairman, by the very filled committee room this morning just how important this issue has be-

come when we've got standing room only on electric reliability, I think that that says something about the importance of this issue. We can judge from recent press reports that our first commitment should really be to do no harm or at least no further harm.

You've mentioned the Metcalf incident. Recent stories about last year's Metcalf incident and a FERC report detailing critical energy infrastructure information have served to sensationalize the issue of physical grid security. Instead of helping to protect the grid from attack the disclosures that we have seen potentially increase its physical vulnerability.

Last month, Madame Chair, you and I wrote and asked the Energy Department's Inspector General to review both the handling of this sensitive, non public information and how it came to be published in the Wall Street Journal. Late yesterday Inspector General Friedman issued a formal management alert informing FERC to the fact that this information should have been classified and protected from release at the time that it was created. This revelation, with its national security implications, I find, extremely troubling. I would commend the Chair, Chairman LaFleur, for taking swift action in response to this report to secure the classified information.

But regardless of how sensitive national security information was handled at FERC or how it found its way to a reporter and we have asked EIG to find this out. The owners of the grid and their regulators are quick to respond to incidents such as Metcalf. Making use of the regulatory framework established by Congress in the 2005 Energy Policy Act NERC provided needed information in a timely fashion. A number of government agencies, including the FERC, DHS and the FBI, undertook significant work with the industry to promote mitigation measures.

Then last month, under the leadership of Chair LaFleur, FERC directed NERC to develop a mandatory standard on physical security within 90 days. Even before the standard setting process was underway we saw lessons learned from Metcalf being applied. I think that that is critically important here.

As experts have recognized for some time, it is likely impossible to ensure that every part of the grid could withstand physical or cyber attack. Thus we need to redouble a properly scaled and continuously improving approach to grid reliability and security. After the facts about the universe of today's threats are clear or perhaps just a little more clear, we can debate whether new legislation might be necessary.

Now some are interested in empowering FERC to direct emergency actions to protect the grid. I've got my own thoughts on that. But clearly, the Commission must do better going forward to protect non public information from disclosure.

But I will say it has been apparent for some time that we may need to empower FERC to protect the grid from our own Federal actions. This sort of every day vigilance is not and need not be high profile. But it's vitally important. We should not lose sight that for the electric grid reliability and affordability must remain our core considerations.

The challenge before us is how to maintain and improve reliability and affordability while keeping environmental performance in balance.

As you note, Madame Chairman, we've got a very impressive group of panelists before us today. I thank each of you.

I particularly would like to thank Chairman LaFleur for your steady leadership there at FERC. Your extensive experience in the energy industry is indispensable as we tackle these myriad issues before the FERC including the cyber and the physical security concerns.

But to each of you and to our second panel as well, equally credentialed. I appreciate the opportunity to discuss this very important subject this morning.

Thank you, Madame Chair.

The CHAIRMAN. Thank you, Senator Murkowski. Thank you for joining me in that inquiry.

I'd like to submit to the record the document from the Inspector General relative to what you and I both referred to in our opening statements this morning.

Let me, at this time, welcome the panel that is joining us.

First, the Honorable Cheryl LaFleur, Chairman of the Federal Energy Regulatory Commission. One of FERC's main responsibilities is maintaining the reliability and resilience of the grid. Thank you for your leadership. We'll have further questions.

Next we have Gerry Cauley, President and CEO of NERC, where he oversees and leads key programs affecting 1,900 North American bulk power system operators, owners and users.

Next we'd like to welcome Ms. Sue Kelly, President and CEO of American Public Power, who is advocating for 2,000 nonprofit, community owned, electric utilities throughout the country in addition to others.

Finally, our last witness is the Honorable Colette Honorable, Chairman of the Arkansas Public Service Commission. Chairman Honorable is here representing the National Association of Regulatory Utility Commissions where she serves as President.

Welcome. Thank you all for being here.

Why don't we begin with your testimony, Chairman LaFleur?

**STATEMENT OF CHERYL A. LAFLEUR, ACTING CHAIRMAN,
FEDERAL ENERGY REGULATORY COMMISSION**

Ms. LAFLEUR. Thank you.

Chairman Landrieu, Ranking Member Murkowski and members of the committee, my name is Cheryl LaFleur.

For nearly 4 years I've had the honor of serving on the Federal Energy Regulatory Commission. I appear before you as FERC's Acting Chairman, an appointment that I received in November. I'd like to thank the committee for holding this hearing and inviting me to testify.

One of my first decisions at FERC was to make electric reliability a personal priority. FERC supports the reliability of the electric grid in several ways.

First, we directly oversee the development and enforcement of mandatory reliability standards for the bulk electric system.

We also support reliability through our regulation of wholesale rates and markets which compensate resources and send investment signals needed for reliability and of interstate electric transmission.

Finally, FERC is responsible for permitting energy infrastructure including gas pipelines, LNG terminals and hydro facilities.

The reliability and resilience of the grid really stems from how it's planned, constructed, operated and how asset owners respond to and learn from events that happen. That means that in setting and overseeing reliability standards the FERC has to pay attention to nuts and bolts issues like trimming trees all the way to emerging issues like cyber security. Last November we approved the fifth generation of NERC cyber security standards that for the first time requires all bulk electric system cyber assets to receive cyber protection commensurate with their impact on the grid.

Reliability also requires protecting the physical security of the grid assets from tampering, vandalism and sabotage. The topic of physical security was highlighted by the April 2013 attack on the Metcalf substation in Northern California. In the wake of that attack FERC worked with other Federal agencies to communicate the facts of the attack and lessons learned.

FERC, also providing guidance to asset owners on steps they could take to improve security based on modeling it had performed. In addition to these efforts on March 7, 2014, FERC directed NERC to develop mandatory physical security standards for the grid within 90 days. In directing NERC to develop these standards we recognize that many asset owners had already taken steps to protect their critical facilities, but a mandatory standard will reinforce, strengthen and broaden these efforts.

We also recognize that not every facility is alike. It's very important that we have the list right and protect the most critical facilities and that the responsive actions be customized to the specific location's circumstance.

I'd like to discuss another aspect of this issue that's received considerable attention. As I noted earlier FERC has applied its familiarity with grid operations to perform sophisticated modeling to identify system vulnerabilities. Last month the Wall Street Journal published an article that included some details of such FERC modeling. I stated then and I continue to believe that publication of such information about the grid undermines its security.

I appreciate Chairman Landrieu's and Ranking Member Murkowski's recent statements highlighting the importance of protecting this type of information.

In light of the release of internal FERC modeling information we are working on many fronts to understand what happened and to ensure that it does not happen again. As part of this effort I asked the Department of Energy Inspector General to advise us on how we could improve our processes with respect to information security. Yesterday the Inspector General issued a management alert indicating that some of FERC's modeling work when it was created in early 2013 should have been designated as classified information at at least the secret level rather than as critical energy infrastructure information as it was classified.

The Inspector General outlined a number of specific steps to take. We are taking them immediately and giving it a top priority.

What we look forward to is further recommendations. We're doing our own work in how we can improve our processes and culture to make sure this doesn't happen again. It's critical that the public have the confidence that sensitive energy information is protected.

During my 4 months as acting chairman, they've been somewhat eventful and FERC has faced many challenges including the ones we're focused on today. In this area I've repeatedly emphasized to the really wonderful team of folks who work there and externally that we have to have our actions guided by two things.

One is protecting the reliability and security of the grid for customers.

Second is protecting the integrity of the Commission so people can have confidence in it.

Thank you for this opportunity to testify. I look forward to your questions.

[The prepared statement of Ms. LaFleur follows:]

PREPARED STATEMENT OF CHERYL A. LAFLEUR, ACTING CHAIRMAN, FEDERAL ENERGY REGULATORY COMMISSION

Chairman Landrieu, Ranking Member Murkowski, and Members of the Committee:

My name is Cheryl LaFleur. For nearly four years, I have had the honor of serving on the Federal Energy Regulatory Commission. Today, I appear before you as FERC's Acting Chairman, an appointment that I received in November.

I would like to thank the Committee for holding this hearing on the reliability and security of our nation's electric grid and for inviting me to testify. One of my first decisions as a FERC Commissioner was to make electric reliability a personal priority. Therefore, I appreciate the Committee's interest in and commitment to these critical issues.

FERC'S ROLE IN SUPPORTING GRID RELIABILITY AND SECURITY

Our nation relies on the electric grid to meet many vital needs: to power our economy, to bolster our national defense, and to support our quality of life. At FERC, we take seriously our obligation to the American people to protect the reliability and security of the electric grid and to enhance its resilience. Indeed, I believe that reliability is job one, a fundamental responsibility for FERC and the electric industry. From my past experience working directly for electricity and natural gas customers, I know firsthand how hard even a short outage can be on families, businesses, and communities. And a major interruption in service could have devastating effects on our nation's citizens and economy, whether it is caused by severe weather, a cybersecurity incident, or a physical attack. FERC works with asset owners and grid operators to address these threats on an ongoing basis.

FERC supports the reliability and security of the electric grid in several ways. For example, FERC oversees the development and enforcement of mandatory reliability standards for the bulk power system. In addition, as part of its responsibility to ensure that wholesale electric rates are just and reasonable, FERC must ensure that these rates provide appropriate signals for investment in needed infrastructure. Further, FERC is responsible for authorizing the construction of certain energy infrastructure, such as interstate natural gas pipelines, liquefied natural gas terminals, and non-federal hydropower generation. The timely development of needed energy infrastructure supports the reliability of the electric grid. Finally, experts from FERC work with representatives of other federal and state agencies and the electric industry to help identify and address threats to energy infrastructure security.

I would like to briefly discuss the process for establishing mandatory reliability standards and the continuing evolution of the relationship among the parties involved. Section 215 of the Federal Power Act, which Congress enacted as part of the Energy Policy Act of 2005, directs FERC to work with an independent Electric Reliability Organization (ERO) to develop reliability standards for the bulk power sys-

tem. In 2006, FERC certified the North American Electric Reliability Corporation (NERC) as the ERO. NERC develops reliability standards pursuant to an open and inclusive stakeholder process and then submits those standards to FERC for consideration. FERC may either approve a proposed standard, or, if it identifies any deficiencies, remand the proposed standard to NERC for further consideration. Section 215 also authorizes FERC to identify gaps in reliability that require new standards or modifications to existing standards and to direct the ERO to address those gaps, but it does not authorize FERC to write or modify the standards.

Section 215 transformed the relationship among FERC, NERC, and the electric industry with respect to reliability. It marked the end of a system under which a group of reliability councils loosely structured under NERC developed reliability standards, with which the industry complied on a voluntary basis. Section 215 inaugurated a hybrid system that retained the industry development of standards through NERC, but subjected those standards to FERC approval and enforcement.

Now eight years since enactment of section 215, the transition to the paradigm that it established has gone well in many respects. There certainly have been growing pains related to the overall level of demands on the system, the volume of work, and disagreements among the industry, NERC, and FERC in some areas. However, FERC and NERC continue to build a strong relationship. We work closely with NERC CEO Gerry Cauley, his team, and the Regional Entities to advance grid reliability, security, and resiliency. This collaboration also includes many stakeholders, such as individual utilities; industry trade associations like the Edison Electric Institute, the National Rural Electric Cooperative Association, and the American Public Power Association, represented here by its President and CEO Sue Kelly; and the National Association of Regulatory Utility Commissioners, here by its president, Collette Honorable. I believe it is important to recognize that, despite the unique nature and relative newness of the process established in the Energy Policy Act of 2005, FERC, NERC, and the industry have put in place for the first time foundational reliability standards that are robust, mandatory, and enforceable.

Overseeing reliability standards for the grid requires that FERC pay attention to the day-to-day, nuts-and-bolts activities necessary to keep the lights on, like tree trimming and relay setting coordination, while also staying abreast of emerging issues. Threats in the former category, including severe weather, are more familiar, and responses are relatively well understood. Threats in the latter category are new and evolving, or at least our understanding of them is evolving over time.

I believe that FERC is making progress on both of these fronts. With respect to nuts-and-bolts issues, FERC has issued orders over the last three-and-a-half years on new or modified reliability standards for tree trimming, frequency response, reliability planning criteria, and protection system maintenance and testing, among other areas. Going forward, the challenge with respect to these and similar day-to-day issues is to improve on the progress that FERC and NERC have made in setting priorities, developing and implementing reliability standards, mitigating violations, and disseminating lessons learned.

We face different challenges with respect to emerging issues, like cybersecurity and geomagnetic disturbances. When it comes to threats like these, we do not have the benefit of decades of experience at our backs; instead, we are in the position of developing meaningful, cost-effective regulation in an environment of rapid change and imperfect knowledge. We must avoid both the temptation to defer action until we have absolute certainty and the pitfall of promulgating specific rules that rapidly become obsolete. In this regard, I believe that FERC thus far has struck a good balance, as illustrated in part by our recent rulemakings on geomagnetic disturbances and cybersecurity.

CYBER THREATS TO THE GRID

Congress referred specifically to cybersecurity when it enacted section 215 of the Federal Power Act to make electric reliability a core part of FERC's mission. Pursuant to that authority, FERC in November 2013 substantially approved Version 5 of the Critical Infrastructure Protection (CIP) standards. Under the Version 5 standards, all bulk electric system cyber assets, for the first time, will be required to receive some level of protection, commensurate with their impact on the grid. This advancement, combined with several new cyber security controls developed by NERC, established the most comprehensive cyber protections yet approved by FERC.

FERC also directed two important modifications to the Version 5 standards. First, FERC directed removal of language that requires certain CIP requirements to be implemented in a manner that "identifies, assesses, and corrects" deficiencies. Commenters disagreed over the obligations imposed by this language, highlighting its inherent ambiguity and underscoring FERC's previously stated concerns about its

enforceability and consistent application across regions. While I strongly support NERC's effort to reform its enforcement process, enforcement considerations should not cause the standards themselves to be ambiguous. Second, FERC directed NERC to develop objective criteria against which NERC and FERC can evaluate the sufficiency of entities' protections for low impact assets. Of course, by definition, low impact facilities do not pose as great a risk to the bulk electric system as high or medium impact facilities. However, the lack of clear standards against which NERC and FERC can evaluate entities' protections for low impact facilities would undermine one of the most important improvements in the Version 5 Standards: the requirement that all bulk electric system cyber assets receive a defined level of protection commensurate with their impact on the system. I believe that the Version 5 standards, and the further changes that FERC directed, are a significant step forward for cybersecurity.

However, because cyber threats are fast-changing, established standards are not enough. We must also engage other government agencies and asset owners and operators to communicate threats, share our expertise, and disseminate lessons learned. President Obama in his February 2013 Executive Order on cybersecurity called on independent agencies like FERC to engage voluntarily in the executive branch's efforts to improve the cybersecurity of the nation's critical infrastructure. FERC has been an early and sustained voluntary participant in this process. Through our Office of Energy Infrastructure and Security, we have worked with the Department of Homeland Security (DHS), the Department of Energy (DOE), the Federal Bureau of Investigations (FBI), and others to help support key initiatives under the Executive Order. Our participation has included coordinating with our Federal partners to provide information sessions (including classified briefings) on threats to asset owners and operators; actively participating in National Institute of Standards and Technology working groups developing the Cybersecurity Framework; and assisting DHS in identifying critical energy infrastructure.

PHYSICAL THREATS TO THE GRID

Grid reliability and security also requires protecting the physical security of the assets that make up the grid—protecting them from tampering, vandalism, and sabotage. FERC has long supported the physical security of the electric grid as part of our broader emphasis on strengthening the resilience of our nation's energy infrastructure. Resilience begins with how the system is planned, designed, constructed, and operated, and is informed by how asset owners and grid operators respond to and learn from events. Many of these factors are addressed in detail in the mandatory reliability standards that I described earlier in my testimony. At the same time, no single action or approach is sufficient. Building a resilient grid requires comprehensive and ongoing assessments under a range of conditions, and FERC is dedicated to this work.

An important part of these efforts is the sophisticated grid modeling FERC performs. This modeling, which draws on our subject matter expertise and helps us fulfill our responsibility to support the reliability and security of the grid, identifies key energy infrastructure facilities, taking into account a wide number of assumptions, factors, and possible scenarios.

The topic of physical security has become more prominent since the April 2013 attack on the Metcalf substation in northern California. In the wake of the Metcalf incident, FERC has worked to explain to asset owners and operators around the country the specific facts of the attack and the need for asset owners to increase the physical protection of key facilities. As part of this outreach, we have participated with NERC, DHS, DOE, and the FBI in a 13-city physical security campaign (including a detailed briefing about the Metcalf incident) for utilities, states, and law enforcement agencies in the United States and Canada. We have also provided asset owners and operators with guidance on specific steps that they could take to improve their facilities' physical security, informed by our modeling and drawing on the combined expertise of FERC, relevant Federal agencies, and NERC.

In addition to these ongoing efforts, on March 7, 2014, FERC acted under our statutory authority to oversee reliability standards to direct NERC to develop physical security standards for the grid within 90 days.

FERC required that these physical security standards include at least three steps. First, the standards should require owners and operators of the bulk power system to identify which of their facilities are critical to the reliable operation of the interstate grid. A critical facility is a facility that, if rendered inoperable or damaged, could have a critical impact on the operation of the interconnection through instability, uncontrolled separation, or cascading failures on the bulk power system. We acknowledged that the number of facilities that will qualify as critical will be rel-

atively small compared to the number of facilities that comprise the bulk power system, and that not every owner and operator of the grid will have critical facilities. Second, the mandatory reliability standards should require owners and operators of identified critical facilities to evaluate potential threats and vulnerabilities to those facilities. Third, the mandatory reliability standards must require owners and operators of critical facilities to develop and implement plans to protect against attacks to their identified critical facilities.

In directing NERC to develop physical security standards, we recognized that many in the industry already have taken steps to identify critical facilities and to protect those facilities from attack. A mandatory standard will reinforce these efforts and ensure that all owners and operators of the bulk power system take such important steps where appropriate. FERC also recognized that there is not a “one size fits all” approach to physical security. Therefore, we acknowledged that the steps owners and operators should take will vary based on factors such as location of the critical facility, its size, function, existing protections, and attractiveness as a target.

While on the subject of physical threats to the grid, I would like to touch briefly on another aspect of this issue that has received considerable attention in recent weeks.

As I noted earlier, FERC draws on our familiarity with electric system operations to perform sophisticated modeling that helps to identify and address system vulnerabilities. Last month, The Wall Street Journal published an article that included some details of such FERC modeling. I stated then, and I continue to believe, that publication of sensitive information about the grid undermines the careful work done by professionals who dedicate their careers to providing the American people with a reliable and secure grid. The Wall Street Journal appropriately declined to identify by name particularly critical substations throughout the country. Nonetheless, I view the publication of other sensitive information as highly irresponsible. While there may be value in a general discussion of the steps we take to keep the grid safe, the publication of sensitive material about the grid crosses the line from transparency to irresponsibility, and gives those who would do us harm a roadmap to achieve malicious designs. I appreciate Chairman Landrieu’s and Ranking Member Murkowski’s recent statements highlighting the importance of protecting this type of information.

Under my predecessor, the modeling discussed in The Wall Street Journal was categorized by FERC as Critical Energy Infrastructure Information (CEII), a designation set forth in FERC’s regulations. My understanding is that, consistent with those regulations, certain aspects of such modeling were shared with the owners and operators of relevant facilities pursuant to non-disclosure agreements. Unfortunately certain details of FERC’s modeling have now been disseminated widely through The Wall Street Journal. In light of these events, we are working to fully understand what happened and what we can do to improve our internal processes to ensure that no similar disclosure will occur in the future. I have asked the DOE Inspector General to help advise us about how we could improve our processes with respect to information security. I look forward to the Inspector General’s report. It is critical that those who deal with FERC are confident that all sensitive information is protected appropriately.

IMPROVING PROTECTION AGAINST CYBER AND PHYSICAL THREATS TO THE GRID

As discussed above, Congress and the Administration have taken important steps to protect against cyber and physical threats to the grid. I am committed to FERC working closely with our governmental partners to support grid reliability and security to the fullest extent possible under our existing statutory authority.

I have frequently suggested two legislative changes to further enhance cyber and physical security. First, I have asked for a narrowly-focused, FERC-specific Freedom of Information Act (FOIA) exemption for sensitive information concerning physical or cyber threats to, or vulnerabilities of, the bulk power system. The recent decision of the U.S. Court of Appeals for the District of Columbia Circuit in a case involving the International Boundary and Water Commission will be useful in protecting such information pursuant to the “law enforcement” exemption under FOIA. However, the specific contours and reach of the case are not entirely clear. I therefore believe a new FOIA exemption is still needed to definitively eliminate any risk of disclosure that may chill the beneficial exchange of information among FERC, NERC, and the industry.

Second, I have called on Congress to designate a federal department or agency (not necessarily FERC) with clear and direct authority to require actions in the event of an emergency involving a physical or cyber threat to the bulk power sys-

tem. This authority should include the ability to require action before a physical or cyber national security incident has occurred. However, it is important that any such authority should not impede FERC's existing, above-noted authority under section 215 to approve reliability standards developed by NERC through its current processes.

OTHER CHALLENGES TO GRID RELIABILITY

Finally, I would like to comment briefly on other challenges to grid reliability, some of which the second panel at today's hearing will discuss in greater detail.

As the Committee is well aware, our nation is currently undergoing major changes in its power supply and associated infrastructure. There are several drivers of this change. First, our nation is experiencing significant growth in the use of natural gas for electric generation, due primarily to the increased availability and affordability of domestic natural gas, but also to its relative environmental advantages and its role in balancing the growing fleet of variable resources. A second factor driving changes in our power supply is the considerable growth of renewable and demand-side resources, fostered by developments in technology and by policy initiatives at both the state and Federal level. Finally, new environmental regulations are also driving changes in our power supply.

FERC has a role to play in protecting grid reliability as new environmental regulations are developed and implemented. While it is not FERC's responsibility to tell the Environmental Protection Agency (EPA) what regulations to issue under the laws it is responsible for enforcing, FERC can and should help the EPA understand the implications that such regulations may have on electric reliability. For example, in conjunction with the issuance of its Mercury and Air Toxics Standards (MATS) rule, the EPA indicated that it will seek advice on requests for extra time for electric generators to comply with the rule. In May 2012, FERC issued a policy statement outlining how it will advise the EPA on this issue. FERC staff also participates in regular conference calls with EPA, DOE, and the Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs) to discuss their efforts to plan the system to meet future needs, including implementation of EPA rules.

FERC's interaction with the EPA on the MATS rule provides one template for FERC lending its expertise on such matters. Similarly, I believe that it is important for FERC to follow the development of EPA regulations on greenhouse gas emissions, because such regulations and state implementation plans could have significant implications for how the grid is operated in the future.

In addition, because vital decisions in this area will be made at the state level, FERC can and should reach out to our state colleagues on these issues. I have served with Commissioner Moeller, who is testifying on the next panel, as one of FERC's leaders of a Forum on Reliability and the Environment established jointly by FERC and the NARUC. This Forum has provided a structure for conversations concerning these issues, including not only FERC and NARUC representatives, but also senior EPA officials. I look forward to working with my President Honorable to continue and build on these efforts.

Finally, although the drivers of power supply changes are largely outside of FERC's jurisdiction we must work to ensure the energy industry and markets adapt to these developments in order to carry out our statutory responsibilities. Just last week, FERC held a technical conference to explore the impacts of this winter's cold weather events on the RTOs and ISOs and to discuss actions taken to respond to those impacts. This technical conference built on FERC's work over the past two years to explore the need for enhanced coordination between the electric and natural gas industries in light of significant growth in the use of natural gas for electric generation. In addition, FERC is considering how centralized capacity market rules and structures can best support the procurement and retention of all resources necessary to meet future reliability and operational needs.

CONCLUSION

During the four months I have had the honor of serving as Acting Chairman, FERC has faced several substantial challenges, a number of which the Committee is focusing on today. I have repeatedly emphasized to the wonderful team of employees at FERC that our actions should be focused on enhancing the reliability and security of the electric grid and assuring that the nation's energy infrastructure and markets meet the changing needs of energy consumers. I look forward to working with the Committee to advance these vital interests.

The CHAIRMAN. Thank you so much.

Mr. Cauley.

STATEMENT OF GERRY CAULEY, PRESIDENT AND CHIEF EXECUTIVE OFFICER, NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Mr. CAULEY. Thank you. Good morning, Chairman Landrieu and Ranking Member Murkowski and other committee members and fellow panelists. My name is Gerry Cauley.

I have 3 main points I'd like to offer to the committee this morning.

The first is that NERC and industry have been working really hard for a really long time to address both the physical and cyber security of the power grid as well as the resilience. Remind the committee that this is a North American international grid that we do work with.

Not long after 9/11 American industry developed the first set of physical security guidelines capturing the best practices across industry in terms of physical security. NERC approved the first set of cyber security standards in August 2003.

As the Chairman just mentioned FERC just approved the fifth generation of those cyber standards. They encompass the entirety of the bulk electric system and they adopt risk based security methods that are captured in the NIST standards. We have a very robust audit and compliance program that we go out and monitor companies through our 8 regions. We've been very active in ensuring that the companies are mitigating and addressing issues. So a lot of work has been accomplished in the area of cyber security.

It's also important to note that the electric industry, along with nuclear, is the only industry, as was mentioned previously, that has mandatory cyber security standards.

We have another little known standard that requires companies, if there is a physical or cyber incident sabotage even suspected, that they must report it to NERC and they must report it to law enforcement.

In response to the FERC order of March 7 we've been working very hard and very quickly. I think the order demonstrates something I've been saying for quite some time is that the Commission does have the authority, if needed, to direct NERC to do a standard that they feel is in the public interest. They did it previously with the solar magnetic disturbance, standard order, and now with the physical security order.

I think it's a good order.

It focuses on the most critical assets.

It provides for a risk based approach.

It provides for accountability and verification.

The industry is behind the standard development. They are supporting us in getting it done. We've taken steps to abbreviate the process so that we can get this standard done in the 90 days.

My second point is that NERC has a number of important tools beyond the use of standards to address physical and cyber security. We operate the industry's Information Sharing and Analysis Center, the ISAC. This allows us to share threat information and other security information with industry and also collect information from industry and share it with our government partners.

The ISAC operates in a controlled and confidential environment so that the information that we're sharing is maintained secure.

We also have a system of alerts. Since January 2010 we've issued 27 alerts to industry covering a number of physical and cyber issues. Immediately following the Metcalf incident last April, on the very next day on April 16, we provided an alert to industry outlining the methods and tactics used in the Metcalf attack and what industry should do to address the issue.

I believe we have the most robust, private/public partnership between industry and government through our Electricity Sector Coordinating Council. We have approximately 30 CEOs, not information officers, not security officers, but the CEOs themselves, meeting on a quarterly basis with the top officials from the various government agencies, including the White House, Homeland Security, DOE, NSA, FBI and so on. We meet quarterly. We discuss what actions we can take to improve information sharing, incident response and tools.

NERC facilitated last November a great exercise that was a severe level attack. I think was an opportunity for us to demonstrate our readiness, but also identify what areas we need to improve in terms of ensuring security and reliability.

My third point, Madame Chair, is a direct response to the question of the hearing, you know, keeping the lights on, are we doing enough?

My answer is we are doing enough. We're doing the right things. We're doing the right things on a prioritized basis. We're making progress and continuously improving.

The Metcalf incident was serious. But it's also a good example of the resiliency of the grid. No customer outages occurred during that incident.

But also Metcalf is an important turning point. It's a signal about looking at physical security from a different perspective, not just keeping bad people out of substations but other aspects of security.

But in the context of all the things we look at, physical and cyber security, there are many other issues that we have to weigh. The storm is under a constant attack from natural phenomena, storms. We have issues with operator training, human error, equipment failures. So we want to make sure that we take the cyber and physical aspects into context of the full spectrum of risk that we have to manage.

Thank you. I look forward to your questions.

[The prepared statement of Mr. Cauley follows:]

PREPARED STATEMENT OF GERRY CAULEY, PRESIDENT AND CHIEF EXECUTIVE OFFICER, NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

INTRODUCTION

Good morning Chair Landrieu, Ranking Member Murkowski, members of the Committee and fellow panelists. My name is Gerry Cauley and I am the President and CEO of the North American Electric Reliability Corporation (NERC). NERC was designated the Electric Reliability Organization (ERO) by the Federal Energy Regulatory Commission (FERC) in accordance with Section 215 of the Federal Power Act (FPA), enacted by the Energy Policy Act of 2005.

I testified before this Committee in May 2011 and July 2012 on the subject of cybersecurity and the grid, and I appreciate the opportunity to update the Com-

mittee on NERC's ongoing cybersecurity and physical security activities to ensure reliability of the bulk-power system (BPS). These activities include, but are not limited to:

- Developing a physical security standard (as directed by FERC on March 7, 2014), and conducting outreach to industry in conjunction with our federal partners;
- Planning and participating in a 13-city outreach effort in response to a physical security attack at a California substation;
- Receiving FERC approval on Critical Infrastructure Protection (CIP) Version 5 standards in November 2013, our most updated version of the mandatory cybersecurity standards;
- Issuing alerts related to cybersecurity and physical security concerns and continuing information sharing through the Electricity Sector Information Sharing and Analysis Center (ES-ISAC);
- Facilitating Grid Security Exercise (GridEx) II, for the Electricity Sub-sector in North America with more than 2000 participants;
- Participating in the Electricity Sub-sector Coordinating Council (ESCC), which provides a forum for communication between public and private sector partners in the Electricity Sub-sector; and
- Contributing to activities related to Executive Order (EO) 13636 and Presidential Policy Directive (PPD) 21, as well as supporting the White House-initiated, Department of Energy (DOE)-led Electricity Sub-sector Cybersecurity Capability Maturity Model (ES-C2M2), which will assist with development and measurement of cybersecurity capabilities within the sub-sector.

THE SECURITY CHALLENGE FOR THE GRID

The electric grid is one of the Nation's most critical infrastructures. The North American BPS is one of the largest, most complex, and most robust systems ever created. Several, if not all, of the other critical infrastructure sectors are dependent on electric power. As CEO of the organization charged with ensuring the reliability and security of the North American grid, I am deeply concerned about the changing risk landscape from conventional risks, such as extreme weather and equipment failures, to new and emerging risks in the security arena. As I said in my testimony in 2011, I am most concerned about coordinated physical and cyber attacks intended to disable elements of the power grid or deny electricity to specific targets, such as government or business centers, military installations, or other infrastructures. These threats differ from conventional risks in that they result from intentional actions by adversaries and are not simply random failures or acts of nature. NERC and industry take these threats very seriously. Long before the advent of mandatory standards, NERC and industry participants have worked to address physical and cyber threats to critical assets. These threats are not new, but have evolved and continue to demand more and more attention from industry, which faces numerous risks. Recognizing the costs for ratepayers associated with these efforts requires prioritization, along with risk management, to ensure that we are focusing resources on the greatest risks to the reliability of the BPS.

PHYSICAL SECURITY

In April of last year, a substation in California was the site of a physical attack. It is important to note the attack did not result in a power outage; in fact, no customers lost service. Nevertheless, the incident is a reminder of the vulnerabilities of our BPS and while rare, demonstrates that attacks are possible and have the potential to cause significant damage to assets and disrupt customer service. I would like to commend the owner of the substation for working tirelessly to not only recover from this attack, but to readily share lessons learned with government authorities and industry. Immediately after the event, the ES-ISAC issued an alert to inform industry of the event and provide advice on steps to mitigate and protect against such attacks. In addition, the ES-ISAC, DOE, FERC, the Department of Homeland Security (DHS), and the Federal Bureau of Investigation (FBI) developed an outreach effort to raise awareness of the event, inform industry of mitigation activities, and provide a forum for industry to meet with state, local, and federal authorities to discuss physical security concerns for their regions. This was an unprecedented public-private partnership effort to address physical security concerns and involved US and Canadian interests.

After September 11, 2001, industry developed and updated physical security guidelines to address the need for coordination and communication. These security guidelines address physical security response, best practices, and substation security. Specifically, they provide guidance on:

- Addressing potential risks;
- Identifying practices that can help mitigate the risks;
- Determining risk for an organization and practices appropriate to manage its risk;
- Identifying actions that industry should consider when responding to threat alerts received from the ES-ISAC and other organizations;
- Defining the scope of actions each organization may implement for its specific response plan; and
- Conducting assessment of and categorizing vulnerability and risk to critical facilities and functions.

In addition to these guidelines, NERC has a mandatory standard requiring reporting to NERC and law enforcement of physical damage or destruction of a facility or threats to damage or destroy a facility (EOP-004-2).

NERC is developing a physical security standard, which FERC ordered on March 7, 2014. NERC has 90 days to complete the standard and provide it to FERC for approval. This standard will address physical security threats and vulnerabilities for the most critical facilities and will focus on risk management activities and foundational physical security practices. The drafting team has already been formed and we fully intend to produce a standard in the timeline identified.

NERC MEASURES TO ADDRESS CYBER THREATS AND VULNERABILITIES

To address this changing risk landscape, NERC has worked with industry and government to better understand security risks and manage those risks. Based on all of the work NERC has been involved in to date, it is clear that the most effective approach against adversaries exploiting the newer risk landscape is through thoughtful application of resiliency principles. Resiliency requires proactive readiness for whatever may come our way and includes robustness; the ability to minimize consequences in real-time; the ability to restore essential services; and the ability to adapt and learn.

As I testified in 2012, NERC has developed a strategic approach to ensure reliability of the BPS, focusing on five main elements: 1) developing mandatory and enforceable standards; 2) ensuring compliance and audit oversight; 3) enhancing the ES-ISAC capabilities; 4) engaging in public-private partnerships; and 5) conducting outreach, training, and education activities within and external to the BPS such as GridEx.

NERC'S MANDATORY AND ENFORCEABLE CIP STANDARDS

Since 2007, NERC has updated its standards to reflect the changing cybersecurity landscape. On November 21, 2013, FERC issued an order approving CIP Version 5. CIP Version 5 requires that all cyber assets must now be categorized as Low, Medium, or High Impact assets. The revised standards also include 12 new requirements with new cybersecurity controls to address emerging cyber threats. In addition, CIP Version 5 removes technology-specific requirements by replacing them with a risk-based approach to implementing appropriate and changing technologies. That is, rather than specifying how to implement a requirement, the revised requirements specify the risk-based result that must be achieved, which enables industry to implement new and emerging technologies to address the risk. NERC is working with industry on the transition to this new standard, which is one of the most comprehensive, risk-based standards ever mandated.

ENSURING COMPLIANCE AND AUDIT OVERSIGHT

Concurrent with developing mandatory reliability standards, NERC supports the ERO's Regional Entities to improve the consistency of compliance program results, improve risk-based approaches for auditing and spot checking, and promote a culture of security and compliance through education, transparency, and incentives. During this process, NERC seeks to capture compliance applications, positive observations, lessons learned, and recommendations. NERC's audit oversights enable NERC to evaluate the processes and criteria used by Regional Entities in their determination of registered entities' compliance with the NERC Reliability Standards, including the CIP Standards.

Compliance with the NERC CIP standards is an important element for properly securing the BPS. However, no single security asset, technique, procedure, or standard—even if strictly followed—will protect an entity from all potential cyber threats. The cybersecurity threat environment is constantly changing and our defenses must keep pace. Security best practices call for additional capabilities and technologies beyond those required by the CIP standards.

ENHANCING THE ES-ISAC'S CAPABILITIES

Not all threats and vulnerabilities can be mitigated through a reliability standard. In such cases, NERC uses tools and technologies through the ES-ISAC, including Alerts and a secure web portal. The ES-ISAC gathers information from electric industry participants across North America about security-related events, disturbances, and off-normal occurrences within the Electricity Sub-sector and shares that information with key governmental entities. In turn, these governmental entities provide the ES-ISAC with information regarding risks, threats, and warnings that the ES-ISAC is then responsible for disseminating throughout the Electricity Sub-sector.

The two functions that the ES-ISAC supports, information sharing and analysis, are vitally important to all other critical infrastructures and key resource sectors that have active ISACs. Effective collaboration and communication is essential to addressing infrastructure protection and resilience within each sector, as well as the important interdependencies that exist among sectors.

For many companies in the Electricity Sub-sector, the ES-ISAC portal is the first and often primary interface with the ES-ISAC. It allows the ISAC to reach thousands of industry members and hundreds of organizations across the sub-sector and is the mechanism for industry and government to contact ES-ISAC staff with questions, concerns, and security-related information in a secure manner.

NERC Alerts

NERC staff with appropriate security clearances often work with cleared personnel from Federal agencies to communicate unclassified sensitive information to the industry in the form of NERC Alerts. As defined in NERC's Rules of Procedure, the ES-ISAC developed the following three levels of Alerts for formal notice to industry regarding security issues:

- **Industry Advisory.** Purely informational, intended to alert registered entities to issues or potential problems. A response to NERC is not necessary.
- **Recommendation to Industry.** Recommends specific action be taken by registered entities. Requires a response from recipients as defined in the Alert.
- **Essential Action.** Identifies actions deemed to be "essential" to BPS reliability and requires NERC Board of Trustees approval prior to issuance. Like recommendations, essential actions require recipients to respond as defined in the Alert.

NERC determines the appropriate Alert notification based on the risk to the BPS. Generally, NERC distributes Alerts broadly to users, owners, and operators of the North American BPS using its Compliance Registry. Entities registered with NERC are required to provide and maintain updated compliance and cybersecurity contacts. NERC also distributes the Alerts beyond BPS users, owners, and operators to include other electricity industry participants who need the information. Alerts may also be targeted to groups of entities based on their NERC-registered functions (e.g., Balancing Authorities, Transmission Operators, Generation Owners, etc.).

Alerts are developed with the strong partnership of Federal technical organizations, including FERC, DOE National Laboratories, DHS, and BPS subject matter experts (SME), called the HYDRA team. NERC has issued 27 CIP-related Alerts since January 2010 (25 Industry Advisories and two Recommendations to Industry). Those Alerts covered items such as Sabotage events, Aurora, Stuxnet, Night Dragon, and the reporting of suspicious activity. Responses to Alerts and mitigation efforts are identified and tracked, with follow-up provided to individual owners and operators and key stakeholders. In addition, NERC released one Joint Product CIP Awareness Bulletin in collaboration with DOE, DHS, and the FBI titled, "Remote Access Attacks: Advanced Attackers Compromise Virtual Private Networks (VPN)." The ES-ISAC also routinely shares actionable threat information through the portal to defend against cyber attacks; this information sharing is a daily activity.

The NERC Alert system is working well. It is understood by industry, handles sensitive information, and communicates this information in an expedited manner. The information needed to develop the Alert is managed in a confidential manner and does not require a NERC balloting process. Information sharing through the ES-ISAC is the greatest asset we have to combat emerging threats to cybersecurity and help ensure the reliability of the BPS.

As a result, NERC continues to grow the ES-ISAC's capabilities by enhancing the ES-ISAC's private, secure portal to receive voluntary reports from industry members and working with various organizations (both industry and government) to obtain the data and mechanisms necessary to conduct these information sharing activities.

ENGAGING IN PUBLIC-PRIVATE PARTNERSHIPS

NERC works closely with Electricity Sub-sector members, other sectors, and our government partners on cybersecurity matters on a regular basis through both formal and informal structures. NERC works closely with the Electricity Sub-sector Coordinating Council (ESCC). As NERC's CEO, I am a member of the ESCC, which coordinates policy-related activities and initiatives to improve the reliability and resilience of the Electricity Sub-sector. The roles of the ESCC are to represent the Electricity Sub-sector, to build relationships with government and other critical infrastructure sectors, and to participate in joint initiatives as part of the "partnership framework" envisioned by the National Infrastructure Protection Plan and Energy Sector-Specific Plan. This past year, the ESCC underwent changes to broaden membership to 30 CEO-level representatives, formally recognizing the significant increased CEO interest and participation on cybersecurity issues. The ESCC's focus to address physical security and cybersecurity issues, working alongside our government partners, remains unchanged.

A broader partnership activity NERC was heavily engaged in this past year was helping to implement EO-13636 and PPD-21. NERC and industry SMEs participated in the working groups to help shape the final products. The various EO and PPD working group activities all focused on enhancing public-private partnerships, developing tools and best practices for sectors to use, and ultimately, reducing risk to critical infrastructure sectors. For all of these efforts, NERC worked closely with industry representatives and government partners to build new and improve upon existing cybersecurity-focused capabilities, processes, and products.

NERC also continues to provide leadership to significant DHS-affiliated public-private partnerships. These groups are:

- Cross-Sector Cyber Security Working Group, which was established to coordinate cross-sector initiatives that promote public and private efforts to help ensure secure, safe, and reliable critical infrastructure services; and
- Industrial Control Systems Joint Working Group, which is a cross-sector industrial control systems working group that focuses on the areas of education, cross-sector strategic roadmap development, and coordinated efforts to develop better vendor focus on security needs for industrial control systems.

Within the sub-sector, NERC's Critical Infrastructure Protection Committee (CIPC) focuses on both physical security and cybersecurity issues impacting the BPS. The committee consists of both NERC-appointed regional representatives and technical SMEs. CIPC coordinates NERC's security initiatives and serves as an expert advisory panel to the NERC Board of Trustees, standing committees in the areas of physical security and cybersecurity, and the ES-ISAC. CIPC also coordinates with government individuals and entities to hold joint briefings and participate in other activities to address security policy matters. NERC also collaborates with the Industrial Control Systems Cyber Emergency Response Team to share threat, vulnerability, and security incident information.

CONDUCTING OUTREACH, TRAINING, AND EDUCATION ACTIVITIES

In addition to collaborating with industry and government partners, NERC regularly conducts outreach to and training for our partners. We do so through assessments, exercises, webinars, and guidelines.

GridEx II

In 2011, NERC facilitated the first-ever GridEx for the Electricity Sub-sector in North America. NERC now holds a biennial distributed play exercise and executive tabletop discussion to:

- Exercise the current readiness of the electricity industry to respond to a security incident, incorporating lessons learned;
- Review existing command, control, and communication plans and tools for NERC and its stakeholders;
- Identify potential improvements in cybersecurity and physical security plans, programs, and responder skills; and
- Explore senior leadership policy decisions and triggers in response to a coordinated cyber and physical event of national significance with long-term grid reliability issues.

NERC held GridEx II on November 13-14, 2013, where over 230 organizations participated in the Distributed Play session. Additionally, a group of senior industry and government executives participated in a tabletop session based on the Distributed Play scenario but greatly expanded in scope. The exercise built upon the objec-

tives and findings from the 2011 GridEx recommendations and simulated a coordinated cyber and physical security attack to offer participants a worst-case scenario to review their existing command control and communication plans and to identify potential areas for improvement. The exercise was the most comprehensive effort to date that addressed both cyber and physical security. NERC released reports in March 2014 detailing lessons learned and recommendations. These reports are posted on NERC's website.

Cyber Risk Preparedness Assessments (CRPA)

The ES-ISAC developed the CRPA program to assess, through exercises, an entity's current cybersecurity capabilities and the adequacy of existing reliability mechanisms. By conducting these assessments, the ES-ISAC targets areas for improvement and identifies best practices that it can then share with industry. Since 2010, over a dozen entities have participated in the CRPA program and have responded positively to the impact the CRPAs have on strengthening their operations, and ultimately helping to protect the BPS.

The CRPA program continued to mature in 2013 with the addition of the ES-C2M2 key practice areas informing and complementing the CRPA program. The program used the ES-C2M2 to shape the analysis of the exercise and focus the post-exercise discussion and report around the response capabilities as defined through the ES-C2M2. As part of the ES-ISAC's strategy to support adoption of the CRPA methodology more broadly across the industry, the ES-ISAC hosted a workshop in 2013 to provide training and templates for industry to use in support of their own exercise programs. The CRPA also supported the GridEx II exercise, providing documentation and training to exercise participants on using the ES-C2M2 in assessing their organization's response capabilities.

Security Briefings and Guidelines

Another example of NERC's outreach and training efforts included a classified briefing campaign in 2013. The ES-ISAC, DHS, DOE, and FBI collaborated to host a series of briefings focused on tactics and tools of emerging cyber threat actors. Similar to the 2014 physical security outreach campaign, this campaign included a multi-city tour across the United States and was developed following a NERC Alert that detailed how attackers use common tools to infiltrate critical infrastructure networks and gain access to control system networks. The briefings were designed to raise awareness within the control systems community to better protect the BPS.

In addition, NERC's CIPC holds security briefings and workshops throughout the year to educate industry about items such as physical security assessments and penetration testing. CIPC also developed physical security guidelines for the Electricity Sub-sector to assist entities in responding to a physical security situation. The guidelines also include a reference document that any entity can adapt to its specific physical security policies and procedures.

Finally, NERC hosts its annual Grid Security Conference (GridSecCon), which brings together cybersecurity and physical security experts from industry and government to share emerging security trends, policy advancements, and lessons learned related to the Electricity Sub-sector. GridSecCon 2013 included discussions focused on industry being transformational, strategic, and tactical in its approach to securing systems. Specifically, participants were asked to consider different information sharing techniques; determine if their organizations are resilient through self-assessments; test response activities through exercises; work to ensure that security is built into operations; and enhance the workforce by recruiting, training, and retaining individuals who can address these and other issues. Additionally, almost 200 stakeholders attended credentialed training sessions in cyber and physical security.

ONGOING RELIABILITY ASSESSMENTS

Assessment of Reliability Impacts Emerging from Large-Scale Generator Retirements

NERC's mission to ensure the reliability of the BPS goes beyond issues related to security of the grid. As directed by Section 215(g) of the FPA, NERC, as the ERO, conducts periodic assessments of the reliability and adequacy of the North American BPS. As part of addressing these reliability assessments, NERC reviewed the impacts resulting from implementation of Environmental Protection Agency (EPA) regulations on generation. NERC's October 2010 Special Reliability Scenario Assessment: Resource Adequacy Impacts of Potential U.S. Environmental Regulations included a detailed analysis of the potential resource adequacy impacts likely to result from four pending and planned EPA regulations. NERC examined the individual and aggregated impacts of: (1) Clean Water Act—Section 316(b): Cooling Water In-

take Structures; (2) Clean Air Act—Section 112, Utility Air Toxics; (3) Clean Air Transport Rule; and (4) Coal Combustion Residuals.

NERC's initial analysis of these regulations indicated 78 GW of projected retirements and derates by 2018. Additional impacts to BPS reliability were also projected due to reduced reserve margins, highlighting the need for additional resources.

NERC continues to monitor and report on the impacts of environmental regulations on generation in the United States and Canada, as industry responds to state, federal, and provincial requirements. This is achieved through ongoing coordination with the NERC Regions, the EPA, and industry at large. NERC is also monitoring ongoing retirements and impacts to both resource adequacy and operations, such as deliverability, stability, localized issues, outage scheduling, operating procedures, and industry coordination. This information is released regularly by NERC in both seasonal and long-term assessments. NERC's latest projections are in line with the initial 2010 analysis.

Accommodating Large Amounts of Variable Generation

In November 2013, NERC published a joint report with the California ISO, which concluded that, when the portion of the resource mix provided by renewable and distributed resources reaches 20% to 30% of the total supply, the reliability of BPS can be diminished. This results from reduced availability of essential reliability services to support bulk system reliability. Larger dispatchable generating units have always inherently provided essential reliability services for the BPS. As these units are retired, and non-dispatchable renewable and distributed generation connect to the grid without replacing the essential reliability services, the availability of essential reliability services is diminished. These services include demand and resource balancing and voltage and frequency support.

As large quantities of variable energy resources—predominately wind and solar PV—are integrated into the BPS, a greater proportion of the system's total resource mix will have limited inertial rotating mass capability and operational flexibility. These new resources with much different operating characteristics will displace electric generation, as well as the essential reliability services, provided by large rotating machines and the operating characteristics those machines provided. Therefore, it is necessary that in addition to the energy and capacity needs of a given system, essential reliability services must be assessed and given due consideration in both BPS planning and policy implementation. NERC continues to assess these challenges and is developing pro-active measures to address any potential issues through a suite of tools available to NERC, including but not limited to Reliability Standards.

CONCLUSION

As outlined today, NERC has many tools available, including standards and guidelines to provide foundational security efforts. These, along with the ES-ISAC and all of its capabilities to help address imminent and strategic physical and cyber threats to the power grid, provide a coordinated comprehensive effort to address cybersecurity and physical security. We work with government, industry, and other stakeholders to share what we know, educate our partners, and learn what we can to secure our systems and stay ahead of the threats.

We recognize the importance of protecting against the misuse of non-public information. Because it is not a government agency, NERC is not subject to the Freedom of Information Act. NERC works to ensure that any information of a confidential nature is provided to federal agencies in a protected format. We continue to encourage increased information sharing by US Government departments and agencies with asset-owners regarding potential threats. The only way industry participants on the ground can truly protect against an event is to be aware of a specific threat or concern. They know which of their assets are critical. They know what they need to do to protect against the majority of physical and cyber threats. However, if the government is aware of a specific threat, communicating that information to those individuals on the front lines is important. This communication differs from providing public access to sensitive information, but is an essential component of security protection.

We appreciate this opportunity to discuss with the committee NERC's activities to protect the grid from physical and cyber threats, and to assess the adequacy of generating resources as the regulatory environment evolves.

The CHAIRMAN. Thank you, Mr. Cauley.
Ms. Kelly.

**STATEMENT OF SUE KELLY, PRESIDENT AND CEO, AMERICAN
PUBLIC POWER ASSOCIATION**

Ms. KELLY. Thank you very much.

My name is Sue Kelly. I'm the President and CEO of the American Public Power Association. APPA is a national trade association based in DC that represents more than 2,000, not for profit, community owned electric utilities in 49 States. I very much appreciate the opportunity to testify on grid security.

But today I represent investor owned, cooperatively owned and publicly owned utilities, independent generators and Canadian utilities as well. For very legitimate reasons we often have different views on the policy issues facing our industry, but we all have come together on grid security. We all supported section 215 that was passed in the Energy Policy Act of 2005. Given the changing nature of threats to the grid, we have also worked with DOE and DHS to develop the Electricity Subsector Coordinating Council, ESCC, which I'll discuss later.

The overall reliability of the bulk electric system or put simply, keeping the lights on, for both ourselves and our neighbors is of a paramount importance to electric utilities. Because electricity is produced and consumed instantaneously and follows the path of least impedance ensuring reliability and grid security is a collected affair in which we are all engaged together. Cyber attacks, meteorological events, potential terrorist acts, they've driven much of the public discussion on this issue in recent years. But utilities have, for decades, planned for physical threats.

Unlike cyber security threats, threats to physical infrastructure have been around for many years. Utilities take these threats seriously. We deploy measures to mitigate them. But the sheer size and in some cases the remoteness of the infrastructure requires that we prioritize the facilities and concentrate on the ones that, if damaged, would have the most severe impact on reliability.

Simple risk mitigation techniques like cameras and locks can help address routine problems. But the key to electric utility physical security is defense in depth which relies on resiliency, redundancy and the ability to recover should an extraordinary event occur. While our systems are built to withstand attacks, successful attacks can happen.

We use modeling to build redundancies into the system to support most critical assets. But since we have over 45,000 substations in the U.S. prioritizing the most critical assets and focusing our planning on them is extremely important.

In recent months a few high profile attacks on physical infrastructure have drawn increased scrutinies. One such incident took place at the Metcalf substation on PG&E system in California. Shooting at substations, unfortunately, is not uncommon. But this incident demonstrated a level of sophistication not previously seen in our sector. We've been working to understand it and to share the lessons learned from it.

Government and industry conducted a series of briefings across the country and in Canada for utilities and local law enforcement to help utilities learn more about the attack and the potential implications for them. APPA and our fellow electric sector trade associations take this incident very seriously. The notion that recent

media stories suddenly spurred our industry to action or somehow enhanced grid security are inaccurate.

These briefings were initiated prior to these stories.

However, in part to response to the Metcalf incident on March 7th, FERC has directed NERC under section 215 to submit proposed reliability standards on physical security within 90 days. APPA and our members, along with many other industry stakeholders, are actively engaged in the NERC process right now to develop this important standard.

Turning to cyber security.

APPA believes the best way to enhance security across critical infrastructure sectors is by improving information sharing between the Federal Government and these sectors. We have therefore supported information sharing legislation that passed the House. We look forward to reviewing the Senate's version.

So far the cyber related section 215 standards coupled with additional best practices in management processes have prevented a successful cyber attack. But that doesn't mean it's not going to happen. The industry therefore applies a similar defense and depth approach to cyber security to insure a quick response. Cyber security is going to have to be an iterate of processes as nature of the threats continue to evolve.

Finally, I have to note that the partnership, coordination and sharing of relevant threat information is crucial to grid security. At the national level the ESCC plays an essential role in coordination and information sharing. It has representatives from trade associations, CEO of public power utilities, IOUs, rural co-ops, TVA, the PMAs and ESCC members coordinate with and periodically meet with officials from the White House, DOE, DHS, Federal law enforcement and national security organizations.

This dialog is currently focused on 3 areas, tools and technologies, information sharing and incident response.

In conclusion APPA, on behalf of the entire electric industry, would like to reaffirm the industry's ongoing commitment to protecting critical electric utility infrastructure from both cyber and physical threats. To do this we have to work in partnership with all levels of government from local law enforcement to cabinet level executive departments. Confidential information, sharing and tools and technologies are needed.

Thank you for the opportunity to appear before you today.

[The prepared statement of Ms. Kelly follows:]

PREPARED STATEMENT OF SUE KELLY, PRESIDENT & CEO, AMERICAN PUBLIC POWER ASSOCIATION

The American Public Power Association (APPA), based in Washington, D.C., is the national service organization for the more than 2,000 not-for-profit, community-owned electric utilities in the U.S.. Collectively, these utilities serve more than 47 million Americans in 49 states (all but Hawaii). APPA appreciates the opportunity to provide the following testimony for the Senate Energy and Natural Resources Committee's hearing regarding "Keeping the Lights on—Are We Doing Enough to Ensure the Reliability and Security of the U.S. Electric Grid?"

APPA was created in 1940 as a nonprofit, non-partisan organization to advance the public policy interests of its members and their customers, and to provide member services to ensure adequate, reliable electricity at a reasonable price with the proper protection of the environment. Most public power utilities are owned by municipalities, with others owned by counties, public utility districts, and states. APPA

members also include joint action agencies (state and regional entities formed by public power utilities) and state, regional, and local associations that have purposes similar to APPA.

INTRODUCTION

The associations in our industry represent a broad variety of stakeholder interests, including investor-owned, cooperatively owned and publicly owned utilities, independent generators, and Canadian utilities. For very legitimate reasons, we often have different views on the policy issues facing our industry. On the issue of the security of the electric bulk-power system, however, we have come together. APPA, the Canadian Electricity Association, the Edison Electric Institute, the Electric Power Supply Association, the Large Public Power Council, the National Rural Electric Cooperative Association and the Transmission Access Policy Study Group (associations) have all supported the mandatory electric reliability regime created by the Energy Policy Act of 2005, that applies to the reliability, cyber-security, and now physical-security of the bulk electric system. In recognition of the changing nature of threats to the security of the grid, particularly cyber-threats given their rapidly evolving nature, we have also worked with the Departments of Energy and Homeland Security to expand and elevate the focus of the Electric Sub-sector Coordinating Council (ESCC), which I will discuss in more detail below. Given our similar positions on these issues, this testimony has been endorsed by these associations.

In this testimony, I will discuss physical-security and its importance to the reliability and overall security of the electric grid. Next, I will focus on the importance of cyber-security and the need for limited liability protection. And finally, I will detail how electric utilities address cyber-and physical-security constantly and simultaneously. (For the purposes of today's testimony, I use the phrase "grid-security" as representative of both cyber-and physical-security.)

Electricity, the movement of electrons, occurs naturally. But to serve industrial, commercial and residential needs for lighting, heating, cooling, refrigeration, computers, and many other daily needs, large amounts of moving electrons must be generated from some other fuel or energy source. Electricity is created from the conversion of a fuel or other source of energy into electrons. Once electricity is generated, it travels over high-voltage bulk power transmission lines to the lower voltage distribution systems where it will be delivered to homes and businesses and consumed. This all happens instantaneously, at nearly the speed of light, making the reliable operation of the electric grid a "24 hours-a-day, seven-days-a-week" job. Furthermore, once electrons flow from the generating unit to the grid, their path cannot generally be controlled. Therefore, the approximately 1,900 owners, users, and operators of the bulk power grid (comprised of the generating facilities and high-voltage transmission lines where electrons freely flow) must work together constantly to ensure security and reliability.

PHYSICAL-SECURITY

While cyber attacks, meteorological events, and terrorist acts have driven much of the public discussion on grid security in recent years, APPA's members and the entire sector have for decades planned for threats to physical security. Unlike cybersecurity threats, which are constantly evolving, many of the threats to physical infrastructure have been identified for years, if not decades, and are more readily understood than potential cyber threats. Electric utilities, including public power utilities, take these threats seriously, and deploy measures to mitigate such threats. At the same time, the sheer size and in some cases, remoteness, of the infrastructure requires that utilities prioritize facilities that, if damaged, would have the most severe impacts on the ability of utilities to "keep the lights on." This risk-based approach enables the industry to prioritize the most important assets, and also allows it to change that prioritization over time. The bulk electric system continually evolves because assets that impact the system change over time. For example, the retirement of a large coal plant might lead to greater reliance on a mix of natural gas based generation, distributed generation, and large wind and renewable projects, which would make very different use of the existing network and require substantial new transmission to reliably serve customers (also known as "load"). This new mix of generation and transmission will present different security risks as well, which the industry analyzes and accounts for in the planning process.

The nation's electric distribution systems have always been, and are today, regulated by state and local governments. Congress "hard-wired" this deliberate separation of jurisdiction into the Federal Power Act (FPA). APPA believes this division of jurisdictional responsibility is appropriate, given the retail nature of distribution

systems and the vast differences in the configuration, size, and ownership of the approximately 3,000 distribution utilities in the U.S., approximately 1,900 of which impact the bulk electric grid. Each individual utility's role in the security of its distribution facilities is unique, due to these substantial differences.

Electric utilities intimately understand the importance of physical security and have longstanding programs and protocols designed to protect their utility systems. As the nature of physical threats has changed over the years (in response to the rising number of incidents of copper theft, for example), electric utilities have planned, prepared, and responded accordingly. Today, due to the increased threat of security breaches such as malicious vandalism and potential terrorist attacks that can cause damage to this infrastructure, utilities must develop the best available mitigation practices to address such attacks.

Simple risk mitigation techniques like cameras and locks help utilities deal with routine problems. The key to electric utility physical-security, however, is its "defense-in-depth" approach that incorporates resiliency, redundancy, and the ability to recover, should an extraordinary event occur. While our systems are built to withstand attacks, successful attacks may still occur even with such planning. We use modeling to assess criticality and to build redundancies into the system to support our most critical assets. By modeling, we can determine how a specific event would require power to be re-routed, which equipment would need to be taken off-or brought on-line, and in extreme conditions, the amount and location of customer load (demand) that must be shed to keep the interstate grid as a whole online and prevent any potential damage to utility equipment that might lead to extended outages.

With these plans in place, we can also determine the criticality of individual assets on our systems. While determining what is critical is complicated, numerous models that incorporate both government and industry priorities help to narrow the focus to a manageable group of assets that need to be treated as priorities. Since there are over 45,000 substations in the United States, this focused planning is very important. Once identified, utilities make the necessary investments to secure these assets and put in place the necessary redundancies to ensure a quick recovery, should they go down. As our adversaries evolve, so do the risks we face. Certainly, there is no single solution that can make the grid completely safe and secure. But by focusing on a series of strategies to mitigate risks (and by understanding that risk elimination is practically impossible), utilities take every reasonable step to avoid operational consequences related to physical damage to their equipment.

In recent months, a few high profile attacks on physical infrastructure have drawn increased scrutiny. One high profile incident took place at the Metcalf substation on Pacific Gas and Electric's (PG&E) system in California. Though I am told that the FBI believes one person is likely responsible for the damage at Metcalf, this incident demonstrated a level of sophistication not previously seen by the communications and energy sectors. As a result, the entire electric sector has responded to this attack to assess its impacts and to share lessons learned. The Department of Energy (DOE) and Department of Homeland Security (DHS), in coordination with the Federal Bureau of Investigation, the Electricity Sector Information Sharing and Analysis Center (ES-ISAC) and industry experts, conducted a series of briefings across the country for utility owners and operators and local law enforcement regarding security of electric substations. These briefings offered an opportunity to grid operators to learn more about the Metcalf attack, was a response to it and other recent acts against the energy sector.

APPA and our electric sector trade association brethren take this incident very seriously. Shooting at substations is, unfortunately, not an uncommon occurrence. But the sophistication of the Metcalf attack and the fact that the perpetrator has still not been apprehended is quite troubling. However, the notion that the Wall Street Journal and other recent media stories have suddenly spurred our industry to action, or have somehow enhanced grid security, is inaccurate. The briefings mentioned above were initiated prior to these recent stories. As discussed previously, the threat of physical attack has been part of our planning for decades. The power stayed on in spite of the Metcalf attack—due to cooperation and coordination with other electric utilities in the region, and redundancy in the system that was planned in advance.

As stated previously, the electric power industry (including nuclear power facilities) is the only critical infrastructure sector with mandatory reliability standards. However, given the evolving nature of threats to both physical and cyber assets, we recognize that standards can only go so far in protecting the actual facilities owned and operated by governmental entities, cooperatives, and private utilities. APPA, therefore, supports physical security initiatives at both the bulk power system and distribution levels and has urged all public power utilities to enact security plans

that address both physical and cyber-security. In light of increasing interest in and attention to physical security by the federal government and Congress, APPA believes this issue should be viewed more comprehensively. On March 7, 2014, under its authority granted in FPA Section 215, the Federal Energy Regulatory Commission (FERC) directed the North American Electric Reliability Corporation (NERC) to submit proposed reliability standards within 90 days that will require utilities with critical assets to take steps, or to demonstrate that they have taken steps, to address physical security risks and vulnerabilities related to the reliable operation of the bulk power system. Again, as contemplated under Section 215, APPA and our members, along with EEI, NRECA, and their members, are offering our expertise to NERC in drafting this important standard.

APPA is grateful for Acting FERC Chairman Cheryl LaFleur's appearance before this Committee today. She and her colleagues at the FERC have a difficult task before them and we applaud their commitment to making the electric grid safer and more reliable. The difficulty in ordering this standard to be crafted was captured by Commissioner John Norris in his concurrence to FERC's March 7, 2014, Order relating to this standard. Noting that measures taken to address physical security need to be reasonable and cost effective, he said:

As I have said previously, I believe that [the Metcalf] incident is a serious one, and significant efforts should be made to determine who was responsible for the incident, and to identify appropriate next steps to prevent such incidents from happening in the future. But, it has been well understood for decades that our nation's grid has been vulnerable to physical attack. We simply cannot erect enough barriers to protect North America's over 400,000 circuit miles of transmission, and 55,000 transmission substations. While some locations may require additional physical barriers, I continue to urge caution against over-reaction. I remain concerned that the recent momentum will result in the electricity sector potentially spending billions of dollars erecting physical barriers to protect our grid infrastructure. I am particularly troubled because most if not all of those costs will be passed through to ratepayers.

APPA, as a trade association of not-for-profit utilities, shares Commissioner Norris' concerns and hopes that NERC's physical security standards will be appropriately drafted to protect truly critical infrastructure and ensure that expenditures in this area are reasonable and needed.

While this will be NERC's first standard on physical security, NERC's Critical Infrastructure Protection Committee (CIPC), has recently produced industry guidance on physical security. Also, FERC has recently approved NERC reliability standard EOP-004-2 (Event Reporting), which requires reporting of physical attacks at bulk electric system facilities. The industry also relies on the NERC Electricity Sector Information and Analysis Center (ES-ISAC) to provide industry alerts of physical attacks on electric facilities.

CYBER-SECURITY

At the top of APPA's priorities, and our members' priorities, is the safety, security, and reliability of the U.S. electric grid. By protecting the facilities they own and operate and by following increasingly robust cyber and physical security protocols, public power utilities play an important role in the safety and reliability of the grid. APPA's commitment to safety and reliability is not unique in the electric sector—cooperatively and investor-owned electric utilities all share this commitment. That is why our industry collaborated on the mandatory reliability regime spelled out in the Energy Policy Act of 2005 (EPA05), and now incorporated in Section 215 of the Federal Power Act, as mentioned above. The electric sector participates, in partnership with Congress, FERC, and NERC, in an ongoing effort to establish and enforce comprehensive standards to strengthen the grid, including those that enhance cybersecurity. APPA believes the best way to support these ongoing efforts and to enhance security across critical infrastructure sectors is by improving information sharing between the federal government and such sectors, and vice versa.

As the grid evolves, unfortunately, so do threats to its integrity. Thus, APPA recognizes that new—but narrowly crafted and limited—authority may be necessary to fully address emergency threats. The threat of cyber attack is relatively new compared to long-known physical threats, but an attack with operational consequences could occur and cause disruptions in the flow of power if malicious actors are able to hack into the data and control systems used to operate our electric generation and transmission infrastructure. While APPA believes that the industry itself, with NERC, has made great strides in addressing cyber-security threats, vulnerabilities,

and potential emergencies, we recognize that any true national emergency will warrant involvement from many federal entities.

To date, the electric utility sector's FPA Section 215 processes coupled with our actions beyond this Section 215 regime have prevented a successful cyber attack causing operational consequences on the bulk electric system. However, the years since full implementation of Section 215 began in 2007 have been marked by jurisdictional debates within the Executive Branch agencies and between the Executive Branch and Congress regarding the appropriate response to the cyber threat regime faced by all critical infrastructure sectors, with some questioning the NERC/FERC standards and calling for more regulation and others focused on enhanced information sharing.

This regulatory partnership between the federal government and the electric sector has proven to be one marked by continuous ongoing improvements in communication, technology, and preparedness as the standards have evolved since 2007. APPA and its members, as well as other utilities, also continue to work on the NERC Critical Infrastructure Protection (CIP) standards on cyber-security. As cyber attacks are ever-changing, so must be the nature of our defenses. As such, CIP Version 3 is in effect and enforceable. Version 5 has been approved by FERC, and is proposed to be enforceable by April 1, 2016. We will continue to enhance these mandatory standards and the independent actions we take to protect our critical cyber assets.

A NOTE ON LIABILITY PROTECTION

There has been discussion in this and other committees relating to providing limited liability protection as an incentive for participation in national cyber-security frameworks. Utilities certainly need no incentive to secure their systems and protect their customers. However, a federal limit on potential legal repercussions to utilities when they are assisting their government partners with national security or for following federal requirements are certainly worth further discussion. Regulatory and legislative proposals from the Obama Administration and Congress focus largely on the steps electric utilities can take to protect and secure their facilities, ensure reliability, and maintain security of customer data. At the same time, it is important to establish guidelines to ensure that unwarranted and counterproductive lawsuits are avoided when utilities are actively engaged in cyber-security and compliance with federal guidelines or regulations. APPA is concerned that electric utilities may not be sufficiently protected from negligence claims alleging they failed to protect against such attacks even when they have taken reasonable precautions.

Some states are considering legislation to address liability related to cyber attacks, but no state or federal statutes currently exist to specifically protect electric utilities, including public power entities, from lawsuits in response to a cyber incident. This leaves APPA's members, which are units of state and local government operating on a not-for-profit basis, vulnerable to time-consuming and expensive litigation even when they are undertaking activities to protect their systems.

Utilities already treat their customers' safety and security as priorities. As the owners and operators of the nation's electric grid, however, we have a unique responsibility to come together in support of national security. Combining and sharing threat information among ourselves and with the federal government will make the nation safer. Utilities should be able share and receive any relevant threat information without fear of retribution in the courts or regulatory proceedings. Limited liability protection would allow utilities facing cyber attacks to share threat information with relevant state and federal law enforcement agencies and, possibly, with other utilities and would result in increased grid security. Failure to provide these protections to our sector could have a chilling effect on information sharing.

Though the White House considers liability protection to be a priority, the Executive Order on Cybersecurity, issued by President Obama in February 2013, and the corresponding Cybersecurity Framework issued by the National Institute of Standards and Technology (NIST) in February 2014, do not include liability protections for cyber attacks. This and previous Congresses have considered legislation focusing on cyber-security proposals which have included provisions that would grant liability protections to critical infrastructure owners and operators affected by cyber incidents, but no such protections have been enacted into law. Therefore, APPA and the associations support legislation that would protect utilities from liability for cyber incidents, when the utilities have taken appropriate, reasonable steps to shield against such attacks.

THE GRID SECURITY PARTNERSHIP

Partnership, coordination, and sharing of relevant threat information are crucial to grid security. At the national level, as mentioned above, the ESCC, a public/private partnership between the utility sector and the federal government, plays an essential role in coordination and information sharing. Each of the 16 critical infrastructure sections identified in Homeland Security Presidential Directive 7, which outlines national policy for federal departments and agencies to identify and prioritize critical infrastructure and to protect them from terrorist attacks, has its own sector coordinating council. Electric utilities are one of only two sectors regulated by a mandatory compliance framework (see above). In October, 2010, the White House's National Infrastructure Advisory Council (NIAC) recommended an "executive-level dialogue with electric and nuclear sector CEOs on the respective roles and responsibilities of the private sector in addressing high-impact infrastructure risks and potential threats" This recommendation led to the creation by the electric utility sector of the Joint Electric Executive Committee, which then transitioned into its current role as a revised and expanded ESCC.

The ESCC includes representatives from electric trade associations, including APPA, EEI, NRECA, the Canadian Electricity Association, the Electric Power Supply Association, the Nuclear Energy Institute, the RTO/ISO Council, NERC, and the NIAC, as well as CEOs of public power utilities, investor-owned utilities, rural electric cooperatives, the Tennessee Valley Authority, and the federal Power Marketing Administrations. As part of the "executive level dialogue" initiated by the 2010 NIAC recommendation, ESCC members engage in regular coordination and discussion with federal officials from the White House, relevant cabinet-level agencies, federal law enforcement, and national security organizations. This dialogue is currently focused on three areas: Tools & Technology (deploying proprietary government technologies on utility systems that enable machine-to-machine information sharing and improved situational awareness of threats to the grid); Information Flow (making sure actionable intelligence and threat indicators are communicated between the government and industry in a time-sensitive manner); and Incident Response (planning and exercise coordinated responses to an attack).

To support the ESCC's mission, a Senior Executive Working Group (SEWG) of utility Chief Operating Officers and Chief Information Officers, utility trade association executives, and other senior executives who have relevant experience in the electric power sector has been established. The SEWG meets by phone on a monthly basis and creates ad hoc "sub-teams" to accomplish goals identified by the CEOs and Cabinet Deputy Secretaries participating in the ESCC. In parallel to this effort, the government has organized around these same goals with a commitment to align government and industry efforts. The ESCC has also helped to enhance industry-government partnerships between electric utilities and law enforcement agencies at the federal, state, and local levels.

Protecting critical infrastructure is a shared responsibility between industry and government. While the government has a law enforcement responsibility and a national security mandate, utility owners and operators own the assets, pay for (via their customers) protection of the assets, and have the operational expertise to keep the lights on. Our industry continuously invests in security measures that protect the grid against evolving threats and to make it more resilient and robust, based, in part, on regular ESCC and ES-ISAC updates on evolving national security threats. We look at all hazards and threats, be they cyber, physical, or natural disasters when protecting our systems. Most recently, a two-day exercise (GridEx II) was held to help drill and prepare for extraordinary scenarios. More than 200 industry and government organizations participated in the grid-wide, international event. There was also an executive tabletop exercise that brought together senior Administration officials and senior utility executives to address the roles and responsibilities of both government and industry in the event of a major power disruption due to national security threats.

In conclusion, APPA, on behalf of the entire electric utility industry, would like to reaffirm the industry's ongoing commitment to protect critical electric utility infrastructure from both cyber and physical threats. To do this, we need to work in partnership with all levels of government, from local law enforcement to Cabinet level executive departments. Information sharing with the assurance of confidentiality, provision of tools and technologies to assist electric utilities in better protecting their assets, and liability protection for utilities that take reasonable measures to protect their systems are all important elements of such a partnership. Thank you for the opportunity to appear before you today to address these issues.

The CHAIRMAN. Thank you, Ms. Kelly.

Chairman Honorable.

STATEMENT OF COLETTE D. HONORABLE, PRESIDENT, NATIONAL ASSOCIATION OF REGULATORY UTILITY COMMISSIONERS (NARUC), CHAIRMAN, ARKANSAS PUBLIC SERVICE COMMISSION

Ms. HONORABLE. Thank you.

Good morning, Chair Landrieu, Ranking Member Murkowski and members of the committee. My name is Colette Honorable. I'm President of the National Association of Regulatory Utility Commissioners and Chairman of the Arkansas Public Service Committee or Commission.

Thank you for the opportunity to testify about the security of our Nation's electricity grid. There are 3 main thoughts I wish to share with you this morning.

First, State utility regulators share your concern about the resilience of our grid. For us it is job No. 1.

Second, the resilience our rate payers expect includes not only security from physical and cyber attacks, but also the ability to bounce back from severe storms and accommodate the impacts of market and regulatory changes.

Finally, NARUC and the States have already taken several important steps toward a more resilient grid. We welcome this conversation about what more can be done.

The seriousness of the Metcalf incident must not be discounted. However, physical threats are but one of the many challenges utilities face each day. These vulnerabilities can take the shape of a sophisticated Metcalf style attack or a massive storm such as Hurricane Sandy. In Arkansas we've experienced consecutive 100-year ice storms along with vandalism on our electricity infrastructure.

Last August a lone assailant allegedly attempted several physical attacks on the electricity infrastructure in Central Arkansas. The suspect was apprehended in October. After admitting responsibility was indicted on several Federal criminal violations. The joint terrorism task force and local law enforcement responded swiftly, engaged with the respective utilities and met with me and my staff during their investigation. This is a shining example of Federal, State and utility cooperation.

Economic regulators view these challenges through the broad lens of resilience. With severe weather seemingly more frequent, concerns growing over cyber and physical security, along with the general day to day operation of the transmission system, providing reliable service may not be enough anymore.

So what are we doing to improve resilience?

The utilities own and operate the infrastructure. They know or should know their systems better than anyone. Therefore, our utilities are ultimately responsible for safety and security.

But as their regulators we acknowledge that it is our responsibility as well. The public has, for the most part, faith that their utility system works. But this faith can be shaken following a prolonged outage or devastating pipeline accident. As citizens we are thankful for Federal, State and local law enforcement and intelligence officials, who are focused on criminal accountability and na-

tional security. As regulators our duty is to ensure reliable service in the face of all threats, no matter the source.

The good news is that despite these vulnerabilities our systems are indeed resilient. The entities that own and operate them are skilled at restoration when something goes wrong. Although customers will, at times, become disgruntled when the lights go out, the industry does an excellent job of overall of restoring service.

Utilities spend billions of ratepayer dollars to train, educate and drill employees and maintain physical infrastructure so that the lights are restored as quickly and safely as possible. It is here that the role of the States is paramount.

We are responsible for setting the rates for the Nation's investor owned utilities and the regulations that govern them. We determine who pays, how much and for what they are paying. State commissioners take this role very seriously as it is solely our responsibility.

My colleagues and I must weigh the cost of every proposed improvement to those systems under our jurisdiction against the risks and benefits of how these investments will impact consumers, the people that we serve. In the end we would like to all have the safest, most reliable system possible. That is everyone's goal.

At the NARUC level we are doing a tremendous amount of outreach and education through workshops, seminars, trainings, participation in the ESCC and more. We are incorporating the multitude of challenges the industry faces. We are also preparing for new Federal emissions reductions rules that will have different impacts throughout the country.

While many States have taken great efforts to reduce carbon emissions well in advance of any Federal environmental regulation, some of my colleagues have concerns regarding local reliability issues due to the retirement of coal fired generation in their States. State commissions seek investments that deliver the best system improvements in rate payer value. Whether these investments address physical or cyber security, they must prudently meet the prevailing expectations of reliability and affordability for the rate payer.

This requires appropriate dialog and discussion in an open and transparent way. We rely upon the utilities to know where vulnerabilities may be. We expect industry to communicate with us so that we can best determine how to move forward.

In conclusion, as we've seen across this country States are pursuing innovative approaches to ensuring grid resilience. While NARUC does not endorse any particular program, we can learn a great deal from those who are pushing ahead. Typically the general public doesn't think about utility resilience unless it is after a hurricane or another disaster that knocks out power to millions.

But we hope that through these types of discussions and improved coordination we can all become better prepared. NARUC and the States are committed to it.

Thank you for the opportunity to address you this morning.
[The prepared statement of Ms. Honorable follows:]

PREPARED STATEMENT OF COLETTE D. HONORABLE, PRESIDENT, NATIONAL ASSOCIATION OF REGULATORY UTILITY COMMISSIONERS (NARUC), CHAIRMAN, ARKANSAS PUBLIC SERVICE COMMISSION

Good morning Chair Landrieu, Ranking Member Murkowski, and members of the Committee. My name is Colette D. Honorable and I am President of the National Association of Regulatory Utility Commissioners. I also serve as Chairman of the Arkansas Public Service Commission, and will be appearing before you in both capacities today.

Thank you for the opportunity to testify about the security of our nation's electricity grid. For the nation's economic utility regulators, ensuring the safe, reliable, and affordable delivery of utility services is Job No. 1. This has been our responsibility for the last century and a quarter, and will continue to be so now and into the future.

NARUC is a quasi-governmental, non-profit organization founded in 1889. Our membership includes the public utility commissions serving all States and territories. NARUC's mission is to serve the public interest by improving the quality and effectiveness of public utility regulation. Our members regulate the retail rates and services of electric, gas, water, and telephone utilities. We are obligated under the laws of our respective States to assure the establishment and maintenance of such utility services as may be required by the public convenience and necessity and to assure that such services are provided under rates and subject to terms and conditions of service that are just, reasonable, and non-discriminatory.

I have three main thoughts I would like to share with you today. First, State utility regulators share your concern about the resilience of our electric system—for us it is “job number one” every day. Second, the resilience that our ratepayers expect includes not only security from physical and cyber attacks but also the ability to bounce back from severe storms and to accommodate the impacts of marketplace changes and shifting regulations. Third, NARUC and the States have already taken several specific important steps toward a more resilient grid. We welcome a conversation about what more can be done.

Today's hearing on Grid Security is timely, and not simply because of the recent press reports on the potential physical threats to our electricity infrastructure. The seriousness of the Metcalf incident is not being discounted; the details of that event are alarming and serve as a lesson about the damage dedicated bad actors can do to our infrastructure. But physical threats are one of the several vulnerabilities facing our utility infrastructure every day. These vulnerabilities can take the shape of a sophisticated Metcalf-style attack or a massive storm such as Hurricane Sandy, which devastated utility infrastructure in the Mid-Atlantic and blacked out parts of New York and New Jersey for weeks.

In Arkansas, we've experienced a little bit of everything in recent years, from consecutive 100-year ice storms to vandalism on our electricity infrastructure. Our utilities responded admirably in all of these circumstances, as they have across the country. In fact, in August 2013, a lone assailant attempted several physical attacks on our electric infrastructure in Central Arkansas. In three separate incidents, this assailant allegedly downed a 500 kV power line, caused substantial damage to a control house and damaged a 115 kV transmission system. He was apprehended on October 11, 2013 after a fourth attempt. The suspect admitted responsibility for the attacks and was indicted on several federal criminal violations. If convicted, he will face life in prison. Credit must be given to the swift, excellent work of the Joint Terrorism Task Force comprised of the FBI, Department of Homeland Security, the Department of Energy, ATF and local law enforcement. They responded promptly to the incident, engaged with the respective utility companies and met with me and my staff during the investigation and demonstrated the benefits of such a strong collaborative effort.

From an economic regulator perspective, we view all of these vulnerabilities through the broad lens of “resilience.” In these days of seemingly more frequent severe weather, concerns over cyber and physical security, and general day-to-day operation of the transmission system, providing reliable service may not be enough anymore. I am not here to defend or demean the industry, but the lights almost always stay on despite the numerous challenges and vulnerabilities our utilities face each day. And when the power does go out, service is restored as quickly and safely as possible. Clearly, though, the times and threats we face are changing. The utilities own and operate the infrastructure themselves, and although we regulate them, they know, or should know, their infrastructure better than anyone. Therefore our regulated utilities are ultimately responsible for shoring up the safety and security of their systems.

But as their regulators, and as the public officials entrusted with the responsibility of ensuring the safe, reliable, and affordable delivery of utility services, this is our responsibility as well. For the most part, the public has faith that their utility system works as intended, but this faith can be shaken following a prolonged outage due to a damaging storm or in the wake of a devastating pipeline accident that destroys homes and neighborhoods, or worse. As citizens, we are thankful for federal, State and local law enforcement and intelligence officials who are focused on criminal accountability and national security. As regulators, our duty is to ensure reliable utility service in the face of all threats, no matter the source.

The good news is that despite the grid's many potential threats and vulnerabilities, these systems are resilient and the entities that own and operate them are quite skilled at restoration when something does go wrong. As we contemplate the critical issue of securing our nation's electric system, a key component of a resilient system is the ability to restore service. Though at times customers will become disgruntled or angry when the lights are out for an extended period of time—the owners, operators and utilities (be they investor owned, cooperatives or municipals) do an excellent job overall of restoring service following a disruption. This industry spends billions of ratepayer dollars per year to train, educate and drill its employees and maintain physical infrastructure so that the lights come back on after an incident as quickly and safely as possible. It is here that the role of the States is paramount.

State regulators are responsible for setting the rates for the nation's investor-owned distribution systems and the regulations that govern them. In vertically integrated systems, this jurisdiction encompasses generation as well as intrastate transmission. In essence, the State commissions determine who pays, how much they pay, and for what they are paying. This responsibility is all the more important in times of economic downturn, where in some cases people must decide whether to pay an electric bill or buy medicine. State commissioners take this responsibility seriously as it is solely our responsibility and not within federal jurisdiction. My colleagues and I must weigh the cost of every proposed improvement to those systems under our jurisdiction against the risks and benefits of how these investments will impact consumers. There are always a wide range of options available and we must make sure we do all we can to maximize ratepayer benefits. In the end, we all would like to have the safest most reliable system possible, and that is everyone's goal. However, we all must remember that at the end of the day, it is the consumer who will be paying for every decision that is made.

NARUC EFFORTS

At the NARUC level, we are taking a direct focus on infrastructure resilience. In fact, during my tenure as NARUC President, resilience and reliability issues are among my top priorities. Our staff is working around the clock on resilience and security issues. Through our Committee on Critical Infrastructure, we are doing a tremendous amount of outreach and education through workshops, seminars, trainings, and much more. On the cybersecurity front, NARUC has launched a multi-state tour, running training and educational seminars at our member offices throughout the country. This training is the foundation of the information sharing called for in Executive Order 13636, and relies on the partnerships that NARUC maintains locally and federally, with industry and our various government counterparts. In fact, by this summer, NARUC will have initiated cybersecurity technical assistance with 35 of our members. The only limitation in our ability to continue this training is resources. We are grateful for the support of the U.S. Department of Energy to allow us to come as far as we have. We are ready and look forward to continuing this important work.

We are now expanding our focus on the broader topic of resilience and incorporating the multitude of challenges our infrastructure faces, from cyber and physical security to natural and manmade disasters. We recognize the complexity of resilience and therefore have adopted an innovative approach, bridging scientific and policy expertise to tackle the challenges in front of us. This is evident in NARUC's participation with the National Research Council's Resilient America Roundtable, which will help decisionmakers use risk analysis to guide investments in resilience. NARUC is also working with the National Academy of Sciences to identify and share best practices for operations and technological and management practices for resilience. Our innovative approach also includes preparing for new federal emissions-reductions rules that will have different impacts throughout the country. When we shift from one dominant generation resource to another, we also trade for a new set benefits and challenges. For example, while many States have taken leadership efforts to reduce carbon emissions well in advance of any federal environ-

mental regulation, some of my colleagues have concerns of localized reliability issues due to the retirement of coal-fired generation assets in their States. There is no silver bullet and, because of this, State regulators are well prepared to manage the shift in a way that manages risks and optimizes benefits. It is my humble but strongly held belief that this balance—this management of risk—could not be achieved by market forces alone. Regulators ensure this balance is struck in the face of an ever-evolving resource mix.

We are getting up to speed on all these developments—and quickly—because utilities are coming to us with requests to harden their system while making it cleaner and more efficient. NARUC has published two papers on resilience since November 2013 (“Resilience in Regulated Utilities” http://www.naruc.org/Grants/Documents/Resilience%20in%20Regulated%20Utilities%20ONLINE%2011_12.pdf, and “Resilience for Black Sky Days” http://www.naruc.org/grants/Documents/Resilience_for_Black_Sky_Days_Stockton_Sonecon_FINAL_ONLINE_Feb5.pdf), sharpening our focus as we prepare to act on these investments. State commissions seek investments that deliver the best system improvements and ratepayer value. To do so, a risk-based approach is preferred. As utilities seek cost-recovery for resilience investments, we need them to prioritize what aspects of their systems are the most vulnerable so we can put ratepayer money where it is most needed first. Whether these investments address physical or cyber security, they must prudently meet the prevailing expectations of reliability and affordability for the ratepayer.

The NARUC papers are conversation starters; we are engaging with our members and other key stakeholders, including utility organizations, the federal government, companies, and consumer advocates, to broaden and inform the dialogue. NARUC staff is planning on holding workshops for commissioners and commission staff around the country to address these issues. The kinds of questions we will be asking are: Do we need new tools to evaluate risks? What kinds of contingency plans may be necessary to prepare for a 1-in-a-100-year storm that may never come, or occur frequently for some States?

Importantly, this requires appropriate dialogue and discussion in an open and transparent way. As always, we rely upon the utilities which own and operate the systems to know where any vulnerabilities may be; they need to communicate with us so we can determine how best to move forward. To that end, we look to the North American Electric Reliability Corporation to develop standards for 100 kV lines and above. The NERC process has worked well thus far. We look forward to working with them to implement a risk-based approach to resilience across and between the transmission and distribution systems.

CONCLUSION

As we’ve seen across the country, States are pursuing innovative approaches to ensuring grid resilience. Some States deal with hurricanes and tornados more frequently than others; we hope to learn from our colleagues in States that are already pursuing resilience programs. While NARUC does not endorse any particular approach, we can learn a great deal from the States who are pushing ahead with new and innovative policies. We applaud their efforts.

Typically the general public doesn’t think of resilience until after a hurricane or other natural or manmade disaster knocks out power to millions. We hope that, through these discussions, we can all be better prepared.

Thank you and I’d be happy to answer any questions at the appropriate time.

The CHAIRMAN. Thank you all very much.

Thank you for bidding by your time because we do have a very important subject to try to cover. Unfortunately we’re going to have votes at 10:30. We’re going to try to keep the hearing moving though because I’ll vote first, Senator Murkowski, second. We’ll keep the hearing going.

Before we start I’d like to call the attention of the members to a document that the staff provided, particularly to page three, to really understand the interconnectivity of this grid. It says here that there are actually three, independent regional grids: the Western Grid, The Eastern Grid and then Texas has its own grid. But Hawaii is not on here, neither is Puerto Rico or Alaska.

[Laughter.]

The CHAIRMAN. But the reason I call it to your attention is that all of us are very supportive, really on both sides of the aisle about the importance of State authorities, and it's really impossible to keep this grid up without regional and national cooperation. This document clearly shows the interconnectivity in the United States as well as into Canada.

So it really does take a combination, as all of you have mentioned of Federal, regional and State as well as private entities. So it really is a quite complex and important subject.

Let me start my first question to you, Ms. LaFleur.

What are you doing, specifically, to respond to Mr. Friedman, the Inspector General's management alert yesterday? I'm going to submit this to the record.

The alert said in part that "the Department subject matter experts have confirmed that at least one electric grid related presentation created by the Commission staff should have been classified and protected from release at the time it was created. This document and others, on the essence of its content, may in whole or part have been provided to both Federal and industry officials in an unclassified setting. That was not appropriate.

The methods used in creating and distributing this document led us to the pulmonary conclusion that the Commission may not possess adequate controls for identifying and handling classified, national security information." There are 4 specific recommendations in this management letter that I know you're familiar with. Could you just comment about what you're doing, again, to implement these and what additional steps that you may be taking as the Acting Chair to make sure that this doesn't happen again?

Ms. LAFLEUR. Thank you for that question, Madame Chairman.

We are meticulously following, first of all, the instructions of the Inspector General's management alert which means we met with him privately to understand the documents he was speaking of, gathering any paper copies we can find and putting them in our secure information facility, wiping and scrubbing all data bases, computers and any portable devices across the Commission to make sure that the documents in question, that potentially should have been classified, are protected. It instructs us to reach out to the DOE on the classification level going forward. It includes reaching out to former employees, including our former Chairman and trying to get our arms around any information that may be out there. That's part of the instructions.

The CHAIRMAN. Can I ask you this?

Does FERC have a high level person that's responsible for trying to help your legal department sort what's classified and unclassified?

Have you all stood up any additional resources in that sphere in the last few years?

Ms. LAFLEUR. Yes, we have a—our chief security officer has our classification authority. He has delegated or derivative classification authority under the delegation from the DOE and our general counsel has been very involved in this also.

Since it happened we've taken a number of steps internally. We sent out an immediate reminder to all employees of the regulations that govern information security. I've ordered a full, immediately,

ordered a full internal review, kind of a chain of custody of all the documents, when they were created. We're giving that to Mr. Friedman's people.

Ultimately what we need to do is develop a crisp and clear internal process so we understand what information we're creating and have a process where the right professionals get a chance to weigh in on what level of classification it should have.

The CHAIRMAN. OK.

Thank you.

Mr. Cauley, let me ask you this. I understand that you testified and I generally agree that the private sector is doing a very fine job, under difficult circumstances. There are, as Ms. Kelly said, a lot of different views, different sizes of companies, different nature of entities that are involved in providing this critical infrastructure for our country.

But when you said that you thought that the industry was doing all that it could I understand in the Metcalf incident that there were no cameras facing to the outside perimeter, only to the inside perimeter. Can you comment about that? When and what actions has the industry taken since to maybe face the cameras in a different direction to see who might be in the area that shouldn't be?

Mr. CAULEY. I think the common and best practice prior to Metcalf was primarily focused on keeping, not only bad actors, but children, just for public safety, keeping people out of the substations. We have a very experienced driven, lessons learned driven industry. So I think they were focused on what they thought was the threat. I think that's the value of Metcalf in looking at it in hind sight is there's opportunities to improve that.

So my understanding, without disclosing too much, is that there has been a change in perspective of both how the cameras and lighting and motion detection and other devices that would help protect it further. Not just at PG&E, but around the industry.

The CHAIRMAN. OK, thank you.

One final question and each of you just hit this very quickly. I'm going to turn it over to Senator Murkowski.

I generally am very strongly supportive of public/private partnerships. I find them, in many areas, and of course we all do, to be very effective and unique in some ways in the United States. They don't operate that way in other parts of the world. I think that that is generally what our constituents believe is a very effective way to handle some government responsibilities is to do it with the public and private sectors.

So NERC and FERC, kind of, represent the best of that with FERC being the Federal Regulatory Commission and NERC being the private sector.

How would each of you all, starting with you, Ms. LaFleur, say how this is working and give one example of some improvement that you could think of.

Ms. LAFLEUR. Really in the grand scheme we've only been at this, as between FERC and NERC, for close to 8 years. I think it's working quite well. We have a somewhat unique hybrid system where the old voluntary system of NERC guidelines had superimposed on it this compliance system with \$1 million -a-day penalty. That's kind of an odd marriage.

So there were naturally some tensions in the beginning. But I think what's really helped is the work we've done together to set a set of priorities because of the hybrid system. We have to have the same reliability priorities even though we might disagree at times about exactly what should get you there.

That I think the communication at the top between the two agencies is what has led and Gerry has led a culture at NERC of learning and setting priorities from what happened. I think that priority setting is the biggest step that we've taken to make the standards better which is what keeps reliability going.

The CHAIRMAN. Mr. Cauley.

Mr. CAULEY. I think the model is working really well. It's almost necessary because it's such a complex electric grid. It's interconnected internationally with Canada and Mexico that we're able to bring the expertise of the industry together.

We're able to work out the standards in a way that have no unintended, adverse consequences and get the buy in for the industry. Yet we have the oversight and direction and guidance from FERC. They've exercised that a number of times. They've pushed back on some standards. They've directed us to do a standard to protect against solar magnetic disturbances.

So I think we have the best of the public interest being represented and government oversight with the expertise and full understanding of how the grid works from industry.

The CHAIRMAN. Ms. Kelly.

Ms. KELLY. I would generally concur in what Chairman LaFleur and Gerry have said.

I would add that I think we're, kind of, moving past our pimply adolescence and into early adulthood. There have been some bumps along the road.

But one of the things that I would point to as an example of ongoing cooperation is, and you know the phrase in the statute, users, owners and operators of the bulk power system, is pretty broad. In theory anyone who turns on a toaster is one of those people.

So when the scheme was first enacted and implemented we had to figure out who that universe was. We made an initial cut. But we are now going back and NERC is looking, taking a second look and deciding, you know, who truly needs to be in and who can be out.

Going back to your discussion about the number of small co-ops in Louisiana, it may be that some of those entities really do not materially impact the bulk power system. Therefore could be exempted from the scheme without adverse impact to the system. So I think we're taking a closer look at that. I think I'd welcome that because frankly that frees up resources to concentrate on the entities and the facilities that truly do impact it.

I think that's a perfect example of how, as we're moving forward, we're refining the regime and improving it.

The CHAIRMAN. So a tighter, risk based analysis?

Ms. KELLY. Absolutely.

The CHAIRMAN. Would be welcome.

Ms. KELLY. Correct.

The CHAIRMAN. Alright.

Chairman Honorable.

Ms. HONORABLE. Thank you, Madame Chair.

I concur with the comments of both the Chairman and of Mr. Cauley and Ms. Kelly. NARUC, in fact, supported this legislation that created the FERC and NERC partnership. Certainly in the real world sense once these standards are implemented retail investor owned utilities come to their respective State commissions for cost recovery to integrate and implement the standards. Certainly even in Arkansas we've approved cyber standards investments even in the last year.

So we expect the utilities to heed these standards. We also plan to stand ready to be responsive when those requests come our way.

The CHAIRMAN. Senator Murkowski.

Senator MURKOWSKI. Thank you, Madame Chairman.

Thank you, Chairman LaFleur, for your responses to the Chairman's question here in terms of those steps that you are taking at FERC to implement or act on the IG's recommendations. I think that's going to be critically important moving forward.

I was going to ask you what you might be doing to strengthen the culture within FERC that supports the work of the professionals. You know, I hear you say that a notice to the employees has gone out reminding them of certain aspects, certainly of the confidentiality. But that may be an area that you need to look to more critically.

I'm not going to suggest how you might be doing your job here. But I do think that that is going to be an important aspect.

I want, in this vein, I want to just make clear that you understand what you will be receiving from me. As the Chairman of FERC you're effectively the Chief Executive to whom the agency staff reports. I'm going to be asking the agency some more extensive questions about the handling of documents and supporting materials such as those that are referred to in the IG's management alert.

I'm also going to have some written questions outside the hearing about the inception of this study itself and its uses.

So I have directed my staff to prepare some interrogatories for the agency. I'm not going to be seeking sensitive information about the findings of the study or the merits of the so-called modeling upon which it's based. But I will have questions about the manner in which the study was conceived and documents and the information concerning it were handled, how they were intended to be used and were, in fact, used.

So I have asked my staff to contact your general counsel today to begin discussing how I can get answers to these questions without drawing further attention to the substance of what we recognize to be the sensitive information itself.

I will be turning over the answers I receive to the IG for his complete report. But what I'm asking of you today is to have your cooperation and the cooperation, the full cooperation of the agencies, its leaders in the senior executive service and other very dedicated Federal employees, who support them, in getting full and complete and of course, prompt responses to my questions.

Ms. LAFLEUR. You will absolutely have our cooperation. Hopefully a lot of them might be the same questions we've been asking ourselves.

I agree with you about your comments on culture.

First of all, I think in many ways, FERC has a very strong culture. In all the decades I've been dealing with FERC I've never known a merger rumor to leak or all the confidential information that FERC deals with day to day which is not to say that we absolutely need to learn the lessons of what happens here. But I think we deal in confidential information in our dockets all the time.

But I've given this a lot of thought. I think culture starts at the top. When I ran an operating company the CEO and everyone had to take a lot of safety tours because I put in place a rule that anyone, even a brand new trainee, could stop a job if they saw any electrical safety incident of any magnitude because that's how you convey that safety is important.

I think here the culture of respect for confidentiality has to start at the top as well. We need to make sure that everyone knows they can ask questions. Before information is created and as that process goes along, to make sure that we're doing it with care and with an intention to asking the right professionals to weigh in on classification or how it's treated, how it's filed or anything else.

I'll take accountability for that because I think it has to start at the top and go all the way through the organization.

Senator MURKOWSKI. I appreciate that.

Chairman Honorable, I don't know why both of us seem to be having difficulty with your name and title here this morning.

You spoke a lot about the reliance of the grid, the resiliency of the grid. I think we acknowledge and accept that there are risks that present themselves when it comes to reliance. You mentioned outages that are caused by hurricanes or major storms. I think people can, kind of, relate to that but as we are seeing more assets, energy assets, retiring there's, kind of, a quiet consensus out there that the risk of a localized reliability event or effect is growing.

I guess the question to you is how acceptable a risk is this if the impact to the reliability is caused by Federal policy? When I say Federal policy, the push within this Administration to move coal out, the fact that we're seeing so many coal facilities going offline. During the Polar Vortex this winter we saw that, I think, it was 89 percent of the coal electricity capacity that is due to go offline was utilized as that backup to meet the demand this winter.

So I think folks are prepared to accept a level of risk. You have an outage when you have a really bad storm. But to what extent do you think that they accept the risk if that is brought about by Federal policy?

Ms. HONORABLE. Thank you for the question, Senator Murkowski.

This is really a great example of the many challenges that economic regulators face across the country in ensuring reliability. This is—so your question is how acceptable is it?

For the economic regulator it is not acceptable.

Senator MURKOWSKI. Right.

Ms. HONORABLE. We have, for that reason, been very engaged with the EPA, with the personnel, even with Administrator McCarthy, about this very important topic of reliability. We are charged with ensuring reliability. It's our main core focus in addition to ensuring safety and affordable utility service.

The utilities on the front line must ensure reliability. When there's a disruption to the grid or an outage for any reason the utilities on the front line to make sure that the lights come back on, that the generation is moving, no matter the source.

We, at NARUC, certainly don't pick winners and losers. We embrace an all of the above energy approach. Senator, I know that you do too. I've heard you say that very thing.

We believe that coal is a low cost option and that it should be a part of our energy mix. We, therefore, are working with the EPA to ensure that they hear us. At our November NARUC meeting we issued a resolution regarding the 111D rulemaking process to urge the EPA to ensure that the States have flexibility, that the Federal Government respects the role of the States, that the EPA also honors this notion of diversity. We embrace that as economic regulators.

The fuel mix in one State is very different from another. States such as Kentucky or West Virginia or Indiana very heavily rely upon coal. So any rulemakings that impact a State's generation mix will clearly be of importance to those States, but also to all of us as economic regulators.

So I appreciate the question. I want all of the members of the committee to know that we are working every day, literally, on this issue. We are a constant voice in helping all of the stakeholders around this issue continue to remember the importance of reliability. It's job No. 1 for us.

Senator MURKOWSKI. Tough one.

Thank you, Madame Chair.

The CHAIRMAN. Thank you very much.

Senator Franken.

Thank you so much for your leadership and interest on this subject.

Senator FRANKEN. Thank you, Madame Chair.

Thank you all for your testimony. I agree Chairman Honorable about the flexibility.

The CHAIRMAN. Excuse me a minute.

I'm going to go vote and leave Senator Cantwell in charge of the committee and I'll be back.

Senator FRANKEN. Sure.

The CHAIRMAN. Please continue.

Senator FRANKEN. OK.

I agree that we need State flexibility in addressing those kinds of issues especially on the new rules that EPA will make on the existing coal fired plants.

We're talking about grid security. It's a serious issue. The attack on the Metcalf power substation in California is one that could have happened anywhere at any number of substations across our country.

As chairman of the Energy subcommittee, I want to make sure that we're doing everything we can to secure our electric grid. That's why I sent a letter, along with Senators Wyden and Reid and Feinstein to our regulators advocating for stronger security measures. I'm pleased that an order has been issued to strengthen grid security. Thank you for that.

As we take steps to secure the grid, I think it's really important that we engage the law enforcement community both at the Federal level and at the State and local level. They are critical partners in the effort to secure the grid.

Chairman LaFleur, Mr. Cauley, can you explain what you're doing to ensure that law enforcement agencies and officials are fully integrated into the efforts to secure our power grid?

Ms. LAFLEUR. Thank you for that question, Senator.

I'll mention two things.

The order that FERC issued on March 7 on requiring physical security standards, one of the things it requires is that after the critical facilities list is done each asset owner identifies specific threats and vulnerabilities of each facility. It contemplates that they will involve government agencies such as law enforcement in assessing the threat and vulnerability of a particular facility because who knows better than the police, the location, the geography and so forth.

In addition FERC and other agencies, DHS and FBI, have done a 13 city tour around the U.S. and Canada to explain the lessons of Metcalf and local law enforcement is one of the main attendees, as I understand it, at these meetings because, obviously as you said, it could happen in any community.

Mr. CAULEY. Thank you for the question, Senator.

I actually personally believe that the most important and most effective security measure we can take is the relationship between the utility company and law enforcement. We recognize that years ago which is why I mentioned we have a standard already. We've had it for many years that requires if there's any issues of incidents related to physical or cyber security that they must get reported to the local law enforcement.

We require companies to have pre-established contacts with their local law enforcement because I just think having that presence and their response capability is very important.

We also participated in the outreach. I went to one of those myself. A third of the room was law enforcement, you know, in addition to first responders and power companies.

I think going forward we need to emphasize that further. I envision facilitating one on ones with utility companies and the local law enforcement and first responders to not only make sure in general they understand our critical infrastructure, but specific stations which are most important, what kind of response would be expected.

Senator FRANKEN. Thank you.

In that way Metcalf was a wakeup call. We all agree on that.

The reliability of the electric grid is essential to our energy security. We are seeing more extreme weather events and those can have serious affects on the grid. But distributed generation makes a grid more resilient by allowing critical facilities, military bases, hospitals, others to stay online during an outage.

That's why I worked closely, with Senator Murkowski, to introduce an amendment to the Shaheen/Portman bill to support the deployment of combined heat and power district energy and other distributed generation technologies. I know that Senator Murkowski has a lot of constituents in her State in areas that are far away

from the centralized grid. She really understands the importance of the issue.

Ms. LaFleur, what is FERC doing to support deployment of combined heat and power, district energy systems and other energy systems that operate in island mode?

Ms. LAFLEUR. Our responsibility is primarily for the interconnected intrastate grid. We work in partnership with State regulators, who have more responsibility at the distribution level within a State.

What we've primarily done to support the growth of distributed generation is make sure that our market rules in the two-thirds of the citizens that are served by competitive markets that these distributed facilities can compete fairly and get paid for their electricity. We have put out a rule in 2013 on small solar installations. We've done rules on fly wheels and some of the storage applications, demand response which often relies on back up generation in hospitals and so forth and others.

We are trying to make sure that there's fair compensation for them in the wholesale markets that helps those grids thrive.

Senator FRANKEN. Thank you, because I just believe that resiliency of the grid. Again, we saw in super storm Sandy. We saw places where they were operating in island mode that it was a good thing. It was a good thing for data storage and those kinds of emergency.

Ms. LAFLEUR. I can never resist a plug for my alma mater, Princeton, which kept its micro grid up and supported law enforcement, I think, across much of New Jersey in the micro grid in Hurricane Sandy, so.

Senator FRANKEN. Absolutely. That's exactly, exactly what I'm talking about. Thank you for bringing up Princeton.

Senator CANTWELL [presiding]. Thank you.

Senator Risch.

Senator RISCH. Thank you, Madame Chairman, Madame Acting Chairman. Thank you very much.

First of all I want to thank Chairman Landrieu for holding this hearing. The security of the electric grid is critically important to most Americans. As with many, many things, most Americans don't realize how important it is to them. When an incident happens then everybody starts wringing their hands and say, why didn't we do this or do that?

I want to focus on something that is available to electric utilities in the government agencies that a lot of people don't know about. In my State, in Idaho, we have a facility called the Idaho National Laboratory. It is the flagship laboratory for nuclear energy, has been since the 1940s. It is the lead laboratory in America for nuclear energy.

What most people don't realize and the reason it is that is because that's where the first reactor was built and the first electricity was generated and the first light bulbs lit. But what most people don't realize is they have a lot of other missions. One of them is exactly what we're talking about and that is grid security.

Since this is a relatively and I use the word relatively, new area of focus, although electric utilities have been focused on this for

many, many years. It has become so sophisticated that it takes much more than what would be an ordinary effort.

At the laboratory today there are a number of facilities that everyone should be aware of.

No. 1, we have a full, a full scale. I want to repeat that, a full scale test grid that can be used to verify and validate modeling and research which is being done on the grid. That is being done there.

We have a SCADA test bed. This is a joint program with Sandia National Laboratory. It supports industry and government efforts to enhance the cyber security of control systems that are being used throughout the electric industry, not only the electric industry, but also oil and gas industries.

Currently they have a wireless test bed. Indeed we just started improvements on the wireless test bed. We're going to continue to do that.

As we all know there are more and more everyday components that are being connected to the grid that are wireless. So this wireless test bed is extremely important as we move forward with grid security.

Last and this is important, particularly in light of the Metcalf incident that has been talked about here. They are in the early stages of this, but they are working on a project to develop security protections, physical protections and others for substations. So that's going to be extremely critical also.

We're very proud of the work that's done at the Idaho National Laboratory. They've, like I said, they're renowned when it comes to nuclear energy. But there are these new areas that they are developing and grid security is certainly one of the things that they're going to be focusing on.

The reason I wanted to say what I've said about this is I want to make sure that everyone in the industry, everyone in the government agencies knows that these facilities are available because sometimes they have a tendency to fly under the radar. So I want to state that for the record. Thank you for making the time available, Madame Chairman.

Senator CANTWELL. Thank you, Senator Risch.

Following up on that, if I could.

Senator RISCH. Mention that you were there.

Senator CANTWELL. I definitely believe that technology is one of our friends here in this solution. I mean when you look at the spectrum of things that we've tried to do whether it's encouraging cooperation on voluntary standards or requirements, I think, obviously things like rely equipment, synchrophasors, storage capacity, so that you can move around problems.

What do you think, panelists, that we need to do to encourage more of the development of these smart grid technologies that give us the capacity to deal with these outages?

In the context of that framework, is it more tax incentives? Is it more regulation? Is it more cooperation?

Mr. CAULEY. I would first respond by echoing the comments of Senator Risch.

I've actually been to both the Pacific Northwest Lab and the Idaho National Lab and they're very rich resources for the industry. Our industry, ISAC, the Information Sharing Analysis Center

is plugged in to them. We know the SCADA testing and the security capability.

We also use those resources for training purposes and behind the scenes analysis of threats.

The grid is becoming more modernized. We've, particularly in the West, there's the synchrophasors have been deployed widely. At this point I don't know that there's any particular incentive I would point at, but we're working to encourage industry to get better visualization, situation awareness, recovery tools, out of that increased capability and visibility into the grid through smart grid technologies and synchrophasors.

Senator CANTWELL. Anybody else?

Ms. Kelly or Ms. LaFleur.

Ms. KELLY. Yes, I would just like to note that, as I mentioned, tools and technologies is one of the main things that FCC is working on but, you know, the partnership between industry and government to try and improve the tools we have to address these threats.

I would just also note that there is an emergency transformer program that the Electric Power Research Institute is working on with the Department of Homeland Security and ABB to try and develop a more portable transformer that can be brought in more quickly. So we really look forward to these types of technological advances to assist us in dealing with these issues. More R and D money would always be welcome.

Senator CANTWELL. Ms. LaFleur.

Ms. LAFLEUR. I would just add that most regulation consists of carrots and sticks. So here the stick is the reliability standards because phasor measurement units and so forth help people meet their standards because they make the grid more reliable.

But the carrot is rate regulation. In 2005 Congress gave us the section 219 of the Federal Power Act that allows for incentives. We have rules allowing greater rate incentives for advanced technologies to encourage people building transmission to put the latest technology because they can get a little higher return on equity if they put better technology on their line.

We recently adopted a rule, for example, in PJM, allowing them to require phasor measurement units for certain types of lines. So that rate regulation helps support those investments.

Senator CANTWELL. You're talking about new deployment. This is, you know, if we are talking about the issue du jour and apparently we are because right now the 9/11 service in Washington State is down in part of our State. So it is the issue du jour.

So if it is, why not look at ways to further incent, not just on new deployment, but on the resiliency of the grid?

I mean, to me, the security measure is smart grid technology and just figuring out why we don't see a faster deployment. Yes, some of the technology is created, you know, in Washington State. But then again, we've lived and breathed and benefited from an electricity grid with cheap hydropower for a long, long time. So it's more of an ethos for us.

But, so my question is, you know, isn't there a faster way?

But unfortunately, I have to go and vote.

Thank you, Madame Chair.

[Laughter.]

The CHAIRMAN [presiding]. I'd like to hear the answer to that so please continue.

Thank you, Senator Cantwell.

Who would like to answer the Senator's question?

Ms. LAFLEUR. I'm going to take that as a challenge to go back and look at how we do our rate regulation for existing transmission.

But most of it is governed by formula rates. So as people invest in those things, they can recover if it's a prudent investment on their line. The question is whether we need to do something to better incent those.

Some of it is happening through market rules, through rules that encourage storage technology, one of the things Senator Cantwell mentioned. But we'll look at some of our other rules and give a more complete answer for the record.

The CHAIRMAN. Thank you.

Let me follow up on that question. I didn't catch all of it, but I'm putting two and two together about what it might be about.

It's an issue that's come up several times in conversations with the industry, but Federal and State requirements for distributive generation and how that can both positively and sometimes negatively affect the price of electricity, the ability or the requirement for utility companies to buy back power at a certain price.

Could some of you comment about the current status of some of that out West, particularly? Chairman Honorable, you should start. I'd like just a comment.

Then as the members come back we'll finish their line of questioning to this panel then move to our second panel in hopefully about 10 minutes.

Go ahead and take that, if you would.

Ms. HONORABLE. Madame Chair, thank you for the question.

There is a wide array of stakeholder interest in this issue, distributive generation. We are working together. We're educating ourselves.

Learning about the importance of being innovative and allowing customer choice, but at the same time it's important to, particularly from an economic regulator perspective, balance the interest to avoid cost shifting, to ensure that reliability is maintained in the first instance. Certainly distributive generation is an important innovation, quite frankly, that's happening all across the world. But also from an economic regulator perspective it's something we continue to be challenged with making sure that all interests are balanced.

Pardon me.

The interest of the industry that does have to be able to receive back this energy at anytime, the interest of consumers from all walks of life, from all ratepayer classes and ensuring the inherent equities of permitting those who would like to put solar panels on their roof tops while ensuring that the lease of these isn't carrying the cost of that.

So these are issues that we're exploring. We're educating our commissions. Quite frankly our commissions are leading the way in being responsive.

The CHAIRMAN. I'm going to come back to that question. Senator Portman and Senator Manchin, I think that Senator Portman is next, but are there scheduling conflicts that I should know about, Senator Manchin with you?

Senator MANCHIN. Not now.

The CHAIRMAN. OK.

Senator Portman.

Senator PORTMAN. Thank you, Madame Chair. Thank you for holding this hearing. I really appreciate it.

I know that this is a focus with this panel on cyber security, but we also talked about reliability a little bit and I know the next panel is going to focus on that. I really appreciate your willingness to move forward, you know, on a hearing so quickly after your taking the Chairmanship.

I'd like to ask a couple of reliability questions just because we've got some great experts here on this panel who maybe can give us a preview of what we're going to hear next, but also for us to be able to compare and contrast what we're going to hear from some of the industry folks.

First, I guess, Chairman LaFleur, I'd like to hear from you a little bit about what you think we ought to be doing in terms of reliability and price spikes. At a FERC technical conference last week you were quoted as having said, "I'm also very concerned about the price, both the absolute magnitude of the price spikes and the increases we saw this winter and the variability when you see these price spikes it's a symptom that protecting reliability is causing this issue."

Can you elaborate a little on that? By the way, is that an accurate quote because you never know?

Ms. LAFLEUR. Yes, the quote was in the context we had somebody had said we're mainly here to worry about reliability not price. I made the comment well, they're closely related because when you see the extraordinary price spikes, as we saw in some regions of the country in January and February, that means the grid operator is doing very unusual things to keep the lights on. That ultimately goes into customer's pocketbooks. So we need to say why is that happening and what can we learn from it?

We're in the middle of probably one of the biggest power supply changes we've ever seen particularly the increased reliance on natural gas to generate electricity. What we looked at very much in the tech conference last week was how we can get the rules right to make sure that No. 1, we have the gas infrastructure in place so that the pipelines are there so that the constraints don't cause the gas price list to spike up.

But second that the market rules and sometimes very geeky specific rules are written in a way to allow people to buy their gas at a more economic time of the day to avoid some of the spikes we saw this winter. FERC has a number. We're actually trying to change the timing of the gas and electric markets to make that happen.

But more fundamentally, one of the things I've been leading is a look at the capacity markets. These are the forward markets. We look 3 years or 5 years out to see what capacity is needed on the system. We have to make sure that the rules are written so that

we're properly rewarding the base load facilities that are very stressed by the short term gas prices.

We're seeing a lot of retirement of base load that could ultimately be detrimental to reliability. So we're taking a very focused look at our base load and what it needs to survive in the markets to make sure that the market price is right both for new resources and old.

So a very geeky answer, but that's very much what the tech conference was about. What can we learn and get the rules right next year.

Senator PORTMAN. Yes, no. I don't think it's very geeky. I think it's an answer that goes to a lot of the important issues. I think we're going to discuss these further in the next panel.

But one thing you didn't discuss is the impact of Federal regulations on a system. I think that's also not geeky, but it's important. In your testimony you said that FERC should help EPA better understand some of the implications of individual regulations. What, you know, their impact might be on electricity, particularly, and reliability.

You mentioned that you had worked with EPA on the finalized mercury and air toxic standards and that FERC should follow the development of EPA greenhouse gas emissions rules.

Let me just ask you this. As you know EPA is currently working on a lot of rulemaking. That would include it affects the utility sector, certainly the 316B cooling water intake rule, the NO_x zone rules, the particulate matter 2.5 rules, regional haze, coal ash.

So let me ask you this with regard to those regulations. What is FERC doing to help EPA understand how these rules collectively might impact grid reliability?

Ms. LAFLEUR. We've tried to be a source of reliability expertise to EPA. A lot of our work has been focused on MATS because that had such short timelines. But my colleague, Commissioner Moeller, who I believe is right behind me and on the next panel.

Senator PORTMAN. He'll be on the next panel.

Ms. LAFLEUR. I co-chaired a forum that met with NARUC and EPA and we've had meetings on 316B, on coal ash and right now a lot of the focus is on greenhouse gas.

I think that as rules are developed we need to be commenters in the draft stage, such as in the greenhouse gas rules that are coming out June 2, I believe, to make sure that those rules are achievable while reliability can be preserved and then look at our knitting how, if you look at the greenhouse gas rules, they could potentially make changes for the markets and the infrastructure, make sure we're doing what we need to do to support reliability as those rules come in.

So it's commenting to the EPA and looking to make sure the infrastructure is keeping up.

Senator PORTMAN. I hope on the front end you will do not just commenting, but analysis for them as to what the effect is.

Ms. LAFLEUR. Yes.

Senator PORTMAN. It's kind of like this cost benefit analysis that, you know, we talk about a lot. This is certainly a cost. Reliability is a cost, as you say to consumers. We talked about the price spikes.

You didn't talk about the potential for brown outs which is also there and black outs and you know, we've gone through a tough winter, admittedly. But we've really stressed the system. Now we're looking at a potentially hot summer too, you know.

So we are at a point where we need your input on the front end here to give them comments but also to be sure these regulations are not going to make it even more difficult for us to have reliability with all the issues. In the historic regulator model States, in conjunctions with regulated utilities were responsible for ensuring the construction and maintenance of adequate generation, adequate reserves.

Who's in charge now? Who do you think is responsible for ensuring adequate generation reserves are constructed and maintained in the so-called organized competitive market?

Ms. LAFLEUR. The States still play the critical role in deciding where the generation goes and a lot of the generation permitting and citing. But in the two-thirds of the country, including Ohio, that are in competitive markets, we're relying on the competitive markets to send the investment signal to make sure that the generation get paid. So it will either stay online if it's needed or get built which means that FERC has a big role to play.

That's why the competitive markets have done a very good job over the last 12 to 15 years in deploying the assets that were already built before we went into this system. But now we're in a major investment cycle. We need to make sure that they draw the investment we need to keep the resources online or bring resources online for reliability. I think FERC has a big role to play.

Senator PORTMAN. OK.

I know my time is up. But we do need to get into this issue for the next panel on base load. I'm sorry I didn't get a chance to ask Ms. Kelly and Chairman Honorable and others about this because I do think this grid liability issue is critical and look forward to following up with you personally, but also with the whole panel on this issue.

Ms. LAFLEUR. Of course. Thank you.

The CHAIRMAN. Thank you, Senator.

Senator MANCHIN.

Senator MANCHIN. Thank you, Madame Chairman and to Ranking Member Murkowski, I think she'll be back. She's voting now.

But as you know my colleague, Senator Portman, who just spoke and I, wrote to you both last month urging the—having a hearing on the grid reliability and stability. I want you to know how pleased I am that you did this in such an expedited manner. Thank you so much for this is extremely important what we just came through this winter.

There are two fuels that keep the lights on, just two right now that keep the lights on 24/7, 365 and that's nuke and coal. Gas will get into that position. They're not in that position yet, but they will get there.

These two base load fuels provide almost 60 percent of the power this country demands. Without these base load fuels our grid can't function. We know that. You all have said that and we cannot keep the lights on.

I'm having a difficult situation, you can imagine, in my side of the aisle with Administration's attitude toward what we're dealing with. I just want the facts to come out. That's why I asked for this today.

I want you all, who are on the front line, people they're relying on you. They're life basically is depending on can we have electricity, keep the lights on, when they turn it on when they need it for their, whether it's the air condition, the heat or for their ventilator or for their oxygen, whatever it may be. With what we've come through right now, you know, coal still is 30 percent of our power, our national mix, plus, 30 plus.

As you are doing, do you think about the fact that nearly 20 percent of the coal fleet is being retired? 20 percent of the coal fleet is being retired. Add the fact that EPA has proposed new source performance standard. What it's going to do will effectively ban the construction of any new coal plants. So then you start looking at the reliability, how do we maintain this system? How do you keep it running?

That's all I'm asking this Administration to look at. How do we keep the lights on so people's lives will not be endangered and we not lose people?

Coal isn't the only base load fuel, as you know, nukes too. In the current market condition it's unlikely that we're going to build any nukes. Yet we may need to replace as many as 100 nuclear units by 2050 if the licenses are not extended again, as you know.

How can the system continue to work for the long haul under this sort of strain? Everything I've asked any expert they say it can't. We are setting ourselves up for a major reliability crisis.

During the Polar Vortex this winter a whopping 89 percent of AEP, I have two providers in my State, AEP and First Energy. AEP said 89 percent of the coal units that are slated to be closed were running 100 percent just to keep up with the demand.

PJM is a RTO that handles our area, as you know. We spoke to them and they're here being represented. I appreciate they came in and spoke to me.

But they were saying that, you know, this was a critical time. You knew, I think, Chairman, they were taking emergency action to keep the system up. They've done a great job. I mean, they're Johnny on the spot. I appreciate all that.

But even they can be strained. They said they were down anywhere from 500 to 750 megawatts out of a 140,000 plus megawatts. They're responsible that the system could have gone down.

With that being said, they said they had another tool in the tool box was reducing the voltage on the lines that keep 1,500, maybe 2,000 megawatts, right?

With that system there you got 10,000 megawatts of coal fired power coming offline. What happens? You're going to be short next year.

So I'd just like to know and I'll start with you, Chairman LaFleur, your view of this. Should FERC be pushing certain kinds of fuel or should it be looking at basically the portfolio in the mix that our utilities have?

I guess, you've touched on it, FERC's proper role.

Ms. LAFLEUR. Yes.

Thank you for that question.

I do not think it's FERC's job to pick certain kinds of fuels. The whole concept of a market is that it uses a generalized product that allows different fuels to compete fairly and so if there are preferences for certain kinds of fuels that is not a fair market by definition.

I think FERC should try to be guided by reliability and what the customers need not by a preference for a particular fuel.

Senator MANCHIN. Let me ask you this because I know time and we'll go through in a second round. But right now just explain as simply as possible, any of you all want to jump in, the system the way it works now you have producers such as AEP and First Energy in my. They're responsible for producing the energy that's needed that goes into the transmission which is what we're calling the grid.

Ms. LAFLEUR. Um hmm.

Senator MANCHIN. Then you have RTOs such as PJM who is responsibility is to make sure it's reliable.

Ms. LAFLEUR. Um hmm.

Senator MANCHIN. Affordable and dependable.

Who makes the decision what goes on and what the reimbursement rate would be? So if you're saying that we think your portfolio is out of balance and we don't think you can continue to give us what we need. Who makes that decision to say I want another coal fired plant or I want to get rid of that coal fired plant. I want more gas generation or we need more renewables because I believe, you know, in West Virginia we're blessed.

We've got it all. We've got coal. We've got gas. We've got wind. We've got solar. We've got it all.

We're using it all. They just don't like it.

Ms. LAFLEUR. PJM does an analysis 3 years out and says how many megawatts are we going to need to keep this system on? Then they run an auction where resources bid in. They say I have so much coal. I have this. I have nuclear.

Senator MANCHIN. Yes.

Ms. LAFLEUR. Some of the existing plants say I'll run at any cost. Others put their—

Senator MANCHIN. Who makes the decision on price? If they say I'm only going to reimburse you on what a gas turbine or gas plant would cost even though I know you need coal. I can't do that. I'm only going to do this.

Who makes that decision?

Ms. LAFLEUR. What you're referring to is embedded in the auction rules. So I would say PJM. But those rules have been approved by FERC which is why we're looking at are the capacity markets—

Senator MANCHIN. Can you overrule PJM if you think they're not having—their portfolio does not have a good mix?

Ms. LAFLEUR. If they come in and say we want to do this and somebody else comes in and says no, if you do that then this will happen to my plant. We try to balance all that and make the fairest decision based on the record of the law.

Senator MANCHIN. So the utility, AEP or First Energy, can come to you and says listen, we're shutting down. You know, we shut our

coal plants down. It's super critical we shut down because they couldn't get reimbursed. That's what they told me.

Ms. LAFLEUR. So they're saying the prices aren't working. Yes, they can come to us. That's why we're doing that right now.

Senator MANCHIN. They're going to need the power. They needed it this—

OK.

Madame Chairman, can I just ask maybe—

The CHAIRMAN. Go right ahead.

[Laughter.]

Senator MANCHIN. Can anybody explain to me the price spike and the gouging that went on during this Polar Vortex and what the people in West Virginia are going to get hit with their bills? I'm hearing it's unbelievable. They're getting almost double bills. They're double the cost of their utilities.

Can you give me a reason why that happened?

Ms. LAFLEUR. The simplest way to explain it is during periods where power was really short because there was a successive days of night and day unusual cold.

Senator MANCHIN. Gotcha.

Ms. LAFLEUR. Generators who were reliant on gas had to spend a lot of money to get emergency gas to get—

Senator MANCHIN. Why did it cost? Did the gas companies take advantage of them? Is the pricing structure so that we can't adjust quick enough?

Ms. LAFLEUR. To the best of our knowledge of our analysis so far, there was no market manipulation. It was actual supply and demand forces of the demand for gas verses how much there was.

Senator MANCHIN. So nobody has long term contracts for gas? They can spike the price every day because of demand? They don't do that with coal or nukes.

Ms. LAFLEUR. Some people have long term contracts, but the price spikes by if more people bid than there is gas. Then that's what made the price go up.

Senator MANCHIN. Gas, it's not as—

Ms. LAFLEUR. It's more variable than a private, like with the coal—

Senator MANCHIN. Yet we're putting all of our eggs in that basket.

Ms. LAFLEUR. That's why we need more pipelines.

Senator MANCHIN. So that means consumers in West Virginia and around the country are going to be held hostage?

Is that fair?

Mr. Cauley.

Mr. CAULEY. In 2010 we predicted, through an independent study that 76 gigawatts of coal would be retired. We updated that last year to be 83 gigawatts.

Senator MANCHIN. At that time the EPA said only 4 gigawatts, correct?

Mr. CAULEY. Something like that, sir.

Senator MANCHIN. So they were off by couple thousand percent.

Mr. CAULEY. A lot.

Senator MANCHIN. Yes.

Mr. CAULEY. We've been working with EPA. They've been cooperative with us. But we're still trying to get the message out that over dependence on one fuel, on gas, is very volatile pricing and it's not as reliable.

The other concern is that there's not any discussion in the value proposition of the reliability services provided by base load units, coal and nuclear units, such as inertia, balancing of frequency, voltage control. The more we move this out into distributed and undispached. They're not essentially controlled resources. The harder and harder it's going to be to manage reliability on the grid.

So that's what we're seeing in these recent events is units that are allowed to operate whenever they'd like to operate are creating the price issues and not adding to reliability.

So our role is to get that message out there and make sure that the State regulators—

Senator MANCHIN. The difference what you're saying is basically you can bring a peaking plant on. You can turn on and off as far as the renewables, but you can't turn off nukes and you can't turn off coal. Once it goes it's got to go.

Mr. CAULEY. Correct.

Senator MANCHIN. So that's where your base comes in.

The CHAIRMAN. Senator Manchin?

Senator MANCHIN. I'm so sorry.

[Laughter.]

The CHAIRMAN. It's OK. It's been really—

Senator MANCHIN. I was waiting for this.

[Laughter.]

Senator MANCHIN. I just want to thank you all for getting the facts out—

The CHAIRMAN. We have a second panel that will focus on this as well.

Senator MANCHIN. This was a warm up.

The CHAIRMAN. Yes, this was a warm up.

We really, really appreciate that line of questioning.

I just want to, as we close this panel, thank you. It's obvious that there are many more questions, many more subjects to talk about.

We have a second panel that will add some light and illuminate this subject even more.

But I do want to put into the record, Senator Manchin, that coal is a very significant base load. Gas is now almost 30 percent and nuclear as well. It just shifted quite a bit over the last 15 years. Some of it is regulation. Some of it is market driven. But we're going to look forward to drilling down more.

Senator MANCHIN. Madame Chairman, if I could just say one quick thing on this, what you just said there?

The CHAIRMAN. Yes, go right ahead.

Senator MANCHIN. You know, I come from West Virginia. We've been a large coal producing State. We've been blessed with natural gas, the fracking. We really have been blessed with everything.

If someone came to me in West Virginia and the citizens of our State and said listen, we've got a new super fuel out. It's commercial hydrogen. We'll be ready in 3 or 4 or 5 years to go.

You know what? It would be tough, but we would adjust. We would adjust.

I'm not here trying to push a product that you don't want. But when we hear from people like you, the professionals, that says we've got to have it. I've got an Administration that's fighting me every way they can to get rid of it.

You got to have it, but you don't want it, but you know you need it. You know, somebody's got to put the facts out. That's what we're doing today.

Thank you.

The CHAIRMAN. Yes.

Thank you very much because you've been a leader. We appreciate your leadership.

As we end this panel though, Chairman LaFleur, let me express to you in the strongest possible terms my opposition to the application filed at FERC for by American Midstream to abandon the Midla pipeline. I know that you cannot discuss this publicly. But I want to just call this to your attention. The letter is in your file. It needs to be responded to.

Again, this gets back to the whole issue of getting fuel to people when they need it to keep lights on. This is about pipelines. We've talked about electricity generation. But it's an extremely important issue for both generators, middle men and middle women and consumers.

So thank you. I'm looking forward to following up.

Again, thank you all. If the second panel will come forward we'll start momentarily.

Ladies and gentlemen, if I could re-convene the meeting. Thank you.

We have a large crowd. Thank you for quickly adjusting panels.

We have 6 experts on this panel and we only have about 30 or 35 minutes left to go. So I want to do this quickly. I'm going to ask each of you to limit your remarks to 4 minutes. If you can do it in less time I would really appreciate it because we do want to leave time for at least one round of questions.

First, Philip Moeller, also here representing FERC, perhaps from a different perspective, we're looking forward to hearing that.

Michael Kormos, Executive Director of President of Operations of PJM, Senator Manchin, who will also give us some additional insight into the line of questioning that you've raised.

Mr. Nicholas Akins, Chairman and President of CEO of American Electric Power, we thank you for being here.

We also have Mr. James Hunter, representing the International Brotherhood of Electrical Workers. I'm proud to have the unions here and the work that you all do and the perspective that you bring to this issue, I think, is very valuable.

Mr. Thad Hill, President and Chief Operating Officer of Calpine Corporation, thank you for being here.

Finally Ms. Cheryl Roberto, again we thank you for your views from the Clean Energy Environmental Defense Fund, for your perspective that you bring to this issue as well.

So if we can start with you, Commissioner Moeller. Really we're going to hold you all to 4 minutes so we can have a very robust line of questioning.

**STATEMENT OF PHILIP D. MOELLER, COMMISSIONER,
FEDERAL ENERGY REGULATORY COMMISSION**

Mr. MOELLER. Thank you, Chairman Landrieu, Ranking Republican Murkowski, members of the committee. I'm Phil Moeller, a member of the Federal Energy Regulatory Commission since 2006. Thank you for holding the hearing on this important topic.

We've gone through quite a winter, particularly in the Eastern interconnect that you referenced on the page 3 of the staff handout with particularly starting January 5th with the Polar Vortex events. I think we need to send appreciation to the thousands of people who kept the system running in the control room, Mr. Hunter's members, people who made decisions, dispatch. They came through remarkably well in a system that was very stressed.

I've consistently said that we'll let the market decide which fuels are the winners based on economics and affordability, but I can't be reliability neutral. On this subject it's just too important. We have to maintain reliability of the Nation's grid.

I went back and looked at the letter that Senator Murkowski wrote me in 2011 and my response and my House testimony that year in which I called for a more formal process to analyze the potential reliability implications, particularly environmental rules. To my knowledge that process has not yet occurred. But I still continue to advocate for it.

The reasons are as follows.

We've had a couple of unusually warm winters before this one and the system was very stressed. Yet in 53 weeks we're going to lose all those MATS plants that are slated for closure. Now plants that retrofit generally have a fourth year, sometimes a fifth year, but the fifth year is full of uncertainty and some of the other panelists will relate to that.

So as referenced earlier our region has very different fuel mixes depending on where you come from, some areas more dependent on natural gas, my home in the Northwest, hydropower. But we're seeing a lot of stress, particularly with prices down, not only with the coal plants that are going to be shut, but also with the nuclear fleet that's been referenced that should be kept in mind.

Specifically the Midwest is looking at some challenges in the summer of 2016 where they project a reserve margin that will be of deficit. Although that reserve margin has been moved upwards to only two gigawatts, it also depends on the fact that the assumption is that consumers will be using less electricity per year. That's a pretty big assumption to make.

We also have individualized situations. I reference one in my written testimony where the local area is going to be in a conundrum as to how they go forward without a coal plant.

On this issue we have a variety of opinions. We have executives who will say we can get through this period without any problem. We have others that are very concerned.

My focus has been to try and get the data.

Which plants retire when?

Where they are in the system?

What they provide in terms of, not just power, but perhaps voltage support is very, very important.

As I have called for data, frankly, we've had some that's been contradictory and some that hasn't been particularly effective in its—we're not exactly confident in a lot of the numbers and that has me very concerned going into the next two to 3 years. I again would call for the fact that we need to do a better job in government working with the private sector, some kind of a formalized process to analyze this.

A lot of it's just going to depend on the weather. If we have mild weather for the next couple of years we might make it through. But if we have extreme weather in the summer or as we saw in the winter, the system will be extremely stressed. That's where reliability is paramount and people's, frankly, their safety and their lives are at stake if we have extended extreme weather and the system isn't able to produce power.

Thank you again for the chance to testify. I look forward to questions.

[The prepared statement of Mr. Moeller follows:]

PREPARED STATEMENT OF PHILIP D. MOELLER, COMMISSIONER, FEDERAL ENERGY
REGULATORY COMMISSION

Chairman Landrieu, Ranking Member Murkowski, and members of the Committee, thank you for inviting me to testify regarding the continued reliability of our nation's bulk power system. I am Philip D. Moeller, and I have been a Commissioner at the Federal Energy Regulatory Commission since 2006.

Every day, men and women sit in windowless control rooms making decisions on how to operate the power grid. They ensure that the right power plants are running at the right time, and they carefully balance power generated with power consumed. On a minute-to-minute basis, they ensure that the lights, heaters and air conditioners stay on, and that manufacturing and other business activity continues. This winter had more than a few days when electricity supplies were at their limits, yet the operators kept the system running without interruption. Every one of us today owe each of them appreciation for their hard work. And going forward, we owe them the resources that they need to keep the lights on in the future.

I have long-stated that I can be "fuel-neutral" but I cannot be "reliability-neutral". That is, I can be neutral as a regulator with regard to how competitive markets ultimately decide which types of power plants are most efficient and affordable, regardless of whether those power plants are fueled by water, natural gas, fuel oil, uranium, coal, wind, the sun or any other fuel. But I cannot be neutral about the reliability of our electricity.

In preparing today's testimony I reviewed the positions that I have presented to Congress over the years on the subject of the reliability. For more than three years I have worked on the reliability implications of our nation's unprecedented transition in the fuels we are using to generate electricity. Sufficient and reliable electricity is necessary for both economic opportunity and the heating and cooling that are essential to the health and safety of our nation's citizens. An insufficient or unreliable supply of electricity endangers economic recovery and can be a matter of life and death during periods of extreme heat or cold.

Specifically in order to prepare for today, I reviewed the letter that I sent to Senator Murkowski in August 2011 in response to her questions about the reliability implications of environmental rules impacting the nation's generation fleet. I also reviewed my testimony to the Energy and Power Subcommittee of the House Energy and Commerce Committee dated September 14, 2011. In both documents, I called for a more formal analysis of electric reliability implications of these rules, potentially including the Commission, the Environmental Protection Agency (EPA), the US Department of Energy, the North American Electric Reliability Corporation (NERC), and regional market participants. As far as I know, this formal analysis never commenced.

I was, and remain concerned that EPA's analysis greatly underestimated the amount of power production that would be retired due to these rules. I reiterate today what I stated then: I am not opposed to closing older and less environmentally-friendly power plants, but I am concerned that the compressed timeframe for compliance with the new environmental rules was not realistic given the amount

of time it takes to construct new plants and energize transmission upgrades to mitigate plant closures. In addition, EPA's analysis failed to analyze whether there was sufficient transfer capability to move power from areas of energy surplus to areas short of power. Given that public policy aspirations cannot violate the laws of physics, we need to act carefully in transforming the power grid.

After two unusually warm winters in most of the country, our latest winter exposed an increasingly fragile balance of supply and demand in many areas in the Eastern Interconnection. Prices at times were extraordinarily high and consumers used more power because of the cold weather, which multiplied the impact of higher prices. Consumers are now beginning to receive utility bills that in some cases are reportedly several times what they paid during similar periods in previous years. Although the operators of the power grid worked hard to keep the system working, the experience of this winter strongly suggests that parts of the nation's bulk power system are in a more precarious situation than I had feared in years past.

In approximately 53 weeks, coal plants that do not employ specific emission-control technology will be closed. Those plants undergoing retrofits have the option to request a one-year extension. Those particular plants will also have the option of requesting an additional year for compliance, although this option comes with the uncertainty of being subject to civil litigation for violating the Clean Air Act during the additional year.

Regarding the structure of our electricity markets, our nation consists of different regions with unique market structures and varying mixes of fuels used to generate this electricity. New England and California are increasingly reliant on natural gas as a fuel to generate electricity, while much of the Mid-Atlantic, Southern and Mid-western regions rely more on coal, and my home of the Pacific Northwest relies heavily on hydropower. Thus the impact of environmental rules on generation resources and constraints in fuel supply chains differ across the nation.

Although there has been attention focused on the loss of coal-fired generation, nuclear plants are under increasing economic pressure to close as a result of record low capacity prices. In addition to several announced nuclear plant closures, some utilities have predicted additional retirements if specific units are unable to operate profitably. Losing these plants has long-term implications both to the reliability of the system and on the nation's emission profile.

To the extent that a region has other resources, the retirement of power plants may not have a material impact on consumers. Yet the experience of this past winter indicates that the power grid is now already at the limit. Heading into the next several years, some regions of the nation will be more vulnerable to supply shortages than others. It is vitally important to recognize, as this latest winter demonstrated, that weather is a significant variable in terms of electricity demand. We can hope for mild winters and summers over the next several years, but hoping for mild weather is not a practical method of planning to meet economic growth and public safety.

For example, the Midwest is struggling to understand whether or not it will have sufficient capacity to handle peak weather over the next few years. In particular, in the region served by the Midcontinent Independent System Operator (MISO), the reserve margin is now expected to be at a deficit of approximately 2 Gigawatts (GW) in the Summer of 2016. Although this figure has been revised downward from a projected deficit of approximately 6 GW a few months ago, the new figure assumes that consumers will collectively reduce their electricity consumption every year by approximately .75 percent. Again, weather will play a role in the actual rate of consumption, as will the strength of economic (and especially industrial) recovery in the region.

In addition to looking at MISO collectively, specific locations across the Midwest may have more significant problems. For example, the Upper Peninsula of Michigan has long depended on a coal plant to serve local customers, but at this time, it is not clear how that part of the state will receive electricity service in the future. Regulators, including FERC, are considering this matter, but resolving regulatory issues is only one step in the process of building infrastructure. That is, infrastructure still needs to be built after the regulators conclude their processes, and that takes time.

Other regions of the country face similar problems, and executives at the utilities have various levels of confidence in their ability to promise the delivery of power on the hottest and coldest days of the year. Some executives are very confident in the ability of the power grid to handle the new environmental regulations, and other executives are hopeful that the weather will be mild. But beyond relying on the confidence of utility executives, as a FERC Commissioner with responsibility for the reliability of the grid nationwide, I need actual data on which power plants are retiring, and which resources will be ready to replace those retiring plants. To date, ob-

taining reliable data and thoughtful analysis as to the changing generation mix and its consequences has been a challenge.

Moreover, advocates for strong environmental rules promise that nothing they do will threaten reliability. And they promise to get their rules right. But on the other hand, advocates for traditional sources of power assert that the rules are not right, and that reliability may be threatened. These differing viewpoints can be tested with data.

In preparing this testimony, I sought the latest data from the various regions on the power plants being retired, and the resources that are replacing them. Lots of data are available, and some of them are contradictory. But lacking in that data is any guarantee that this nation will continue its history of reliability on the coldest and hottest days of the year. While nobody can guarantee future reliability, we can do better in understanding the risks and issues facing the power grid in the future. As the history of my testimony before Congress demonstrates, the sufficiency of our generating resources has been clouded by uncertainties arising from changing environmental regulation. While we have been sensitive to the fragility of our electric infrastructure in certain pockets of the country, this winter has demonstrated that our margin of surplus generation is narrower and more constrained than many understood. Together, industry and the federal government can do better in devoting resources to looking carefully at individual power plants that are expected to retire, the load they serve, and the strategies being used to replace those power plants.

In conclusion, our nation is undergoing an unprecedented change in the electricity sector in a very compressed time frame. I continue to believe a more formal review process is necessary including the Commission, the EPA, and non-government entities to analyze the specific details of retiring units as well as the new units and new transmission that will be needed to manage this transition so as to best assure reliability of the nation's electricity sector.

Thank you again for the opportunity to testify, and I look forward to answering any questions from members of the Committee.

The CHAIRMAN. Thank you so much for adhering to the time.
Mr. Kormos.

**STATEMENT OF MICHAEL J. KORMOS, EXECUTIVE VICE
PRESIDENT-OPERATIONS, PJM INTERCONNECTION LLC**

Mr. KORMOS. Good morning. On behalf of PJM I also want to thank Chairman Landrieu, Ranking Member Murkowski, members of the committee and their staff.

I'm Michael Kormos. I'm Executive Vice President of Operations for PJM. Again, as has already been discussed, PJM is going through a major transition as we shift from coal to gas. We see significant coal resources retire on our system.

As part of our responsibilities to maintain reliability and that is our primary responsibility. As been mentioned, we do run a 3 year forward capacity auction where we look to procure adequate commitments from resources to cover the expected load plus an adequate reserves. Throughout the next 3 years, through the METS integration period, we have, in fact, procured not only the minimum amount we needed, but in fact excess. With that we believe we will be able to maintain reliability.

Having said that I will not tell you it is not going to be without a challenge.

Our fuel mix is changing fairly radically with the retirement of coal, with the low availability of natural gas and with our increased use of demand response to meet our needs. Coal will continue to play a big role in PJM. It will still be one-third of our capacity going forward. However the cushion we've enjoyed that coal has provided, as the other units have, is in fact diminishing.

Coal, in many parts, is being replaced by demand response. For those who may not be familiar demand response is a contractual

obligation for a customer interrupt when needed. The issue with demand response that it's typically not available to us until we are at or very near an emergency and it is typically extremely high priced, one of the most highest priced resources on our system.

Having replaced our coal resources with demand resources I would expect to see that much more significant volatility in the energy market as we will have to rely on them more as being part of our capacity mix.

Also, as we mentioned before, we are moving much more into natural gas. In many ways we are becoming more balanced. We're going to be about a third natural gas.

Natural gas also has its challenges as well, particularly in the winter, like typically it has been a very good resource for us. Prices have been very affordable. During the winter when it competes with residential heating for natural gas we do see some difficulties in managing it.

The prices can become quite volatile. Those prices will ultimately be reflected into the energy prices. Quite frankly the contractual terms have been onerous that we've had to be able to secure it.

While we ultimately secured enough gas this winter that under some of the contractual terms we had to accept led to some of those increased costs that were mentioned previously.

While talking about the Polar Vortex I will tell you it was probably one of the most difficult winters I've been involved in in the last 26 years. I'd probably have to go back literally 20 years to 1994 to see a winter of that. We saw extended periods of cold.

We saw demand response, our demand being 20 to 40,000 megawatts. That's 20 to 40 nuclear plants over what our typical winter loads would be. We saw 22 percent forced outages on our system.

I would agree while we were close we were able to maintain reliability through it even though it was a fairly difficult time period.

Just in summary I would mention I would not be realistic for me to stay up here and tell you there will never be an interruption in service. But having said that, I do believe that we have met our reliability objectives. We have procured the capacity we need. We will be able to serve the load in all but the most extreme circumstances.

I do caution however, we will have to continue to work with our regulators as well as our members as we make this transition, particularly in the energy pricing side as we see in that volatility.

[The prepared statement of Mr. Kormos follows:]

PREPARED STATEMENT OF MICHAEL J. KORMOS, EXECUTIVE VICE PRESIDENT,
OPERATIONS, PJM INTERCONNECTION LLC

On behalf of PJM Interconnection, L.L.C. (PJM), I want to thank Chairman Landrieu, Ranking Member Murkowski and members of the committee and its staff for calling this important oversight hearing today. My name is Michael Kormos, and I serve as the executive vice president of operations for PJM Interconnection. As depicted below, PJM is the Regional Transmission Organization (RTO) serving all or parts of the states of Illinois, Indiana, Michigan, Ohio, Kentucky, Tennessee, West Virginia, North Carolina, Virginia, Maryland, Delaware, Pennsylvania, New Jersey and the District of Columbia. You can think of PJM as the "air traffic controller" of the electric grid ensuring the delivery of electricity across the high-voltage electric transmission grid to customers in the 13-state region we serve. We are not the local utility, nor do we control the distribution lines that deliver electricity to individual

homes and businesses. Rather, like an air traffic controller, we operate the high-voltage electric grid for our member companies, which include companies such as American Electric Power, Dominion and Exelon to name a few.

We are not alone in this endeavor. There are other RTOs serving other parts of the nation including the Midcontinent ISO, which serves the upper Midwest as well as the region served by Entergy; ISO New England, serving the New England states; and the California ISO, serving that state among others.

Reliability is job one at PJM, and, as executive vice president, I oversee PJM operations associated with ensuring the reliability of the electric grid in our region. In addition, PJM operates the world's largest competitive wholesale electricity market where we serve as a platform for procuring electricity both day ahead and in real time for the 61 million people in our footprint as well as procuring sufficient resources three years ahead to meet our future reliability requirements. Finally, we are responsible for planning the build-out of the electric grid, another PJM function that I oversee.

The committee has asked me to provide testimony on the impacts of future environmental regulations on the future reliability of the power grid. Although we are at the beginning of implementation of a host of new environmental regulations including the Environmental Protection Agency's Mercury and Air Toxics (MATS) rule, its Section 316 Cooling Water Rule and its Greenhouse Gas Rulemaking, we at PJM are required, as part of our reliability function, to look forward and try to incorporate the impact of these rules into our future plans for ensuring reliability of the grid. That task is not easy. For example, amid a changing fleet of resources, in order to ensure that we can keep the lights on during stressed conditions, we are called upon to procure more resources than we might need based strictly on the actual demand on the system in a given day in order to take into account the many short and longer-term contingencies that can occur—ranging from extreme weather conditions to generation plant outages to economic rebounds. Today, we procure at least 116 percent of our forecasted needs three years ahead (known as our “reserve margin”) to take into account these contingencies and often procure additional resources above 116 percent of forecasted demand when it is economic to do so. This cushion has served us well. Over just the past six months, we saw record-breaking heat waves in September of 2013 and record cold in January of 2014, both events which broke previous records for demand on the system.

Where does this leave us in managing the impact of environmental regulations? My bottom line message today is several-fold:

- As illustrated in the top two lines of the chart below, we have procured adequate reserves for the next three years (and will continue to procure such supplies on a rolling year-by-year basis three years forward) and, in fact, have procured into 2017 approximately 5,000-8,000 megawatts more than our target reserve margin to address contingencies. As a result, the PJM region has adequate reserves to meet our forecasted needs through the next three years including 2016 when the EPA MATS rule is scheduled to take effect.
- Although overall, we have procured adequate reserves to meet the projected demand, the mix of resources will change dramatically during this period. We are seeing a rapid “change out” of the generation fleet with a record number of coal plant retirements: approximately 12,000 megawatts in 2015/2016 alone and a total of more than 19,000 megawatts of coal retirements from 2011 to 2019. This kind of turnover of the generation fleet usually takes over a decade—yet we are seeing this turnover occurring over the next two to three years.
- The PJM generation fleet profile will markedly change in this short time period. Coal will still play a large role in our overall resource fleet representing over 32 percent of the total generation mix in PJM. But our future reserves will be made up of a great deal more demand response resources, natural gas generation, renewables and imports from other regions.

“Demand response” occurs when customers respond to a directive when PJM calls an emergency to curtail their use of electricity. For factories, this could mean temporarily halting a production line. For residential customers, this could mean having their air conditioners automatically cycle during emergency periods. Retail customers decide whether or not they wish to commit to make these curtailments, but, once they so commit, they are bound for one year or one summer (as PJM is counting on these curtailments in order to ensure region-wide reliability) and face penalties for failing to curtail their electricity use in response to PJM-designated emergencies. In return, the customers who participate in the program at the wholesale level are paid the same clearing price that we would otherwise pay a generator to produce electrons during this period.

As another game changing event, natural gas has proven to be the “fuel of choice” for new generation developing in our region. Over 64 percent of new resources in our queue are proposed gas-fired generation. Improvements in the efficiency of combined-cycle generating plants, the availability of Marcellus and Utica shale right in our region as well as the impact of the EPA rules on coal generators clearly have driven the industry to invest in new gas-fired rather than coal-fired generation.

All of these rapid changes leave us with a mixed picture of the future:

- As indicated previously, PJM has procured adequate reserves three years forward and will continue to do so on a rolling basis three years forward into the future.
- Although we have procured adequate reserves, the reliability “cushion” we previously enjoyed with the large fleet of coal-fired generation has substantially diminished. As a result, and due to the fact that demand response resources are only available to us when we are approaching emergency conditions (what is defined as a “pre-emergency” condition), we potentially will have to run the system closer to its limit than we have previously in order to be able to call on demand response resources. As a system operator, I am not comfortable with having to plan my system to go into emergency (or pre-emergency conditions) before I can call upon resources to restore the system to more normal operating conditions. But, the limitations that have been placed on the availability of demand response resources along with the loss of the cushion of coal units have made this the “new normal” operating condition for PJM into the future.
- Finally, many of your constituents, especially those on variable rate plans, will likely see more volatile wholesale prices than they have in years past. Although the exact amount of exposure to the wholesale markets that retail customers see in their monthly bills varies by state, there is no question that at the wholesale level, as we depend more on natural gas, volatility in the cost of electricity will significantly increase from what we have seen in past years when we could rely more on predictably-priced coal and nuclear facilities to meet our baseload requirements. Natural gas prices have proven quite volatile. Although they generally have cleared at levels of \$4 to \$5 per million BTU, during the height of the polar vortex in January of this year, prices reached over \$100 per million BTU. In addition, because the short-term natural gas market is not as transparent as the electric markets, we saw generators subjected to extremely onerous terms and conditions, which required us to pay for gas at times when it was not economic to run the particular generator, and we witnessed generators procuring gas for an entire weekend merely to ensure its availability to meet the increased Tuesday morning demand after the three-day Martin Luther King Day holiday. These all are issues we are working with the Federal Energy Regulatory Commission to prepare for a more gas-centric world in the future.
- While I am on the subject of the Polar Vortex, I will just note that this was the most difficult winter challenge the grid has faced since the winter of 1994. Summer heat stresses transmission lines while winter cold is particularly hard on generators. It was not simply cold in the PJM region—it was deeply cold over a very long period across our entire footprint. On many days, demand was 20,000 to 40,000 megawatts above normal January peaks. When you consider that only 18 U.S. states use more electricity in an entire year than the PJM region consumed during the single month of January, you get an idea of the extreme stress January placed on the system. An unprecedented 22 percent of our generators—coal, nuclear and gas—were forced out of service by problems such as equipment breakdowns, prolonged operations in extremely cold temperatures and fuel supply limitations. Advanced planning and close coordination between PJM and our members paid off as we were able to meet record demands without interrupting power supplies to anyone. While the system was indeed very tight, we were never—as some accounts have portrayed—700 megawatts away from rolling blackouts. On the worst day, January 7, our next step if we had lost a very large generator would have been to implement a small voltage reduction. This action, which is unnoticeable to consumers, can produce up to an additional 2,000 megawatts. Even this step, however, proved to be unnecessary, and we were able to meet the record peak with our remaining reserves.

Going forward, we, along with the other RTOs and independent system operators, have requested that EPA build into its Greenhouse Gas Rulemaking a “reliability safety valve,” which would ensure that regional reliability considerations are taken into account before a particular state or federal implementation plan is approved. We negotiated a similar Reliability Safety Valve with EPA in the MATS rule, one which generation owners have employed to seek a fourth year extension on com-

plying with the MATS rule. We believe reliability reviews need to be hard-wired into any final EPA rule at key points in the process including at the beginning when the parameters of the rule are being developed and at key points in the rule's implementation. We look forward to working with the administration and the Congress on these issues going forward.

Let me end where I began. I cannot say that we will never have an interruption in service in the PJM footprint. No one can realistically make that assertion. We are figuring out how to meet reliability objectives by deploying the resource portfolio mix that results from governmental policy preferences and the economics of competing resource options. We are working hard to manage these changes to ensure reliable, cost-effective service to the 61 million Americans that depend on us every day.

The CHAIRMAN. Thank you very much.
Mr. Akins.

**STATEMENT OF NICHOLAS K. AKINS, CHAIRMAN, PRESIDENT
AND CHIEF EXECUTIVE OFFICER, AMERICAN ELECTRIC
POWER**

Mr. AKINS. Thank you, Chair Landrieu. I want to thank you and certainly, Ranking Member Murkowski for putting on this hearing. It's very important it's been 2 years in the making, I think. There's been a lot of activity associated with our industry.

We're American Electric Power. We serve 11 States including Louisiana, West Virginia and Ohio. It's been certainly an area where we're very focused on the activities associated with the grid.

We have the largest transmission system in the country. We're one of the largest generators in the country as well. When we look at some of the issues that have occurred over the winter it really makes us think about this all the above strategy. Does it actually include voltage reduction and perhaps low jetting? That's not a good place to be particularly in the extremes when people are living through extreme cold or extreme heat, people die in their homes as a result.

That's something I think that we're very concerned about.

So a month ago I made headlines when I said that 89 percent of the generation that AEP will retire in mid 2015 was called upon to meet electricity demand in January. That's a fact. We needed it.

In fact it's also a concern. Those power plants will no longer be available after next year to help meet demand peaks. The capacity markets aren't supporting the development of diversified generations or replace them.

I'm not saying we should abandon mercury MATS or any of those types of activities. What we have been concerned about all along has been the timing associated with the transition that needs to occur so that we can make thoughtful decisions about what happens to the grid in the future and how we accommodate the multiple set of diverse resources that will be attached to it.

So even PJM's market which is probably the most developed in the country and I certainly thank Mike Kormos and his team for the what—their efforts during the winter time operations. They're trying to support several fixes that will be put in place. There's several changes to be made in the capacity markets so that we can adequately have a view of what new generation should look like in the PJM markets. We support those changes.

Really it goes to the notion of not having long term price signals to support new investment in generation. You're seeing that over

and over again with generation. We're retiring a substantial amount of our fleet during the period. Twenty-five percent of the coal fleet will retire by mid-2015.

Certainly you've heard nuclear operators saying that they're also challenged. I believe, Chris Crane today said 5 units, 5 nuclear units, may come offline if there's not changes to the capacity market. So there's clear concern when it's reflected through base load capacity that we ensure that we are able to maintain that type of capacity going forward.

So AEP is retiring more than 6,500 megawatts in the next 14 months. There's no turning back on those units. When we anticipate closing units we are obviously harvesting those assets to continue toward closure, making human resource decisions about moving people from those facilities to other facilities. It's a very difficult proposition to go through to close down a plant.

We're in that process. They will close down in mid-2015. What we're concerned about is the additional closures that may occur as a result of not only impending regulatory environmental regulatory impositions that may occur such as the greenhouse gas rules and others that could have a more dramatic effect.

The issue you're really having with base load generation is you're seeing the cost go up as a result of regulations and other activities. At the same time the capacity markets aren't supporting these long term assets that support the grid. That's a key concern because you're getting hit from both directions. That's why we're seeing these multiple announcements of retirements.

So going forward when you think about the grid itself there's many aspects. We talk about physical security. We talk about security associated with the grid from a cyber standpoint.

Every bit of importance should be placed upon, not only the capacity in the market threats. But also the combined impact of the environmental regulations. What impact they ultimately have on the reliability of the grid going forward.

Thank you.

[The prepared statement of Mr. Akins follows:]

PREPARED STATEMENT OF NICHOLAS K. AKINS, CHAIRMAN, PRESIDENT AND CHIEF EXECUTIVE OFFICER, AMERICAN ELECTRIC POWER

Good morning Chair Landrieu and Ranking Member Murkowski, members of the Committee and fellow panelists. My name is Nicholas K. Akins, and I am Chairman, President, and Chief Executive Officer of American Electric Power (AEP).

AEP is one of the largest electric utilities in the United States, delivering electricity to more than 5.3 million customers in 11 states. AEP owns nearly 38,000 megawatts of generating capacity in the U.S. and the nation's largest electricity transmission system, a 40,000-mile network that includes 2,100 miles of 765-kilovolt extra-high voltage transmission lines. AEP's transmission system directly or indirectly serves about 10 percent of the electricity demand in the Eastern Interconnection, the interconnected transmission system that covers 38 eastern and central U.S. states and eastern Canada, and approximately 11 percent of the electricity demand in ERCOT, the transmission system that covers much of Texas. AEP's headquarters is in Columbus, Ohio.

Today's hearing is focused on electric grid reliability and security, and whether we are doing enough to address significant challenges to the grid.

We are beginning to make progress as evidenced by the fact that this hearing is occurring today and is one of the first under Chair Landrieu. The white paper authored by Senator Murkowski provided excellent background and potential solutions. Additionally, Federal Energy Regulatory Commission (FERC) Acting Chair Cheryl LaFleur has recognized the challenges facing the gas and electric industries.

However, we need to do more to ensure that we maintain a diverse portfolio of generation reserves, and we need to do it sooner rather than later. This country's grid was tested in January, and we passed, but barely.

A month ago, I made headlines when I said 89 percent of the generation that AEP will be retiring in 2015 was called upon to meet electricity demand in January. That is a fact. These units were called upon by PJM and relied upon to maintain regional reliability. In making this statement, I am not saying we should abandon or postpone the Mercury and Air Toxics Standards (MATS) rule. Nor am I saying we should avoid building more natural gas-fueled power plants. What I am calling attention to is the fact that our nation's fleet of power plants is undergoing a significant transition, and we need to ensure that the electric system that the American economy relies upon is equipped to serve that need in a reliable manner. AEP has been sounding the alarm on long-term reliability for several years now and time is running out.

The current capacity markets are not functioning as intended. From my perspective, the current structure of the capacity markets is not attracting a mix of new generating resources that will keep the lights on, nor providing the correct pricing signals for the existing fleet. This, coupled with the high number of base load unit retirements, jeopardizes the reliability of the grid.

Most of the new capacity being offered is either gas or demand response. There are a host of difficulties in coordinating the gas and electric industries, and demand response continues to be paid similar capacity prices to steel-in-the-ground generation despite having rules and penalty provisions that are much less prescriptive.

THE POLAR VORTEX: A WARNING SIGNAL

During this past winter, PJM was faced with certain challenges that threatened the reliability of the electric grid. PJM set a new all-time winter peak load of 141,846 megawatts on January 7, 2014. In fact, eight of PJM's top 10 all-time winter peaks occurred in January 2014.¹

At the same time that peak demands were being set, approximately 22 percent of total installed generation capacity in PJM was unavailable.² Some generation units experienced forced outages resulting from equipment failure, cold temperature operations and some fuel supply issues. The initial polar vortex event at the beginning of January was an extreme, followed by continuing arctic weather throughout the month. The polar vortex represented only two of the 10 days PJM needed to call on Emergency Operating Procedures.³ Fortunately, the system operated without a loss of load event. It could have been much worse. As FERC Acting Chair LaFleur said at the April 1 FERC technical conference, "We had a difficult winter for both the electric and gas infrastructure and markets across the country. As others have noted, the system bent but it did not break. Reliability was sustained, but at times was very close to the edge."⁴

The weather events experienced this winter provided an early warning about serious issues with electric supply and reliability. PJM was not alone. Many of the Regional Transmission Organizations (RTOs) and Balancing Authorities needed to call on Emergency Procedures to ensure reliable operations. This country did not just dodge a bullet—we dodged a cannon ball.

We need to take action now to ensure adequate power plant capacity, fuel diversity and grid investment after the retirement of significant amounts of base load generation in mid-2015 and beyond. Because the base load generation that will retire in 14 months will not be fully replaced, this reliability concern is imminent and is a concern we need to proactively address.

Although average consumers may not be well versed on the intricacies of grid reliability, after examining their power bills, they will understand all too well the price volatility that comes with it. We are focused today on reliability, but price signals—and there have already been high price signals—are a symptom of reliability threats. FERC Acting Chair LaFleur summed it up well at a technical conference last week when she said, "I'm also very concerned about price, both the absolute magnitude of the price spikes and the increases we saw this winter and the variability. When you see these price spikes, it's a symptom that protecting reliability is causing this issue."⁵ She is absolutely correct.

¹ Polar Vortex 2014, Michael Kormos, PJM, FERC Technical Conference Presentation, p. 3

² Polar Vortex 2014, Michael Kormos, PJM, FERC Technical Conference Presentation, p. 6

³ <http://www.pjm.com/-/media/committees-groups/committees/mc/20140224-webinar/20140224-item-01-winter-operations.ashx>. Slide 6 on Cold Weather Operations report.

⁴ <http://ferc.capitolconnection.org/>

⁵ <http://ferc.capitolconnection.org/>

RELIABILITY IMPACTS: FLAWED CAPACITY MARKETS

Reliable electric service is a critical public need. Our nation's economic success depends upon our ability to preserve this fundamental resource. To that end, we must ensure that we have the necessary long term investment to maintain reliability. The competitive wholesale markets are not currently providing the structure necessary to maintain that reliability and do not currently provide the proper economic signals to foster new power plant investment for the future.

The real value of steel-in-the-ground capacity must be recognized in the competitive markets. Insufficient revenues from both the capacity and the energy markets mean additional nuclear and fossil generation may be retired. We already have the retirement of the Kewaunee Nuclear Plant in Wisconsin. This 556-megawatt facility was retired May 7, 2013, ending a 40-year service life. Plant owner Dominion Power said "this decision was based purely on economics."⁶ Vermont Yankee in New England, owned by Entergy, closed for the same reason.⁷

Exelon announced last month that they will consider closing efficient nuclear plants by the end of this year because they are no longer profitable. Exelon's CEO Chris Crane told the Chicago Tribune that, "Despite our best-ever year in generation, some of our nuclear units are unprofitable at this point in the current environment, due to the low prices and the bad energy policy that we're living with. A better tax policy and energy policy would be the clear answer, but if we do not see a path to sustainable profits, we will be obligated to shut units down to avoid the long-term losses."⁸

Even PJM's market, which is probably the most developed in the country, does not provide the type of long-term price signals that encourage and support investment. This lack of investment, coupled with announced retirements, puts reliability at risk.

The market flaws that create economic inefficiencies include inequities in the treatment of actual generating assets versus demand response (DR), imported power and even new planned generation. Yes, PJM has more than 8,000 megawatt of planned (mostly gas) generation⁹ identified in the last two auctions, but many of those generators are being proposed with some form of state regulatory funding support. What this means is that many new builds are the result of state directives rather than a response to market signals. Other market design problems exist with demand response compensation. While existing generators are required to be available for dispatch when needed and face financial penalties for failure to respond, most demand response is only required to perform in the summer.¹⁰ Even then, most of the summer demand response is only required to perform 10 times a summer for a maximum of six hours each time. In PJM, only 1,911 megawatts of demand response voluntarily responded at the peak on January 7.¹¹ A total of 12,000 megawatts of demand response cleared the PJM capacity auction for 2016/17.¹² This comprises about half of the PJM reserve margin for 2016/17, and 99 percent of that demand response is a summer-only resource.¹³

Importing power from plants in other reliability regions can also be an issue. On July 15, 2013, a Tennessee Valley Authority transmission constraint, exacerbated by the reduction of a MISO resource, resulted in the curtailment of more than 3,300 megawatts of PJM imports,¹⁴ including 29 megawatts of imports on firm transmission.¹⁵ This is the reliability risk of depending on imported power. PJM has cleared power imported from Louisiana in its capacity auction, although the ability of that Louisiana power to ever be delivered into PJM territory during emergency conditions is problematic at best.

Currently, PJM's three-year Base Residual Auctions are augmented with annual incremental auctions. Demand response resources can bid into the Base Residual Auction at one price, and buy back their own resources in the incremental auctions

⁶ Dominion news release, May 7, 2013.

⁷ <http://www.entergy.com/vy/>

⁸ Chicago Tribune, March 9, 2013, Business Section, page 1

⁹ The PJM "2016/2017 RPM Base Residual Auction Results" report (page 1).

¹⁰ The PJM "2016/2017 RPM Base Residual Auction Results" report (page 10) shows that of the 12,407MWs of DR cleared for 2016/17, only 88MWs were available year-round.

¹¹ PJM Emergency Demand Response (Load Management) Performance Report 2013/2014

¹² PJM "2016/2017 RPM Base Residual Auction Results" report (page 10), Table 3B.

¹³ Slide 13 of Kormos presentation at April 1, 2014 FERC Tech Conference on Polar Vortex. Target Reserve level is approximately 25,000 MWs. DR cleared for 2016/17 was approximately 12,000MWs.

¹⁴ <http://www.pjm.com/media/committees-groups/committees/mrc/20130829/20130829-item-13-hot-weather-operations-presentation.ashx>. Slides 8 and 9.

¹⁵ <http://www.pjm.com/media/committees-groups/committees/mrc/20130829/20130829-item-13-hot-weather-operations-presentation.ashx>. Slides 8 and 9.

at a nice profit, and never have to perform a demand response function for reliability.¹⁶ PJM's Independent Market Monitor has issued two reports on this problem.¹⁷ As much as 57.6 percent of demand resources have purchased replacement capacity in the incremental auctions. The average over the seven-year measurement period was 32.5 percent.¹⁸ These speculative resources are replacing the actual physical generation we need because it is financially more lucrative to buy back in the incremental auctions than to deliver the capacity.¹⁹ Nor does demand response provide the very important ancillary services currently provided by many of the retiring generating units.

Beyond the demand response issue, PJM went into 2013/14 with a 20 percent reserve margin, but called 10 emergency operations in January 2014.²⁰ PJM has conducted auctions for 10 planning years and the average clearing price has been \$90/megawatt-day.²¹ This is less than 30 percent of the Net Cost of New Entry (CONE)²² and may not be enough to sustain existing units, let alone entice new construction. PJM has made several filings recently to try to eliminate the speculative bidding that has made it more profitable to be a financial player in PJM than offer up real generation resources. I applaud those efforts. Although PJM is trying to correct many of these shortcomings through FERC filings, it is not enough.

In the next 14 months, AEP will retire almost a quarter of our coal-fueled generating units. We have one of the largest generation fleets in the country, and one-fourth of our coal-fueled capacity will be shuttered. There is no turning back for these units. In PJM, 13,000 megawatts of additional capacity will be retiring by mid-2015.²³ Unless the market structure changes, the capacity replacements for these assets may not provide the same level of reliability we have experienced historically.

AEP believes that capacity prices should be augmented by a reliability adder, or price floor. This would support continued operation of base load generating units and provide incentives (and penalties) to spur construction of new generation. We also believe a longer-term commitment for price certainty would help all companies with both existing and new assets to make long-term investment decisions. Power plant investments are for 30+ years. A reliability adder combined with a longer-term award would provide proper incentives, ease financing, and provide longer-term price stability for the markets, all of which will preserve and increase grid stability.

RELIABILITY IMPACT: THE DASH TO GAS

These situations are exacerbating a dash to gas as the nation looks for quick alternatives to our retiring base load plants. Incongruities in the gas and electric markets create a new set of problems.

Inconsistencies in scheduling protocols between the gas and electric industries create difficulties for many gas-fired electric generators. These inconsistencies can make it challenging for gas-fueled generators to purchase gas supplies and schedule pipeline capacity.

The coordinated operation of the natural gas and the electric industries is not impossible. In fact, in AEP's southwestern footprint, we have been coordinating our industries fairly well for years. It is important to realize that no one is at fault for the disconnect between the two industries. The industries matured independently, and they developed unique operating procedures that worked well for their individual businesses. Now that they both have operating protocols that have been in place for decades, we need to find a way to successfully merge their processes.

In New England during the polar vortex, it became clear that we are having to make a choice in the winter between committing natural gas resources to generating

¹⁶ Latest report is Analysis of Replacement Capacity for RPM Commitments: June 1, 2007 to June 1, 2013.

¹⁷ Latest report is Analysis of Replacement Capacity for RPM Commitments: June 1, 2007 to June 1, 2013.

¹⁸ *Ibid.*, Table 8

¹⁹ http://www.monitoringanalytics.com/reports/Reports/2013/IMM_Report_on_Capacity_Replacement_Activity_2_20130913.pdf. Page 35. The Market Monitor in referring to the high percentage of replacements being done by demand resources says, "The result is an increasing share of total capacity resources that are limited DR, which are clearly not a substitute for generating capacity which is on call 8,760 hours per year."

²⁰ <http://www.pjm.com/-/media/committees-groups/committees/mc/20140224-webinar/20140224-item-01-winter-operations.ashx>. Slide 6 on Cold Weather Operations report.

²¹ Average taken from all 10 Base Residual Auction reports for Rest-of-market 2007/08 through 2016/17.

²² Net CONE for 2016/17 was \$330/MW-day.

²³ Andy Ott's presentation at February 12, 2014, PJM General Session, page 3.

electricity or to heating homes.²⁴ Right now, we cannot do both. Given the number of additional base load generating units that will be retired in the next 14 months, we face a very real possibility that we will have to make that choice more often in the future.

Many of the issues of harmonizing the gas and electric industries revolve around scheduling. FERC currently has three open dockets related to scheduling. RM14-2-000, the primary docket, has adopted a unique approach to resolving the scheduling problems. FERC has offered new scheduling procedures and steps to bring the gas and power days closer together. FERC has charged the North American Energy Standards Board (NAESB) with reaching full industry consensus for both industries within six months. NAESB is the nation's only organization that reaches across both industries and NAESB is ANSI certified for standards development. NAESB's window to reach consensus will be followed with a public comment period on the NAESB proposals. If NAESB cannot reach consensus in the time allotted, the FERC proposals in RM14-2-000 will, after notice and comment, become the new scheduling standards.

AEP is supportive of the FERC natural gas proposals in the Notice of Proposed Rulemaking (NOPR). Currently the gas day begins at 9 a.m. Central Clock Time (CCT), all across the country.²⁵ The power day begins at midnight in the time zone in which the energy is generated.²⁶ FERC proposes moving the start of the gas trading day to 4 a.m. CCT, which allows power traders to purchase the gas supply they need in time to receive delivery for their morning peak load. RM14-2-000 also proposes adding nomination cycles to the current four cycles (two real-time cycles and two day-ahead).

These two changes would resolve several of the timing issues that currently either a) require gas generators to purchase fuel for much longer times than what they really need, increasing their costs as they buy far more fuel than is actually required or b) force gas generators to risk not getting a gas supply if they wait to buy gas until after their dispatch awards. For example, under the current rules generators have to purchase fuel for Monday on Friday afternoon, and they cannot always predict that far ahead exactly how much gas they will need.

With the growing dependence on natural gas for electricity generation, availability and deliverability of gas must be considered in RTO planning and when setting generation reserve requirements. In general, gas cannot be stored on site at an electric generation plant in sufficient quantities to guarantee future fuel supply. Meanwhile, gas pipelines are looking for firm transport contracts, meaning they want a reservation fee for the full capacity of a generating station for every hour of the year. Many of these gas plants are peakers, generating units that only operate during peak demand periods, and only need the gas reservation for a small portion of the year.

Most capacity markets do not require a firm contract in order for a generator to be counted as reliable capacity. If all gas-fueled generators were required to obtain firm transport contracts, the result would be much higher electricity costs. This would improve reliability somewhat, but even firm transport does not guarantee availability of the gas supply. Discounted non-firm transport carries even more reliability issues. Further, in many cases the location of a gas unit precludes the ability to obtain firm gas supply because it is on a pipeline that is already fully subscribed.

RELIABILITY IMPACT: GENERATION IS RETIRING

Prior to implementation of MATS, we did not have an adequate assessment of the impact of these environmental regulations on our nation's base load generation. When the MATS rule was proposed, the U.S. EPA projected that the rule would result in approximately 10,000 megawatts of coal-fueled generation being retired.²⁷ More recently, NERC's 2013 Long Term Reliability Assessment places the retirement number at 62,800 megawatts by 2023.²⁸ Not all of these retirements are due to MATS, with lower natural gas prices, weak electric demand and flawed markets all playing a role. But the timing of many of the retirements will be driven by the MATS compliance deadline.

²⁴ <http://www.forbes.com/sites/jamesconca/2014/01/12/polar-vortex-nuclear-saves-the-day/>

²⁵ Appendix F, page 19

²⁶ Appendix G, page 19

²⁷ National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-fired Electric Utility Steam Generating Units, Proposed Rule, 76 Fed. Reg. 24975, 25073 (May 3, 2011).

²⁸ 2013 Long-Term Reliability Assessment, p. 29, North American Electric Reliability Corp

AEP will retire an additional 6,586 megawatts (approximately 1/4 of its coal-fueled capacity) with most retirements occurring in mid-2015.²⁹ We will not add any new capacity in the near term. The total PJM capacity market is approximately 169,000 megawatts.³⁰ According to PJM, more than 9,827 megawatts of generation already has been shut down since the 2007/08 delivery year and another 12,909 megawatts is scheduled to retire in the next two years.³¹ While 8,750 megawatts of new generation that cleared in the PJM capacity auction is supposed to go online in 2015 and 2016, only approximately 4,500 megawatts currently is reported as under construction.³² Many planned generation plants were offered into the auction or are being built only because they have a regulated-type of cost recovery structure (such as in Virginia).³³ Further, almost all of the new generation that was offered in the market in the last several years has been natural gas-fueled; and that is the predominant type of generation that is currently in the planning queue.

Many times, new generation projects are permitted but never built. The average construction time for a gas plant is 2.5 to 3.5 years, depending on the technology used.³⁴ So even if some of those additional projects are built, I am concerned they will not be online in time to relieve the immediate reliability challenges that stem from the coal-fueled unit retirements.

All of these factors (capacity markets, environmental standards, gas coordination) are significant issues impacting our power generation fleet today. Additional environmental rules still in development could create additional issues. The Cooling Water Intake Rule (316b), the Coal Ash Rule and the Greenhouse Gas New Source Performance Standards all could potentially result in additional base load generation units being retired. The MATS rule implementation did not allow a lot of flexibility in meeting the regulatory standards. If a rational approach with sufficient flexibility is not taken in setting these new environmental standards, we will face additional threats to grid reliability.

RESOLVING RELIABILITY THREATS

I am not saying we should repeal MATS. Nor am I saying we should avoid building natural gas power plants. I am saying that we are facing some serious reliability concerns that require quick action.

Regulators at the federal and state levels must recognize and consider the complexity of the transitions and challenges facing the electric grid today. The combination of capacity markets, environmental regulations, and gas coordination issues are potentially a bigger threat to reliability and safety than physical and cyber security violations. Regulated utilities plan for peak usage through integrated resource planning processes. Competitive generators depend on clear market signals to support the investment necessary for stable operations. Megawatts flow seamlessly across state borders. As additional stressors impact the bulk power system in the coming years, state and federal regulators must be vigilant to ensure that regulated customers are not harmed by the scarcity and volatility that will develop if competitive markets are not fixed.

Toward that end, AEP advocates for:

- Significant progress on fixing the capacity markets by January 2015. We need to return the focus of the nation's electric grid to reliability and away from a financial scheme that rewards speculative activity. That can be achieved through the FERC, and I would encourage this Committee to support the FERC in that effort.
- Passage of legislation to resolve the conflict between the authority of the Department of Energy and that of the Environmental Protection Agency that could manifest in the DOE ordering a unit to run even when that unit would violate environmental requirements. Legislation is needed to clarify the rules and expedite new construction to ensure that existing generation will not have to face a choice between violating the environmental rules and letting the lights go out.

²⁹Total retirements per American Electric Power 2013 Corporate Accountability Report are 7,201MW. Of this total, 6,586MW are to be retired between now and mid-2015.

³⁰The PJM "2016/2017 RPM Base Residual Auction Results" report (page 1).

³¹Andy Ott's presentation at February 12, 2014, PJM General Session, page 3.

³²Andy Ott's presentation at February 12, 2014, PJM General Session, page 3 for planned units. 4,280MW's under construction from the Ventyx database monitored by AEP.

³³Virginia's units are Brunswick and Warren County - total approximately 2500MW. Although the New Jersey and Maryland state-subsidized programs were found to be in violation of the PJM Tariff rules, the units that were awarded in those state-run auctions offered and cleared in the RPM before the state programs were overturned. Some of these units decided to continue to build and some are undecided or continue to have contractual issues.

³⁴AEP 2011 Integrated Resource Plan cost model for new units

- Completion of the action recently begun by the FERC to coordinate the natural gas and electric industries. I believe FERC has taken important steps in this direction and is doing so as rapidly as possible. We need resolution before next winter. Nothing good comes from a scenario in which anyone has to choose between electricity and heat. The severe weather this winter highlighted the many challenges that are seriously threatening the reliability of our electric grid. These issues are real and they are pressing, and we have been given an opportunity to address them. Few things in this country are as critical as grid reliability. We should not waste this opportunity to ensure that we address the issues challenging our ability to provide reliable electric service. The electric grid powers our economy, our citizens' homes and our national security. And the next cannon ball we see coming at us may not be one we can dodge.

I thank you for the opportunity to address you on these issues. I would be happy to respond to any questions.

[Note: Appendixes A–G provided with this statement have been retained in committee files.]

The CHAIRMAN. Thank you so much. Excellent.
Mr. Hunter.

STATEMENT OF JAMES L. HUNTER, DIRECTOR, INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS UTILITY DEPARTMENT

Mr. HUNTER. I think Nick said everything I need to say. Thank you.

[Laughter.]

Mr. HUNTER. I appreciate the invite to come here, Chairman Landrieu and members. My name is Jim Hunter. I'm Director of the Utility Department for the IBEW. We have about 725,000 members nationally. 220,000 of those are directly working in the utility industry in the U.S. and Canada.

To put the situation plainly, the U.S. is facing a crisis, we believe, in power generation. It's caused by a conflict between environmental regulations and demand for power and flaws in the structure of the system.

I've worked in the industry now for over 40 years. I've never seen our generation business in a worse position than it is today. Many of our veteran members are telling me the same thing.

We just had a conference with over 500 delegates from all over the U.S. and Canada, our leaders in our industry. Everybody is in total agreement that we are in deep trouble. We're not seeing, not only coal retirements, but we're also now seeing nuclear retirements.

We submitted for the record back in 2011 our estimate of 56 gigawatts of coal closing due to the MATS rule. At the time EPA was saying 4.7. All of this came from not extensive modeling but came from us from common sense looking at 40-year-old plants under 400 megawatts that were not scrubbed simply would not be capable of staying in service.

That number turned out to be pretty much right on the nose.

That translates into over 50,000 direct jobs. Those come from rail workers, plant workers and workers in the industry. You take a BLS number uses about 4 to one for any electrical generation employees that we're talking about 250,000 people losing their jobs over the next 2 years.

The impact of lost generation will be severe. We've already talked about how many of those plants were running during this

cold Polar Vortex. We believe that next year we're going to be in deep trouble.

We've been told that FERC can address the issue by issuing must run orders. But we're also told that you can't be—alleviate a civil lawsuit under the Clean Air Act. So where are the utilities going to be?

I totally agree with Mr. Akins that we know from the inside as you start closing a plant it's an irreversible thing. I mean, we've got people moving to other plants. We've got people to other parts of the industry and people getting out of the industry as a whole.

We firmly believe that FERC, you know, needs to address some of the issues. We also believe that Congress needs to address this double jeopardy issue.

You know, base load power plants are the heart of the industry. Nuclear and coal fired closing due to market conditions, even the cleanest and most efficient, for example, you know, we know Clinton nuclear facilities, IBEW facility, ran at 100 percent efficiency last year and lost \$30 million. Now if that doesn't common sense tell people that there's something wrong with the market, I don't know what does.

We have a situation right now where the only plants that can be built are gas. I agree with Senator Manchin, putting all our eggs in one basket, a volatile basket, I've been told that there are no long-term contracts for gas. We saw many situations where we are doing less maintenance. We have less people. We weren't able to bring some of the coal units online because of that.

Not getting gas. There was one plant that starts the unit with gas, a coal plant. They weren't able to get gas to even put a coal unit on.

With that, thank you.

[The prepared statement of Mr. Hunter follows:]

PREPARED STATEMENT OF JAMES L. HUNTER, DIRECTOR, INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS UTILITY DEPARTMENT

Good morning Chairman Landrieu, Ranking Member Murkowski, and members of the committee.

My name is James Hunter. I am the Director of the International Brotherhood of Electrical Workers (IBEW) Utility Department. I have been asked by our President, Ed Hill, to speak today on behalf of the IBEW. Thank you for the opportunity to speak on this critical issue.

IBEW represents 725,000 members; more than 220,000 of them are utility workers, who are covered by some 1,400 collective bargaining agreements in the United States and Canada.

SITUATION

To put the issue plainly: The United States is facing a crisis in electric power generation caused by a conflict between environmental regulations and the demand for power, and by flaws in the economic structure of our system.

I have worked in the utility industry for over 40 years now and have never seen our generation business in a worse position, and many of our veteran members believe the same. The IBEW provides a view of the utilities from the inside that we feel is unique. We do not have multi-million dollar models for predicting plant closure, but we have common sense and practical knowledge of the system. In 2011 the IBEW and several other unions testified before the Environmental Protection Agency—a copy of which has been submitted for the record—in which we predicted that 56 gigawatts of generation would be lost due to plant closing under then-proposed rules. At the time, EPA predicted only 4.7 gigawatts would be lost. The EIA

in their latest "Annual Energy Outlook" now shows about 56GW of closing by 2016. Our experience enabled us to see what the agency's models could not.

The 56GW of closings represents over 50,000 direct job losses. Those losses come from mineworkers to rail workers to power plant jobs all gone in the next 2 years. The BLS number for indirect job losses when a plant closes is 4 outside jobs for every one electrical worker. And many of these job losses will fall heavily on rural communities where most of these plants are located.

The impact of this lost generation will be severe. We saw in the recent cold winter 80% to 90% of the plants that are closing were needed to meet demand and ensure reliability. We have been told that PJM has not done any winter modeling in over 10 years and we believe that we were simply lucky not to have seen blackouts this winter. Luck is a poor substitute for proper planning.

We have been told that the Federal Energy Regulatory Commission can address the issue by issuing a "must run" order if the system cannot meet demand. However, closing a plant is a long, complex process—one that cannot easily be reversed to meet urgent needs. Plant maintenance is reduced and staffing levels decrease as the plant closing dates near. Workers seek to transfer to the transmission and distribution side of the utility, or leave the industry altogether. Contracts for coal and other critical materials are scaled back. None of this can be turned around in a short period of time. In fact, we saw plants that were called on to operate during the cold spell unable to get on line because of problems like boiler leaks and other issues caused by not running.

Another very important issue is that a "must run" order from FERC does not exempt the owner of plant from civil lawsuits or federal penalties under the Clean Air Act. Therefore, utilities will find themselves whipsawed between environmental regulations and the mandate to provide adequate electrical power.

We believe that the loss of the affected plants over the next two years will cause a severe shortage of generation, but that is only part of the problem. The second, and potentially more disruptive, part of the equation consists of the economic stress fractures in our electrical system caused by the partial deregulation of the industry in the 1990s and—ironically—the boom in domestic energy production.

I think we would all agree that the increased supply of natural gas has been a good thing for our country. But it has driven down the price of electricity and had an unintended consequence for the utility industry.

We see base load plants that are at the heart of electric system, nuclear and coal-fired, closing due to market conditions, even the cleanest and most efficient. For example, the Clinton nuclear facility in Illinois run at 100% efficiency last year with no down time and yet lost 30 million dollars. We have seen perfectly good plants with license extensions close due to the market.

This is not a matter of the market making some forms of generation obsolete. We have a situation where the only plants that can be built are Gas. We learned from bitter experience that an overreliance on one source of energy is not a sound policy. An unexpected disruption in the supply of natural gas could send prices spiraling on the spot market. We also know that renewable energy sources such as wind and solar are not far along enough in development to provide a major share of our nation's power supply. We need to address these issues now or risk destroying the heart of our great electric system.

SUGGESTED SOLUTIONS

There are solutions; if we act quickly.

We need seasoned and knowledgeable Commissioners on FERC who can and will make changes to the market to properly compensate our base load plants for the services they provide.

We need better coordination between FERC and EPA. EPA and the NRC must consider the cost impacts their rules have on the industry. Specifically, the new rules EPA is considering for water in the 316b rule and the CO-2 rule for existing plants could have a profound impact on our coal and nuclear plants.

Congress must address the double jeopardy issue between a must run order and the fact that plant owners can be sued under the Clean Air Act.

The IBEW wants clean water and clean air as much as anyone and has always supported reasonable approaches by the EPA. We understand that EPA has done all that it can do to extend the time needed to comply with their rule on MATS. The problem now must be solved by FERC and the Congress.

Thank you very much for the opportunity to testify today.

The CHAIRMAN. Thank you very much.
Mr. Hill.

**STATEMENT OF THAD HILL, PRESIDENT AND CHIEF
OPERATING OFFICER, CALPINE CORPORATION**

Mr. HILL. Thank you.

Good morning, Chairman Landrieu and Ranking Member Murkowski and to the rest of the committee. My name is Thad Hill. I'm the President and COO of Calpine Corporation and next month I'll also become the CEO.

We are an independent power producer with 29,000 megawatts of generation with 94 plants in 20 States. So we produce enough energy for about 30 million homes. We are the largest gas fired generator in the United States. Ninety-five percent of our capacity is natural gas.

In PJM we have 5,000 megawatts of generation capacity. It's worth a note that 90 percent of those actually have fuel oil back up. So we have the dual fuel capability at our units.

The key message is we believe that competitive electric sector in particular and PJM is in solid shape to transition. I'll make this transition from one of predominately coal, less gas, to, you know, more of an equal mix between coal and gas over the next several years. The PJM market is not perfect. There are some changes needed that I'm going to come and I'm going to talk about at the end. But it is working.

We strongly believe that competition free markets, you know, are a much better way to solve problems than having government pick winners and losers or some kind of central planning. The market is encouraging to investment including we actually have a power plant under construction right now in Dover, Delaware. We're considering a pact of other investment in PJM.

To talk about the Polar Vortex for a minute. We all know the facts. You know, very, very strong winter weather. The grid came close to some kind of noticeable disruption. A lot has been talked about that I think the facts are really important around this.

The real issue is that there were 40,000 megawatts or as Mr. Kormos said, 22 percent of the system forced out. Of those 40,000, 30,000, 75 percent, were because of mechanical or operational failures because of the winter weather. Of those 30,000 megawatts about 9,000 of those megawatts were natural gas, by the way, only about 1,500 megawatts of modern combined cycle natural gas. There were almost 15,000 megawatts of coal units that were forced out during that winter weather.

The point being is that this isn't about over reliance on any one fuel. It was about operational readiness this winter. I want to make sure we understand that because the solution is a lot different if you actually think that operational, you know, we should have a much higher standard for how our fleet operates in extreme weather events.

Coming out of the Polar Vortex in a go forward basis, Mr. Kormos said this, but there are about 15,000 megawatts of coal plants that will be retiring over the next 3 years. They'll be replacing it with 19,000 megawatts of new resources. So we actually will have more resources then than we do now even after accounting for the retirements. The summer reserve margin will be 30 percent above where it's supposed to be and in winter we'll, you know, even be in better shape.

The gas supply issue, there's almost \$3 billion of investment in the Northeast in gas supply going forward. It will create about 5 and a half BCF a day of new capacity. That's two Calpines worth of gas, 60,000 megawatts.

So with all that said, you know, we think the free market are working, but there are some changes. I'm going to mention four.

First, the renewable production tax credit which is now under consideration for an extension is really distorting the market and potentially leading to premature retirements. You've got billions of dollars of taxpayer money that are actually subsidizing wind resources to the point they actually run at negative prices even. They're paying somebody to take their power so they get the production tax credit. We don't know these resources will be on when we need them and they're actually, because of this tax subsidy, actually threatening, including the nuclear and coal plants that we've talked about, the reliability of the grid.

Second, demand response has become a significant part of the resource mix play. We're OK with demand resource competing, just like we do. But they need to have the same rules. They need to be available all the year round. They need to be available when it's not just an emergency. Other than that, it's OK.

Third is better coordination of power and gas. Given time I won't go deeper.

Fourth is making sure that the capacity markets actually are appropriate. If you take a capacity payment you need to be there operationally. You need to be there with your fuel. If you say you're going to be there you need to be there. There needs to be a different financial outcome than there is today.

Now the first one of these is clearly Congress's.

The second through the fourth are being handled already in a lot of ways by PJM, FERC and ongoing processes.

So with that, thank you for your time.

[The prepared statement of Mr. Hill follows:]

PREPARED STATEMENT OF THAD HILL, PRESIDENT AND CHIEF OPERATING OFFICER,
CALPINE CORPORATION

Good morning Chairman Landrieu, Ranking Member Murkowski and members of the Committee. Thank you for inviting me to speak this morning on "Keeping the Lights on—Are We Doing Enough To Ensure the Reliability and Security of the U.S. Electric Grid?" My name is Thad Hill. I am President and Chief Operating Officer of Calpine Corporation and will assume the role of Chief Executive Officer this May.

Calpine is an Independent Power Producer with more than 29,000 Megawatts (MW) of generation capacity from 94 power plants in 20 states, and is the largest independent power producer measured by power produced, almost enough to power 30 million homes. We sell our power into competitive wholesale electricity markets, including PJM. We are not a regulated utility receiving a guaranteed return. Rather, we compete against other generators to sell wholesale power into markets where the purchasers are utilities and other suppliers who then deliver the power to their retail customers. So the economics of supply and demand are fundamental to our business.

About 95% of the electricity generated by Calpine's fleet is from natural gas-fired power plants. Overall, Calpine burns more than 10% of all natural gas consumed by the power industry, making us one of the largest consumers of natural gas in the U.S., and the largest among all power generators. Despite our size, Calpine's fleet is the cleanest among the major players in America's independent power generation sector.

In the PJM market, Calpine owns approximately 5,000 MW of generating capacity and virtually all our plants run on natural gas. Particularly relevant to today's dis-

cussion, nearly 90% of this capacity also has the capability to burn oil as a primary or back-up fuel, with onsite oil tanks. This dual fuel capability was specifically designed into the system to allow Calpine's assets to continue generating even under extreme conditions such as we witnessed this January.

My key message here today is that the competitive electric sector—in particular PJM, which covers much of the mid-Atlantic and the Midwest, and which I believe is most of the focus of this panel—is in solid shape to transition over the next several years from one supported by older, less efficient and more costly coal plants to one supported by newer, more efficient, less expensive and cleaner natural gas plants. At Calpine, we believe that competition yields the best results—that relying on entrepreneurialism and the free market creates more value than central planning or government picking winners and losers. There is significant new investment occurring in the mid-Atlantic power and gas markets—including our own brand new gas fired power plant under construction in Dover, Delaware. These investments are being made due to the game-changing discovery of shale natural gas, the existence of a competitive market with a set of rules, and a commitment by the stakeholders to seeing the market function. Although this market is not perfect, changes to address some of the issues are underway, and grid reliability is secure.

But before going deeper into the evolution of the mid-Atlantic grid over the next couple of years, let me first pause and discuss the recent extreme weather events and the lessons I think are important regarding how the grid is managed going forward.

JANUARY EXTREME WEATHER AND WINTER PREPAREDNESS

Early in January, record winter load and several unit outages caused some risk of a reliability event in PJM—specifically on January 7. There has been much written and said about this event—but at its core, the issue was that more than 40,000 MWs of generation was forced off-line when load was at its highest. On that day, PJM set an all-winter peak load record of 141,286 MW and, at the same time 22%, or 40,200 MW, of the generation fleet was unable to come online and produce power, a term the industry calls a “forced outage”. The January 7th forced outage rate was two to three times higher than PJM's typical winter forced outage rate of seven to ten percent, and together with the very high load level, created tight system conditions.

The primary problem on January 7, and to a lesser degree later in the month, was that generators weren't ready for the extreme cold. More than three quarters, or 30,000 MW, of the forced outages were associated with equipment breakdowns, startup failures, and other problems related to operating in extremely cold temperatures. These problems occurred across all generation types with 9,000 MW of gas and more than 14,000 MW of coal being affected. This wasn't a fuel supply problem; it was a winter preparedness problem.

There is already evidence that the forced outage issue has been partly corrected due to competitive market forces: In each of the extreme cold weather events occurring subsequent to January 7th, generator forced outages were significantly lower and, as a result, there was more than 10,000 additional MW available to PJM to meet the needs of electricity consumers. There is more work to be done. An increased focus on cold weather preparedness will inevitably bring the forced outage rate down even further.

Indeed, in response to January's system conditions, PJM has begun to review its market and operational rules to improve performance of the system for next year. Some of the recommendations already emerging from PJM and stakeholder discussions include requiring resources to perform regular winter capability testing, improving communications, and enhancing emergency procedures.

In addition to mechanical and other failures leading to plant outages, there were 9,300 MW of outages because of gas curtailments—situations in which gas-fired generation did not have a firm contractual right to the pipeline transportation nor did they have backup fuel like we have at most of our power plants in the PJM region. In response, PJM is undertaking important discussions on whether and how to define a “firm fuel requirement” for generators that commit to sell capacity to the grid. This means that in order to receive payment for providing capacity, generators must have mechanisms in place to guarantee fuel availability for a pre-specified period of time. Whether this concept is ultimately implemented through a “carrot” or a “stick” approach, Calpine believes all suppliers should have strong incentives to

meet capacity supply obligations they've made to PJM, especially during times of system stress.¹

Another key learning from January is the increasing need to tighten power and gas market coordination, especially in terms of daily operating decision-making. Although this lack of alignment did not create a reliability issue, it was responsible for price volatility and constrained how gas-fired generators could respond to changing system conditions. The Federal Energy Regulatory Commission (FERC) has opened a proceeding to address this issue. In a Notice of Proposed Rulemaking issued in March, FERC set a six month deadline for the natural gas and electric industries to better align their schedules. FERC also issued a "strawman" proposal that Calpine believes will result in meaningful improvements to this process. Other changes may be needed as well to better coordinate the electric and gas markets, such as changes to allow better coordination of gas deliveries over weekends and on Mondays.

EVOLUTION OF THE ELECTRICITY AND GAS MARKET INFRASTRUCTURE

Let me turn now to the question of the electric supply mix going forward. As noted earlier, we are in an era of tremendous change within the electric power industry. Several older, less efficient and more costly coal plants are retiring, while newer, more efficient, cheaper, and cleaner gas-fired units are taking market share, supplemented by renewable units and increasing use of demand response.

Specifically in PJM, there are approximately 15,000 MW of expected retirements over the next three years. Most of this is coal-fired, and a smaller portion consists of older gas and oil-fired resources. This old, inefficient generation is being replaced by nearly 11,600 MW of new generation capacity, mostly natural gas fired, 4,230 MW of new imports from other markets adjacent to PJM, and a little more than 3,400 MW of new demand response and energy efficiency resources.

When we do the math, these subtractions and additions mean that by the summer of 2017 PJM expects to have significantly more generation capability than it needs. In industry terms, the summer reserve margin in PJM is expected to be 21.1%, or 5.5% higher than the target.² Further, Calpine estimates that the winter reserve margin will be even higher, in the 21% to 25% range, based on winter forced outages in the 7-10% range. In other words, even including forced outages, PJM will have plenty of supply relative to expected demand.

To be clear, despite this changing resource mix, coal is by no means going away. In fact, by 2017, we expect coal generation in PJM to represent approximately one-third of PJM capacity. This isn't a war on coal. It is a market-driven move towards newer, more efficient, cleaner generation.

Concurrent with the expansion of natural gas fired capacity, there is also a significant expansion of the pipeline infrastructure occurring in the Northeastern US. Information from the Energy Information Administration shows that approximately \$2.8 billion is expected to be spent over the next two years on natural gas expansion projects, representing approximately 5.5 Billion cubic feet/day of new pipeline capacity in the Northeastern United States.³ Calpine burns 2.1 -2.5 billion cubic feet/day, so this new pipeline capacity is large enough to serve more than two new companies the size of Calpine. Finally, we note that, overall, pipeline companies have announced approximately 25 projects scheduled to be in service over the next 3-4 years that will move approximately 15 Billion cubic feet/day from the Marcellus Shale region to markets east of the Rockies. While it is unlikely all of these projects will materialize, they represent total capital expenditures of \$12-\$18 billion, and could fuel more than 130,000 MW of gas-fired generation.

THE POWER MARKET

As I've described above, the market signals are broadly working to incentivize investment in new electric and gas market infrastructure. However, markets are not perfect and some level of ongoing optimization is required. The very good news is that many of the tweaks needed to remove market distortion and ensure efficient deployment of capital is well underway.

One issue policymakers must deal with sooner rather later is that non-market interventions, such as the wind Production Tax Credit (PTC), may be leading to premature retirements of certain baseload resources, potentially impacting the reli-

¹ As noted earlier, nearly 90% Calpine's capacity in the PJM region has the capability to burn oil as a primary or back-up fuel, with onsite oil tanks.

² <http://www.pjm.com/-/media/markets-ops/rpm/rpm-auction-info/2016-2017-base-residual-auction-report.ashx>

³ <http://www.eia.gov/todayinenergy/detail.cfm?id=10511#capacity>

ability of the future resource mix. The current structure of the PTC subsidizes wind resources in the energy market to the point where wind generators will pay others to take power that is otherwise unneeded, in order to maximize their benefit from the PTC. So, while the wind resources cannot generally be counted on to provide energy during extreme winter or peak summer conditions, the effect of the PTC is to take revenues from resources that can supply the market. The PTC interferes with market forces and is no longer necessary.

Yet another distortion to markets comes from demand response (DR), which is provided by customers that are paid to curtail their load when asked by PJM. DR competes against traditional supply side resources in PJM's capacity market to commit to providing reliability when needed by the system. As a result of a significant policy focus on growing this segment of electricity business, DR has become an increasingly large part of PJM's resource mix. This summer, DR will account for approximately 8% of PJM's peak resource needs, yet PJM can not call on the resource unless it is experiencing "emergency" conditions, nor is the vast majority of it required to be available to provide reliability during the winter.

PJM has recently proposed to FERC a package of DR rule changes that will address some of these issues, and we're hopeful FERC will approve them shortly. But, we think more needs to be done. To the extent DR is counted on for providing reliability to the system, it should be available year-round like other generators, and should be able to be called prior to PJM declaring a system emergency.

There are also other market changes in various phases of consideration at PJM and before FERC, including: changes to limit imports into the region from neighbors, changes to ensure capacity that is committed in an auction is actually built, and others.

In summary, there are three points I'd like to leave you with: First, the bulk power electric system in PJM—while undergoing a transition—is in great shape from a reliability stand point. PJM is well equipped to manage the transition. While its role may be diminished, coal will continue to play a critical role in meeting the region's reliability needs. But cheap American gas and its associated expanding infrastructure is poised to play a much larger role than before—not only in power generation but more broadly in our country's industrial efforts. Second, the power market is working well—it is incenting new investment—and in the case of older, less efficient generation, it is sending the appropriate retirement signals. We do not think that regulatory or governmental interference in functioning markets can lead to better outcomes—we must continue to rely on the free market. While some changes in market rules over time will certainly be required, PJM and FERC have all the necessary tools to enact these. Finally, while the events of January in the mid-Atlantic were volatile, the system worked. There are, however, certainly some improvements necessary, as examples: the fuel availability and coordination issues that I discussed today. Again, PJM and FERC have the right processes and authority to put in place these and other changes.

Thank you again for the opportunity to testify on these important issues.

The CHAIRMAN. Thank you. Thank you very much.
Ms. Roberto.

STATEMENT OF CHERYL L. ROBERTO, ASSOCIATE VICE PRESIDENT, EDF CLEAN ENERGY PROGRAM, ENVIRONMENTAL DEFENSE FUND

Ms. ROBERTO. Good morning, Madame Chairman and distinguished members of the committee. I am delighted to be with you this morning. My name is Cheryl Roberto. I serve as the Associate Vice President of the Environmental Defense Fund's Clean Energy Program.

EDF is not your typical environmental organization. As a former State regulator I served as a commissioner in Ohio and an electric system executive, I likely don't fit your stereotype of an environmental activist. At EDF we work to solve the most critical environmental problems using market based solutions. We are uniquely effective in that approach drawing on science, economics, partnerships and ardent bipartisanship.

The clear message that I want to share with you today is that with or without new environmental regulations market based changes are transforming our electricity system. But our electricity system can still meet our reliability needs.

As a former regulator and a system operator no one puts a higher premium on safety and reliability on our electric system than I do. While the fundamental nature of our electric grid is transforming irreversibly, I'm confident that this transition can be accomplished without sacrificing safety and reliability or even cost effectiveness.

Our national commitment to reliability is nonnegotiable. But we need to recognize that the electricity system we built in the last century and the regulations that govern them are no longer adequate either to ensure reliability or to accommodate the rapid changes in technology, consumer needs, environmental standards or the changing marketplace.

You've heard from other panelists and I agree that we're seeing a market based change in fuel choice for centralized generation. It's marketedly shifted our energy landscape, the change in fuel for large and utility scale electricity generation units. However is not even the most significant part of the transformation.

The very model of centralized utility scaled generation itself is no longer sacrosanct. The cost of distributive generation technologies are falling. Energy productivity is rising. In our digital world, consumers have increased demands for power quality and reliability, but needs for power quantity are falling, are predicted to fall. As a result our system is transforming from a one way power delivery network in which customers passively receive electricity to a two way flow of both power and information in which customers both receive and produce electricity.

For anyone as concerned about reliability as I am it is difficult not to notice that the power outages we suffer do not arise from the lack of generation. They are rooted in our transmission and our distribution systems. In fact, power outages due to severe weather impacting our distribution system costs between \$18 billion and \$33 billion per year. This grid transformation can enhance our reliability. We have every reason to believe that our energy system that seamlessly knits together centralized and distributive generation is possible and will meet our energy needs more reliably and cost effectively.

In order to realize the benefits of this transformation we need to unleash the innovation that we see in our States. From a perspective as a former regulator and a system operator in the State of Ohio I strongly support active State engagement. Our history and experiences demonstrated that we can weather this transition without threatening our uniform and nonnegotiable commitment to reliability.

But to do that we need to tap all the tools at our disposal, to ensure that robust, reliable and an integrated energy system that is no longer dependent exclusively upon centralized generation. Managed properly it can deliver benefits to electricity consumers, the economy, environment generators, innovators and workers alike.

Thank you very much.

[The prepared statement of Ms. Roberto follows:]

PREPARED STATEMENT OF CHERYL L. ROBERTO, ASSOCIATE VICE PRESIDENT, EDF
CLEAN ENERGY PROGRAM, ENVIRONMENTAL DEFENSE FUND

Madam Chairman and distinguished members of the Committee, I appreciate the opportunity to appear before you today. My name is Cheryl Roberto and I serve as the Associate Vice President, EDF Clean Energy Program for the Environmental Defense Fund (EDF).

EDF is not your typical environmental organization, and—as a former state regulator and electric system executive—I likely do not fit your stereotype of an environmental activist. At EDF, we work to solve the most critical environmental problems using market-based solutions. We use a uniquely effective approach, drawing on science, economics, partnerships and ardent bipartisanship. We have a long history of working collaboratively with corporate partners, beginning in 1990 when EDF worked collaboratively with McDonalds to reduce the company's solid waste, including from those foam “clamshell” containers.

We recognize that technological innovations like horizontal drilling and hydraulic fracturing have enabled us to tap vast new reserves of natural gas in the U.S. This has been good for our economy, and it could be good for our environment—but only if we take action to address the very real risks to public health, the environment, and our climate that come along with increased gas production and use. In just the past few months, we worked closely with the administrations of Colorado Governor John Hickenlooper, Wyoming Governor Matt Mead, and Ohio Governor John Kasich as they formulated common-sense leak detection and repair requirements to reduce methane emissions from leaking valves, connectors and other equipment at oil and gas well sites.

I lead EDF's Clean Energy Program, a national effort in which we work with utilities, state regulatory commissions, legislatures, governors and other stakeholders in the nine states¹ in which more than one half of US electricity is produced and consumed. Our goal is to reform utility regulation and market rules so that customers can choose clean-energy options with the same ease they currently access traditional sources of electricity. The policies we promote include: aligning market incentives for utilities and third-party entrepreneurs to reward investments in clean energy; ensuring that the market values clean resources fairly; improving consumer access to data and information; advancing clean energy financing mechanisms that connect customers to private capital; and optimizing electric grid efficiency.

I am a former utility regulator and a former electric system operator. Prior to joining EDF last summer, I served as a commissioner on the Public Utilities Commission of Ohio, my home state and one long dependent upon coal-fired generation. As a member of the National Association of Regulatory Utility Commissioners (NARUC) I served as: vice chair of the Critical Infrastructure Committee and a member of the Electricity Committee, the board of directors for the National Regulatory Research Institute, and Task Force for Environmental Regulation and Generation. I was tapped by NARUC to co-chair the National Electricity Forum 2012, a national conference addressing cutting-edge issues and potential collaborations to successfully modernize the nation's electricity infrastructure. I served and continue to serve on the executive committee for a national network of more than 200 utilities, financial service companies, energy service companies, commissioners, and consumer advocates working toward the goal of achieving deployment of all cost-effective energy efficiency by 2020.

I have provided testimony before the Federal Energy Regulatory Commission's (FERC) Technical Conference on Reliability of the Bulk Power System, in anticipation of environmental rules for mercury and air toxics. The testimony that I prepared received the unanimous, bi-partisan support of my colleagues on the Ohio Public Utilities Commission. Prior to my appointment to the commission, I served for six years as the Deputy Director and then Director of the City of Columbus, Ohio Department of Public Utilities. My duties there included running the City's electric distribution utility. That hands-on experience meeting the daily needs of electricity customers while protecting the financial integrity of the system gave me a keen appreciation for the real-world demands of system reliability.

The clear message that I want to share with you today is that, with or without new environmental regulations, market-based changes—including those that are reducing the number of older, coal-fired power plants—are transforming our electricity system but our electricity system can still meet our reliability needs. As a former regulator and system operator, no one puts a higher premium on the safety and reliability of our electric system than I do. While the fundamental nature of our electric

¹Texas, Pennsylvania, Ohio, North Carolina, New York, New Jersey, Illinois, Florida, and California.

grid is transforming irreversibly, I am confident that this transition can be accomplished without sacrificing either cost-effectiveness or safety and reliability. Our national commitment to reliability is non-negotiable, but we need to recognize that the electricity systems we built in the last century, and the regulations that govern them, are no longer adequate—either to ensure reliability, or to accommodate the rapid changes in technology, consumer needs, environmental standards, and the changing marketplace.

The nation's electricity system stands at a transformative crossroads, which was not fully apparent just six or seven years ago. We have seen a massive and dynamic reduction in the price of natural gas as a result of developments in horizontal drilling and hydraulic fracturing of shale. By all appearances, abundant domestic natural gas will be our reality for the foreseeable future, making natural gas in many instances a cheaper alternative for electricity generation than coal. "Coal-fired power plants in the United States have been under significant economic pressure in recent years because of low natural gas prices and slow electricity growth demand," according to the Energy Information Administration.² Beyond the market-price advantage of natural gas, aging coal-fired generation plants built decades ago (75% of all coal-fired plants in the United States are more than thirty years old with a typical useful life of forty years³) will require new investments to keep up with market changes, as well as to conform to evolving environmental rules.

It would be a mistake, however, to attribute the economic challenges faced by coal plant operators solely, or even largely, to environmental standards—as a 2012 study performed for EDF makes clear: "The sharp decline in natural gas prices, the rising cost of coal, and reduced demand for electricity are all contributing factors in the decisions to retire some of the country's oldest coal-fired generating units. These trends started well before EPA issued its new air pollution rules."⁴ Moreover, coal plant operators are not alone in the challenges posed by America's abundant new gas supplies. Nuclear power faces economic challenges from the availability of natural gas.⁵ In short, we are seeing market-based changes in fuel choices for centralized electricity generation that have markedly shifted our energy landscape.

The change in fuel for large- or utility-scale electricity generation units, however, is not even the most significant part of the transformation. The very model of centralized, utility-scale generation itself is no longer sacrosanct. The costs of distributed generation technologies such as solar photovoltaics, battery storage, fuel cells, geothermal energy systems, wind, and micro turbines are falling with renewable options becoming available at a level equivalent near to where natural gas prices were just a few years ago. And Energy productivity is rising. In the last 40 years, the United States has experienced a 300% increase in economic output with less than a 50% increase in energy used to produce it.⁶

The U.S. Energy Information Administration (EIA) actually projects that average energy use per person will decline between 2011 and 2040.⁷ In our digital world, consumers have demands for power quality and reliability that have not been adequately served from electricity cascading from centralized generation plants through miles of transmission and distribution lines. In fact, power outages due to severe weather impacting our distribution system (not our generation plants) cost between \$18 billion and \$33 billion per year. These figures do not include losses from major storms like Hurricane Ike or Sandy.⁸ Falling natural gas prices reduce the operational costs of natural gas-fueled combined heat and power systems.

Customers are increasingly interested in how distributed generation, on its own or working in concert with the power from the grid, can meet their needs. Increased integration of intermittent renewable sources, such as wind, mean that distributed resources including demand response have added value to the operators of the cen-

²"AEO2014 projects more coal-fired power plant retirements by 2016 than have been scheduled." Today in Energy (U.S. Energy Information Administration) <http://www.eia.gov/todayinenergy/detail.cfm?id=15031>

³http://www.eia.gov/energy_in_brief/article/age_of_elec_gen.cfm

⁴Tierney, Susan F. "Why Coal Plants Retire: Power Market Fundamentals as of 2012" (Analysis Group, February 16 and 24, 2012) http://www.analysisgroup.com/uploadedFiles/News_and_Events/News/2012_Tierney_WhyCoalPlantsRetire.pdf

⁵See generally AEO2014 Early Release Overview http://www.eia.gov/forecasts/aeo/er/early_elecgen.cfm

⁶America's Energy Resurgence: Sustaining Success, Confronting Challenges, Bipartisan Policy Center's Strategic Energy Policy Initiative, February 2013, p. 6 ("Bipartisan Policy Center Report") <http://tinyurl.com/crp7uxm>

⁷Annual Energy Outlook 2013, released April 15-May 2, 2013 http://www.eia.gov/forecasts/aeo/chapter_market_trends.cfm

⁸"Economic Benefits of Increasing Electric Grid Resilience to Weather Outages" (Executive Office of the President, August 2013) http://energy.gov/sites/prod/files/2013/08/f2/Grid%20Resiliency%20Report_FINAL.pdf

tralized grid—also driving interest in investment and adoption of distributed resources. The Edison Electric Institute, the association representing all U.S. investor-owned electric companies published a report last year acknowledging and describing this “disruptive challenge” to the model upon which our electric service has been based for the past century.⁹ Not all utilities see this disruption as only a challenge—some utilities see this transformation as an opportunity: “Hardly expecting the nation’s grid to collapse with the advent of more distributed generation, heads of three major U.S. utility companies see customer interest in generating their own power as a prime opportunity to focus on their wires business and new, potentially profitable customer service offerings.”¹⁰

Our system is transforming from a one-way power delivery network in which customers passively receive electricity to a two-way flow of both power and information in which customers both receive and produce electricity. The utilities are becoming a platform for integration of the full range of energy services. The two-way system is animated by customers who are now receiving information about their usage (when and how much they use) and price signals indicating moment-by-moment the changed value of electricity. We see instances of distributed resource alternatives smoothly integrated into the grid with no preference given to the incumbent centralized generation. The proliferating diversity of options is providing opportunities to customers to hedge risk for both price and reliability (for example, customers may find that their electric vehicle may be plugged back into their home to provide power to ride out storm outages.)

Changes in the energy landscape across the nation are significant—but not to be feared. My home state of Ohio is a prime example. Each of the electric utilities in Ohio purchases the electricity its customers require through auction, or it is on a pathway to do so. Ohio consumers in the Duke Energy and AEP territories are increasingly able to participate in a two-way relationship with their utilities through technology platforms enabled by smart meter installation. Duke Energy has installed 426,000 smart meters. AEP has installed 110,000¹¹ and recently filed plans¹² with the Public Utilities Commission to add 900,000 more. Consumers with this technology platform will progressively gain more options to choose how, when, and even if they will use electricity—and from what source. Consumers served by Duke Energy and AEP are already enjoying briefer outages—greater reliability—due to a more responsive distribution system informed by smart grid investments. Consumers are participating in energy efficiency opportunities and enjoying savings at levels we have not seen before.

The transformation of the grid—both as a result of the fuel-switching by central generators and the growth of distributed generation—does not need to impact reliability negatively. All indications are that, in fact, transformation will enhance reliability.

A number of factors point to continued confidence in the resilience of our grid. The first of which is market response. The PJM regional transmission organization holds auctions (called Reliability Pricing Model Base Residual Auctions or RPM) looking ahead three years, in order to secure enough generation for reliable grid operations. For the past three years, these auctions have both confirmed impending coal-fired plant retirements and provided reason for confidence that alternate strategies will successfully meet reliability and affordability needs.

In the most recent 2016/2017 PJM RPM Auction, approximately 9,000 MW of coal-fired generation offered into the auction failed to clear it.¹³ Approximately 4,000 MW coal-fired generation failed to clear the previous auction.¹⁴ These trends, shown on the first chart below, illustrate that coal-fired plants are becoming less economically competitive as less expensive options squeeze them out, a trend continued during the past three years. These coal-fired plants were replaced by a combination of gas-fired generation, renewables, energy efficiency, and demand response. At the same time, the winning auction prices have decreased significantly, as shown by the second chart below. Of particular note, 23% more energy efficiency cleared

⁹Kind, Peter *Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Energy Business* (EEL, January 2013). <http://www.eei.org/ourissues/finance/Documents/disruptivechallenges.pdf>

¹⁰Cordner, Christine, “Utility CEOs see distributed generation as opportunity, not threat” (SNL April 7, 2014)

¹¹<http://www.puco.ohio.gov/puco/index.cfm/consumer-information/consumer-topics/smart-grid-in-ohio/>

¹²Case No. 2013-24.

¹³PJM, 2016/2017 RPM Base Residual Auction Results at p. 29, Fig. 3—Offered and Cleared Quantities of Coal and Gas.

¹⁴Id.

the 2016/2017 auction as compared with the prior year.¹⁵ Thus, a market response alone successfully replaced the coal-fired power at a cost-effective rate.

The second reason for confidence that the grid will remain reliable during this ongoing transition is that it has successfully managed each prior concern precipitated by environmental requirements. Most recently reliability concerns were raised when the Mercury and Air Toxics Standards were adopted as well as when the Cross-State Air Pollution Rule was adopted. Predictions by the U.S. Environmental Protection Agency¹⁶ and by the U.S. Department of Energy¹⁷ that reliability would not be impacted have proven accurate. Finally, during the most recent “polar vortex”, we saw the grid stressed by the combination of high demand and generation plant failures (including 13,700 MW of coal-fired plants which failed to perform)¹⁸ and yet it continued to perform well.

Centralized generation plants will persist in an important role within our nation’s energy system. Some of these plants may continue to be coal-fired. EDF supports a flexible compliance framework for existing coal-fired plants to meet anticipated greenhouse gas rules that will deploy the most cost-effective solutions available, which include harvesting the vast amounts of widely available cost-effective energy efficiency. In order to facilitate maximum use of this resource, last month EDF offered concrete suggestions to U.S. EPA regarding the opportunity to account for energy efficiency as an element of compliance.¹⁹

Utility operators are embracing energy efficiency as a solution as well. As reported earlier this week, AEP CEO Nick Akins has urged that energy efficiency and renewable energy additions should serve as a pathway to greenhouse gas standards compliance for existing coal-fired generation:

In order to not add fuel to the fire already begun by MATS [EPA’s mercury and air toxics rule] and low gas prices, . . . EPA should acknowledge early action measures taken by utilities to reduce their greenhouse gas emission profiles such as renewable energy additions and energy efficiency measures. In taking this step, the agency will be enabling utilities to move funds from environmental compliance to wires investments aimed at boosting reliability²⁰

We have every reason to believe that an energy system that seamlessly knits together centralized and distributed generation is possible and will meet our energy needs more reliably and cost-effectively. For instance, we know from a National Renewable Energy Laboratory study that renewable electricity generation technology commercially available today could meet 80% of our electricity needs every hour of every day in every region of the country by 2050, if we adopted a more flexible electricity system and we made the investment.²¹ Energy efficiency remains the most cost-effective means to meet our energy needs. In a recent comprehensive analysis by Lawrence Berkeley National Lab, the average cost of energy efficiency over the past three years has been a mere 2.1 cents/kWh.²²

In order to realize the benefits of all of this transformation, we need to unleash the innovation we see in the states. From my perspective as a former regulator and system operator in the State of Ohio, I strongly support active state engagement in

¹⁵ Id.

¹⁶ “Resource Adequacy and Reliability in the IPM Projections for the MATS Rule” http://www.epa.gov/ttn/atw/utility/revise_resource_adequacy_tsd.pdf

¹⁷ “Resource Adequacy Implications of Forthcoming EPA Air Quality Regulations,” (U.S. DOE December 2011) http://energy.gov/sites/prod/files/2011%20Air%20Quality%20Regulations%20Report_120111.pdf

¹⁸ In re: Winter 2013-2014 Operations and Market Performance in RTO and ISO, Statement of Michael J. Kormos Executive Vice President—Operations PJM Interconnection, L.L.C. (FERC Docket No. AD14-8-000, April 1, 2014) <http://www.ferc.gov/CalendarFiles/20140401084122-Kormos,%20PJM.pdf>

¹⁹ Hibbard, Paul J. and Andrea Okie, “Crediting Greenhouse Gas Emission Reductions from Energy Efficiency Investments: Recommended Framework for Proposed Guidance on Quantifying Energy Savings and Emission Reductions in Section 111(d) State Plans Implementing the Carbon Pollution Standards for Existing Power Plants” (Analysis Group March 2014) <http://www.edf.org/sites/default/files/eemv-111d-recommended-framework.pdf>

²⁰ Corder, Christine, “AEP CEO: Polar vortex should be a ‘red flag’ for EPA as it crafts greenhouse gas standards” (SNL, April 7, 2014)

²¹ National Renewable Energy Laboratory. (2012). Renewable Electricity Futures Study. Hand, M.M.; Baldwin, S.; DeMeo, E.; Reilly, J.M.; Mai, T.; Arent, D.; Porro, G.; Meshek, M.; Sandor, D. eds. 4 vols. NREL/TP-6A20-52409. Golden, CO: National Renewable Energy Laboratory. http://www.nrel.gov/analysis/re_futures/

²² Ernest Orlando Lawrence Berkeley National Laboratory. (March 2014) The Program Administrator Cost of Saved Energy for Utility Customer-Funded Energy Efficiency Programs. Billingsley, M.A.; Hoffman, I.M.; Stuart, E.; Schiller, S.R.; Goldman, C.A.; LaCommare, K. <http://emp.lbl.gov/sites/all/files/cost-of-saved-energy-for-ee-programs.pdf>

the design of compliance strategies. I do so because I know that it works. Reliability of the grid is best protected when state utility commissions and state air agencies are empowered with flexible standards to work on their own or regionally to meet these challenges.²³

State utility regulators have long recognized and trusted that energy efficiency and load management are effective tools for cost-effectively managing reliability.²⁴ They are leading the way in Hawaii, Illinois, and Ohio to ensure that customers have access to information about their energy usage and options to pay for clean energy alternatives with private capital. In California and Texas, they are clearing away arcane rules to ensure that their energy needs are met by “just-in-time” service—only generating when the power is needed and sending price signals to provide options to customers to dial back their demand when electricity would be more costly.

Massachusetts is investigating what it takes to have the most nimble grid that it can. Minnesota has established protocols to value distributed solar installations in a manner both fair to the utilities and to the home owners. Meanwhile, New Jersey and New York are implementing the lessons learned from Superstorm Sandy, by promoting resilient microgrids using combined heat and power and renewable generation sources. All across the country, utility regulators, utilities, clean-tech companies, and advocacy organization such as EDF, are engaged in nurturing and implementing ideas for utility business models to support a transformed grid.

There is no great disagreement that the U.S. energy system is transforming. With or without additional environmental regulations, this transition is occurring. Our history and experience have demonstrated that we can weather it without threatening our uniform and non-negotiable commitment to reliability. But to do that, we do need to recognize that this is about far more than the relative market advantages and disadvantages of various energy sources. It is about tapping all of the tools at our disposal to ensure a robust, reliable and integrated energy system that is no longer dependent exclusively upon centralized generation. It is about a fundamental transformation that is happening across the country, one that can deliver benefits to electricity consumers, the economy, the environment, generators, innovators, and workers alike.

The CHAIRMAN. Thank you very much. That was excellent.

We’re under a little bit of a time constraint so I’m going to ask one question to Mr. Hill, turn it over to Senator Murkowski for hers and then Senator Baldwin, I will recognize you because you have to preside at 12 o’clock. Then we’ll follow up with Senators Portman and Manchin and close out the hearing.

Let me just submit for the record, though, the price of electricity currently, today, from a high of 16 cents per kilowatt/hour in New York.

New Jersey is 14 cents per kilowatt/hour approximately.

California is 14 cents per kilowatt/hour.

To the lows in the country which are in Louisiana, Arkansas, and Wyoming.

I’d like to submit that to the record.

In addition I’d also like to submit the EPA proposed utility air toxic rules manage and compliance and reliability ways.*

There’s an EIA study, this graph** is a little frightening to me because it doesn’t show a mix of fuels which I think we need. Al-

²³ See Comments Submitted on Behalf of The PUCO by Cheryl Roberto, Commissioner to the FERC Reliability Technical Conference November 30, 2011 (Docket No. AD12-1-00) <http://www.ferc.gov/CalendarFiles/20111208072456-Roberto,%20PUCO.pdf>

²⁵ See NARUC resolution, “Energy efficiency and load management as cost-effective approach to reliability concerns” (July 23, 1999 concerns <http://www.naruc.org/Resolutions/Resolution%20Supporting%20Energy%20Efficiency%20and%20Load.pdf>)

* Chart has been retained in committee files. [Source: Sue Tierney, “EPA Proposed Utility Air Toxics Rule—Managing Compliance in Reliable Ways,” Congressional Staff Briefing, May 9, 2011, p. 10. The chart is based on EIA Form 860 data. A similar chart produced by EIA itself can be found at <http://www.eia.gov/todayinenergy/detail.cfm?id=1830>]

** Graph has been retained in committee files.

though, it does show the potential of natural gas which I'm excited about. I'd like to submit that to the record.

Mr. Hill, let me ask you.

Senator Manchin and I have many discussions about the role of nuclear, coal and gas. Could you just reiterate what your thoughts are about gas as a base load fuel for electricity production? What is making that possible? Is it government rule and regulation or is it just technology to market or a combination of both?

Mr. HILL. Thank you, Madame Chairman.

The gas is perfectly capable of being a base load fuel. In fact, is a base load fuel in many markets around the world and increasingly in some of the markets here in the United States.

What has changed is the shale gas revolution. We, as a country, have been blessed with the natural gas which is very affordable. This is not about government. This is about technology innovation, having a resource which is much cheaper to extract than anybody ever thought possible. It's cheaper all in to deploy natural gas plants than it is other technologies.

So it is witness to market working.

The CHAIRMAN. OK.

I'm going to come back to a question about how exports do or don't, I think they do, but open to hear, effect the supply issues of natural gas in the United States. But because of time I'm going to move to Senator Murkowski.

Thank you so much.

Senator MURKOWSKI. Thank you, Madame Chairman.

Thank you to each of you for, I think, very, very important testimony following on our first panel here.

Commissioner Moeller, I want to recognize your leadership in this issue. You mentioned the letter back in 2011. As you know, I've spent a lot of time on these issues, on the issue of reliability of the electric grid before it was, kind of, fun and popular and generated a full committee room of interest here.

When I had posed a series of questions back a couple years ago that really started, I think, to prompt a more robust dialog on these real important issues, the impact of Federal policy on reliability. I think we're finally starting to get some traction here. It's taken longer than I had hoped, but I really do think that what we've heard today just goes so much to the heart of this.

I think if there is one point of agreement amongst everybody at the witness table this morning, Madame Chairman, it's that we cannot be reliability neutral. That we have got to ensure that the lights go on and that our electric sources, whatever they may be, where ever they may be coming from, that they're robust. They're reliable and of course, they are affordable.

I want to ask a question. This is probably directed to you, Mr. Akins and you, Mr. Hill.

We're talking about what is happening with the move from coal fired plants to gas fired plants. I think you spoke, Mr. Hill, to really what is online in terms of investment out there. But how confident are we that we're going to have the gas pipeline infrastructure that can be placed in service in time to allow these new gas facilities to enter when we need them for reliability?

I'm concerned about how this all knits together. I'm not convinced that we've got a real good handle on what the investors are doing with great opportunities to move to gas. But how do we get it from here to there?

Mr. AKINS. I'll certainly try to address that and then, obviously, Thad, you can take over.

But as we've been retiring generation we put in 5,000 megawatts of natural gas facilities. It's very clear that when you go through that process it has to be done in a very measured way because you're not only looking at the resource itself, you're looking at the deliverability.

Certainly from a natural gas perspective, if we're going to depend more on natural gas as even a base load type of fuel, we need to make sure that that underlying grid of the natural gas infrastructure is just as reliable as the electric infrastructure because we'll be only as good at delivering electricity as that lowest common denominator.

Senator MURKOWSKI. Do you think that we're talking enough about the reliability of those systems, though?

Mr. AKINS. Oh, I don't think so. I think there's a lot of work being done through the Federal Energy Regulatory Commission, not only on terms of their nomination cycles and things like that relative to natural gas, but the pipeline activities are also being looked at from a reliability perspective. So we need to continue that process.

The issue is and I think you hit on the point, is the timing of that transition. Because naturally there are parts of the country and our Midwestern part of the country, natural gas wasn't very prevalent until recently. So there's a lot of activity there in our south central part of the U.S. with Louisiana, Texas, Oklahoma and Arkansas, it's been prevalent for years.

So it takes time to get that kind of infrastructure in place.

Senator MURKOWSKI. Mr. Hill, your comments?

Mr. HILL. As I mentioned in my prepared remarks there are billions of dollars of capital being spent on this problem right now. I mentioned \$3 billion in the Northeast alone. What's driving that is that the producers want to get their fuel out. Again, it's the market working.

You've got, you know, during the Polar Vortex you had gas at a very low, single digit price trapped behind a constraint in Pennsylvania. You had gas that priced, as we know, at \$100 per BTU just miles down the road. You know, there are a lot of gas producers who care a lot about that. They will spend heavily and encourage investment as contractors on the pipeline expansion.

So, I think, for the time period we're talking about which is the next two or 3 years, the investment will follow. Certainly, longer term we need to pay very close attention to this.

Senator MURKOWSKI. Thank you.

I'll defer, Madame Chairman.

The CHAIRMAN. Thank you.

Senator Baldwin, thank you so much for your presence this morning.

Senator BALDWIN. Thank you. Thank you for convening this incredibly important hearing. I want to also thank my colleagues for letting me jump the line before I head over to preside.

Madame Chair, I was not able to be present for the questioning of panel one. I just want to let you know that I had intended to ask some questions about large power transformers and will be submitting those for the record that hopefully we can hear back from panel one.

But jumping to panel two and thank you all for being here and your testimony.

Commissioner Moeller, I think I walked in just as you were concluding your comments about capacity markets. I know that FERC has taken some time to really look a little bit more deeply at capacity markets.

Given that examination, and the performance of those markets during this past winter, I'd like to hear whether you believe that capacity markets are performing as they should?

Are you considering any changes to current capacity market constructs?

Also are you planning, is FERC planning, to receive any additional stakeholder comments on capacity markets following the challenges that were witnessed this past winter?

Mr. MOELLER. Thank you, Senator Baldwin.

That question also could be relevant to our Acting Chair LaFleur. We did have a technical conference in September on capacity markets and extended the comment deadline at least once. We, I think, have the staff analyzing that. It's an ongoing proceeding. It's one that has a lot of interest.

Can't tell you where we're going because I'm not even sure what the options are right now. But at least some of the discussion has been should we assign a higher value to those generating resources that have onsite fuel whether that be oil, fuel rods or coal. Is there greater value there that's not being recognized now? That's one of the concepts that's out there.

Did they work as intended?

The system worked, but the prices were very, very high. A lot of that though was, as referenced before, to pipeline capacity constraints. You would have gas 100 miles away trading at the national levels, but then 20 times that where there's constraint.

So that goes to a little bit different subject. I'd be happy to talk in more detail so I don't take up all your time.

Senator BALDWIN. OK.

I'll just close with a quick comment before I have to leave, but as many of you know Wisconsin is no stranger to extreme weather and extreme cold. In fact this past winter we had pretty fierce conditions. The community of Antigo had negative 30 degrees. I wanted to say that things actually worked pretty well in the State during this extreme weather with regard to electricity. The Chair and I have talked a lot about our challenges with propane.

But American Transmission Company and MISO operate in Wisconsin. Their transmission lines and other facilities, I think, fared quite well. So I'm wondering if Wisconsin's success and experience during this really extreme weather can serve as lessons for other

regions. I certainly would suggest you reach out to hear about our best practices.

The CHAIRMAN. Thank you, Senator.

In future hearings which Senator Murkowski and I are talking about doing, we want to hear from different parts of the country because we do think that we can pick up best practices. I know that there's a lot of that conversation going on. But I think getting more of that on the record here in Washington would be very helpful.

Alright, Senator Manchin, we're going to give you the last word. Senator MANCHIN. Oh, thank you.

The CHAIRMAN. Now we're limiting him to 1 hour.

[Laughter.]

The CHAIRMAN. Now he's got 10 minutes or less.

Senator MANCHIN. OK.

The CHAIRMAN. Alright.

Senator MANCHIN. First of all I want to thank you again. This has been extremely interesting. It's something we've been looking forward for a long time.

Commissioner Moeller, I'll start with you.

There's been some Senators who believe that basically FERC's—FERC does not play a policy role, as far as in energy reliability, only oversees rates. Do you want to correct or basically, for the record, tell us what FERC does and how much input they may have?

Mr. MOELLER. Senator, thanks for the question.

We essentially create policy almost daily in terms of the precedent that is set through the variety of—

Senator MANCHIN. How? Is that basically how energy will be produced or delivered or a little bit of everything?

Mr. MOELLER. We do not have a role in really generation outside of our role as a regulator of hydropower production. That is primarily a safety and environmental role.

Senator MANCHIN. The question I asked earlier was with PJM since they are in the area that I live in. If they're not able to and you see that they're not able to produce because they don't have that power or the reliability of the power are you able to step in and give them ability to keep running something that they might have?

Mr. MOELLER. Typically we call those reliability must run contracts.

Senator MANCHIN. Yes.

Mr. MOELLER. We have several that we've approved in the last few years. We probably anticipate some more. That was kind of the essence of my testimony. I think we need a deeper dive into exactly what's going on.

Senator MANCHIN. So it wouldn't be accurate for any of us to believe that you do not have any input whatsoever in the policy or directly of generation. You entwined at all of it, correct?

Mr. MOELLER. We're entwined, yeah.

Senator MANCHIN. OK.

If I can go to Mr. Akins, if I may?

Could you reverse the closures if FERC or PJM, you know, determined and this is what we just talked about now that the system

could not be maintained or relied upon and not to be guaranteed to give us the power as needed, could you reverse any of the closures you have underway?

Mr. AKINS. Yes, there may be areas where it's a possibility. But we'd have to look at each individual circumstance because, you know, we've known these units were going to shut down for years when the rules came out. So, you know, like investing in the bottom of boilers, for example.

Senator MANCHIN. Sure.

Mr. AKINS. To keep those running.

You'd have to put a substantial amount of investment back into units which would take time itself.

Then second, you'd have to staff up again. They're running with skeleton crews at this point in time just so that we can—

Senator MANCHIN. Are all the units? Mr. Akins, all the units that you're taking offline, are they, all the older units that weren't scrubbed or didn't have low NO_x boilers or hadn't met the Clean Air Act?

Mr. AKINS. Yes, typically they were the small, subcritical, 200 megawatt units. But there are larger units—

Senator MANCHIN. Have you taken anything offline or predicted to take something offline that doesn't meet the clean air standard as we've had in the past which is SO_x and NO_x?

Mr. AKINS. All the units that we're taking offline do not have scrubbers. I think one of them has selective catalytic production devices. So it's a matter of making investment decisions based upon, you know, the rules and what's required verses the other options available. But that takes time.

Senator MANCHIN. Mr. Kormos, were you concerned when First Energy took off super critical units?

Mr. KORMOS. I mean, obviously we're concerned when anybody retires a unit.

Senator MANCHIN. But this unit here met the clean air standards.

Mr. KORMOS. Excuse me?

Senator MANCHIN. This unit met the clean air standard.

Mr. KORMOS. That is our understanding.

Senator MANCHIN. They made a decision because of reimbursement that they couldn't recoup the cost.

Mr. KORMOS. They felt that economically the unit wasn't viable going forward.

Senator MANCHIN. Is that because of you alls pricing or your policies?

Mr. KORMOS. It's based on the prediction of what they thought the future market revenues would be. It was a business choice made by them.

Senator MANCHIN. You didn't encourage or involve because of reliability factor? You didn't get involved?

Mr. KORMOS. No, very much like FERC. I know, from reliability analysis we absolutely got involved to make sure the grid would be reliable should the unit choose to retire from a business perspective, very much like Commissioner Moeller, we're still neutral.

Senator MANCHIN. What was the average increase of the bills of the people are going to get hit with in your system this year, I mean, this past winter and this vortex?

Do they have any idea how much they went up?

Mr. KORMOS. That is very dependent on what kind of rate they have settled with with their supplier. For those on a fixed—

Senator MANCHIN. What kind of prices were you paying for what period of time? What kind of prices were you paying and you're going to be passing on that? I mean, you have to, that charge.

Mr. KORMOS. The average price was probably well over \$100 dollars per megawatt/hour or whatever dollar/kilowatt.

Senator MANCHIN. That possibly could double a person's bill very easily, right?

Mr. KORMOS. If you were on a variable rate contract, yes, if you're on a fixed rate, obviously not.

Senator MANCHIN. Mr. Hill, should we open the gates? I think that Senator Landrieu, kind of, addressed this, but right now we have an awful lot of people wanting to export LNG and we thought we were going to need to import LNG.

Should we open the gates unfettered on LNG exports?

Mr. HILL. Senator, you know, our view is in most things that our free market should be allowed to work. You know, obviously there are questions if you were to export LNG or anything else for that matter whether prices go up.

Senator MANCHIN. Knowing the pricing volatility of gas right now and setting in our policy seats, do you think that would be a good policy decision for us to vote to open an unfettered matter when we're going to be needing so much more of this product at a competitive price?

Mr. HILL. I won't comment on it, but I will say this about natural gas. There is lots of it. There's a long, flat, what economists would call a supply curve.

Senator MANCHIN. They've told me that before, but then it didn't turn out to be what we thought it would be. I hope it is because West Virginia has been blessed. I just hope there's as much as you tell me.

I knew how much coal was there because I could see it. I can't see the other. OK? I'm just taking your word for it.

So you want us to open an unfettered market. I'm a marketeer. I think that's the concern we have right now that we could get ourselves in one heck of a bind putting our eggs in one basket. We made AEP and everybody else shift because of the policies. That was the question I was asking.

Now if I could ask anybody who wants to chime in on this one, please do.

Do any of you believe that this government or this Administration's energy policy and regulatory agenda is in sync with reality or ahead of the curve?

[Laughter.]

The CHAIRMAN. I knew it. I knew I should have cut him off before this last question.

Senator MANCHIN. I still have 1 minute.

The CHAIRMAN. You have 1 minute.

Senator MANCHIN. One minute.

The CHAIRMAN. We do have two other Senators that have to go. Senator MANCHIN. We're ahead of the practicability of what can be done.

[Laughter.]

Senator MANCHIN. Are you being put in a bind in your shorts? You're really tight right now.

Go ahead, Nick, take it.

Mr. AKINS. I'll take a crack at it.

[Laughter.]

Mr. AKINS. So here's the issue. I think there needs to be a lot more thorough analysis and thoughtful analysis. If I were to encourage anything for the existing Administration it's for the EPA, the Federal Energy Regulatory Commission and the Department of Energy to get together and have substantial discussions about, not only the environmental policy, but in the framework of the other activities that are occurring around reliability and grid resiliency. That's what needs to be done.

Yes, we were in a box. But I think it's because of the aggressive timelines that were put in place. We are adjusting to that. Mike Kormos is doing everything that he can from a PJM perspective. The markets are trying to respond.

Senator MANCHIN. The citizens will be vulnerable in the price, right? The citizens?

Mr. AKINS. They'll be vulnerable for a period of time because it is a transition, a substantial transition, that's occurring. That takes time in our industry.

Senator MANCHIN. Anyone else want to jump in real quick?

The CHAIRMAN. Yes, OK.

Mr. HILL. Senator, if I could?

You know, the rule that we've talked the most about, the MATS rule, you know, there are lots of other debates out there including climate change and other topics. But there is no debate about the fact that mercury is bad for human health.

Senator MANCHIN. Sure.

Mr. HILL. That SO₂ causes acid rain. That NO_x causes smog and respiratory issues, right? That's what that rule is about.

The technology for controlling these units—commercial technology from one of these units is 40 years old. The 89 percent of the units that were talked about in Mr. Akins fleet that are retiring are on average over 50 years old.

So I think maybe there's a question about how you implement it. But there's no doubt about, you know, the rules.

Senator MANCHIN. Needs to be retrofitted?

Mr. HILL. Yes, sir.

The CHAIRMAN. Thank you so much.

Senator Portman and then Senator Barrasso and then we're going to have to bring this kvery interesting hearing to a close.

Senator Portman.

Senator PORTMAN. Thank you, Senator Landrieu.

I appreciated being here earlier to hear the testimony from both panels. The questions I was asking earlier about grid reliability of the first panel I really wanted to, kind of, tee up for you all. So if you have comments on those, jump in.

But let me just, if I could, go to this issue of how do you have an EPA coordination with FERC and Mr. Akins just talked about, but also adding DOE to that mix. But really with the private sector too, to figure out, you know, and you know, with the utilities in particular, to figure out how are we going to have this reliability that all of us want to see.

I mean, we came really dangerously close this winter. My understanding is we came so close that people almost found themselves in a situation where their lives, you know, were going to be at stake because people do lose their lives when the electricity grid is going down in a cold winter, partly because people rely on it for heat, partly because of other reasons. You've got to have electricity.

So, you know, we are in a situation where you guys are in a box. We've got this huge problem with consumers having to pay more and not having the reliability that we should have. Yet EPA just seems to be continuing on without any concern about that.

So I understand that we need to have regulations and to Mr. Hill's point, some of these plants are old, it's true. A lot of these plants also, although, had upgraded equipment on specifically on dealing with some of the environmental concerns.

So I guess my question would be, you know, the cumulative effect of these regulations, it seems to me, is not being analyzed. There is no cost benefit analysis about that. There's not dis-coordination, you know, with the utilities, with the new regulatory model which in, as we talked about earlier is, you know, no longer with a historic regulator model where the States in conjunction with the utilities are responsible for it. In our area it's PJM.

What should we be doing about that?

So who wants to jump in on that about better coordination and how do we ensure that we're not going to run into the same problem this summer should we have a heat wave and next winter if we have another Polar Vortex?

Mr. Hunter.

Mr. HUNTER. Thank you. I think it's a great question, great point.

These two hearings really are very much alike. As we're closing down more and more of these plants we're depending more and more upon transmission grid. We're talking about cyber security/physical security, looking at the grid and transformers. I came from a substation here at Pepco.

You know, we've got a very vulnerable grid. We're making it more vulnerable the more generation that we close down.

These EPA rules, 316B water rule, will affect the nuclear as well as it will coal. We're, you know, we're beyond now talking about 60,000 or 56, 60 or however it's going to be in coal plants. We're now talking about possibility of closing down nuclear and super critical coal.

It's an issue that needs to be addressed. I had in my comments that I didn't get to that the coordination and the cost of these new rules and NRC also needs to come in to that picture. We've got regulatory rules coming from the NRC that have significant cost impacts. We're not looking at those cost impacts from EPA or NRC.

Senator PORTMAN. Nick, do you have a comment?

Mr. KORMOS. Nick's going to let me go first.

I probably just offer one thing. In the METS rule we asked for and got what was called the Reliability Safety Valve. I really think it's important going forward, particularly any of the future EPA rules that allow that analysis to happen, allows some, hopefully, some people to look at it. If we do see the reliability problems we will be the first to speak up.

Again, I think Nick is right. A lot of this is about time. We need to make the time. We need the time to make the transition.

If you give us that time, this industry is very robust and resilient. We'll make the transition. It's more about the time of it, the time it takes.

Senator PORTMAN. The problem with that is we've got all these plants shutting down. By 2015, I mean, you know, in Nick's comments earlier, that 89 percent of that power would have been needed. So we're, you know, as Mr. Hunter said earlier, when you shut these things down and people leave and they're dismantled. You can't bring it right back up.

I understand and I appreciate what Ms. Roberto said about the fact that there is more distributive power that's coming. I understand there's a fuel mix changing. I understand that there's some changes.

But in the meantime, 2015 is right around the corner. So my question is what can we do right now? Commissioner you talked about that a little bit earlier, but if you guys could comment on that as well and Ms. Roberto too.

Mr. AKINS. I think certainly we should take the time to get this right. Now I don't know what that means in terms of legislation or other activities that can ensure that the right parties are coming together to make the situation better.

But there's clearly and certainly it was hit on earlier, this notion of capacity markets, environmental regulations, grid security around physical and cyber security, all of those come together in the same framework. It is a national security issue and one that we need to be very thoughtful about.

I think that when you think about some of the issues that can occur, certainly that we talk about first contingency outages in our business a lot. When the system is stressed we plan the system around those stressful events, first and second contingency outages.

When we're taking away resources that, not only provide power, but this is sort of a larger focus is the reactive power that many of these facilities provide that maintain voltage on the system. Those are key components that maintain the integrity of the grid that many people don't talk about. Solar rooftop and those kinds of renewable supplies do not provide that kind of resource.

So it's incredibly important to not only think about the power that's needed to serve customers, but also the ancillary services that are used to really facilitate the grid operating properly with the base load.

The CHAIRMAN. Thank you, Senators.

I'm sorry. Can we hold that for just a minute?

OK.

Senator Barrasso.

Senator BARRASSO. Thank you very much, Madame Chairman.

Commissioner Moeller, in your testimony you explained that your main concern, the EPA has “Greatly underestimated the amount of power production that would be retired due its rules.” So August 2011 you’ve been calling for a formal analysis of the cumulative impact of EPA’s regulations on the reliability of the electric grid. You have proposed that FERC, EPA, Department of Energy, others participate in this analysis.

You also explained that as far as you know this formal analysis has never commenced.

Can you shed a little light onto why you think the analysis hasn’t taken place?

Mr. MOELLER. Thank you, Senator.

I’ve wondered that many times myself because I think what’s the downside? They are not our rules that are driving this. Again, they’re EPA rules. So we’ve been in a little bit of an awkward situation.

There are informal communications that have gone on. I know that EPA calls the RTOs or the RTOs call EPA every month if they have something to talk about. But I think we just need a little more transparency and accountability in this because, as you mentioned, the cumulative—it’s not just the rule that’s coming into effect in April 2015, but it’s accumulation of the rules and the reliability consequences have to be talked about. People have disagreements on this.

Senator BARRASSO. That’s my question. Does the Administration have the head in the sand or are they just actively opposed to conducting the analysis because they don’t want to see intentionally wanting to not see what the results are?

Mr. MOELLER. I don’t know their motivation.

Senator BARRASSO. Mr. Hunter, in 2011 you union and several other unions testified before EPA about the cumulative impact of the agency’s then proposed regulations. I understand the unions predicted that the EPA’s regulations would result in the retirement, I think you said, of 56 gigawatts of electric generation. You said that the 56 gigawatts of closing represents over 50,000 direct jobs in all in the next couple of years, that the job losses come from mine workers, rail workers, power plants.

Finally you stated that these job losses will fall heavily on rural communities where most of the plants are located.

Why do you think the EPA is ignoring the concerns of your union and several other unions when issuing the new regulations?

Mr. HUNTER. Senator, we have asked that question numerous times. We met with the EPA Director. We met with staff.

Originally they sat with their 4.7 number and said that, you know, we were going to be fine. It’s not that big of a deal.

Now it’s come true that it is a big deal. They’re still furthering more regulations, the CO₂ regulation, the coal ash rule. I mean it’s just multiple.

Every one of those have a cost to it. Every time there’s more cost we see more plants closing.

Senator BARRASSO. So do you think the EPA takes this issue that we are very concerned about, of job loss. Do you think they take it seriously when they issue regulations?

Mr. HUNTER. I don't think they've taken into consideration the cost of their rules, no.

Senator BARRASSO. In your testimony you explain that steps can be taken to ensure reliability of the electric grid. You explain the power plants may be directed to operate under what's known as the must run orders to ensure electric grid meets electric demand.

But you also note that a must run order doesn't exempt the power plant from civil lawsuits or Federal penalties under the Clean Air Act. For that reason you stated that Congress must address the double jeopardy issue between a must run order and the fact that the plant owners can be sued under the Clean Air Act. So it's double jeopardy.

So generally speaking would your union support legislation exempting power plants subject to the must run order from lawsuits and penalties under the Clean Air Act?

Mr. HUNTER. Absolutely.

Senator BARRASSO. Thank you.

Thank you, Madame Chairman.

The CHAIRMAN. Thank you very much.

Again, it's really been an extraordinary hearing. Thank you all for your participation.

The record of this committee will stay open for another week. I really encourage anyone to submit additional information.

Ms. Roberto, thank you for your patience. I know you have some additional things to add to the record.

The meeting is adjourned.

[Whereupon, at 12:10 p.m. the hearing was adjourned.]

APPENDIXES

APPENDIX I

Responses to Additional Questions

RESPONSES OF PHILIP D. MOELLER TO QUESTIONS FROM SENATOR CANTWELL

Question 1. A shortage of transformers has been identified as a resiliency problem for the grid. What options should Congress consider to promote the manufacture of transformers?

Answer. Congress can certainly encourage the manufacture of more transformers in the United States. In particular, Congress may want to consider whether we should increase the “surge capacity” of American companies to build a significant number of transformers in a short time frame. Private companies do not typically have an incentive to maintain unused factory capacity, but the public interest may benefit from such capacity in an emergency.

Question 2. Do you agree with Chairman LaFleur’s recommendations that Congress:

- designate an agency with the authority to direct action in the event of an emergency; and
- exempt FERC and NERC from Freedom of Information Act for some third party-related communications?

Answer. I agree that one agency should be in charge of directing appropriate action in an emergency. Yet the critical questions will be the proper scope of that agency’s emergency authority and the proper definition of an “emergency” when that agency action can be taken. I also agree that the law should be clarified to exempt certain FERC and NERC communications from disclosure under FOIA.

Question 3. You have recommended a comprehensive report on electric reliability going forward. Is this comprehensive look something that could be accomplished by the Quadrennial Energy Review, currently underway? Can you tell us how FERC is feeding into the Quadrennial Energy Review process?

Answer. By definition, a quadrennial review happens only once every four years, yet the decisions being made to close coal and other power plants are being made on a continuous basis. I have been told the quadrennial review will be ready in January, 2015 at the earliest. Yet the electricity sector is going through its most fundamental transformation in its history, and this is happening in a very short time frame. For these reasons, the quadrennial process would not be expected to capture important developments that occur after the process is completed. A comprehensive review will be better if performed continuously and cooperatively among the various agencies in the federal government, with assistance from the electric industry and other stakeholders. I am extremely concerned about electric system reliability in the next three to four years, and the need to have a formal and transparent process is urgent.

Regarding how the FERC is “feeding into” the quadrennial process, I have been told by FERC staff that there are several individuals who are involved at this point, including providing updates on FERC action related to natural gas and electricity coordination and also with the upcoming public meetings on the quadrennial review. I would expect more FERC staff involvement later in the process. Reportedly there are approximately 20 federal agencies involved in the quadrennial review.

RESPONSES OF PHILIP D. MOELLER TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. Do you agree with GAO that NERC and FERC should have a formal and documented role in EPA's rulemaking process when EPA is developing regulations that impact grid stability?

Answer. While I am not certain that I have seen the referenced GAO report, I absolutely believe that at least NERC and FERC should have an ongoing formal and documented role in EPA's rulemaking process, because EPA is developing regulations that impact grid stability and reliability. A formal and documented role would be subject to rigor and transparency, as compared to vague claims that EPA is talking to individuals at FERC, NERC, and others about the topic.

Question 2. Do you believe market prices for energy and capacity are sufficient at this time to attract investors to invest their capital in a new coal facility even though EPA standards would require the use of CCS technology that is not commercially viable?

Answer. No. As evidenced by the recent lack of actual investment, I do not believe that market prices for energy and capacity are sufficient at this time to attract investors to risk their capital in a new coal facility. Although there is one plant—in a very unique situation where captured carbon can be sold for enhanced oil recovery and where most of its costs will be borne by retail ratepayers—nearing operation, that plant has had significant financial and construction challenges.

RESPONSES OF MICHAEL J. KORMOS TO QUESTIONS FROM SENATOR CANTWELL

Question 1. A shortage of transformers has been identified as a resiliency problem for the grid. What options should Congress consider to promote the manufacture of transformers?

Answer. As early as 2006, PJM proactively began analyzing and taking action on the need to ensure the availability of an adequate supply of spare critical transformers. Specifically, PJM undertook a detailed probabilistic risk analysis of the existing fleet of critical transformers in use throughout the PJM 13-state footprint. That analysis looked at both the reliability impacts as well as the price impact to customers of the failure of specific transformers in order to analyze, from a cost/benefit viewpoint, where best to invest ratepayer dollars to procure spare transformers. Moreover, in working with its transmission owners, PJM utilized that analysis to develop standardized specifications for the procurement of transformers and formally, through PJM Board action, ordered the procurement of a number of spare transformers at key locations throughout its footprint consistent with PJM's cost/benefit analysis. Based on this analysis, seven spare transformers have been purchased, in addition to the existing number of spares located throughout the PJM system. Also based on this PJM analysis, Transmission Owners replaced 103 transformers identified as being a risk based on the age of the transformer. Currently, PJM has spare transformers at 38 of 49 substations (note: Those substations that do not have spares either do not have adequate risk to justify placing a spare transformer at the location, or have sharing arrangements with another location).

The type of focused analysis that PJM undertook could be helpful to promote the manufacture of transformers and allow for more standardization than currently exists in transformer design and utilization. Each substation and each transmission owner will need to adapt transformers to their individual systems but the more standardization that can occur over a larger regional footprint, the more incentives will exist to promote additional manufacture of transformers as some of the inefficiencies associated with the need for individualized design and construction can be removed. Nevertheless, transformers will never become a true "shelf product" and the demand for transformers will be uniquely affected by grid topology, the level of demand for electricity and the overall age of the existing fleet. Transformers are utilized in electricity grids throughout the world. Factors such as grid topology, the demand for electricity and the age of the existing fleet of transformers vary widely around the globe making the pace of manufacturing as well as the location of manufacturers of transformers uniquely affected by worldwide demand rather than just US demand.

At FERC's direction, the industry is undertaking an intensive effort at addressing security issues around critical substations. Moreover, federal as well as private dollars have been pledged toward efforts to "harden" the grid as a result of extreme weather events such as Hurricane Sandy. Although we do not believe that additional legal authority or federal funding is necessarily needed at this time, a focus on promoting the type of holistic analysis such as what PJM has undertaken in analyzing both reliability and market impacts from transformer failure could be helpful in determining the right level of spare transformers to have available for use. PJM

stands ready to participate in industry discussions on utilizing the kind of regional analysis that PJM has already taken or exploring alternatives to ensure the right mix of this critical component of the electric grid going forward.

Question 2. Please clarify the 22 percent loss of generation capacity during the polar vortex. How much of this lost generation was attributable to coal, natural gas, and nuclear power, separately? I would like to better understand the extent to which coal generation was, or was not, more reliable than other kinds of base load power generation.

Answer. During the Polar Vortex the 22 percent loss of generation capacity (forced outages) totaled 40,200 MW. These unavailable megawatts were due to either the entire generator being unavailable or a limitation of megawatts the generator can supply to the system. The primary fuel types that were unavailable during the peak, comprising this forced outage amount, were natural gas, coal, and nuclear. Of the total forced outage amount, 19,000 MW (47 percent) were natural gas, 13,700 MW (34 percent) were coal, and 1,400 MW (3 percent) were nuclear (the remaining 6,100 MW was a combination of other fuel types such as oil, wind, hydro, waste, etc.).

Forced outages experienced by coal units during the Polar Vortex were primarily due to multiple effects of the extreme cold weather on various components of coal handling and processing facilities. Frozen coal or wet coal, frozen limestone, frozen condensate lines, frozen fly ash transfer equipment, cooling tower basin freezing, and freezing of injection water systems for emissions control equipment were among the numerous causes of coal unit forced outages.

Regarding overall reliability of coal generation compared to other kinds of base load generation, the magnitude of gas related forced outages during the Polar Vortex exceeded that of coal related forced outages, but the coal related forced outages comprised approximately one-third of the overall forced outage total.

PJM analyzed the performance of approximately 14000 MW of generation pending retirement during the Polar Vortex peak. PJM determined that the generators pending retirement were producing at a level of approximately 52% of their capability.

RESPONSES OF MICHAEL J. KORMOS TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. What winter, summer, or shoulder period modeling, if any, has PJM done in the past 10 years?

Answer. PJM models a range of seasons, including winter, summer and shoulder in a variety of timelines from the present time through a 15 year planning horizon. The two major timeframes are the operating and planning horizons. The modeling in the operating horizon encompasses the present day up to one year into the future. The planning horizon models the longer term anticipated system from one year through the 15 year planning horizon.

In the operating horizon, PJM completes summer and winter pre-seasonal studies that are conducted by the PJM Operations Analysis Task Force (OATF). In addition, near-term studies are performed on models that reflect the anticipated next day configuration and demand in advance of every operating day. These operating analyses evaluate the system considering existing transmission system topology and resources, planned transmission outages, planned generation outages, forced transmission outages, and forced topology outages.

In the planning horizon, PJM conducts extensive modeling and assessment of the system as part of the Regional Transmission Expansion Plan (RTEP). PJM completes exhaustive studies of the transmission system throughout a 15-year planning horizon as part of the RTEP. These studies include analyses of the system at various load levels and consider generation outages and conditions consistent with the period under study. Following is a link to the recent studies that have been completed pursuant to the RTEP.

Regional Transmission Expansion Plan (RTEP) Documentation

<http://pjm.com/documents/reports/rtep-documents.aspx>

In addition to the RTEP studies, PJM also completes seasonal assessments of the transmission system as part of the OATF. Links to these studies can be found at the following locations:

2014 OATF Summer Study Summary

<http://www.pjm.com/?/media/committees-groups/committees/oc/20140506/20140506-item-08-oc-presentation-2014-summer-oatf.ashx> 2013-14 OATF Winter Study

Summary

<http://www.pjm.com/?/media/committees-groups/committees/oc/20131209/20131209-item-08-oc-presentation-2013-14-winter-oatf.ashx>

In addition to the modeling requirements for PJM operating and planning activities, PJM also participates in the development of modeling by the Multiregional Modeling Working Group (MMWG), a group responsible for developing a library of solved power flow models and associated dynamics simulation models of the Eastern Interconnection. The models are developed for use by the Regional Reliability Organizations and their member systems in planning future performance and evaluating current operating conditions of the interconnected Bulk Electric System. The annual MMWG case builds typically include fourteen (14) cases that include a variety of future system model years and also a variety of system demands including light load, spring, summer, summer shoulder, fall and winter. This process has existed for more than 10 years and PJM has participated during that time. PJM annually uses several of the MMWG models for the Regional Transmission Expansion Planning (RTEP) assessment.

Question 2. If modeling has been done, how is it used and is it distributed beyond PJM?

Answer. PJM's models that are used for the RTEP assessment are available on www.pjm.com pursuant to CEII handling procedures. <http://www.pjm.com/planning/rtep-development/powerflow-cases.aspx>

In addition, MMWG modeling is available directly from the MMWG pursuant to CEII and modeling release procedures. <https://first.org/reliability/easterninterconnectionreliabilityassessmentgroup/mmwg/Documents/ERAG%20Base%20Case%20Release%20Procedure.pdf>

PJM is also very transparent in sharing the results of the assessments that are performed on the various models. The PJM RTEP is the transmission enhancement plan that results from analysis of the future models. This plan is reviewed extensively with stakeholders. In addition, the MMWG models are used by Transmission Owners, Generation Developers, Load Developers, Transmission Planners, Planning Coordinators, economists, et al. for thousands of annual studies of the Eastern Interconnection to examine system reliability.

Studies are also shared and reviewed with neighboring balancing authorities including Midcontinent ISO, New York ISO, TVA, Duke Carolinas and VACAR through a variety of forums. The study forums include the Inter-Regional Stakeholder Advisory Committee (IPSAC) where targeted studies coordinated by PJM and neighboring entities. Additionally, PJM also participates in a variety of studies coordinated by our NERC Regional Reliability Entities. These studies include analysis coordinated with the entities in both the ReliabilityFirst (RFC) and the SouthEast Electric Reliability Council (SERC) footprints.

Question 3. In your written testimony, you state that "the reliability cushion we [PJM] previously enjoyed with the large fleet of coal-fired generation has substantially diminished." You further note that demand response resources are only available to the RTO when you are in "pre-emergency" conditions as you define the term. In fact, you say "we will potentially have to run the system closer to its limit than we have previously in order to be able to call on demand response resources." Please elaborate. Does this concern you?

Answer. PJM's emergency procedures call for PJM to deploy long and short lead time demand response resources during hours when the system is actually in emergency condition. This action is taken by PJM to deploy demand response resources in order to avoid PJM invoking further emergency procedures. Calling on these demand response resources to be available to reduce their demand is one of the earliest stages in PJM's multi-layered emergency procedures. To date, demand response resources have performed well in response to PJM's call in these circumstances. It should also be noted that within the requirements of the PJM tariff and their obligations as capacity resources, DR capacity resources face substantial penalties should they fail to reduce when called upon by PJM to do so.

Nevertheless while allowed and encouraged, demand response resources have not been willing to also participate in PJM's energy market through the submission of an economic bid that would allow the load reducing benefits to be available earlier to PJM and prior to PJM having to invoke emergency procedures to reach these resources. In addition, demand response resources face a much higher bid cap (presently set at \$1,800/MWh) as compared to generation which must submit a bid in the energy market at \$1,000/MWh. The issue as to whether demand response should be required to submit a bid in the energy market is presently pending before the Federal Energy Regulatory Commission (FERC).

The fact that PJM cannot reach demand response resources until PJM has moved into emergency conditions is the basis for our statement in Mr. Kormos' testimony

that “we will potentially have to run the system closer to its limit than we have previously in order to be able to call on demand response resources.” We have recently tried to somewhat mitigate this concern by proposing to FERC a “pre-emergency” category that allows PJM to call upon demand response resources immediately prior to entering emergency conditions and by proposing to shorten some of the notification periods prior to our being able to call upon demand response resources. That proposal is also pending before the FERC and was not in effect during the Polar Vortex.

Nevertheless, because of the advent of demand response resources and their growing role in serving as capacity resources in PJM, we will be required to run the system closer to emergency conditions than we have before. Moreover, with the loss of a sizable portion of the coal fleet, the resource mix, although more diverse than it has been before, is made up of a portfolio that potentially has less flexibility than existed previously.

This changing nature of the resources is certainly a concern. It does not cause reliability issues for PJM—we procure reserves above our installed reserve margin to address these very type of contingencies but does increase complexities for PJM system operations and will result in greater price volatility for customers. PJM has been proactively addressing these challenges through a variety of filings before FERC incentivizing the clearing of year-round demand response products and more flexibility in PJM operations’ ability to call upon and dispatch these demand response resources. FERC’s rulings have so far been very helpful in addressing PJM’s concerns. Additional issues such as whether demand response should have a “must offer” energy bid as well as some of our operational reforms, are pending before the Commission in active proceedings.

Question 4. Your written testimony notes that during the Polar Vortex, the “system was indeed very tight, [but] we were never—as some accounts have portrayed—700 megawatts away from rolling blackouts.” How close was the PJM system to a rolling blackout? You further noted that PJM’s next step would have been to implement a small voltage reduction. Is it typical to implement voltage reductions to manage the system or is that something the grid operators would prefer to avoid if possible?

Answer. While the system’s Synchronized Reserves (reserves that are supplied to the system from resources that are synchronized/connected to the grid and able to load within 10 minutes) fell to a low of approximately 500 MW for a brief 5 minute period of time and averaged around 700 MW for that hour, they are not the only reserves PJM has that can be deploy prior to requiring rolling blackout. PJM had an additional 1,167 MW of primary reserves (reserves available in 10 minutes but not synchronized) for a total of 1,667—1,997 MW ten minute reserves in the lowest hour. As well PJM could have deployed a 5 percent voltage reduction to further reduce load and create reserves as we had done the previous night and is a specific step in our emergency procedures. PJM would expect about 1,100-2,000 MW of relief from this step. PJM also has reserve sharing agreements with our neighbors that could have been called upon if needed. PJM’s agreement with NPCC allows up to 50 percent of the contingent loss to be requested and PJM’s VACAR agreement allows up to 1,263 MW to be requested. All or part of all available resources would have be deployed prior to requesting rolling blackouts. We would estimate we had between 2,500-4,000 MW of reserves remaining.

While PJM always attempts to avoid emergency procedures when possible, they are designed and expected to be deployed in extreme situations such as the one we faced during the polar vortex.

Question 5. Do you agree with GAO that NERC and FERC should have a formal and documented role in EPA’s rulemaking process when EPA is developing regulations that impact grid stability?

Answer. PJM believes that reliability issues must be considered in the context of EPA’s rulemaking process. Reliability analyses should be conducted during the formulation of EPA’s policy proposals. In addition, PJM believes that appropriate “safety valves” be built into final EPA rules so that there is a means to address reliability impacts that may arise from a specific rule’s implementation. It is for this reason that the ISO/RTO Council proposed a “Reliability Safety Valve” which was eventually incorporated into the EPA Mercury and Air Toxics rule. The ISO/RTO Council has proposed a similar “Reliability Safety Valve” for incorporation into EPA’s impending greenhouse gas rule.

PJM believes that the entities responsible for system operations as well as planning are in the best position to conduct the majority of “on the ground” reliability analyses of the impacts of various proposals. Nevertheless, both NERC and FERC can play a valuable role in this process and as a result, FERC and NERC should have the formal documented role in any EPA rulemaking process with RTOs/ISOs

and other system operators providing input to all of these entities, including EPA. NERC provides a national view of bulk electric system reliability and can provide an independent verification of the reliability analysis undertaken by system operators. Moreover, there remains an important question of legal authority to address reliability. Congress has given that role to FERC and although there seems to be some concern as to EPA's ability to address these issues under the Clean Air Act, there is no question that Congress sought federal regulatory oversight of bulk power reliability by assigning that task to FERC through the Energy Policy Act of 2005. Accordingly, both FERC and NERC as well as the RTOs/ISOs have an important role in this process. The "formal and documented" role should be limited to those entities that Congress has specifically recognized in this area—namely FERC and NERC (the latter acting as the Energy Reliability Organization appointed by FERC pursuant to EPACT 2005). The RTO/ISO role and other system operator roles' should not necessarily be "hard-wired" into the rule but clearly are an integral input that should be sought by EPA, FERC and NERC through the rulemaking process.

Question 6. Do you believe current market prices for energy and capacity are sufficient to attract investors to invest their capital in a new coal facility even though EPA standards would require the use of CCS technology that is not commercially viable?

Answer. The independent PJM Market Monitor has determined that over the last several years, the overall revenues being received from the various PJM markets have been less than needed to recover the overall fixed and operating costs of a new coal plant. Specifically in his 2013 State of the Market Report, the IMM stated:

In 2013, a new CP ("coal plant") would not have received sufficient net revenue to cover levelized fixed costs in any zone. The results for CPs are relatively uniform. A new CP would not have received sufficient net revenue to cover more than 30 percent of levelized fixed costs in any zone. However, the results for coal plants in 2013 are better than they were in 2012 based on higher energy market net revenues in all but one zone and higher capacity market revenues in ten zones. These are the same ten eastern zones that increased the net revenue results for both CTs and CCs. All but two zones showed increases in the coverage of fixed costs by CPs in 2013

PJM's markets are designed to be resource-neutral. As a result, our capacity market clears resources at the cost of new entry of the most efficient new technology available to supply the needed MWs—presently represented as a gas combined cycle unit. But the capacity markets only make up approximately 30 percent on average of the total revenue stream for a given generator. Coal units receive revenues above their marginal costs in many hours in the PJM energy market which clears in many peak hours at the cost of producing energy from natural gas which often is more expensive than production of energy from coal. As a result, the total revenue picture from the combination of the PJM markets is examined by the PJM Market Monitor..

PJM has not undertaken a specific analysis, but given the observations of the independent market monitor as to the net revenue position of new coal plants without CCS, we believe that a requirement for mandatory CCS technology would further exacerbate the strain on the viability of new coal technology from being developed.

RESPONSE OF MICHAEL J. KORMOS TO QUESTION FROM SENATOR BARRASSO

Question 1. You explain that EPA's regulations will cause utilities to rely to a greater degree on demand response programs. Through demand response programs, utilities compensate customers who voluntarily agree to curtail their use of electricity during emergencies. You suggest that demand response programs will help utilities make up for the loss of coal-fired electric generation resulting from EPA's regulations.

Earlier this week, Tony Alexander, President and CEO of First Energy, explained that: "Many businesses are now considering whether they can continue to interrupt their ability to manufacture the product they sell in order to accommodate the changes being made in the electric system."

He went on to say that: "If [these businesses] change their minds, all customers could be left with inadequate power supplies."

Do you believe Mr. Alexander has correctly characterized what is at risk with utilities relying on demand response programs?

Answer. PJM believes that Mr. Alexander's statement has validity but does not represent the entirety of the picture. For one, a decision of a business customer to simply renege on its prior demand response forward commitment to the PJM mar-

ket is not without substantial cost. That business, acting through its curtailment service provider, is required to either replace its promised reductions with another capacity resource or face substantial penalties for not being available to PJM despite its prior commitment. Thus, the problem of industrial customers simply “changing their minds” in the short term is not without substantial cost that works to disincite such sudden reversals.

Moreover, every year PJM procures megawatts above its forecasted reserve margin (which itself is designed to account for the unavailability of specific resources at the time of the system peak). PJM’s required reserve margin currently is 16.2 percent; however, PJM’s forward capacity auction has procured up to a 21.1 percent reserve margin on a 3-year forward basis. PJM will continue to procure these additional supplies in order to address the type of concern raised by Mr. Alexander.

Beyond the three year forward commitment period, PJM believes that businesses could stop providing demand response if the cost of producing the business’ product could exceed the cost of curtailing that production when called upon by PJM. From a reliability perspective, PJM’s market structure is designed to attract new resources that would substitute for this loss of demand response resources should there be an exit from the market. In essence, capacity prices would rise should there be an exit of the market by demand response resources which would then incent the development of new short term resources to substitute for those exiting resources. Moreover, as gas generation can generally be developed in a relatively short time period (particularly in the PJM region which sits on top of the substantial Marcellus and Utica shale supplies), the market should work to produce substitute resources. Nevertheless, PJM has the authority to procure additional resources should the market, for some reason, not produce the amount of megawatts needed to meet our projected peak demand.

RESPONSE OF NICHOLAS K. AKINS TO QUESTION FROM SENATOR CANTWELL

Question 1. A shortage of transformers has been identified as a resiliency problem for the grid. What options should Congress consider to promote the manufacture of transformers?

Answer. Based upon our current large power transformer spare inventory, and concerted industry attention to the issue of grid resiliency, we do not see the need for Congressional action at this time to directly promote manufacturing capacity.

The cycle time for producing a new large power transformer is typically a year or more. As a result, electric utilities maintain spare transformers on hand to ensure reliable continued operation based upon risk assessments. Aside from company specific spare programs, EEI has developed a Spare Transformer Equipment Program (STEP) to share spare equipment in event of a declared emergency.

Moreover, the industry is currently working collaboratively on a new standard for physical security in response to FERC’s recent directive regarding Reliability Standards for Physical Security Measures. Among the mitigation measures, it is anticipated that utilities will refresh their strategy and assessments of availability and placement of spare equipment.

RESPONSES OF NICHOLAS K. AKINS TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. After a power outage, “blackstart” power plants are needed to re-start the grid. How should “blackstart” power plants be treated to ensure reliability?

Answer. AEP believes that black start responsibility is a shared obligation between the regional transmission organization (RTO) and the Transmission Owner. The issue of who is ultimately responsible to provide black start service and how it should be compensated has been, and still is, being debated throughout the industry. This ongoing debate has been compounded with the industry retiring (in mid-2015) a record amount of traditional “steel in the ground” generation, much of which provides black start services.

AEP alone will be retiring approximately 2,000 MWs which provide black start capability. PJM has issued multiple request for proposal (RFPs) to replace black start service within the AEP zone and throughout the PJM footprint and still has areas that are in need of black start replacement. These retirements (black start and non-black start) coupled with PJM’s capacity market flaws (volatility and suppressed clearing prices) point to a perfect “reliability storm” brewing, especially when extreme weather events like the polar vortex hit.

Efforts need to continue to focus on ensuring that the PJM black start tariff compensation is compensatory of the associated risk in providing this critical service. Additionally, FERC needs to support PJM and the industry’s efforts in ensuring that any capacity market construct flaws are mitigated. Generator owners need to

be able to rely on a stable market to know when to build, invest or retire a unit. Absent these measures, additional unplanned “steel in the ground” generating units will retire, along with their capability to provide ancillary services such as black start.

Question 2. You previously indicated in January as a result of the weather conditions, you ran 89 percent of the coal capacity that is slated for retirement next year, in order to meet demand. What if we fast forward two years, and another polar vortex occurred, where will the power come from to meet the demand and what will it cost?

Answer. If no new generation (or the right mix of generation) materializes over the next several years, after these units retire it is quite possible that we could experience rolling blackouts or regular voltage reductions. PJM has indicated that much of the retired capacity will be replaced by demand response and new gas units that have cleared in the capacity auctions. What PJM does not say is that some of the units that have cleared in the auction for 2015/16 have not made any significant progress on construction and may “buy out” of their obligation in one of the incremental auctions to be held before the 2015/16 delivery year.

This is substantiated in two reports by the PJM Market Monitor. The reports show that historically a large percentage of capacity offered into the base auction bought itself out in the incremental auction.

PJM acknowledges that this speculative bidding is a problem. PJM recently filed to change some of the incremental auction (Docket ER14-1461) rules to reduce the amount of speculative bidding taking place. At this point FERC has not ruled on these proposed changes.

AEP supported the proposed fixes to the incremental auctions. However even if FERC accepts all of the recommendations, it will not alleviate the concerns we have about real capacity being available for the 2015/16 delivery year. For example, 14,000MWs of demand response cleared the market for 2015/16. Almost all of it was summer only. That will not help in a polar vortex situation.

Question 3. As investors are planning to replace coal plants with gas-powered plants, how confident are you that gas pipeline infrastructure can be placed in service in time to allow new gas plants to enter service when needed for reliability?

Answer. AEP is concerned. There is a lot to be done within the industry to ensure we have adequate replacement capacity moving forward. AEP is concerned that the RTO and gas trading days are not aligned and that there may not be sufficient pipeline capability, that is “steel pipe in the ground” to meet future needs. FERC has issued a notice of proposed rulemaking (NOPR) to address the coordination of scheduling. This is just a start. There is major disagreement between the electric and gas industry and consensus will be difficult to obtain on a common set of scheduling procedures.

On April 29 ICF International hosted a webinar discussion where they agreed with our concerns about gas pipeline infrastructure being insufficient to meet the future demand of additional gas units. Other parties, including PJM, argue that the pipeline infrastructure is sufficient, and it is only the gas/electric trading day that needs to be fixed.

From a reliability standpoint, any assumptions with regard to pipeline capability need to err on the side of reliability. We highly support the discussions between the gas and electric industries with regard to the trading day and scheduling. But no amount of alignment of the industries can keep the lights on and the homes heated if there is not sufficient actual physical capacity available to meet load.

Question 4. Do you agree with GAO that NERC and FERC should have a formal and documented role in EPA’s rulemaking process when EPA is developing regulations that impact grid stability?

Answer. Yes. Our recent experience with EPA’s rulemaking process has revealed several limitations on the ability to meaningfully coordinate interagency reviews and properly evaluate potential impacts on grid stability. We are currently facing imminent deadlines to comply with stringent new limitations on emissions under the Mercury and Air Toxics Standards (MATS). These are limitations that will, for certain units, require substantial capital investments in order to achieve compliance. There are no alternative compliance options for older units where there is inadequate time to recover that type of investment. We, along with many other utilities, will be retiring substantial portions of our coal-fueled fleet. We have worked closely with Department of Energy, FERC, NERC, the regional reliability organizations, and our states, to assure that impacts on grid reliability were considered, and that mitigation measures will be taken to preserve the stability and reliability of the grid.

However, at the same time EPA was finalizing MATS, we were also facing immediate implementation of:

- Cross-State Air Pollution Rule (CSAPR)
- Revised standards for cooling water intakes under Section 316 (b) of the Clean Water Act
- New requirements for coal combustion residuals (CCR) management under the Solid Waste Disposal Act.

No comprehensive analysis of the potential impacts of these combined requirements was performed. The GAO and others endorsed the value of a more formalized process for such evaluations as an aide to informed rule development. CSAPR was not implemented as scheduled, but the U.S. Supreme Court has reversed the decision of the D.C. Circuit which vacated the rule. Neither the 316(b) rule nor the CCR rule has been issued in final form. These rules and the proposal of New Source Performance Standard (NSPS) guidelines for existing fossil-fueled electric generating units and combustion turbines may all have unintended consequences that could compromise grid stability and reliability, and should be the subject of careful, coordinated, comprehensive analyses.

Question 5. Do you believe market prices for energy and capacity are sufficient at this time to attract investors to invest their capital in a new coal facility even though EPA standards would require the use of CCS technology that is not commercially viable?

Answer. No. Although we saw a significant price spike in January due to the polar vortex, it was just that—a price spike. Both the capacity and energy markets have been extremely volatile over the last several years. And the prospects going forward do not look any different. AEP will not commit to building any unit, let alone a baseload CCS unit, without some very long term economics in place to assure us that this is a sound investment.

PJM's capacity market does not help with this planning. The reliability pricing model (RPM) is designed around a one-year clearing mechanism. Even if a new generator receives sufficient revenues in its first year of operation, there are no guarantees that this capacity revenue stream will continue.

The only scenario where new baseload CCS units would be feasible is if a state regulatory agency allowed full cost recovery in rate base. PJM has already seen that in certain states in their footprint, and we may see even more state activity if the reliability of needed gas units prove insufficient after the 2015 retirements.

RESPONSE OF NICHOLAS K. AKINS TO QUESTION FROM SENATOR BARRASSO

Question 1. You advocate for the: "Passage of legislation to resolve the conflict between the authority of the Department of Energy and that of the Environmental Protection Agency that could manifest in the DOE ordering a unit to run even when that unit would violate environmental requirements." You explain that: "Legislation is needed to clarify the rules and expedite new construction to ensure that existing generation will not have to face a choice between violating the environmental rules and letting the lights go out." Would you please expand upon the importance of passing such legislation?

Answer. As our MATS compliance planning was underway, we encountered several instances where retiring units could have created serious reliability concerns unless significant transmission reinforcement or other actions were undertaken prior to their retirement. We have been diligently working to ensure that all of these conditions are fully addressed, and anticipate that AEP's system will complete the transition without any serious reliability issues.

However, we do not know whether or how EPA will respond to the recent CSAPR decision, or whether additional de-ratings, changes in duty, or retirements may be triggered by other actions that have not been finalized. The 316(b) rule, new effluent limitation guidelines, coal combustion residual rules, or greenhouse gas requirements could all potentially impact reliability. It is possible that a regional transmission operator or regional reliability organization could need the operation of a unit not in compliance with MATS or these other requirements due to reliability concerns. Operators should not be faced with a Hobson's choice of either operating in violation of an applicable environmental requirement, or compromising grid reliability. In situations of this nature, legislation should clarify that an operator, responding to an order by the Department of Energy to operate a unit for reliability reasons, would be relieved of any liability for exceeding any applicable environmental limits.

RESPONSE OF GERRY CAULEY TO QUESTION FROM SENATOR CANTWELL

Question 1. A shortage of transformers has been identified as a resiliency problem for the grid. What options should Congress consider to promote the manufacture of transformers?

Answer. It is important to acknowledge ongoing government and industry efforts, and build upon those efforts, while recognizing that more can be done.

One option to consider would be to allow utilities to recover costs to procure additional spare transformers, including modular spare transformers, and to maintain retired transformers as spares. Measures to determine the appropriate level of additional spares should be based on ongoing utility and RTO reliability reviews, as well as security scenarios and assessments assuming concurrent attacks. Participation in NERC's Grid Security Exercise (GridEx) and Grid Security Conference provide opportunities for this type of review and assessment, in addition to individual utility efforts.

With respect to domestic manufacture of transformers, the Department of Energy (DOE) has undertaken several efforts to encourage the domestic production of large transformers; further discussion with the Department about the range of potential incentives, including tax incentives that may benefit this effort, would be worthwhile. Finally, government funding of a modular spare transformer reserve would be helpful. Any effort along these lines would send a clear signal of the value the government places on spare transformers, which could also help support cost recovery.

RESPONSES OF GERRY CAULEY TO QUESTIONS FROM SENATOR BALDWIN

Question 1. According to the International Trade Commission, in 2010 the US demand for Large Power Transformers was valued at over \$1 billion, and we have an increasing number of manufacturing facilities able to produce the largest scale transformers. Despite projections that domestic demand and production capacity are growing we imported around 500 large power transformers (LPTs) in 2013 alone.

Restoring grid functionality requires the ability to repair and replace transformers in a short time frame. How are supply chain issues accounted for when calculating the time and resources necessary to recover from outages and attacks?

Answer. Replacing high-value equipment that is limited in availability is addressed in transmission system designs and engineering plans to increase reliability and resiliency of the grid. Strategic placement of spare transformers and mutual aid agreements serve as a safety net in regional and national recovery plans to reduce long term outages. The time and resources needed for recovery from severe events, including supply chain factors and logistics of moving large transformer equipment, are important aspects to establishing sound recovery plans.

Supply chain issues are primarily addressed through spare equipment programs at individual utilities and within RTO/ISOs, as well as broad programs such as NERC's Spare Equipment Database (SED), the Edison Electric Institute's Spare Transformer Equipment Program (STEP), and the Department of Homeland Security's Recovery Transformer program. These are valuable programs that complement individual utility and RTO/ISO efforts.

Challenges involved in the replacement of high-voltage transformers were discussed during NERC's GridEx II, held in November 2013. The extreme challenges posed by the Severe Event scenario provided an opportunity for participants to discuss how the electricity industry's mutual aid arrangements and inventories of critical spare equipment may need to be enhanced. A key lesson learned was to further evaluate and potentially increase participation in recovery programs like STEP or SED. This issue is discussed further in the GridEx II report (<http://www.nerc.com/news/Pages/GridEx-II-Report-Highlights-Recommendations,-Lessons-Learned-from-Grid-Security-Exercise.aspx>). These lessons are being further discussed with the Electricity Sub-sector Coordinating Council (ESCC).

Question 2. Transformers are a critical and vulnerable part of our grid. In the discussion about access to spare transformers, we often hear about two important initiatives: the Edison Electric Institute's Spare Transformer Equipment Program (STEP), and NERC's Spare Equipment Database.

Are these planning strategies adequate to ensure stability of the Bulk Power System in rare high-impact events? What additional tools would assist NERC, grid managers, and utilities to improve grid recovery?

Answer. As discussed in response to Question 1, the STEP program and NERC's SED program are important initiatives to address the availability of transformers, complementing the inventory of utility and RTO/ISO spare transformers. Currently, nearly 25 utilities participate in the SED program, with over 130 large power transformers representing nearly 29,000 MVA of capacity. Expanding the supply of spare

transformers may benefit from government funding or provisions for recovering the costs incurred by utilities in procuring and maintaining spare transformers. While transformer availability is needed to ensure the stability of the BPS in the event of rare, high-impact events, as well as improve grid recovery, it is not the only necessity. Other aspects are addressed in response to Question 3.

Question 3. Low frequency, high-impact events could seriously impact the Bulk Power System for a long period of time because transformers take so long to build and a large portion of our supply comes from abroad.

a) In the event of supply disruptions in the global shipping system, from geopolitical events, or from other disasters, how does our current domestic production capacity position us to respond?

b) What reserve capacity ought we have in order to be able to respond to a severe grid failure?

c) How does this capacity compare with our current capacity?

d) What domestic production capacity would we need in order to respond to severe grid failures?

Answer. In 2010, six large power transformer (typically with a maximum capacity rating greater and or equal to 100 MVA) manufacturing facilities existed in the United States. According to a DOE study, at that time, these facilities provided approximately 15 percent of US demand for transformers.

Since then, domestic production capacity has been improving with the addition or expansion of several new US-based facilities: (1) EFACEC transformer plant (Rincon, Georgia, April 2010); (2) the Hyundai Heavy Industries' facility, opened in Montgomery, Alabama, in November 2011; (3) the SPX Corporation transformer plant expansion, unveiled in Waukesha, Wisconsin, in April 2012; and (4) the Mitsubishi Electric Transformer Factory, which began operations in Memphis, Tennessee, in April 2013.

While global procurement remains a common practice for many utilities to obtain transformers, the potential impacts of geopolitical events, global shipping interruptions, and other risks are reduced as domestic production grows.

NERC has also developed an online spare equipment database to track the inventory of spare equipment (particularly transformers). This database will be a helpful industry resource should a high-impact, low-frequency event result in damaged equipment. Providing information to the database is voluntary and meant to complement existing transformer sharing and mutual assistance agreements. The database is populated and managed by participating organizations bound by a mutual confidentiality agreement. NERC's initial focus is on high-voltage transmission and generator step-up transformers, which are vital for operation of the integrated bulk power system (BPS).

By "reserve capacity," we assume this to mean spare transformer capacity. Ultimately, the amount of spare transformer capacity deemed necessary involves a judgment similar to that made in procuring insurance: How likely is there to be an event that causes "severe grid failure," and what are the costs that customers are willing to pay to protect against that event?

DOE, NERC, the Federal Energy Regulatory Commission (FERC), State commissions, and industry continue to assess the best way to prepare for and protect against high-impact, low-frequency events. Ultimately, the necessary amount of domestic production capacity depends on the severity and duration of a given event and the availability of spare transformers.

RESPONSES OF GERRY CAULEY TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. You testified that "information sharing through the ES-ISAC is the greatest asset we have to combat emerging threats to cybersecurity and help ensure the reliability of the Bulk Power System." Do you believe there are any barriers to information sharing right now? If so, how can these barriers be overcome?

Answer. As we learned with Aurora, it can take a great deal of time for industry to be provided actionable threat information from the government. Government agencies, through communication with the Electricity Sector Information Sharing and Analysis Center (ES-ISAC), are increasing their outreach and communication efforts. Forums like the ESCC and the Energy Government Coordinating Council (EGCC) allow for more open conversations about barriers and steps needed to remove them. The ESCC and the EGCC, communicating and coordinating through the ES-ISAC, are key components to improved information sharing. Another solution is developing methods and procedures for addressing sensitive information so that it can be useful and made available to the broad range of private sector decision-makers who must take action to protect against the threat or vulnerability. The govern-

ment should enhance its approach to sharing the information it has with the very people who are expected to defend their systems. A key effort would be for government agencies to identify the ES-ISAC as their primary coordination tool for the Electricity Sub-sector.

Additional security clearances for industry members are beneficial. NERC has over 1900 entities on its Compliance Registry, some have just a few employees and some have many thousands. It is important to be realistic about the number of clearances that are made available, but obtaining security clearances for utility personnel remains a cumbersome process.

Question 2. In your judgment is the grid more or less vulnerable as a result of the disclosure of non-public critical energy infrastructure information and the resulting news reports?

Answer. I issued a statement indicating my great concern about the public discussion of specific vulnerabilities of critical grid assets. As I mentioned in my statement, articles like that do little to improve security; rather they jeopardize it. This raises serious national security concerns and undermines the ongoing work that NERC, industry, and government are doing.

The government's ability to secure critical grid information is important for several reasons, including to encourage exchange of information with industry. Preparing a list identifying critical locations, itself, creates a risk that such a list will fall into the wrong hands. If a list is prepared, it should be properly classified. All federal agencies, including FERC, have the ability to designate information as Protected Critical Infrastructure Information. Proper classification should be accompanied by a distribution plan that limits access to this information to those who need to know or have legitimate need for this information and are prepared to honor the conditions imposed on access to that information.

NERC works hard to protect grid-related critical, sensitive, and classified information. Our ES-ISAC has a secure portal, which protects the information shared to and from industry. The ES-ISAC abides by a NERC Board of Trustees approved "Firewall" policy and ES-ISAC personnel use strict controls when working with asset owner information. Attributable information is treated as confidential and not shared outside of the ES-ISAC personnel consistent with the NERC Code of conduct. Because NERC is not a government agency, FOIA is not applicable.

Question 3. Do you agree with GAO that NERC and FERC should have a formal and documented role in EPA's rulemaking process when EPA is developing regulations that impact grid stability?

Answer. NERC has a long practice of undertaking comprehensive reliability assessments to evaluate current or proposed major regulatory or legislative changes that could impact reliability of the BPS and advising policy decision-makers and industry of our conclusions. NERC continues to stand ready to assist our federal partners to ensure that the reliability of the grid is properly considered as regulations are developed.

RESPONSE OF THAD HILL TO QUESTION FROM SENATOR CANTWELL

Question 1. A shortage of transformers has been identified as a resiliency problem for the grid. What options should Congress consider to promote the manufacture of transformers?

Answer. As a power generator, the transformers that Calpine uses at its power plants are different than the transformers used by transmission and distribution companies. Calpine has not, in fact, experienced any kind of shortage for the types of transformers used in our business. Because of this lack of first-hand experience, this question is much better directed at a transmission or distribution company. We would note, however, that Calpine maintains an inventory of spares to cover the majority of our transformer fleet in order to avoid waiting 7-12 months for a newly ordered replacement to arrive.

RESPONSES OF THAD HILL TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. Do you agree with GAO that NERC and FERC should have a formal and documented role in EPA's rulemaking process when EPA is developing regulations that impact grid stability?

Answer. FERC and NERC already have the ability to participate in EPA's rulemaking processes and Calpine encourages them to do so where appropriate. However, discretion should be left to those agencies to determine when it is necessary to participate, and they should not be subjected to a mandated formal and documented role.

In addition, it is clear that EPA already recognizes the importance and expertise of FERC and NERC and has demonstrated its willingness to rely on their advice and counsel when making decisions that could affect the reliability of the power grid. For example, in December, 2011, EPA issued a policy memorandum regarding how it will handle a power generator's request for an administrative order authorizing it to operate in noncompliance with MATS for a one-year period in order to address a specific reliability concern. In that memorandum, EPA stated that it will rely on FERC, RTOs, ISOs, Planning Authorities, NERC and its affiliated regional entities, and state public service commissions to identify and analyze the reliability risks associated with a power facility that may be required to retire unless EPA permits the facility to operate in noncompliance. This type of interaction among all interested entities should be encouraged, but not mandated.

Question 2. Do you believe market prices for energy and capacity are sufficient at this time to attract investors to invest their capital in a new coal facility even though EPA standards would require the use of CCS technology that is not commercially viable?

Answer. No. Based on current forward energy and capacity prices in different competitive markets throughout the United States, and using capital expenditure and operational cost estimates for a new coal plant from EIA, investment in a new coal facility, either with or without CCS, is not economic at this time.

RESPONSES OF COLETTE D. HONORABLE TO QUESTIONS FROM SENATOR CANTWELL

Question 1. A shortage of transformers has been identified as a resiliency problem for the grid. What options should Congress consider to promote the manufacture of transformers?

Answer. It is our opinion that this question would be better posed to the transformer manufacturers themselves as they would be better able to articulate the specific proposals necessary for that sector of the industry. However, in more general terms we would respectfully request that Congress, should it decide to consider legislation regarding this issue, carefully consider the costs that would be borne by the ratepayer depending upon the policy approach. I am presuming that the equipment contemplated in the question is for bulk power system substations and facilities. This equipment is extremely expensive to build, transport and store. As I mentioned in my testimony, these costs will ultimately be passed on to the end use consumers through rates. A collaborative process where the transformer manufacturers, electric utilities (investor, cooperative, municipal), and State regulators are involved is necessary to explore the policy options that are available so that we can produce a risk-based process that uses resources efficiently, thereby holding costs down while making the system more resilient.

Question 2. At a Bipartisan Policy Center event, you said: "We have demonstrated, proven cleaner energy offerings. It would be a shame not to acknowledge [these solutions]." What kinds of solutions were you talking about? Would these "cleaner" solutions be good for grid security?

Answer. This statement comes from an April 7 panel discussion with Environmental Protection Agency Administrator Gina McCarthy. We discussed the agency's upcoming proposal to reduce carbon emissions from existing power plants. My comment reflected the numerous efforts States have undertaken to promote energy efficiency and renewable energy well in advance of the EPA proposal. These efforts make clear the regional and local differences that exist in each of our States. We've asked EPA to ensure its rules are flexible and account for these regional differences and the actions already taken. Although NARUC has no position on the EPA proposal, we believe it should allow States to use these clean-energy programs in fashioning solutions to the EPA proposal. These comments were not made in response to the physical security of the grid.

RESPONSES OF COLETTE D. HONORABLE TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1a. In your written testimony you discuss how State Commissions determine who pays, how much they pay, and for what they are paying. After all, it is the consumer who must pay the electric bill at the end of the month and, as you noted in your testimony, some people must decide whether to pay that electric bill or buy medicine instead.

Is it feasible then to secure every inch of the transmission/distribution system?

Answer. No, it is not feasible, practical, economical, efficient, or even possible to secure "every inch" of the transmission/distribution system. We must use a risk-based approach to determine how and where to deploy the resources that we have at our disposal. Unfortunately, we will never be able to completely eliminate every

vulnerability. But what we can do is to target our resources based upon the known risk factors and limit the number (and severity) of actionable threats that evolve from the known vulnerabilities.

Question 1b. How do you suggest that proposed security upgrades to the grid should be prioritized to maximize benefits?

Answer. Again, I believe resource allocation ought to be based upon risk: What/where are the most critical facilities? Are these facilities sufficiently hardened? Where would a compromised facility do the most harm to the grid as a whole? Which part of a particular facility, if compromised, would do the most extended harm? These are just examples of the questions that the owners and operators of the systems that make up “the grid” are asking, and frankly these owners and operators are the ones who should know the questions, as well as the answers, regarding their systems better than anyone. State regulators rely upon the owners and operators to tell us what is expected for the levels of resiliency and security that are required. From there, our job is to determine whether these costs and investments are prudent and in the public interest.

Question 2. Do you agree with GAO that NERC and FERC should have a formal and documented role in EPA’s rulemaking process when EPA is developing regulations that impact grid stability?

Answer. NARUC has not taken a position on this specific question, but personally speaking, yes. Although it may be unusual to include entities from outside the federal government in the initial rulemaking process, in the case of reliability/grid stability I would advocate the inclusion of State utility Commissioners as well.

Question 3. Do you believe market prices for energy and capacity are sufficient at this time to attract investors to invest their capital in a new coal facility even though EPA standards would require the use of CCS technology that is not commercially viable?

Answer. Given other market and regulatory pressures, I believe that it would be difficult to attract investors to new coal generation at this time, notwithstanding CCS technology levels.

Question 4. In your judgment, is the grid more or less vulnerable as a result of the disclosure of non-public critical energy infrastructure information and the resulting news reports?

Answer. We prefer that this kind of information be kept internally because we do not know who could use it for nefarious reasons. The release of sensitive information regarding critical infrastructure at any level could be exploited. Therefore, the key question is whether the knowledge of this vulnerability could potentially threaten the reliability of the grid or one of its component systems. The owners and operators of the grid expend many resources every time a vulnerability is disclosed or identified. Some of these vulnerabilities will need additional resources to ensure that the likelihood of an actionable threat developing is reduced or eliminated.

RESPONSE OF JAMES L. HUNTER TO QUESTION FROM SENATOR CANTWELL

Question 1. A shortage of transformers has been identified as a resiliency problem for the grid. What options should Congress consider to promote the manufacture of transformers?

Answer. The U.S. has lost most of its capability to manufacture large power transformers over the last 30 years. Congress needs to help the revitalization of the industry by adding the “Made in America Provision” to any transformers purchased by the Federal Government. The IBEW represents several U.S. transformer manufacturers and we believe that any action by Congress that supports and strengthens the United States capability to produce our own equipment is vital to our economy, job growth and most importantly, the creation and maintenance of grid security. Second, being that the industry has many different voltages and configurations of transformers, a wise approach would be that our government manufactures specifically designed units that can be designed in several different configurations in order to be placed anywhere at any given time when eventually needed. If we rely on foreign manufacturing, we will be leaving our systems extremely vulnerable to extended outages by having long transport times and possible security issues, not to mention taking away jobs from our citizens. It should be noted that many of our existing transformers are already beyond their useful life expectancy. EPRI has done some research in this area and have issued reports that summarize the age of the units. We believe it is likely that once we start losing transformers due to catastrophic failures we could lose several within a short period of time. This issue should be studied and minimum levels of replacement transformers should be built and made available to the industry.

RESPONSES OF JAMES L. HUNTER TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. Thank you for providing an important perspective to the grid reliability debate. Your testimony outlines how over 50,000 direct jobs would be lost if there are 56 gigawatts of closings. Please elaborate on the jobs that will be lost, and the salaries that are associated with these positions.

Answer. I am attaching our analysis of job losses and the background information (see Analysis of units at risk EPA MATS Rule 2). I am also attaching an average IBEW wage for power plants workers that conservatively place the average wage at \$72,552 per year.

ELECTRIC GENERATION FROM ALL SOURCES AND FROM COAL "UNITS AT RISK" WITH DIRECT AND TOTAL JOB ESTIMATES												
	ELEC. GENERATION BY STATE 2009 GWH*		GENERATION (2005) FROM "UNITS AT RISK"*** 25-400 MW, >40 YEARS W/O SCRUBBERS		PCT OF STATE GENERATION		EST. DIRECT COAL/UTILITY/RAIL JOBS AT RISK***		JOBS MULTIPLIER RIMS****		EST. TOTAL DIRECT & INDIRECT JOBS	
	TOTAL	COAL	# UNITS	GWH	TOTAL	COAL	EST. DIRECT JOBS AT RISK***	EST. DIRECT COAL/UTILITY/RAIL JOBS AT RISK***	JOBS MULTIPLIER RIMS****	EST. TOTAL DIRECT & INDIRECT JOBS		
New England	116,118	14,715	11	11,620	10%	79%	1,975			6,552		
Connecticut	29,786	2,118	1	2,736	9%	129%	465		3.28	1,526		
Mass.	37,065	9,583	7	7,904	21%	82%	1,344		3.36	4,515		
New Hamp.	20,586	2,939	3	980	5%	33%	167		3.07	511		
Rhode Isl.	7,309	0	0	0	0%	0%	0		NA	0		
Vermont	6,263	0	0	0	0%	0%	0		NA	0		
Middle Atlantic	392,410	116,518	34	15,082	4%	13%	2,564			13,101		
New Jersey	58,474	4,920	3	561	1%	11%	95		3.83	365		
New York	127,589	13,649	10	2,687	2%	20%	457		2.91	1,329		
Pennsylvania	206,346	97,948	21	11,834	6%	12%	2,012		5.67	11,407		
East North Central	569,271	390,895	146	103,556	18%	26%	17,605			82,873		
Illinois	180,248	83,746	31	31,715	18%	38%	5,392		5.36	28,889		
Indiana	110,151	102,935	24	14,106	13%	14%	2,398		5.33	12,781		
Michigan	94,928	63,579	32	23,503	25%	37%	3,996		3.66	14,624		
Ohio	126,855	105,124	38	22,192	17%	21%	3,773		5.16	19,467		
Wisconsin	57,093	34,511	21	12,040	21%	35%	2,047		3.47	7,102		
West North Central	294,526	212,291	74	40,401	14%	19%	6,868			29,880		
Iowa	48,119	35,359	23	8,266	17%	23%	1,405		3.99	5,607		
Kansas	44,033	29,715	6	2,633	6%	9%	448		5.4	2,417		
Minnesota	48,736	28,529	13	4,640	10%	16%	789		3.69	2,911		
Missouri	83,210	67,621	21	16,853	20%	25%	2,865		4.53	12,978		
Nebraska	31,588	20,466	8	5,519	17%	27%	938		3.45	3,237		
N. Dakota	31,266	27,673	3	2,490	8%	9%	423		6.45	2,730		
S. Dakota	7,576	2,930	0	0	0%	0%	0		NA	0		

NETL Coal Plant Database 2007 EGUs 25-400 MW AND >40 YEARS W/O SCRUBBERS REMOVING >50% SO2
Includes Munis (w/o age data), excludes industrials and cold reserves,excludes units with planned/announced FGD

F_767_Plant D EIA-2005	F_767_Plant J EIA-2005	F_767_Plant L EIA-2005	F_767_Plant D EIA-2005	F_767_Boiler AH EIA-2005	This Sheet Formula	F_767_Generator E EIA-2005	F_767_Boiler_Fuel T EIA-2005	F_423_Coal_State Several EIA-2005	
Utility Name	Plant Name	Plant Location State	Boiler ID	Boiler In Service Date	Boiler Age as of 2/11/2011 (years)	Generator Nameplate Rating (MW)	Net Annual Electrical Generation (MWh)	Primary Fuel Consumed (1000 tons)	Coal Origin State (Largest Source in 2005)
Alabama Power Co	Barry	AL	1	2/1/1954	57.0	153	935,406	413	Imported
Alabama Power Co	Barry	AL	2	7/1/1954	56.6	153	1,039,559	463	Imported
Alabama Power Co	Barry	AL	3	7/1/1959	51.6	272	1,888,773	821	Imported
Alabama Power Co	Gadsden	AL	1	4/1/1949	61.9	69	218,587	118	Alabama
Alabama Power Co	Gadsden	AL	2	7/1/1949	61.6	69	211,241	111	Alabama
Alabama Power Co	Gorgas	AL	6	4/1/1951	59.9	125	611,469	312	Alabama
Alabama Power Co	Gorgas	AL	7	7/1/1952	58.6	125	661,966	325	Alabama
Alabama Power Co	Greene Coun	AL	1	6/1/1965	45.7	299	1,932,777	139	Illinois
Alabama Power Co	Greene Coun	AL	2	7/1/1966	44.6	269	1,852,732	114	Alabama
Alabama Power Co	E C Gaston	AL	1	5/1/1960	50.8	272	1,488,861	600	Alabama
Alabama Power Co	E C Gaston	AL	2	7/1/1960	50.6	272	1,496,973	612	Alabama
Alabama Power Co	E C Gaston	AL	3	6/1/1961	49.7	272	1,616,927	674	Alabama
Alabama Power Co	E C Gaston	AL	4	6/1/1962	48.7	245	1,868,088	747	Alabama
Tennessee Valley Authority	Widows Cree	AL	1	7/1/1952	58.6	141	719,503	354	Kentucky
Tennessee Valley Authority	Widows Cree	AL	2	10/1/1952	56.4	141	699,166	345	Kentucky
Tennessee Valley Authority	Widows Cree	AL	3	11/1/1952	58.3	141	667,433	323	Kentucky
Tennessee Valley Authority	Widows Cree	AL	4	1/1/1953	58.1	141	764,030	364	Kentucky
Tennessee Valley Authority	Widows Cree	AL	5	6/1/1954	56.7	141	702,224	322	Kentucky
Tennessee Valley Authority	Widows Cree	AL	6	7/1/1954	56.6	141	729,701	331	Kentucky
UNS Electric Inc	H Wilson Sun	AZ	4	5/1/1967	43.8	173	783,197	369	Colorado
Aquia Inc	W N Clark	CO	59	NL	NL	25	172,856	100	NL
Public Service Co of Colorado	Arapahoe	CO	3	6/1/1951	59.7	46	257,863	166	Wyoming
Public Service Co of Colorado	Arapahoe	CO	4	6/1/1955	55.7	112	635,999	377	Wyoming
Public Service Co of Colorado	Cameo	CO	2	NL	NL	44	336,526	202	Colorado
Public Service Co of Colorado	Cherokee	CO	1	6/1/1957	53.7	125	743,189	355	Colorado
Public Service Co of Colorado	Cherokee	CO	2	6/1/1959	51.7	125	807,480	374	Colorado

Colorado Springs City of	Martin Drake	CO	5	6/1/1962	48.7	50	304,539	NL	Colorado
Colorado Springs City of	Martin Drake	CO	6	6/1/1968	42.7	75	613,618	NL	Colorado
Colorado Springs City of	Martin Drake	CO	7	6/1/1974	36.7	132	1,130,607	NL	Colorado
PSEG Power Connecticut LLC	Bridgeport St:	CT	BHB3	8/1/1968	42.5	400	2,735,970	1,496	Idaho
Connectiv Energy Supply Inc	Edge Moor	DE	3	12/1/1957	53.2	75	449,193	182	West Virginia
Indian River Operations Inc	Indian River C	DE	1	6/1/1957	53.7	82	352,160	165	West Virginia
Indian River Operations Inc	Indian River C	DE	2	6/1/1959	51.7	82	367,476	165	West Virginia
Indian River Operations Inc	Indian River C	DE	3	6/1/1970	40.7	177	869,366	337	West Virginia
Gulf Power Co	Criet	FL	6	5/1/1970	40.8	370	1,810,453	819	Illinois
Gulf Power Co	Scholz	FL	1	NL	NL	49	193,644	101	Kentucky
Gulf Power Co	Scholz	FL	2	NL	NL	49	171,802	93	Kentucky
Gulf Power Co	Lansing Smit	FL	1	6/1/1965	45.7	150	1,209,964	534	Imported
Gulf Power Co	Lansing Smit	FL	2	6/1/1967	43.7	190	1,156,489	514	Imported
Georgia Power Co	Jack McDono	GA	MB1	6/1/1963	47.7	299	1,819,178	707	NL
Georgia Power Co	Jack McDono	GA	MB2	6/1/1964	46.7	299	1,819,787	691	NL
Georgia Power Co	Mitchell	GA	3	5/1/1964	46.8	163	636,154	268	Kentucky
Georgia Power Co	Yates	GA	Y2BR	11/1/1950	60.3	123	527,511	233	Virginia
Georgia Power Co	Yates	GA	Y3BR	8/1/1952	58.5	123	432,433	196	Virginia
Georgia Power Co	Yates	GA	Y4BR	6/1/1957	53.7	156	798,740	321	Virginia
Georgia Power Co	Yates	GA	Y5BR	5/1/1958	52.8	156	743,536	313	Virginia
Savannah Electric & Power Co Kraft		GA	1	6/1/1953	57.7	50	256,717	123	Imported
Savannah Electric & Power Co Kraft		GA	2	6/1/1961	49.7	54	288,952	135	Imported
Savannah Electric & Power Co Kraft		GA	3	6/1/1965	48.7	104	568,193	248	Imported
Ameren Energy Resources Ga E D Edwards		IL	1	6/1/1960	50.7	136	722,391	6	Illinois
Ameren Energy Resources Ga E D Edwards		IL	2	6/1/1968	42.7	281	1,671,030	18	Illinois
Ameren Energy Generating Co Hulsenville		IL	05	2/1/1953	58.0	75	383,621	162	Indiana
Ameren Energy Generating Co Hulsenville		IL	06	7/1/1954	56.6	75	371,882	44	Indiana
Ameren Energy Generating Co Meredosia		IL	03	1/1/1949	62.1	58	109,708	40	Illinois
Ameren Energy Generating Co Meredosia		IL	04	1/1/1949	62.1	*	*	44	Illinois
Ameren Energy Generating Co Meredosia		IL	05	7/1/1960	50.6	239	1,039,273	641	Wyoming
Midwest Generations EME LLC Crawford		IL	7	5/1/1958	52.8	239	1,190,315	717	Wyoming
Midwest Generations EME LLC Crawford		IL	8	4/1/1961	49.9	358	1,775,558	1,055	Wyoming
Midwest Generations EME LLC Joliet 9		IL	5	7/1/1959	51.6	360	1,673,848	1,055	Wyoming
Midwest Generations EME LLC Waukegan		IL	17	4/1/1952	58.9	121	405,718	272	Wyoming
Midwest Generations EME LLC Waukegan		IL	7	6/1/1958	52.7	326	2,001,661	1,189	Wyoming
Midwest Generations EME LLC Waukegan		IL	8	6/1/1962	48.7	355	2,153,125	1,316	Wyoming
Midwest Generations EME LLC Will County		IL	1	5/1/1955	55.8	188	726,859	459	Wyoming
Midwest Generations EME LLC Will County		IL	2	3/1/1955	56.0	184	725,094	456	Wyoming
Midwest Generations EME LLC Will County		IL	3	6/1/1957	53.7	299	1,444,123	854	Wyoming

Midwest Generations EME LLC Frisk Street	IL	19	3/1/1989	52.0	374	1,673,848	863	Wyoming
Electric Energy Inc	IL	1	8/1/1953	57.5	183	1,334,446	830	Wyoming
Electric Energy Inc	IL	2	9/1/1953	57.4	183	1,345,537	839	Wyoming
Electric Energy Inc	IL	3	5/1/1954	56.8	183	1,286,422	802	Wyoming
Electric Energy Inc	IL	4	8/1/1954	56.5	183	1,395,791	867	Wyoming
Electric Energy Inc	IL	5	6/1/1955	55.7	183	1,313,742	823	Wyoming
Electric Energy Inc	IL	6	8/1/1955	55.5	183	1,202,957	766	Wyoming
Dynegy Midwest Generation In Hennepin Po	IL	1	6/1/1953	57.7	75	426,690	281	Wyoming
Dynegy Midwest Generation In Hennepin Po	IL	2	5/1/1959	51.8	231	1,555,459	924	Wyoming
Dynegy Midwest Generation In Vermilion	IL	1	5/1/1955	55.8	74	333,744	165	Indiana
Dynegy Midwest Generation In Wood River	IL	2	11/1/1956	54.3	109	299,524	179	Indiana
Dynegy Midwest Generation In Wood River	IL	4	6/1/1954	56.7	113	530,260	365	Wyoming
Dynegy Midwest Generation In Wood River	IL	5	7/1/1964	46.6	388	2,414,032	1,458	Wyoming
Springfield City of	IL	7	4/1/1961	49.9	38	77,529	48	Illinois
Springfield City of	IL	8	12/1/1965	45.2	38	130,922	82	Illinois
Slate Line Energy LLC	IN	3	12/1/1955	55.2	125	566,157	639	Montana
Slate Line Energy LLC	IN	4	5/1/1962	48.8	209	796,387	766	Montana
Indiana Michigan Power Co	IN	U1	3/1/1951	60.0	153	845,728	384	West Virginia
Indiana Michigan Power Co	IN	U2	11/1/1952	58.3	153	873,420	390	West Virginia
Indiana Michigan Power Co	IN	U3	12/1/1954	56.2	215	1,048,578	457	West Virginia
Indianapolis Power & Light Co	IN	50	5/1/1958	52.8	114	573,130	289	Indiana
Indianapolis Power & Light Co	IN	60	4/1/1961	49.9	114	635,929	315	Indiana
Indianapolis Power & Light Co	IN	3	11/1/1951	59.3	50	244,956	146	Indiana
Indianapolis Power & Light Co	IN	4	1/1/1953	58.1	69	314,669	178	Indiana
Indianapolis Power & Light Co	IN	5	12/1/1953	57.2	69	341,177	182	Indiana
Indianapolis Power & Light Co	IN	6	10/1/1956	54.4	114	576,371	283	Indiana
PSI Energy Inc	IN	7-1	1/1/1949	62.1	40	91,309	50	Indiana
PSI Energy Inc	IN	7-2	1/1/1949	62.1	69	87,308	60	Indiana
PSI Energy Inc	IN	8-1	12/1/1951	59.2	*	*	68	Indiana
PSI Energy Inc	IN	1	7/1/1959	51.6	150	717,609	327	Indiana
PSI Energy Inc	IN	2	12/1/1958	52.2	150	738,073	339	Indiana
PSI Energy Inc	IN	3	4/1/1960	50.9	150	644,914	296	Indiana
PSI Energy Inc	IN	4	3/1/1961	49.9	150	776,308	358	Indiana
PSI Energy Inc	IN	4	11/1955	56.1	113	602,049	298	Indiana
PSI Energy Inc	IN	6	8/1/1968	42.5	387	2,149,048	1,028	Indiana
Logansport City Of	IN	6	NL	NL	25	101,968	NL	NL
Richmond City of	IN	1	NL	NL	33	195,648	NL	NL
Hoosier Energy R E C Inc	IN	1SG1	5/1/1970	40.8	117	686,229	308	Indiana
Hoosier Energy R E C Inc	IN	2SG1	5/1/1970	40.8	117	497,108	229	Indiana

Interstate Power & Light Co	IA	1	NL	NL	38	164,192	NL	NL	NL
Interstate Power & Light Co	IA	5	NL	NL	29	50,058	NL	NL	NL
Interstate Power & Light Co	IA	2	5/1/1967	43.8	218	1,225,857	NL	Wyoming	Wyoming
Interstate Power & Light Co	IA	3	6/1/1958	52.7	50	98,904	32	Wyoming	Wyoming
Interstate Power & Light Co	IA	4	6/1/1967	43.7	149	706,549	538	Wyoming	Wyoming
Interstate Power & Light Co	IA	1	6/1/1955	55.7	38	210,202	137	Wyoming	Wyoming
Interstate Power & Light Co	IA	2	6/1/1955	55.7	38	210,202	144	Wyoming	Wyoming
Interstate Power & Light Co	IA	3	6/1/1961	49.7	82	453,592	283	Wyoming	Wyoming
MidAmerican Energy Co	IA	9	6/1/1961	49.7	136	640,217	379	Wyoming	Wyoming
MidAmerican Energy Co	IA	1	2/1/1954	57.0	49	297,837	220	Wyoming	Wyoming
MidAmerican Energy Co	IA	2	2/1/1958	53.0	82	635,618	399	Wyoming	Wyoming
MidAmerican Energy Co	IA	1	5/1/1964	46.8	147	953,847	578	Wyoming	Wyoming
Interstate Power & Light Co	IA	1	6/1/1968	42.7	212	1,143,174	741	Wyoming	Wyoming
Ames City of	IA	7	NL	NL	33	156,380	NL	NL	NL
Ames City of	IA	8	NL	NL	65	351,759	NL	NL	NL
Cedar Falls City of	IA	7	NL	NL	35	109,692	NL	NL	NL
Muscatine City of	IA	7	6/1/1958	52.7	25	96,538	82	Wyoming	Wyoming
Muscatine City of	IA	8	6/1/1969	41.7	75	148,807	363	Wyoming	Wyoming
Pella City of	IA	7	NL	NL	26	105,922	NL	NL	NL
Pella City of	IA	8	NL	NL	*	*	NL	NL	NL
Corn Belt Power Coop	IA	1	NL	NL	33	138,410	NL	NL	NL
Central Iowa Power Coop	IA	1	NL	NL	25	127,013	NL	NL	NL
Central Iowa Power Coop	IA	2	NL	NL	38	238,377	NL	NL	NL
Empire District Electric Co	KS	39	NL	NL	38	174,627	NL	NL	NL
Empire District Electric Co	KS	40	NL	NL	50	313,874	NL	NL	NL
Westar Energy	KS	3	1/1/1955	56.1	49	331,036	228	Wyoming	Wyoming
Westar Energy	KS	10	4/1/1962	48.9	150	895,209	578	Wyoming	Wyoming
Westar Energy	KS	9	8/1/1957	53.5	82	508,011	301	Wyoming	Wyoming
Kansas City City of	KS	1	5/1/1965	45.8	82	409,574	260	Wyoming	Wyoming
Kentucky Power Co	KY	4	1/1/1963	48.1	281	1,542,054	653	Kentucky	Kentucky
Kentucky Utilities Co	KY	5	4/1/1954	56.9	75	336,573	177	Kentucky	Kentucky
Kentucky Utilities Co	KY	5	7/1/1959	51.6	114	336,730	160	Kentucky	Kentucky
Tennessee Valley Authority	KY	5	7/1/1953	57.6	75	355,762	184	Kentucky	Kentucky
Tennessee Valley Authority	KY	1	4/1/1953	57.9	175	914,556	414	Colorado	Colorado
Tennessee Valley Authority	KY	2	6/1/1953	57.7	175	917,047	417	Colorado	Colorado
Tennessee Valley Authority	KY	3	10/1/1953	57.4	175	894,467	403	Colorado	Colorado
Tennessee Valley Authority	KY	4	1/1/1954	56.4	175	1,016,621	459	Colorado	Colorado
Tennessee Valley Authority	KY	5	10/1/1954	56.4	175	1,038,069	467	Colorado	Colorado
Tennessee Valley Authority	KY	6	11/1/1954	56.3	175	1,006,847	455	Colorado	Colorado

Tennessee Valley Authority	Shawnee	KY	7	12/1/1954	56.2	175	883,478	399	Colorado
Tennessee Valley Authority	Shawnee	KY	8	3/1/1955	56.0	175	966,383	439	Colorado
Tennessee Valley Authority	Shawnee	KY	9	7/1/1955	55.6	175	1,000,910	453	Colorado
Western Kentucky Energy Corp	Robert A Reic	KY	R1	NL	NL	96	307,446	NL	NL
East Kentucky Power Coop Inc	Cooper	KY	1	2/1/1965	46.0	114	664,895	258	Kentucky
East Kentucky Power Coop Inc	Dale	KY	1	12/1/1954	56.2	27	139,898	70	Kentucky
East Kentucky Power Coop Inc	Dale	KY	2	12/1/1954	56.2	27	146,290	72	Kentucky
East Kentucky Power Coop Inc	Dale	KY	3	10/1/1957	53.4	81	451,304	209	Kentucky
East Kentucky Power Coop Inc	Dale	KY	4	8/1/1960	50.5	81	495,308	224	Kentucky
Constellation Power Source	G&C P Crane	MD	1	7/1/1961	49.6	190	975,724	389	Pennsylvania
Constellation Power Source	G&C P Crane	MD	2	2/1/1963	48.0	209	1,152,590	464	Pennsylvania
Constellation Power Source	G&C P Crane	MD	2	1/1/1959	52.1	136	718,492	330	West Virginia
Constellation Power Source	G&C P Crane	MD	3	8/1/1966	44.5	359	2,253,747	891	West Virginia
Allegheny Energy Supply Co	LJR Paul Smith	MD	11	11/1/1956	52.3	75	327,598	158	Pennsylvania
Allegheny Energy Supply Co	LJR Paul Smith	MD	9	10/1/1947	63.4	35	69,054	40	Pennsylvania
Northeast Generation Services	Mount Tom	MA	1	6/1/1960	50.7	100	1,026,279	459	Kentucky
Somerset Power LLC	Somerset Sta	MA	8	7/1/1959	51.6	100	790,385	320	Colorado
Dominion Energy New England	Brayton Point	MA	1	4/1/1953	47.9	241	1,867,848	782	Colorado
Dominion Energy New England	Brayton Point	MA	2	5/1/1964	46.8	241	1,990,026	830	Colorado
U S Gen New England Inc	Salem Harbor	MA	1	11/1/1951	59.3	82	585,305	271	Colorado
U S Gen New England Inc	Salem Harbor	MA	2	9/1/1952	58.4	82	587,005	280	Colorado
U S Gen New England Inc	Salem Harbor	MA	3	6/1/1958	52.7	166	1,057,458	450	Colorado
Consumers Energy Co	BC Cobb	MI	4	7/1/1956	54.6	156	861,914	91	Montana
Consumers Energy Co	BC Cobb	MI	5	5/1/2000	10.8	156	1,191,896	135	Montana
Consumers Energy Co	Dan E Kam	MI	1	7/1/1959	51.6	136	942,115	222	Wyoming
Consumers Energy Co	Dan E Kam	MI	2	3/1/1961	49.9	136	930,553	310	Wyoming
Consumers Energy Co	JH Campbell	MI	1	8/1/1962	48.5	265	2,069,528	NL	Wyoming
Consumers Energy Co	J C Weadock	MI	7	4/1/1955	55.9	156	977,940	126	Wyoming
Consumers Energy Co	J C Weadock	MI	8	4/1/1958	52.9	156	1,078,462	137	Wyoming
Consumers Energy Co	J R Whiting	MI	1	5/1/1952	58.8	106	764,421	72	Wyoming
Consumers Energy Co	J R Whiting	MI	2	2/1/1953	58.0	106	763,397	76	Wyoming
Consumers Energy Co	J R Whiting	MI	3	8/1/1953	57.5	133	810,393	74	Wyoming
Detroit Edison Co	Harbor Beach	MI	1	4/1/1968	42.9	121	357,180	172	Kentucky
Detroit Edison Co	River Rouge	MI	2	11/1/1957	53.3	293	1,871,689	824	Wyoming
Detroit Edison Co	River Rouge	MI	3	10/1/1958	52.4	358	1,277,771	662	Wyoming
Detroit Edison Co	St Clair	MI	1	8/1/1953	57.5	169	751,091	NL	Montana
Detroit Edison Co	St Clair	MI	2	11/1/1953	57.3	156	757,796	NL	Montana
Detroit Edison Co	St Clair	MI	3	6/1/1954	56.7	156	737,856	NL	Montana
Detroit Edison Co	St Clair	MI	4	10/1/1954	56.4	169	864,820	NL	Montana

Detroit Edison Co	MI	6	4/1/1961	49.9	353	1,901,210	NL	Montana
Detroit Edison Co	MI	16	7/1/1948	61.6	120	719,953	NL	Wyoming
Detroit Edison Co	MI	17	8/1/1949	61.5	120	473,181	NL	Wyoming
Detroit Edison Co	MI	18	11/1/1949	61.3	*	*	NL	Wyoming
Detroit Edison Co	MI	19	2/1/1950	61.0	*	*	NL	Wyoming
Wisconsin Electric Power Co	MI	3	1/1/1964	47.1	54	337,485	153	Colorado
Wisconsin Electric Power Co	MI	4	12/1/1966	44.2	58	375,120	175	Colorado
Holland City of	MI	5	NL	NL	29	119,934	NL	Colorado
Lansing City of	MI	1	6/1/1954	56.7	44	216,731	135	Wyoming
Lansing City of	MI	2	6/1/1958	52.7	44	190,396	131	Wyoming
Lansing City of	MI	3	6/1/1961	49.7	47	209,882	136	Wyoming
Lansing City of	MI	4	6/1/1964	46.7	80	274,638	162	Wyoming
Lansing City of	MI	5	6/1/1968	42.7	80	351,617	202	Wyoming
Lansing City of	MI	6	6/1/1970	40.7	80	451,259	285	Wyoming
Lansing City of	MI	1	6/1/1973	37.7	155	1,082,747	615	Colorado
Allete Inc	MI	1	4/1/1953	57.9	58	353,900	241	Montana
Allete Inc	MI	2	9/1/1953	57.4	58	341,600	233	Montana
Allete Inc	MI	1	7/1/1958	52.6	75	471,911	278	Montana
Allete Inc	MI	2	1/1/1960	51.1	75	472,980	271	Montana
Northern States Power Co	MI	3	8/1/1955	55.5	114	520,519	349	Wyoming
Northern States Power Co	MI	4	10/1/1960	50.4	180	1,165,666	706	Wyoming
Northern States Power Co	MI	3	1/1/1942	69.1	NL	NL	NL	NL
Northern States Power Co	MI	4	1/1/1944	67.1	NL	NL	NL	NL
Otter Tail Power Co	MI	2	6/1/1959	46.7	54	398,304	242	Montana
Otter Tail Power Co	MI	3	6/1/1964	46.7	75	533,326	328	Montana
Austin City of	MI	3	NL	NL	32	140,898	NL	NL
Rochester Public Utilities	MI	3	NL	NL	25	66,585	NL	NL
Rochester Public Utilities	MI	4	NL	NL	54	175,084	NL	NL
Empire District Electric Co	MO	1	6/1/1970	40.7	213	1,366,270	669	NL
Kansas City Power & Light Co	MO	1	7/1/1958	52.6	188	1,124,149	703	Wyoming
Kansas City Power & Light Co	MO	2	4/1/1960	50.9	188	1,124,183	737	Wyoming
Kansas City Power & Light Co	MO	3	5/1/1964	46.8	188	1,094,570	661	Wyoming
Aquila Inc	MO	1	6/1/1960	50.7	55	314,149	196	Wyoming
Aquila Inc	MO	2	5/1/1962	48.8	50	320,879	207	Wyoming
Aquila Inc	MO	5	6/1/1957	53.7	*	*	NL	Wyoming
Aquila Inc	MO	6	5/1/1967	43.8	90	610,924	NL	Wyoming
Ameren UE	MO	1	5/1/1953	57.8	138	937,915	601	Wyoming
Ameren UE	MO	2	7/1/1954	56.6	138	966,581	607	Wyoming
Ameren UE	MO	3	1/1/1959	52.1	289	1,896,179	1,208	Wyoming

Ameren UE	MO	4	7/1/1961	49.6	359	1,869,095	1,171	Wyoming
Independence City of	MO	1	4/1/1958	52.9	25	80,926	58	Missouri
Independence City of	MO	2	5/1/1958	52.6	25	75,196	50	Missouri
Independence City of	MO	3	6/1/1965	45.7	65	173,196	108	Missouri
Springfield City of	MO	3	2/1/1960	51.0	44	272,769	188	Wyoming
Springfield City of	MO	4	5/1/1964	46.8	60	421,827	268	Wyoming
Springfield City of	MO	5	5/1/1970	40.8	105	674,595	420	Wyoming
Associated Electric Coop Inc	MO	MB1	12/1/1966	44.2	180	1,248,024	749	Wyoming
Associated Electric Coop Inc	MO	MB2	3/1/1969	41.9	285	1,969,327	1,173	Wyoming
Central Electric Power Coop	MO	2	NL	NL	44	292,833	NL	NL
PPL Montana LLC	MT	2	7/1/1968	42.6	173	1,070,647	643	Wyoming
Nebraska Public Power District Sheldon	NE	1	7/1/1968	42.6	109	744,968	480	Wyoming
Nebraska Public Power District Sheldon	NE	2	7/1/1961	49.6	120	807,432	518	Wyoming
Omaha Public Power District North Omaha	NE	1	6/1/1954	56.7	74	361,170	236	Wyoming
Omaha Public Power District North Omaha	NE	2	6/1/1957	53.7	109	600,520	398	Wyoming
Omaha Public Power District North Omaha	NE	3	6/1/1959	51.7	109	597,538	394	Wyoming
Omaha Public Power District North Omaha	NE	4	6/1/1963	47.7	136	785,291	480	Wyoming
Omaha Public Power District North Omaha	NE	5	6/1/1968	42.7	218	1,072,896	657	Wyoming
Hastings City of	NE	1	NL	NL	76	549,295	365	Wyoming
Public Service Co of NH	NH	4	10/1/1952	58.4	50	322,425	163	Imported
Public Service Co of NH	NH	5	5/1/1955	55.8	50	313,777	162	Imported
Public Service Co of NH	NH	6	7/1/1957	53.6	50	343,650	169	Imported
Atlantic City Electric Co	NJ	1	12/1/1958	52.2	82	48,849	NL	N/A
Atlantic City Electric Co	NJ	8	12/1/1954	56.2	74	430,108	175	West Virginia
Vineland City of	NJ	10	NL	NL	25	81,820	NL	NL
AES Westover LLC	NY	11	10/1/1943	67.4	44	186,370	48	Pennsylvania
AES Westover LLC	NY	12	10/1/1943	67.4	*	*	48	Pennsylvania
AES Westover LLC	NY	13	12/1/1951	59.2	75	613,413	247	Pennsylvania
AES Greenidge LLC	NY	4	4/1/1950	60.9	50	223,897	57	Pennsylvania
AES Greenidge LLC	NY	5	4/1/1950	60.9	*	*	56	Pennsylvania
AES Greenidge LLC	NY	6	12/1/1953	57.2	113	665,481	278	Pennsylvania
Rochester Gas & Electric Corp Rochester 7	NY	1	11/1/1948	62.3	46	87,091	41	West Virginia
Rochester Gas & Electric Corp Rochester 7	NY	2	12/1/1960	60.2	63	232,833	102	West Virginia
Rochester Gas & Electric Corp Rochester 7	NY	3	9/1/1953	57.4	63	212,109	102	West Virginia
Rochester Gas & Electric Corp Rochester 7	NY	4	3/1/1957	53.9	82	449,419	182	West Virginia
Jamestown City of	NY	10	NL	NL	29	16,418	NL	NL
Progress Energy Carolinas Inc Cape Fear	NC	5	12/1/1956	54.2	141	886,991	365	West Virginia
Progress Energy Carolinas Inc Cape Fear	NC	6	7/1/1958	52.6	188	979,183	420	West Virginia
Progress Energy Carolinas Inc Lee	NC	1	6/1/1952	58.7	75	357,027	173	West Virginia

Progress Energy Carolinas Inc Lee	NC	2	5/1/1951	58.8	75	342,283	157	West Virginia
Progress Energy Carolinas Inc Lee	NC	3	8/1/1962	48.5	252	1,350,227	549	West Virginia
Progress Energy Carolinas Inc L V Sutton	NC	1	8/1/1954	56.5	113	434,803	215	West Virginia
Progress Energy Carolinas Inc L V Sutton	NC	2	5/1/1955	55.8	113	507,990	228	West Virginia
Progress Energy Carolinas Inc W H Weather	NC	1	9/1/1949	61.4	46	190,443	100	Kentucky
Progress Energy Carolinas Inc W H Weather	NC	2	6/1/1950	60.7	46	184,257	95	Kentucky
Progress Energy Carolinas Inc W H Weather	NC	3	8/1/1952	58.5	74	422,875	194	Kentucky
Duke Energy Corp	NC	5	7/1/1941	69.6	80	187,154	112	West Virginia
Duke Energy Corp	NC	6	6/1/1941	69.7	*	*	112	West Virginia
Duke Energy Corp	NC	7	9/1/1942	68.4	40	81,227	50	West Virginia
Duke Energy Corp	NC	8	9/1/1953	57.4	125	691,815	312	West Virginia
Duke Energy Corp	NC	9	12/1/1953	57.2	125	686,814	310	West Virginia
Duke Energy Corp	NC	1	12/1/1949	61.0	70	206,770	99	West Virginia
Duke Energy Corp	NC	2	3/1/1950	61.0	70	170,831	80	West Virginia
Duke Energy Corp	NC	3	8/1/1955	55.5	150	271,712	115	West Virginia
Duke Energy Corp	NC	10	11/1/1954	56.3	133	545,397	230	NL
Duke Energy Corp	NC	7	10/1/1952	58.4	100	386,624	171	NL
Duke Energy Corp	NC	8	1/1/1952	58.3	100	419,207	191	NL
Duke Energy Corp	NC	9	8/1/1954	56.5	133	484,561	208	NL
MDU Resources Group Inc	ND	B1	11/1/1954	56.3	40	109,952	119	NL
MDU Resources Group Inc	ND	B2	11/1/1963	47.3	75	497,382	281	North Dakota
Minnesota Power Coop Inc	ND	B1	11/1/1970	40.3	257	1,883,383	1,616	North Dakota
American Mun Power-Ohio Inc Richard Gors	OH	1	6/1/1951	59.7	50	229,032	172	Ohio
American Mun Power-Ohio Inc Richard Gors	OH	2	6/1/1951	59.7	50	271,747	187	Ohio
American Mun Power-Ohio Inc Richard Gors	OH	3	6/1/1951	59.7	50	213,148	164	Ohio
American Mun Power-Ohio Inc Richard Gors	OH	4	6/1/1951	59.7	50	231,898	164	Ohio
Cincinnati Gas & Electric Co	OH	1	6/1/1952	58.7	115	527,295	258	Kentucky
Cincinnati Gas & Electric Co	OH	2	10/1/1953	57.4	113	503,252	241	Kentucky
Cincinnati Gas & Electric Co	OH	3	11/1/1954	56.3	125	762,907	347	Kentucky
Cincinnati Gas & Electric Co	OH	4	7/1/1958	52.6	163	1,008,854	457	Kentucky
Cincinnati Gas & Electric Co	OH	5	12/1/1962	48.2	245	1,272,573	577	Kentucky
Cincinnati Gas & Electric Co	OH	6	11/1/1960	50.3	163	1,138,334	485	West Virginia
Cleveland Electric Illum Co	OH	7	12/1/1958	52.2	256	1,408,106	845	NL
Orion Power Midwest LP	OH	10	12/1/1949	61.2	86	234,796	150	Pennsylvania
Cleveland Electric Illum Co	OH	1	9/1/1953	57.4	123	739,967	396	NL
Cleveland Electric Illum Co	OH	3	12/1/1953	57.2	123	657,096	344	NL
Cleveland Electric Illum Co	OH	4	8/1/1954	56.5	208	1,465,556	835	NL
Cleveland Electric Illum Co	OH	18	6/1/1962	48.7	256	950,870	663	NL
Columbus Southern Power Co Conesville	OH	1	2/1/1959	52.0	148	41,534	19	Ohio

Columbus Southern Power Co	OH	2	2/1/1957	54.0	138	68,262	31	Ohio
Columbus Southern Power Co Conesville	OH	3	10/1/1962	48.4	162	726,694	307	Ohio
Columbus Southern Power Co Picway	OH	9	11/1/1955	55.3	106	241,192	127	Ohio
Dayton Power & Light Co O H Hutching	OH	H-1	7/1/1948	62.6	69	66,750	39	West Virginia
Dayton Power & Light Co O H Hutching	OH	H-2	3/1/1949	61.9	69	67,716	39	West Virginia
Dayton Power & Light Co O H Hutching	OH	H-3	12/1/1950	60.2	69	142,165	63	West Virginia
Dayton Power & Light Co O H Hutching	OH	H-4	2/1/1951	60.0	69	126,658	55	West Virginia
Dayton Power & Light Co O H Hutching	OH	H-5	11/1/1952	58.3	69	149,967	73	West Virginia
Dayton Power & Light Co O H Hutching	OH	H-6	9/1/1953	57.4	69	134,430	63	West Virginia
Ohio Edison Co R E Burger	OH	5	3/1/1950	61.0	103	11,838	8	NL
Ohio Edison Co R E Burger	OH	6	3/1/1950	61.0	*	*	8	NL
Ohio Edison Co R E Burger	OH	7	3/1/1955	56.0	156	946,472	441	NL
Ohio Edison Co R E Burger	OH	8	6/1/1955	55.7	156	1,036,329	463	NL
Ohio Power Co Muskingum R	OH	1	12/1/1953	57.2	220	1,023,374	409	West Virginia
Ohio Power Co Muskingum R	OH	2	6/1/1954	56.7	220	720,451	288	West Virginia
Ohio Power Co Muskingum R	OH	3	12/1/1957	53.2	238	885,630	349	West Virginia
Ohio Power Co Muskingum R	OH	4	10/1/1968	42.4	238	937,101	363	West Virginia
Toledo Edison Co Bay Shore	OH	2	2/1/1959	52.0	141	853,560	481	NL
Toledo Edison Co Bay Shore	OH	3	5/1/1963	47.8	141	808,672	470	NL
Toledo Edison Co Bay Shore	OH	4	6/1/1968	42.7	218	1,470,130	844	NL
Orville City of Orville	OH	13	NL	NL	25	117,987	NL	NL
Reliant Energy Mid-Atlantic PH Portland	PA	1	10/1/1958	52.4	172	782,336	322	Pennsylvania
Reliant Energy Mid-Atlantic PH Portland	PA	2	10/1/1962	48.4	255	1,386,782	534	Pennsylvania
Reliant Energy Mid-Atlantic PH Titus	PA	1	6/1/1951	59.7	75	430,662	180	Pennsylvania
Reliant Energy Mid-Atlantic PH Titus	PA	2	6/1/1951	59.7	75	420,236	179	Pennsylvania
Reliant Energy Mid-Atlantic PH Titus	PA	3	6/1/1953	57.7	75	422,283	178	Pennsylvania
Reliant Energy Mid-Atlantic PH Shawville	PA	1	6/1/1954	56.7	125	687,481	314	Pennsylvania
Reliant Energy Mid-Atlantic PH Shawville	PA	2	6/1/1954	56.7	125	609,528	281	Pennsylvania
Reliant Energy Mid-Atlantic PH Shawville	PA	3	6/1/1959	51.7	188	960,274	414	Pennsylvania
Reliant Energy Mid-Atlantic PH Shawville	PA	4	6/1/1960	50.7	188	941,587	405	Pennsylvania
Orion Power Midwest LP New Castle P	PA	3	6/1/1952	58.7	98	379,812	176	Pennsylvania
Orion Power Midwest LP New Castle P	PA	4	6/1/1958	52.7	114	387,596	178	Pennsylvania
Orion Power Midwest LP New Castle P	PA	5	6/1/1964	46.7	136	547,499	253	Pennsylvania
Sunbury Generation LLC WPS Energy	PA	1A	11/1/1949	61.3	75	433,438	165	Pennsylvania
Sunbury Generation LLC WPS Energy	PA	1B	11/1/1949	61.3	90	460,553	177	Pennsylvania
Sunbury Generation LLC WPS Energy	PA	2A	9/1/1949	61.4	104	373,753	176	Pennsylvania
Sunbury Generation LLC WPS Energy	PA	2B	9/1/1949	61.4	*	*	183	Pennsylvania
Sunbury Generation LLC WPS Energy	PA	3	4/1/1951	59.9	*	*	210	Pennsylvania
Sunbury Generation LLC WPS Energy	PA	4	8/1/1953	57.5	156	359,900	178	Pennsylvania

UGI Development Co	Hunlock Pow	PA	6	NL	NL	50	236,046	NL	NL
Allegheny Energy Supply Co L	Armstrong Pc	PA	1	4/1/1958	52.9	163	998,552	409	Pennsylvania
Allegheny Energy Supply Co L	Armstrong Pc	PA	2	6/1/1959	51.7	163	1,015,752	413	Pennsylvania
Progress Energy Carolinas Inc	H B Robinsor	SC	1	5/1/1960	50.8	207	1,185,543	492	Kentucky
Duke Energy Corp	W S Lee	SC	1	3/1/1951	60.0	90	370,142	163	NL
Duke Energy Corp	W S Lee	SC	2	7/1/1951	59.6	90	312,274	137	NL
Duke Energy Corp	W S Lee	SC	3	12/1/1958	52.2	175	763,363	316	NL
South Carolina Electric&Gas C	Canadys Stez	SC	CAN1	4/1/1962	48.9	136	753,076	310	Kentucky
South Carolina Electric&Gas C	Canadys Stez	SC	CAN2	5/1/1964	46.8	136	702,852	287	Kentucky
South Carolina Electric&Gas C	Canadys Stez	SC	CAN3	5/1/1967	43.8	218	742,691	302	Kentucky
South Carolina Electric&Gas C	McMeekin	SC	MCM1	6/1/1958	52.7	147	879,681	NL	Kentucky
South Carolina Electric&Gas C	McMeekin	SC	MCM2	11/1/1958	52.3	147	911,922	NL	Kentucky
South Carolina Electric&Gas C	Urquhart	SC	URQ3	10/1/1955	55.4	100	602,974	231	Tennessee
South Carolina Pub Serv Auth	Dolphus M Gi	SC	1	6/1/1966	44.7	82	547,407	231	Kentucky
South Carolina Pub Serv Auth	Dolphus M Gi	SC	2	6/1/1966	44.7	82	585,626	247	Kentucky
South Carolina Pub Serv Auth	Jefferies	SC	3	1/1/1970	41.1	173	896,635	386	NL
South Carolina Pub Serv Auth	Jefferies	SC	4	7/1/1970	40.6	173	1,012,419	430	NL
Tennessee Valley Authority	Allen Steam f	TN	1	5/1/1959	51.8	330	1,744,664	917	NL
Tennessee Valley Authority	Allen Steam f	TN	2	5/1/1959	51.8	330	1,657,662	888	NL
Tennessee Valley Authority	Allen Steam f	TN	3	10/1/1959	51.4	330	1,757,813	943	NL
Tennessee Valley Authority	Gallatin	TN	1	11/1/1956	54.3	300	1,778,478	946	Pennsylvania
Tennessee Valley Authority	Gallatin	TN	2	6/1/1957	53.7	300	1,709,067	904	Pennsylvania
Tennessee Valley Authority	Gallatin	TN	3	5/1/1959	51.8	328	1,974,103	1,044	Pennsylvania
Tennessee Valley Authority	Gallatin	TN	4	8/1/1959	51.5	328	2,031,619	1,063	Pennsylvania
Tennessee Valley Authority	Johnsonville	TN	1	10/1/1951	59.4	125	587,866	NL	Kentucky
Tennessee Valley Authority	Johnsonville	TN	10	8/1/1959	51.5	173	972,034	NL	Kentucky
Tennessee Valley Authority	Johnsonville	TN	2	11/1/1951	59.3	125	646,478	NL	Kentucky
Tennessee Valley Authority	Johnsonville	TN	3	2/1/1952	59.0	125	667,154	NL	Kentucky
Tennessee Valley Authority	Johnsonville	TN	4	4/1/1952	58.9	125	649,347	NL	Kentucky
Tennessee Valley Authority	Johnsonville	TN	5	11/1/1952	58.3	147	631,668	NL	Kentucky
Tennessee Valley Authority	Johnsonville	TN	6	2/1/1953	58.0	147	758,947	NL	Kentucky
Tennessee Valley Authority	Johnsonville	TN	7	11/1/1958	52.3	173	806,945	NL	Kentucky
Tennessee Valley Authority	Johnsonville	TN	8	1/1/1959	52.1	173	937,747	NL	Kentucky
Tennessee Valley Authority	Johnsonville	TN	9	6/1/1959	51.7	173	959,223	NL	Kentucky
PacifiCorp	Carbon	UT	1	11/1/1954	56.3	75	526,435	265	Utah
PacifiCorp	Carbon	UT	2	9/1/1957	53.4	114	823,423	408	Utah
Appalachian Power Co	Clinch River	VA	1	9/1/1958	52.4	238	1,382,762	556	Virginia
Appalachian Power Co	Clinch River	VA	2	12/1/1958	52.2	238	1,273,554	521	Virginia
Appalachian Power Co	Clinch River	VA	3	12/1/1961	49.2	238	1,283,266	514	Virginia

Appalachian Power Co	VA	51	6/1/1944	66.7	100	320,880	83	Virginia
Appalachian Power Co	VA	52	6/1/1944	66.7	*	*	83	Virginia
Appalachian Power Co	VA	6	5/1/1957	53.8	238	1,330,240	503	Virginia
Mirant Mid-Atlantic LLC	VA	1	10/1/1949	61.4	92	260,950	142	West Virginia
Mirant Mid-Atlantic LLC	VA	2	6/1/1950	60.7	92	206,828	107	West Virginia
Mirant Mid-Atlantic LLC	VA	3	7/1/1954	56.6	110	303,263	118	West Virginia
Mirant Mid-Atlantic LLC	VA	4	2/1/1956	55.0	110	263,041	108	West Virginia
Mirant Mid-Atlantic LLC	VA	5	5/1/1957	53.8	110	285,669	116	West Virginia
Virginia Electric & Power Co	VA	3	6/1/1950	60.7	69	374,235	192	Kentucky
Virginia Electric & Power Co	VA	4	8/1/1958	52.5	185	1,060,572	439	Kentucky
Virginia Electric & Power Co	VA	1	6/1/1953	57.7	113	624,822	271	Virginia
Virginia Electric & Power Co	VA	2	12/1/1954	56.2	113	662,801	281	Virginia
Virginia Electric & Power Co	VA	3	6/1/1959	51.7	185	1,069,211	429	Virginia
Virginia Electric & Power Co	VA	4	5/1/1962	48.8	239	1,424,392	577	Virginia
Virginia Electric & Power Co	VA	3	6/1/1955	55.7	114	42,742	NL	Kentucky
Virginia Electric & Power Co	VA	4	4/1/1962	48.9	239	84,962	NL	Kentucky
Virginia Electric & Power Co	VA	1	7/1/1957	53.6	188	1,003,384	405	Kentucky
Virginia Electric & Power Co	VA	2	1/1/1959	52.1	188	1,064,934	433	Kentucky
Appalachian Power Co	WV	1	7/1/1953	57.6	220	1,092,162	456	West Virginia
Appalachian Power Co	WV	2	12/1/1953	57.2	220	973,982	404	West Virginia
Central Operating Co	WV	11	1/1/1950	61.1	153	869,234	379	West Virginia
Central Operating Co	WV	21	7/1/1950	60.6	153	783,060	331	West Virginia
Central Operating Co	WV	31	8/1/1951	59.5	153	626,288	259	West Virginia
Central Operating Co	WV	41	2/1/1952	58.0	153	642,943	255	West Virginia
Monongahela Power Co	WV	1	11/1/1952	58.3	69	225,654	116	West Virginia
Monongahela Power Co	WV	2	9/1/1952	58.4	69	245,168	127	West Virginia
Monongahela Power Co	WV	3	10/1/1954	56.4	140	590,169	263	West Virginia
Monongahela Power Co	WV	7	1/1/1943	68.1	35	-3,278	1	Pennsylvania
Monongahela Power Co	WV	8	9/1/1951	59.4	75	178,789	94	Pennsylvania
Monongahela Power Co	WV	1	2/1/1949	62.0	50	115,600	69	Pennsylvania
Monongahela Power Co	WV	2	10/1/1960	50.4	163	518,814	256	Pennsylvania
Ohio Power Co	WV	1	7/1/1958	52.6	238	1,267,029	493	Pennsylvania
Ohio Power Co	WV	2	11/1/1958	52.3	238	1,359,865	529	Pennsylvania
Ohio Power Co	WV	3	3/1/1958	53.0	238	1,355,825	525	Pennsylvania
Madison Gas & Electric Co	WI	7	12/1/1949	61.2	*	*	44	Indiana
Madison Gas & Electric Co	WI	8	6/1/1957	53.7	50	200,198	94	Indiana
Madison Gas & Electric Co	WI	9	7/1/1951	49.6	50	172,437	90	Indiana
Wisconsin Electric Power Co	WI	1	6/1/1968	42.7	136	772,465	222	Colorado
Wisconsin Electric Power Co	WI	2	6/1/1968	42.7	*	*	232	Colorado

Wisconsin Electric Power Co	Valley	WI	3	3/1/1969	41.9	136	690,367	209	Colorado
Wisconsin Electric Power Co	Valley	WI	4	3/1/1969	41.9	*	*	200	Colorado
Wisconsin Power & Light Co	Edgewater	WI	3	7/1/1951	59.6	60	395,951	261	Wyoming
Wisconsin Power & Light Co	Edgewater	WI	4	12/1/1969	41.2	330	1,799,567	1,078	Wyoming
Wisconsin Power & Light Co	Nelson Dewe	WI	1	12/1/1959	51.2	100	688,211	311	Montana
Wisconsin Power & Light Co	Nelson Dewe	WI	2	12/1/1962	48.2	100	701,724	312	Montana
Wisconsin Public Service Corp	Pulliam	WI	5	9/1/1949	61.4	50	310,522	221	Wyoming
Wisconsin Public Service Corp	Pulliam	WI	6	11/1/1951	59.3	69	387,696	247	Wyoming
Wisconsin Public Service Corp	Pulliam	WI	7	11/1/1958	52.3	82	605,989	374	Wyoming
Wisconsin Public Service Corp	Pulliam	WI	8	12/1/1964	46.2	150	943,492	543	Wyoming
Wisconsin Public Service Corp	Weston	WI	1	12/1/1954	56.2	60	401,263	291	Wyoming
Wisconsin Public Service Corp	Weston	WI	2	9/1/1960	50.4	82	622,817	375	Wyoming
Manitowoc Public Utilities	Manitowoc	WI	6	6/1/1957	53.7	22	109,822	52	Pennsylvania
Manitowoc Public Utilities	Manitowoc	WI	7	6/1/1964	46.7	32	154,113	55	Pennsylvania
Dairyland Power Coop	Alma	WI	B4	9/1/1957	53.4	54	281,238	115	Wyoming
Dairyland Power Coop	Alma	WI	B5	3/1/1960	50.9	82	388,214	150	Wyoming
Dairyland Power Coop	Genoa	WI	1	7/1/1969	41.6	346	2,414,001	461	Illinois
PacificCorp	Dave Johnstc	WY	BW41	2/1/1959	52.0	114	858,353	574	Wyoming
PacificCorp	Dave Johnstc	WY	BW42	1/1/1961	50.1	114	847,085	564	Wyoming
TOTALS			433		53.5	56,338	299,535,716	133,865	
					AVG			135	
					Totals	56,338	299,535,716	133,865	
					US coal totals	312,738	2,016,456,000	1,040,000	2005
					Pct US coal	18%	15%	13%	2005

MW CAP GWH GEN COAL TONS (000)

Wage Review of Generation Jobs (excluding nuclear) (Average IBEW wages)

	Hourly	Annual
Instrumentation & Control Technician	\$39.62	\$ 82,409
Operator	\$34.68	\$ 72,134
Laboratory Technician	\$36.01	\$ 74,900
Electrician	\$35.14	\$ 73,091
Mechanic	\$35.29	\$ 73,403
Storekeeper	\$28.87	\$ 60,049
Welder	\$34.56	\$ 71,884
Average	\$32.56	\$ 72,552

The 50,000 job estimate comes from our analysis of plants most at risk of closure, total of 56 GW. (See attached pdf.)

The direct jobs include utility workers, railroad workers, and coal mining workers.

Question 2. Do you agree with GAO that NERC and FERC should have a formal and documented role in EPA's rulemaking process when EPA is developing regulations that impact grid stability?

Answer. Yes. EPA's role is to look at pollution not reliability of the electric system. NERC and FERC have the responsibility for reliability but not pollution. It only makes sense that both groups need to coordinate their areas of responsibility so that we can reduce pollution while not causing massive outages of large price spikes.

Question 3. Do you believe market prices for energy and capacity are sufficient at this time to attract investors to invest their capital in a new coal facility even though EPA standards would require the use of CCS technology that is not commercially viable?

Answer. In my testimony I spoke about the market as it exists today. The market is not providing adequate price signals to our existing base load plants. When we have nuclear plants that run 24/7 for an entire year and lose money, it would seem obvious that the market is flawed. The price of electricity on the market is not sufficient to incentivize building gas plants let alone coal with CCS. EPA estimates show an 80% increase in the price of a coal plant when you add CCS.

RESPONSE OF SUE KELLY TO QUESTION FROM SENATOR CANTWELL

Question 1. A shortage of transformers has been identified as a resiliency problem for the grid. What options should Congress consider to promote the manufacture of transformers?

Answer. To date, including as a result of hurricanes such as Sandy and Katrina, or man-made events such as the 2013 Metcalf substation attack, the industry has not experienced an insurmountable shortage in transformer supply. The utility industry has concentrated on resiliency for decades, and a variety of transformer replacement strategies are employed throughout the United States. Redundancy of units at individual utilities, contractual, legally binding transformer sharing agreement programs such as the Edison Electric Institute's STEP program, transformer databases such as NERC's Spare Equipment Database, or other web-based programs, are employed to ensure transformers are available in the event of an emergency. Furthermore, many public power utilities have the capability to request and receive spare transformers from other utilities, using resources provided by APPA, if needed. However, given that some manufacturers have chosen to build large transformer units outside of the U.S., Congress could consider incentives for increased production of such units within the U.S.

APPA is also encouraged by the work being done by the Department of Homeland Security, the Electric Power Research Institute, and others on the Recovery Transformer (RecX) project. This program is dedicated to developing a recovery transformer that will allow for more speedy replacement and deployment of transformers and quicker recovery and restoration of electrical power.

RESPONSES OF SUE KELLY TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. In your judgment is the grid more or less vulnerable as a result of the disclosure of non-public critical energy infrastructure information and the resulting news reports?

Answer. The specificity of the information and the diagrams that appeared in some of the press reports following the Metcalf substation attack were very troubling. Should would-be attackers take interest in these reports and disclosures, they could potentially be used as inspiration or fodder for "copycat" attacks.

DOE's General Counsel has noted that some of the information that was apparently disclosed should have been classified and protected appropriately. APPA believes that FERC will act to address these disclosures promptly and to prevent future disclosures. However, this episode underscores the need for Congress to clarify roles and responsibilities involving sensitive or classified information related to critical infrastructure.

Question 2. Do you agree with GAO that NERC and FERC should have a formal and documented role in EPA's rulemaking process when EPA is developing regulations that impact grid stability?

Answer. APPA believes the Federal Energy Regulatory Commission (FERC) and North American Electric Reliability Corporation (NERC) should have a formal and documented role in all Environmental Protection Agency (EPA) rulemakings that could impact electric reliability. The electric utility industry is facing numerous EPA regulations that have been recently finalized, are proposed, or are expected to be proposed in the near future, including the Mercury and Air Toxics Standards, coal

ash management and disposal, New Source Performance Standards for greenhouse gas emissions from new and existing power plants, and cooling water intake structures (316(b)), among others. Individually, these major regulations are likely to cost the electric utility industry billions of dollars—a significant challenge in and of itself. Combined, they will impose unprecedented cost and management challenges and lead to the retirement of significant numbers of coal-fired power plants. EPA is imposing these regulations without any statutory requirement to assess the cumulative impact of these rules on the industry, electricity prices, and/or the economy.

Given the impact that EPA's regulations could potentially have on electric reliability due to plant retirements, shutdowns for retrofits, and shifting resource portfolios, FERC and NERC should have a formal role in these rulemakings. Both organizations work closely with the electric industry to ensure electric reliability and should share their subject matter expertise on the operation of the electric grid. EPA lacks this knowledge and should be required to formally work with FERC and NERC to evaluate how its rules could impact reliability before they are proposed, as well as the cumulative impact of existing rules with ones expected to be finalized in the next five years. Informal interagency communications are insufficient to satisfy this role. Congress should consider enacting legislation that would require the EPA to consult with FERC and NERC on its regulations for the electric utility industry, and would also require the agency to assess the cumulative impacts of these rules.

Question 3. Do you believe market prices for energy and capacity are sufficient at this time to attract investors to invest their capital in a new coal facility even though EPA standards would require the use of CCS technology that is not commercially viable?

Answer. There are two issues raised in this question. The first is whether it is possible to attract investors to a new coal plant required to use CCS. Regardless of the market prices or regulatory regime, it will be nearly impossible to finance a new coal plant under the CCS requirement. It is unlikely that the current CCS projects serving as the basis for EPA's decision to mandate CCS will be commercially viable soon, given the myriad of financial, technical and regulatory hurdles impeding the sequestration of CO₂ in the country. Moreover, all of these projects are tied to enhanced oil and gas recovery, which will not be an option for most new coal-fired power plant locations. Therefore, by inappropriately mandating CCS, EPA's re-proposed rule effectively precludes coal as a resource for new electricity generation.

An example of the difficulties of using CCS is illustrated by the Kemper County Energy facility, a coal plant under construction by Southern Company that will incorporate coal gasification and carbon capture. The Kemper facility is currently estimated to cost \$5.5 billion. It has been subject to frequent delays and cost overruns. As the Wall Street Journal reported on April 29, total shareholder losses from the plant so far total about \$1.6 billion and Southern Company recently announced that because the coal gasifier will not be in working condition this year, it will have to forfeit federal tax benefits valued at between \$120 million to \$150 million.

There is another important issue raised by this question, however—whether needed new generation resources of any type can be financed given current electricity (energy and capacity) prices. Given the high levels of expected coal plant retirements and the inability to build new coal plants with CCS, other resources will certainly be needed. But the ability to finance such resources largely depends upon the wholesale and retail electricity market structure in the affected region. Where the wholesale electricity markets have been restructured and are operated by Regional Transmission Organizations (RTOs) or Independent System Operators (ISOs), collectively referred to as RTOs, such financing will be difficult. Securing financing will be particularly difficult in those states that have implemented retail access legislation.

In retail access states within RTO regions, investor-owned utilities generally cannot own generation resources. Hence most new central station generating capacity is built by merchant owners, which determine whether to build based upon expected revenues from the RTO-operated capacity and energy markets. But the prices in these markets are highly volatile and do not necessarily reflect the costs of constructing a new plant. Many plants over-recover their costs in some years and under-recover them in others, and there is very substantial price volatility in both energy and capacity markets. Even in years when energy and capacity prices rise to a sufficient level for a new plant to recover its costs in the short-term, those clearing prices are earned by all power plants clearing the energy or capacity auctions, regardless of their actual costs. Therefore, consumers pay not only for the new plant, but also for windfall earnings for lower-cost existing plants. Moreover, it

would still be difficult for a new plant to attract investors because of the dramatic volatility of prices in these markets. A number of banks have publicly stated that they cannot lend to a new generation facility based on a highly volatile revenue stream. Instead, they require the stable revenue provided by a long-term contract of at least 15 years, or by direct utility ownership (self-supply).

For non-merchant power plant owners within retail access states, primarily public power and cooperative utilities, the capacity markets themselves directly impede contracting for or ownership of new facilities. The PJM Interconnection, the New York ISO and ISO New England all have what are known as “mandatory” capacity markets. In these markets, entities such as public power utilities cannot build or contract for new resources without such resources first clearing the RTO-run mandatory capacity auctions. Under rules approved by the Federal Energy Regulatory Commission, new resources within these mandatory capacity markets must offer into the auctions under restrictive minimum pricing rules, potentially preventing such resources from clearing the auctions. This raises the risk that public power utilities and their consumers may have to pay twice—once for the resource and a second time to purchase capacity from the market because their own resources have not “cleared.” Such regulatory uncertainty further exacerbates the difficulty of financing new resources.

In a state or region where the utilities are vertically integrated, the cost of a new resource can be recovered from the regulated rates charged to a utility’s customers, subject to either state commission or local governing authority approval. Such rates cover only the cost of the new plant. Investors would likely be more willing to lend money at a reasonable interest rate for such projects, because the cost recovery would be guaranteed, and in the case of a public power utility, the plant could be financed at a lower cost through the use of tax-exempt bonds.

RESPONSES OF CHERYL A. LAFLEUR TO QUESTIONS FROM SENATOR CANTWELL

Question 1. A shortage of transformers has been identified as a resiliency problem for the grid. What options should Congress consider to promote the manufacture of transformers?

Answer. I agree that the adequacy of transformer supply is important to the resiliency of the electric grid. In considering action with respect to that issue, Congress may wish to examine potential security and economic benefits of increased domestic capacity to manufacture transformers, as well as whether such benefits warrant additional Federal support. Such additional support could include direct financial assistance from the Department of Energy and tax incentives to promote increased transformer manufacturing and inventories.

With respect to transformer manufacturing in general, I note that DOE recently updated its 2012 study of transformer manufacturing and inventory issues.¹ DOE reports that, in 2010, domestic manufacturers met approximately 15 percent of the Nation’s demand for transformers greater than or equal to 60 megavolt-amperes (MVA), and that domestic production may have been even less for extra-high voltage transformers at or above 345 kilovolts. However, DOE reports that, since 2010, manufacturers have added or expanded four domestic facilities for large power transformers (LPTs). DOE states that LPT imports peaked in 2009 at 610 units valued at more than a billion dollars, and that imports in 2013 remained relatively high, with 496 units totaling \$676 million.

In addressing supply chain and appropriate inventory levels, it is important to have a clear understanding of which assets are the most critical in terms of how their loss would impact operation of the bulk power system. The version of cybersecurity reliability standards recently approved by FERC (CIP version 5) expressly requires utilities to determine the criticality of cyber assets and tailor protections accordingly. The FERC directive that NERC develop a physical security standard also requires identification of the most critical facilities. Finally, FERC’s final rule on geomagnetic disturbance standards also required identification of the assets most important to protect and explicitly identified inventory management as a possible mitigation strategy to be used under the standards.

Question 2a. You have stated that, “Congress should consider designating a federal department or agency. . . with clear and direct authority to require actions in the event of an emergency involving a physical or cyber threat to the bulk power system.”

Is there no one who has the authority to direct the agencies involved to take action?

¹ <http://energy.gov/sites/prod/files/2014/04/f15/LPTStudyUpdate-040914.pdf>

Answer. Currently there is no Federal agency with the express and comprehensive authority to direct the industry to take action in the event of an emergency involving a physical or cyber threat to the bulk power system. The Department of Energy has authority under section 202(c) of the Federal Power Act (FPA) to require temporary connections of facilities, and generation, delivery, interchange, or transmission of electricity in certain emergency circumstances (including war or shortages of electric energy or facilities). I believe that this authority is not well-suited to proactively address an imminent physical or cyber threat to the bulk power system.

Question 2b. Currently, how is a response coordinated?

Answer. DOE is the energy sector specific agency in these types of situations. As such, DOE receives reports from industry and shares alerts with other government agencies. Additionally, the North American Electric Reliability Corporation (NERC) is the Electricity Sector Information Sharing and Analysis Center. In this role, NERC collects threat information from industry, collaborates with government agencies, and issues alerts and advisories to help industry respond to adverse conditions and events.

In addition, industry and the government officials at many levels participate in exercises to practice coordinating responses to major power system events. For example, Grid Ex II was a two-day exercise, coordinated by NERC, to evaluate the readiness of government and industry to respond to a coordinated cyber and physical attack against the power infrastructure and to provide suggestions for improvement. The exercise specifically focused on formalizing paths for information sharing and the roles of participants in the event of an emergency.

Over 234 organizations from both private and government sectors, including FERC staff, participated in the exercise, which demonstrated industry's and government's commitment to this effort.

Question 2c. What could be improved if a single actor were the designated with the authority to be "Chief Responder"?

Answer. Providing clear authority to one Federal agency to require actions in the event of an emergency involving a physical or cyber threat to the bulk power system would allow the Federal government to take action more quickly once a threat was known, perhaps even before an incident has occurred. In addition, establishing such authority would provide affected entities and relevant agencies with a single point of contact after an incident, which would promote efficient preparation and response coordination.

Question 3. You have recommended a targeted exemption from the Freedom of Information Act, in order to improve FERC and NERC's ability to coordinate with outside parties about threat information.

Can you give us an example of how a targeted FOIA exemption could improve our ability to protect the grid?

Answer. A targeted exemption from the Freedom of Information Act (FOIA) would help FERC, NERC, and industry more effectively coordinate and exchange information regarding potential threats. At present, such coordination and information exchange may be chilled by concerns that sensitive energy infrastructure security information provided to FERC could be subject to disclosure under FOIA. In addition, a targeted exemption from FOIA could reduce the risk that sensitive information shared by FERC with industry on potential security risks or vulnerabilities could be subject to disclosure under FOIA, thereby revealing information that could be used to harm the grid.

RESPONSES OF CHERYL A. LAFLEUR TO QUESTIONS FROM SENATOR BALDWIN

Question 1. According to the International Trade Commission, in 2010 the US demand for Large Power Transformers was valued at over \$1 billion, and we have an increasing number of manufacturing facilities able to produce the largest scale transformers. Despite projections that domestic demand and production capacity are growing we imported around 500 large power transformers (LPTs) in 2013 alone.

Restoring grid functionality requires the ability to repair and replace transformers in a short time frame. How are supply chain issues accounted for when calculating the time and resources necessary to recover from outages and attacks?

Answer. Planning for availability of long lead-time items is an important part of companies' reliability and recovery plans. Each utility develops those plans based on its system configuration, regional needs, and reliability standards.

FERC's reliability standards under FPA section 215 govern reliability performance; in general, each utility must determine the actions it will take to meet the required level of performance. Maintaining adequate inventory of parts is one way

in which utilities manage their operations in order to meet their performance obligations.

Question 2. Transformers are a critical and vulnerable part of our grid. In the discussion about access to spare transformers, we often hear about two important initiatives: the Edison Electric Institute's Spare Transformer Equipment Program (STEP), and NERC's Spare Equipment Database.

Are these planning strategies adequate to ensure stability of the Bulk Power System in rare high-impact events? What additional tools would assist NERC, grid managers, and utilities to improve grid recovery?

Answer. The Edison Electric Institute's STEP program and NERC's Spare Equipment database program are valuable voluntary initiatives that promote readiness and flexibility within the industry. I believe, however, that more can and should be done to alleviate possible limitations of these programs. For example, the STEP program is based on the aggregated needs of the voltage class, and the number of transformers maintained across a voltage class is calculated to provide sufficient spares to restore service to a Participating Utility whose transformers are disabled. As such, the ability of this program to provide adequate resources to multiple Participating Utilities in the event of an extreme event is unclear. As discussed in my response to your next question, Federal agencies are exploring what further steps can be taken to build on this foundation. Congress also could promote increased availability of spare transformers through a variety of means, such as direct financial assistance from the Department of Energy and tax incentives to promote increased transformer manufacturing and inventories.

Question 3. Low frequency, high-impact events could seriously impact the Bulk Power System for a long period of time because transformers take so long to build and a large portion of our supply comes from abroad.

a) In the event of supply disruptions in the global shipping system, from geopolitical events, or from other disasters, how does our current domestic production capacity position us to respond?

Answer. I agree that the adequacy of transformer supply is important to the resiliency of the electric grid. In considering action with respect to that issue, Congress may wish to examine potential security and economic benefits of increased domestic capacity to manufacture transformers, as well as whether such benefits warrant additional Federal support. It is important to note, however, that the response to supply disruptions is not necessarily a matter of whether the transformers are produced domestically or internationally, but more generally is a matter of the available inventory.

With respect to domestic transformer manufacturing, DOE recently updated its 2012 study of transformer manufacturing and inventory issues.²

DOE reports that, in 2010, domestic manufacturers met approximately 15 percent of the Nation's demand for transformers greater than or equal to 60 megavolt-amperes (MVA), and that domestic production may have been even less for extra-high voltage transformers at or above 345 kilovolts. However, DOE reports that, since 2010, manufacturers have added or expanded four domestic facilities for large power transformers (LPTs). DOE states that LPT imports peaked in 2009 at 610 units valued at more than a billion dollars, and that imports in 2013 remained relatively high, with 496 units totaling \$676 million.

In addressing supply chain and appropriate inventory levels, it is important to have a clear understanding of which assets are the most critical in terms of how their loss would impact operation of the bulk power system. The version of cybersecurity reliability standards recently approved by FERC (CIP version 5) expressly requires utilities to determine the criticality of cyber assets and tailor protections accordingly. The FERC directive that NERC develop a physical security standard also requires identification of the most critical facilities. Finally, FERC's final rule on geomagnetic disturbance standards also required identification of the assets most important to protect and explicitly identified inventory management as a possible mitigation strategy to be used under the standards.

b) What reserve capacity ought we have in order to be able to respond to a severe grid failure?

c) How does this capacity compare with our current capacity?

d) What domestic production capacity would we need in order to respond to severe grid failures?

²<http://energy.gov/sites/prod/files/2014/04/f15/LPTStudyUpdate-040914.pdf>

Answers. b-d: I do not have the necessary information to respond to these questions in detail. In general, the amount of reserve capacity needed to address a “severe grid failure” depends on the severity of the circumstances anticipated. In sufficiently severe circumstances, the short-term need for transformers could exceed available inventory and domestic production capacity.

As discussed in the response to the previous question, FERC has issued rules requiring jurisdictional entities to determine their most critical facilities with respect to physical and cyber security and geomagnetic disturbances. A goal of these actions is to prioritize grid security efforts on facilities that, if damaged or destroyed, could cause blackouts or similar disruptions of electricity supply.

RESPONSES OF CHERYL A. LAFLEUR TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. I commend you for observing that “the publication of sensitive information about the grid undermines the careful work done by professionals who dedicate their careers to providing the American peoples with a reliability grid.” How might we strengthen the culture that supports the work of these professionals now that the damage is done?

Answer. As I stated at the April 10, 2014 hearing, I believe that our actions should be guided by two things. First, we should be guided by protecting the reliability and security of the grid for customers—through both our formal actions, such as orders and rulemakings, and our informal actions, such as speeches and outreach. Second, we must maintain FERC’s integrity so people can have confidence in the Commission and in the security of information shared with us.

I believe that one important component of that perspective is leading a culture that respects the security of information. FERC carefully guards confidential information in our dockets, such as upcoming action on a merger application or other matters with potentially significant economic consequences.

However, we certainly can learn from recent events. I believe that culture starts at the top, and the culture of respect for the security of information must start at the top, as well. I have personally asked the Department of Energy’s Inspector General to provide recommendations on ways in which FERC can improve its approach to information security, and I look forward to receiving his advice.

Question 2. Do you agree with GAO that NERC and FERC should have a formal and documented role in EPA’s rulemaking process when EPA is developing regulations that impact grid stability?

Answer. FERC’s formal role in reviewing EPA rules is during the Office of Management and Budget interagency review process. I believe it is also valuable for FERC and NERC to have an informal role in EPA’s rule development. The GAO Report recommended that FERC, DOE and the EPA develop and document a formal, joint process to monitor industry’s progress in responding to recent EPA regulations that address air pollution, disposal of coal combustion residuals, and water withdrawal for use for cooling at certain electricity generating units until at least 2017. I agree that FERC should be involved in monitoring industry’s progress in responding to rules that potentially impact electric reliability, and helping assure that energy infrastructure and markets support environmental compliance.

I note that in issuing its Mercury and Air Toxins Standards (MATS) rule, the EPA did include a formal role for both FERC and NERC in identifying reliability risks. In a Policy Memorandum that EPA issued concurrently with the MATS rule, EPA stated that it would rely on advice and counsel of reliability experts, including, among others, FERC and NERC, for identification and/or analysis of reliability risks. The Policy Memorandum described its intended approach of using Administrative Orders to address sources that must operate in noncompliance with the MATS for up to an additional year to address a specific and documented reliability concern (i.e., for a total of five years).

RESPONSE OF CHERYL A. LAFLEUR TO QUESTION FROM SENATOR BARRASSO

Question 1. On November 7, 2013, I wrote then Chairman Jon Wellinghoff expressing my concern about his decision to remain Chairman of FERC following his acceptance of employment at the law firm, Stoel Rives, L.L.P.

In my letter, I explained that it was unclear whether Chairman Wellinghoff had recused himself or would recuse himself from FERC actions, such as rulemakings, which apply generally. I noted that, as Chairman, he would be in an ideal position to influence such actions as rulemakings for the benefit of specific parties or sectors. I requested that Chairman Wellinghoff explain, in detail, all the matters from which he had recused himself or would recuse himself as well as his reasoning for not recusing himself from any matters that would affect Stoel Rives’ current or future clients.

On November 21st, Chairman Wellinghoff responded to my letter indicating that he had recused himself “from all matters having a direct and predictable effect on the financial interests of Stoel Rives” including “any matter having a direct and predictable effect on the financial interests of the firm’s clients if they are actually represented by Stoel Rives as to such matters before the Commission.”

I interpreted Chairman Wellinghoff’s response to my letter to mean that he participated in FERC rulemakings (and other FERC actions which apply generally) throughout his tenure as Chairman which ended on November 24, 2013.

Would FERC confirm for the record that Chairman Wellinghoff did not recuse himself from FERC rulemakings (and other FERC actions which apply generally) after entering into employment discussions with Stoel Rives on July 3, 2013?

If Chairman Wellinghoff did recuse himself from FERC rulemakings (and other FERC actions which apply generally) on or after July 3, 2013, please describe the full extent of his recusal.

Answer. The Commission’s Designated Agency Ethics Official (DAEO) has informed me that that former Chairman Wellinghoff: (1) recused himself from all matters having a direct and predicable effect on the financial interests of Stoel Rives during the time period in question; and (2) did not recuse himself from any rulemakings during that time period because Stoel Rives did not represent any commenters or submit any comments in any rulemakings during that time period.

RESPONSES OF CHERYL A. LAFLEUR TO QUESTIONS FROM SENATOR SCOTT

Question 1. Can you please provide an update as to where in the process the Commission is on the relicensing application for the Catawba-Wateree Hydro facility in South Carolina?

Answer. The Commission cannot act on the license application without a water quality certification from the state of South Carolina, which it has not yet received. Pursuant to section 401(a) of the Clean Water Act,³ the Commission cannot issue a license for a project, such as the Catawba-Wateree project, that may result in a discharge into the navigable waters of the United States unless the state or states in which a discharge originates has either issued a water quality certification that the discharge will comply with specified portions of the act or has waived certification.

The most recent Commission action on the project was an April 17, 2014, denial of a Duke Energy petition asking that the Commission deem water quality certification by the State of South Carolina waived. In that order, the Commission determined that South Carolina had timely acted on Duke Energy’s water quality certification, and that it had ultimately denied certification by written order on August 6, 2009.⁴

Question 2. Do you expect the Commission to act on this application any time soon? If yes, can you provide a timeline?

Answer. Once it receives the required water quality certification, the Commission will have all information necessary to act on the application. Currently, Duke Energy is pursuing remedies at the state level regarding the water quality certification issue. On January 13, 2013, Duke Energy filed a petition for rehearing of a South Carolina Court of Appeals opinion that held the state had not waived the certification. That petition is pending. Consequently, it is uncertain as to when a valid water quality certification will be issued for the project and when Commission will be able to act on the relicensing application.

[A response to the following question was not received at the time the hearing went to press:]

QUESTION FOR CHERYL L. ROBERTO FROM SENATOR CANTWELL

Question 1. A shortage of transformers has been identified as a resiliency problem for the grid. What options should Congress consider to promote the manufacture of transformers?

³ 33 U.S.C. § 1341(a) (2012).

⁴ Duke Energy Carolinas, LLC, 147 FERC § 61,037.

APPENDIX II

Additional Material Submitted for the Record

STATEMENT OF THE AMERICAN WIND ENERGY ASSOCIATION

Thank you for the opportunity to provide written comments for the record. We would like to explain how wind energy is making important contributions to electric reliability today, and also respond to some of the concerns that were expressed in the testimony at the April 10, 2014, hearing.

Grid operators are reliably integrating large amounts of wind energy today

- U.S. wind energy provides enough electricity to power the equivalent of over 15 million homes. Iowa and South Dakota produced more than 25% of their electricity from wind last year, with a total of nine states above 12% and 17 states at more than 5%. At times, wind has supplied more than 60% of the electricity on the main utility system in Colorado without any reliability problems.
- More than a dozen utility and independent grid operator studies have found wind can reliably provide an even larger share of our electricity. PJM just studied the impacts of increasing its use of wind energy by a factor of 15, and found the “PJM system, with adequate transmission and ancillary services in the form of Regulation, will not have any significant issue absorbing the higher levels of renewable energy penetration considered in the study.”¹
- The ERCOT (Texas) and MISO (Upper Midwest) grid operators each reliably accommodate more than 10,000 MW of wind energy on their power systems. ERCOT has found that amount of wind is reliably accommodated with less than 100 MW of additional fast-acting reserves,² while MISO explains that the incremental need for those reserves due to wind is “little to none.”³
- By a large margin, the most expensive challenge for grid operators is accommodating the abrupt failures of large conventional power plants. PJM currently holds 3,350 MW of expensive, fast-acting reserves 24/7 in case a large fossil or nuclear power plant unexpectedly breaks down. For comparison, PJM’s renewable study found that adding 28,000 MW of wind would only increase the need for fast-acting reserves by 340 MW.⁴ In addition, the largest hourly changes in electricity demand are 10 times larger than the largest hourly changes in wind energy output for PJM.⁵

During this winter’s cold snaps, wind energy provided large amounts of very valuable power when grid operators needed it most.

- Early on January 6, the Nebraska Public Power District met record winter electricity demand with wind providing about 13% of its electricity. The utility explained that “Nebraskans benefit from NPPD’s diverse portfolio of generating resources. Using a combination of fuels means we deliver electricity using the lowest cost resources while maintaining high reliability for our customers.” The utility also noted that “NPPD did not operate its natural gas generation because the fuel costs were up more than 300 percent over typical prices.”⁶

¹ <http://www.pjm.com/media/committees-groups/committees/mic/20140303/20140303-pjm-pris-final-project-review.ashx>, page 12

² http://variablegen.org/wp-content/uploads/2012/12/Maggio-Reserve_Calculation_Methodology_Discussion.pdf

³ http://variablegen.org/wp-content/uploads/2012/12/Navid-Reserve_Calculation.pdf

⁴ <http://www.pjm.com/media/committees-groups/committees/mic/20140303/20140303-pjm-pris-final-project-review.ashx>, page 111

⁵ <http://www.pjm.com/media/committees-groups/task-forces/irtf/20130417/20130417-item-05-wind-report.ashx>, and <http://www.pjm.com/markets-and-operations/energy/real-time/loadhryr.aspx>

⁶ <http://www.nppd.com/2014/nebraska-customers-set-time-winter-peak-nppd/>

- Later that day, PJM's wind output was around 3,000 MW when the grid operator faced challenges due to the unexpected failure of 20% of its conventional generation across all fuel types.⁷
- On January 7, wind output was very high when the New York grid operator faced record winter demand.⁸
- On January 22 and 23, PJM electricity and natural gas prices skyrocketed to 10-50 times normal due to extreme cold. Wind output was again above 3,000 MW, saving consumers millions.
- As "a shortage of natural gas triggered by extreme cold weather" affected California on February 6, wind energy provided the state with around 2,000 MW at the time of peak demand, with wind output above 2,500 MW for most of the rest of the evening.⁹ The state grid operator noted that this wind output allowed it to avoid calling an energy emergency alert.¹⁰

These events illustrate that all energy sources experience failures, so a diverse mix of resources is critical for reliability. Thanks to its zero fuel cost, wind energy is uniquely well-positioned to protect consumers from energy price spikes.

Wind energy helps ensure a reliable and risk-averse energy mix

- Thanks to wind turbines' sophisticated power electronics, they provide many electric reliability services as well as or better than conventional power plants.¹¹ Xcel Energy sometimes uses its wind plants' exceedingly fast response to meet its total system need for dispatchable resources.¹²
- Wind energy directly displaces the most expensive power plants, saving consumers money and protecting against fuel price increases. A May 2013 Synapse Energy Economics report found that doubling the use of wind energy in the PJM states would save consumers \$6.9 billion per year.¹³

RESPONSES TO WITNESS TESTIMONY AT THE HEARING ON APRIL 10, 2014

We would like to first respond to the claim in Mr. Hill's testimony that the renewable production tax credit is significantly affecting the economics of other generators. In reality, the renewable Production Tax Credit is almost never factored into the electricity market prices that other power plants receive, any instances of negative prices are extremely rare, isolated to remote pockets of the grid where they have little to impact on other power plants, and regardless instances of negative prices are being eliminated anyway. For more information on this topic, please see the appended AWEA report and one-page fact sheet that were released last month.

We would also like to respond to Mr. Cauley's concerns about the provision of essential reliability services in a future with an extremely large amount of renewable energy. Wind plant technology has matured significantly over the last decade so that modern wind turbines can provide many power system reliability needs as well as or better than conventional power plants. As explained by NERC, modern wind turbines "may provide voltage regulation and reactive power control capabilities comparable to that of conventional generation."¹⁴ Wind plants meet a higher standard and far exceed the ability of conventional power plants to "ride-through" power system disturbances, which is essential for maintaining reliability when large conventional power plants break down.¹⁵

All modern wind turbines have sophisticated power electronics that allow the turbine to provide significant voltage and reactive power control at all times, even when the wind turbine is not producing electricity. As compellingly illustrated by the actual power system data¹⁶ presented in the chart below, wind turbines can significantly improve power system voltage stability, indicated by the fact that power

⁷ <http://www.pjm.com/media/documents/reports/20140113-pjm-response-to-data-request-for-january%202014-weather-events.ashx>

⁸ http://www.nyiso.com/public/webdocs/media_room/press_releases/2014/NYISO%20-%20Frigid%20Temperatures%20from%20Polar%20Vortex%20Drive%20Record%20Winter%20Demand%20-%202001_09_14%20-%20FINAL.pdf

⁹ <http://www.caiso.com/Documents/ISOissuesStatewideFlexAlert.pdf>

¹⁰ SNL Energy article, Christine Cordner, "CAISO: Wind, demand response helped avoid February emergency alert," March 21, 2014

¹¹ http://www.nerc.com/files/ivgtf_report_041609.pdf, page 17

¹² http://www.nrel.gov/electricity/transmission/pdfs/wind_workshop2_13bartlett.pdf, <http://www.nrel.gov/news/press/2014/7301.html>

¹³ <http://cleanenergytransmission.org/library/detail.php?id=178>

¹⁴ NERC, "Accommodating High Levels of Variable Generation," April 2009, available at http://www.nerc.com/docs/pc/ivgtf/IVGTF_Report_041609.pdf, page 22

¹⁵ <http://www.ferc.gov/whats-new/comm-meet/052505/E-1.pdf>

¹⁶ Miller, N., GE Presentation, June 2008

system voltage is much better regulated when wind turbine generators (WTGs) are online than when they are not.

Recent analysis by WECC, the entity responsible for power system reliability in the Western U.S., found that in a scenario with very high renewable penetration across the West, “the system results did not identify any adverse impacts due to the lower system inertia or differently stressed paths due to the higher penetration of variable generation resources.”¹⁷ Analysis conducted for the California grid operator identified no major concerns for frequency response in a transition to a high renewable future, finding that “None of the credible conditions examined, even cases with significantly high levels of wind and solar generation (up to 50% penetration in California), resulted in under-frequency load shedding (ULFS) or other stability problems.”¹⁸ Adding wind generation can increase total power system frequency response by causing conventional power plants to have their output reduced, which provides them with more range to increase their output and provide frequency response.¹⁹

In addition, new techniques employing wind plants’ sophisticated controls and power electronics enable wind plants themselves to provide fast-acting frequency response. The National Renewable Energy Laboratory recently released in-depth analysis that concluded “wind power can act in an equal or superior manner to conventional generation when providing active power control, supporting the system frequency response and improving reliability.”²⁰ The report further documented how major utilities like Xcel Energy are using this capability of wind plants in some hours to provide all of the frequency response and regulation needed to maintain power system reliability, which has enabled Xcel’s Colorado power system to at times reliably obtain more than 60% of its electricity from wind energy.

BACKGROUND: WHAT IS FREQUENCY RESPONSE?

A major challenge and expense faced by grid operators is how to keep the lights on when individual power plants break down, as all power plants do from time to time. The challenge is particularly great for failures at large fossil and nuclear power plants, which because of their size can take offline in a fraction of a second enough electricity to supply a large city.

Over the last century, power grid operators have perfected tools for combining hundreds of power plants that are each individually unreliable into a power system that is very reliable. By using most power plants to “back up” all other power plants, grid operators ensure that the lights stay on when even the largest power plant on the grid breaks down. This process works so well that most people are not aware that it occurs, even though the expense of maintaining that backup 24/7 for the unpredictable failure of conventional power plants is quite large, far larger than the expense of accommodating predictable changes in wind energy output.

It is this process of “backing up” conventional power plants that is called “frequency response.” Because large conventional power plant failures occur so abruptly, often in a fraction of a second, the response from other power plants must also occur in a fraction of a second. Through frequency response, many power plants are programmed to immediately increase their output when they automatically sense that a large conventional power plant has failed. While wind energy output does change over time, these changes occur far too gradually (over many minutes or hours) to cause an increased need for frequency response, which is designed to accommodate losses of generation that occur in a matter of seconds or less.

As a side note, in recent years many of the conventional power plants that are supposed to be providing frequency response have reduced or eliminated that response due to cost-cutting measures by their owners. Fortunately, NERC and other entities responsible for maintaining electric reliability are proposing market-based solutions to ensure that sufficient frequency response is maintained.

THE FACTS ABOUT WIND ENERGY’S IMPACT ON ELECTRICITY MARKETS

Exelon, the largest owner of merchant fossil and nuclear power plants in the U.S., has been leading a campaign to undermine the broad support for wind energy with the argument that the lower electricity prices brought about by wind energy are

¹⁷ Available at <http://www.wecc.biz/committees/StandingCommittees/PCC/RS/RPEWG%20-%20RS%20Meetings8-21-13/Lists/Minutes/1/VGSStudy7-15-13.doc>

¹⁸ Available at <http://www.cao.com/Documents/Report-FrequencyResponseStudy.pdf>

¹⁹ <http://web.mit.edu/windenergy/windweek/Presentations/GE%20Impact%20of%20Frequency%20Responsive%20Wind%20Plant%20Controls%20Pres%20and%20Paper.pdf>

²⁰ Available at <http://www.nrel.gov/news/press/2014/7301.html>

somehow a bad thing. The crux of Exelon’s campaign against wind energy has been to conflate two very different phenomena:

1. The real economic savings wind energy provides to consumers by displacing more expensive forms of energy, and
2. The exceedingly rare and isolated occurrences of negative prices, which do not significantly affect other energy sources and are being eliminated by long-needed grid upgrades.

Wind energy does have an impact on markets by displacing more expensive forms of energy. However, this impact is entirely market-driven, is widely seen as beneficial, and occurs for all low-fuel-cost sources of energy, including nuclear. In fact, Exelon has touted this impact as a benefit when it occurs at its nuclear plants. This real story of wind energy successfully competing against more expensive forms of energy in the market doesn’t make for a compelling argument against wind energy.

Instead, Exelon has developed an alternate story about wind’s market impact, built around the claim that the wind Production Tax Credit is distorting markets by causing frequent occurrences of negative electricity prices at Exelon’s nuclear power plants. That claim is false for a number of reasons:

Negative electricity prices at Exelon’s nuclear plants are extremely rare, occurring at a fraction of the rate claimed by Exelon

Grid operator data document that Exelon has repeatedly overstated the frequency of negative prices at its nuclear plants by a factor of 10-20 times the actual frequency.

Exelon Plant	LaSalle	Dresden	Braidwood	Byron	Quad Cities	Clinton	Fleet-wide
Share of day-ahead prices below \$0 in 2013	0.10%	0.01%	0.42%	0.78%	1.15%	1.31%	0.63%
What Exelon claimed	Enough to cancel uprate	NA	NA	16%	14-15% of off-peak hours	14.00%	14.00%

The majority of those negative prices are not caused by wind, with many apparently caused by Exelon’s own nuclear plants

The vast majority of these negative price occurrences occurred when wind output was very low. Instead, the data show most of these negative prices were caused by the inability of Exelon’s nuclear plants to reduce their output in response to periods of low electricity demand or localized transmission outages.

The wind Production Tax Credit is almost never factored into the electricity market prices that other power plants receive

For the PTC to be reflected in electricity market prices and cause negative prices, wind energy would have to set the market clearing price. That almost never happens because wind energy has no fuel cost and a much lower marginal operating cost than other resources that have fuel costs. Regardless of whether a wind plant receives the PTC, the wind plant does not have the highest operating cost and therefore does not set the market price.

The real threats to Exelon, and the economics of nuclear generation in general, come from cheap natural gas and low electricity demand

Numerous utility industry experts, and even Exelon’s own statements and reports, show that declining natural gas prices and flat electricity demand are by far the largest challenges to the sector. Nationwide, occurrences of negative prices are rapidly being eliminated as long-needed transmission upgrades are completed to solve bottlenecks on the electric power grid.

U.S. DEPARTMENT OF ENERGY,
OFFICE OF INSPECTOR GENERAL,
OFFICE OF AUDITS AND INSPECTIONS,
Washington, DC, April 9, 2014.

MANAGEMENT ALERT.—REVIEW OF INTERNAL CONTROLS FOR PROTECTING NON-PUBLIC INFORMATION AT THE FEDERAL ENERGY REGULATORY COMMISSION

MEMORANDUM FOR THE ACTING CHAIRMAN, FEDERAL ENERGY REGULATORY COMMISSION

FROM: Gregory H. Friedman, Inspector General
SUBJECT: Management Alert: Review of Internal Controls for Protecting Non-Public Information at the Federal Energy Regulatory Commission

BACKGROUND

In March 2014, the Department of Energy (Department) Office of Inspector General initiated a review of internal controls for protecting non-public information at the Federal Energy Regulatory Commission (Commission). The review was initiated in response to an alleged leak of modeling studies exposing certain power grid vulnerabilities and of non-public information relating to the investigation of the April 2013 attack on the Pacific Gas and Electric Company's Metcalf substation located just south of San Jose, California. Information regarding the alleged leak was communicated to us by the Commission's Designated Agency Ethics Official. Further, we received a letter from the Chairwoman and Ranking Member of the Senate Energy and Natural Resources Committee requesting that we review the same matter.

IMMEDIATE CONCERN

The Department's subject matter experts have confirmed that at least one electric grid-related presentation created by Commission staff should have been classified and protected from release at the time it was created. Based on preliminary information, we determined that the presentation was accessible to, and in specific instances, was viewed and handled by Commission employees who may not have had personnel security clearances and thus, were not fully aware of their obligation to protect the information. Similarly, the document was reported to have been maintained on portable electronic equipment and transmitted via unsecured means. Finally, the document, and/or the essence of its contents, may, in whole or in part, have been provided to both Federal and industry officials in unclassified settings. The methods used in creating and distributing this document led us to the preliminary conclusion that the Commission may not possess adequate controls for identifying and handling classified national security information.

As you are aware, the materials in question raise concerns with the security and integrity of our Nation's critical energy infrastructure, including the Nation's power grid. We are especially concerned with reports that the document that was not properly classified and may currently be stored on unclassified Commission servers, as well as on current and former Commission employees' desktop computers, laptops, portable electronic devices, and copiers. These are the main reasons for the urgency of this management alert.

RECOMMENDATIONS

Although the analysis on which this alert is based is preliminary, we have concluded that the Commission should take immediate action to ensure that the information referred to in this management alert is afforded maximum protection. Consequently, we recommend that the Acting Commission Chairman:

1. Move immediately to protect the information in question by identifying and securing any/all source data, studies and modeling material, including supporting reports and presentations. The search for such information should be comprehensive, including hard copy data and information stored or transmitted via email and all electronic systems which contain relevant information. In the case of electronic data, all systems (to include copiers, client computers, handheld and/or tablets as well as email and other servers) containing data related to or supporting the information should be taken out of service and segregated from unclassified networks until the actions taken in Recommendation 2 are complete.
2. Immediately seek assistance from appropriate program/staff offices within the Department of Energy, or any other Federal entity with appropriate original classification authority in this matter, to ensure that the information in ques-

tion and any associated source material, reports and/or presentations are properly classified and secured. As necessary, assistance should also be obtained to ensure that any required remedial action is completed expeditiously (i.e. computer/electronic device sanitizing, secure storage of any information deemed to be classified, etc.).

3. Ensure that all current and former handlers of the material are fully apprised and acknowledge their duty to protect all classified information.

4. Segregate and secure all classified information discovered during the searches conducted pursuant to Recommendation 1 in an approved classified repository. Such data should also be made available to Office of Inspector General employees engaged in the on-going review.

PATH FORWARD

Please advise us of the actions the Commission plans to take with regard to the recommendations. The Office of Inspector General's review is ongoing.

We appreciate your cooperation in this matter.

MANAGEMENT REACTION

Federal Energy Regulatory Commission (Commission) Acting Chairman LaFleur indicated to us that she has reviewed the management alert and has instructed Commission staff to implement its recommendations promptly, and to give them top priority.

FOUNDATION FOR RESILIENT SOCIETIES,
Nashua, NH, April 7, 2014.

Hon. MARY L. LANDRIEU,
Chairman, Senate Energy and Natural Resources Committee, 304 Dirksen Office Building, Washington, DC,

Hon. LISA MURKOWSKI,
Ranking Member, Senate Energy and Natural Resources Committee, 304 Dirksen Office Building, Washington, DC.

DEAR CHAIRMAN LANDRIEU AND RANKING MEMBER MURKOWSKI:

Our organization is writing in regard to the upcoming April 10th hearing of the Senate Energy and Natural Resources Committee on "Keeping the lights on—Are we doing enough to ensure the reliability and security of the US electric grid?"

Our short answer is that if the current regulatory system for electric grid reliability is allowed to persist, the United States grid will continue to be vulnerable to physical attack and other threats, risking the lives of millions of Americans and putting national security at risk. Below is our analysis supporting this assertion and recommended questions for your April 10th hearing.

WHO WE ARE

Our non-profit group, the Foundation for Resilient Societies, has the mission of scientific study and education on critical infrastructures such as the electric grid. We have spent extensive time participating in the regulatory system for electric grid reliability. We are a member of the ballot body at the North American Electric Reliability Corporation (NERC) for the physical security standard currently under development, as well as the ballot body for standards on protection of the grid against solar storms. Since 2011 we have actively participated in the Geomagnetic Disturbance Task Force at NERC. Resilient Societies is a frequent commenter on Federal Energy Regulatory Commission (FERC) dockets for electric reliability; our work is well-known to FERC staff and Commissioners. Our docket filings are available on our website: www.resilientsocieties.org.

SPECIFIC CONSIDERATIONS AND ANALYSIS

NERC, the designated Electric Reliability Organization under Section 215 of the Federal Power Act, is an organization dominated and effectively controlled by electric utility interests. Seventy percent of NERC members are electric utilities. NERC members regularly vote to place representatives from large investor-owned utilities in key committee positions. While the NERC Board of Trustees is nominally independent, their election is also controlled by NERC members. With this membership and governance structure it should be no surprise that NERC acts to further the goals of for-profit electric utilities.

From our perspective as an advocate for the public, NERC has the apparent goal of limiting financial liability of utilities for cascading outages or long-term regional

blackouts; this leads NERC to propose reliability standards that will protect its utility members but not protect the public interest.

How does NERC bury a standards project that has become inconvenient? Twenty-three days after a sophisticated assault on 17 transformers at the Metcalf substation in April 2013, a key NERC committee recommended to eliminate the physical security standard in development, with the rationale “No longer needed: EOP-004-2 addressed FERC’s directives for sabotage and reporting of physical threats, while CIP version 5 addressed cyber security.” The NERC Standards Committee then unanimously ratified this action 50 days after the Metcalf attack by vote on June 5, 2013. The NERC Board of Trustees, also unanimously, ratified the cancellation of the physical security project in October 2013. But for press accounts in year 2014 and a 90-day FERC reliability directive in March 2014, there would be no physical security standard under development now.

What recourse does the public have when NERC approves a defective “reliability standard,” such as the standard for protection against solar storms that is currently in rulemaking at FERC? Under Section 215 of the Federal Power Act, FERC has no authority to correct defects or substitute a better standard. FERC can accept the inadequate standard. FERC can reject the inadequate standard. Or FERC can remand the inadequate standard to NERC for revisions. When FERC remands a standard, delays for revisions at NERC can take years.

NERC makes no bones about its desire to block legislative improvement to the standard-setting system it now controls. For example, NERC CEO Gerry Cauley testified during the May 5, 2011 hearing of your committee:

FERC has the authority now under FPA Sec. 215(d)(5) to direct NERC to prepare a proposed standard to address a specific vulnerability or other matter, and to do so by a certain date. Thus, it is not clear to NERC that the vulnerability section (proposed new FPA Section 224(b)) is needed.

During the May 31, 2011 hearing of the House Energy and Commerce Committee, “Protecting the Electric Grid: The Grid Reliability and Infrastructure Defense Act,” Mr. Cauley testified:

Additional authority to address grid security vulnerabilities is not necessary. FERC already has authority under FPA Sec. 215(d)(5) to direct NERC to prepare a standard to address a specific vulnerability. Proposed new FPA Section 215A(c) is not needed.

NERC operations are funded by fees imposed on electric utilities, which are in turn funded by ratepayers. Via Section 215 of the Federal Power Act the Congress has created the ironic situation of American ratepayers being forced to pay for lobbying against laws which could improve electric grid reliability and better protect the public.

As a balloting participant, we have directly observed how NERC turns the standard-setting process on its head, providing liability protection for electric utilities while providing little protection for the American public. Characteristics of the NERC standards setting process include:

1. Minimization of entities subject to mandatory standards.—For example, for standard setting on physical security, the draft standard would leave out operators of grid control rooms, despite a specific provision in the FERC Reliability Directive.¹ As another example, generator operators, who have the greatest ability to detect and quickly minimize harmful currents during solar storms, are exempted from mandatory participation in the NERC standard for solar storm “operating procedures.”²

2. Self-directed plans by utilities as a substitute for specific requirements and measures.—As an example, no specific measures would be required in the draft NERC standard for physical security, only self-directed security plans. As another example, under the NERC-approved standard for operating procedures during solar storms there are no specific requirements for mitigative steps during storms, only self-directed plans and studies.

¹ See the FERC Order of March 7, 2014 in Docket RD14-6-000. For NERC’s current standard setting on physical security, the toothless nature of the draft standard has been too much even for some electric utilities to accept. For example, Southwest Power Pool Standards Review Group said in its comment to the NERC standard drafting team, “. . . Balancing Authorities and Reliability Coordinators are not listed as applicable entities. Shouldn’t they be included also? Will FERC accept a standard without these entities being included?”

² On March 24, 2014 the Foundation for Resilient Societies petitioned FERC to remand the NERC proposed “operating procedure” standard for solar storms (EOP-010-1) to include generator operators and other improvements. See comments filed in FERC Docket RM14-1-000.

3. Exemption of large portions of the Bulk Electric System.—For example, the approved standards on vegetation management and transmission relay loadability can exempt transmission lines operating between 100 kV and 200 kV, despite the inclusion of these lines in the FERC-approved definition of the Bulk Electric System.

4. Cancellation of projects where the standard-setting process might result in real requirements upon utilities or cause public scrutiny.—We again give the example of the NERC Standards Committee cancelling in June 2013 the standards project for physical protection of critical grid facilities, including transmission substations. At the same June 2013 meeting, the Standards Committee voted to cancel a standards project for monitoring of critical equipment, including monitoring transformers for overheating, despite the important role of equipment monitoring in mitigating the Metcalf attack.

5. Rubber-stamping of standards by the NERC Board of Trustees.—In support of its defectively drafted standards, from time to time NERC authors pseudo-scientific studies and white papers. Characteristics of NERC studies and white papers include non-collection of real-world data and omission of bulk power system operating data inconsistent with the NERC policy position.

It appears that avoidance of legal liability and transfer of risks onto the public are core components of NERC's standard-setting process. NERC's April 1, 2014 Physical Security Standard Technical Conference revealed that the draft NERC standard for physical security will provide a liability shield for utilities through use of security consultants that are "certified" but not necessarily familiar with grid operations. The standard as currently drafted will not require protection of control rooms, generation facilities, and other critical grid assets.

RECOMMENDED QUESTIONS

We urge your committee to conduct a diligent inquiry into the fundamental regulatory deficiencies that have caused longstanding grid vulnerability—including vulnerability to physical attack—during your upcoming April 10th hearing. Attached are suggested questions for witnesses before the committee. We ask that this letter and attachments be made part of the official record for the hearing.

Should your committee staff require additional information before the April 10th hearing, please do not hesitate to contact me by email at thomasp@resilientsocieties.org or at the number below.

Sincerely,

THOMAS S. POPIK,
Chairman.

ATTACHMENT.—SUGGESTED QUESTIONS FOR WITNESSES AT APRIL 10, 2014 HEARING OF SENATE ENERGY AND NATURAL RESOURCES COMMITTEE

QUESTIONS FOR NERC

On the Metcalf Attack and Subsequent Cancellation of Relevant NERC Standards Projects

Is it correct at the time of the Metcalf substation attack in April 2013 that NERC had a standard in process for physical protection of critical grid facilities, including transformer substations, designated as "Project 2012-2 Physical Protection"?

Is it also correct that the NERC RISC Committee on May 9 and the NERC Standards Committee on June 5, 2013 voted to cancel this standards project, giving the rationale "No longer needed: EOP-004-2 addressed FERC's directives for sabotage and reporting of physical threats, while CIP version 5 addressed cyber security" and that this cancellation was later approved by the NERC Board of Trustees?

Can you please explain why the NERC Standards Committee cancelled its project for physical security 50 days after the Metcalf attack?

Can you please explain the role of transformer temperature and oil level monitoring in preventing overheating and complete destruction of the 17 transformers whose radiators were shot out during the Metcalf Attack? Had the transformers overheated and catastrophically failed, could it have caused a cascading blackout? How long do high voltage transformers take to replace?

Is it correct that at the time of the Metcalf attack NERC had a standard in process for automated monitoring of substation transformers and other critical grid equipment?

Is it also correct that the NERC Standards Committee voted to cancel this standards project, designated as "Project 2012-01 Equipment Monitoring and Diagnostic Devices," at their June 5, 2013 meeting and this cancellation was later approved

by the NERC Board of Trustees? Can you please explain why NERC cancelled this standards project?

On Communications with Congress

Is it correct that in written response to a letter from Senators Feinstein, Franken, Wyden, and Reid that NERC CEO Gerry Cauley failed to disclose that NERC standards projects for physical security and equipment monitoring were canceled shortly after the Metcalf substation attack? Can you please explain why this information was omitted from the NERC letter to Congress?

In his February 7, 2014 reply letter to Senator Feinstein and others, NERC CEO Gerry Cauley highlighted the GridEx II grid security conference held in November 2013. This security conference simulated cyber and physical attacks on the United States electric grid.

Are you aware of a 2006 report titled “NSTAC Report to the President on Telecommunications and Electric Power Interdependencies—The Implications of Long-Term Outages” by the President’s National Security Telecommunications Advisory Committee?

Did the NERC GridEx II grid security exercise assume that all commercial telecommunications would work perfectly despite the dependence of commercial telecommunications on power from the electric grid?

Can you please comment on whether GridEx II was a realistic exercise in its assumptions about the full operability of commercial telecommunications?

Can you please comment on any mistaken impression Mr. Cauley’s letter may have created about the value of the GridEx II exercise, especially since the exercise did not address arguably one of the most critical grid vulnerabilities—telecommunications interdependency—during Long-Term Outage?

On NERC Opposition to a Mandatory Physical Security Standard

In NERC’s February 7, 2014 letter to Senator Feinstein and others regarding physical security for electric grid assets, CEO Gerry Cauley stated:

I do not believe it makes sense to move to mandatory standards at this time. There are more than 55,000 substations of 100 kV or higher across North America, and not all those assets can be 100% protected against all threats. I am concerned that a rule-based approach for physical security would not provide the flexibility needed to deal with the widely varying risk profiles and circumstances across the North American grid and would instead create unnecessary and inefficient regulatory burdens and compliance obligations.

Do you still believe the NERC position opposing a physical security standard to be appropriate? If the NERC position opposing a physical security standard has changed, can you explain why?

Is it correct that the FERC Reliability Directive on physical security of the electric grid specifically requires protection of grid control rooms?

Is it further correct that the NERC standard for physical security as currently drafted leaves out protection for control rooms?

Can you explain why NERC is developing a standard that is apparently not in compliance with the express scope of the FERC directive?

On Compliance with Section 215 of the Federal Power Act

Is it correct that Section 215 of the Federal Power Act requires that NERC conduct a public standard-setting process?

Is it correct that a draft physical security standard was completed by the April 1, 2014 NERC technical conference, yet the standard was not posted on the NERC website nor otherwise made public, despite the standard being reviewed at the technical conference?

Why was the draft standard not promptly posted? Does this kind of non-disclosure put the public at a disadvantage in reviewing draft standards?

Is it correct that NERC has a pattern and practice of withholding its technical reports from public view for periods of time after approval by the NERC Board of Trustees and that during this time NERC technical reports are circulated to selected parties in Washington, D.C.?

Is it further correct that the NERC bylaws specifically state that NERC technical reports shall be made public 24 hours before the report is presented at the NERC Board of Trustees meeting?

Why does NERC appear to operate in a manner noncompliant with its own bylaws and Section 215 of the Federal Power Act?

On Lobbying Activities of NERC

Is it correct that NERC maintains an office in Washington DC for the purpose of coordinating with Congress and federal officials?

Is it further correct that NERC has prepared talking points in opposition to legislation that would enable FERC to impose FERC-initiated regulations and that NERC may have coordinated its talking points with industry lobbyists?

Is it correct that the operations of NERC are financed by fees assessed on regional entities and furthermore that the ultimate sources of NERC's funding are the nation's electricity ratepayers?

Is it appropriate for NERC to lobby for or against legislation when that lobbying is financed by electricity ratepayers?

On the Independent NERC Board of Trustees

Is it correct that NERC has an independent Board of Trustees, per the FERC-approved bylaws of NERC?

How many standards have been approved by the NERC Board of Trustees since NERC's designation by FERC as the designated Electric Reliability Organization?

How many standards voted on by the NERC ballot body and sent to the NERC Board of Trustees for approval have been sent back for rework or otherwise disapproved before submission to FERC?

Of the 10 independent trustees on NERC's board, how many were previously employed in the electric utility industry or otherwise have ties to that industry?

Of the current voting NERC membership, how many are representatives of the electric utility industry? Is it correct that the NERC membership elects the NERC Board of Trustees?

On Protection of the Electric Grid from Solar Storms

Is it correct that the March 1989 blackout in Québec, Canada conclusively proved that solar storms can cause widespread cascading outage?

Why in the intervening 25 years did NERC not introduce a standard to protect electric grids against solar storms on its own initiative?

Is it correct that in its technical report dated March 2012 that NERC downplayed the risk of solar storms to the electric grid, saying that a grid collapse resulting from a solar storm could be recovered in only hours or days?

Do you view a widespread grid outage of "hours or days" as being acceptable to the American public?

QUESTIONS FOR FERC

On Interdependency between the Electric Grid and the Natural Gas Distribution System

Has FERC conducted any studies or technical conferences on the interdependence of the electric grid and natural gas supply and distribution system?

Does FERC have any initiatives to assure reliable natural gas supplies for electricity generation?

Are states with electrically powered pumps on their gas pipelines more vulnerable to long-term grid outage?

Have utilities in the State of California predominantly installed electrically powered pumps on their gas pipelines?

Some generation facilities have significant fuel reserves stored on-site while others rely on energy sources that are immediately transported or intermittent. For example, gas-fired generation plants rely on fuel delivered by pipeline and not stored on-site. Wind and solar generation operates only when the wind is blowing or sun is shining. In contrast, coal-fired plants store significant quantities of fuel on-site, enhancing grid reliability. In past years, coal-fired plants typically had 30 to 60 days of fuel stored on-site, providing a substantial degree of "fuel resilience." In a March 13, 2014 article in the Wall Street Journal titled "Surge in Rail Shipments of Oil Sidetracks Other Industries," an executive close to big utility companies said, "The railroads tell us they aren't serving power plants until their inventories are in single-digit days."

Has FERC conducted any studies or technical conferences on the impact of retirement of coal-fired plants on grid reliability and also on the impact of less coal now stored on-site at power plants?

Has FERC considered any policies to take into consideration the resilience of natural gas-fired electric generation plants as this fuel source now supplies nearly 30% of US electric power and is expanding significantly further?

On Vulnerability of Long-Distance Electricity Transmission

Some states lack local generation and as a result must import electricity over long-distance transmission lines that may be vulnerable to terrorist attack or solar storms. For example, the State of California imports 25% of its electricity.

Has FERC performed state-by-state studies of the vulnerability of electricity transmission to terrorist attack or other disruption?

What policy initiatives could mitigate the dependence of individual states and their populations on long-distance electricity transmission?

Are you aware that a representative of the Department of Homeland Security disclosed in September 2012 in a public industry forum that an attack on only six transformer substations in the Eastern interconnection could bring down the electric grid east of the Mississippi river for a period of months?

Do you believe that the locations of transmission “choke points” are commonly known in the electric utility industry? What should be done to protect these choke points?

On the NERC Standard Setting Process

How long did NERC take to set a standard on so-called “vegetation management” around transmission lines, otherwise called tree-trimming, after the 2003 Northeast Blackout affecting 50 million people, initiated by a tree limb contacting a transmission line?

How long did NERC take to set standards for cyber security?

When NERC proposes a technically defective standard, what options does FERC have?

When a technically defective standard is remanded by FERC to NERC, what is the range of delay that can be expected before finally setting a corrected standard?

In the NERC document, “Reliability Standards for the Bulk Electric Systems of North America, Updated April 3, 2014,” NERC has placed the text of Standard “EOP-010-1—Geomagnetic Disturbance Operations.” FERC opened a rulemaking docket on this standard, with comments due by March 24, 2014, and significant public comments in opposition to the proposed standard were placed on the docket. Is promulgation of NERC standards “approved” by the NERC Board of Trustees, without formal approval by FERC via the federal administrative rulemaking process, consistent with federal law?

QUESTIONS FOR PACIFIC GAS & ELECTRIC

On the Metcalf Attack

Why did PG&E initially characterize the well-planned and coordinated Metcalf Substation attack of April 2013 as mere “vandalism”?

Is it correct that the Metcalf substation attackers shot through a chain-link fence that gave clear view to transformers within the yard?

Is it correct that in the intervening year between the Metcalf substation attack and the FERC Physical Security order of March 2014, PG&E had not installed opaque fencing for the Metcalf substation?

On Reliability of Electric Power for Silicon Valley

Is it correct that the Metcalf substation is one of only three 500kV substations serving the San Francisco metropolitan area?

Is it correct that the Metcalf substation is the only major substation serving Silicon Valley and its dense concentration of internet companies?

Is it correct that an analysis by the California Public Utilities Commission has concluded that the Metcalf substation is already overloaded on hot summer days, resulting in voltage sags for customers in Silicon Valley? Has PG&E proposed plans for a backup substation to support Silicon Valley?

Have major internet firms in Silicon Valley complained to Pacific Gas & Electric about the reliability and quality of their grid power? How does PG&E intend to address any complaints?

QUESTIONS FOR TRADE GROUPS

On Effectiveness of Self-Regulation

Is it correct that trade groups often advocate for the ability of electric utilities to develop their own plans for grid protection instead of relying on mandatory “one size fits all” solutions?

Every car and driver is different, yet speed limits apply to all equally. Aren’t speed limits a “one size fits all” solution?

When a utility develops its own plan for grid protection, what assurance does the public have that this plan will be effective?

As a general matter, should electric utilities be allowed to manage the protection of their own facilities rather than having mandatory regulations written and imposed by governmental entities?

Did self-regulation result in significant protection for the Metcalf substation?

Do you support inclusion of control rooms in the physical security standard now under development at NERC?

FOUNDATION FOR RESILIENT SOCIETIES,
Nashua, NH, April 10, 2014.

Hon. MARY L. LANDRIEU, *Chairman*,
Hon. LISA MURKOWSKI, *Ranking Member*,
Senate Energy and Natural Resources Committee, 304 Dirksen Office Building,
Washington, DC.

DEAR CHAIRMAN LANDRIEU AND RANKING MEMBER MURKOWSKI:

In regard to today's 9:30am hearing on increasing the security of the nation's electric grid from cyber and physical attacks, NERC first made public the text of its draft physical security standard last night at 6:57 PM. The draft standard had been reviewed in a public NERC meeting held on April 1st, but this is the first time the public has been afforded a copy of the standard.

Section 215 of the Federal Power Act requires that NERC "provide for reasonable notice and opportunity for public comment, due process, openness, and balance of interests in developing reliability standards." Releasing the text of a draft standard eight days after it is reviewed in a public meeting does not appear to meet the requirements of the law.

The late release of this document places the public and your Committee at disadvantage, because the standard is a subject of today's hearing. We have previously had similar issues with NERC.

Now that we have documented confirmation that control centers for some Reliability Coordinators will not be covered in the NERC physical security standard, we suggest that your Committee members ask Mr. Cauley of NERC about this apparent omission. Peak Reliability, Midcontinent Independent System Operator, and Southwest Power Pool provide the highest level of grid supervision for 141 million Americans altogether and operate regional control centers.

Suggested questions for Mr. Cauley are in the attachment to this letter.

We ask that this letter and attachment be made part of the official record for the hearing.

Sincerely,

THOMAS S. POPIK,
Chairman.

ATTACHMENT.—SUGGESTED QUESTIONS FOR NERC CEO GERRY CAULEY AT APRIL 10, 2014
HEARING OF SENATE ENERGY AND NATURAL RESOURCES COMMITTEE

On FERC Reliability Directive RD14-6-000

Is it correct that the draft NERC physical security standard, first published last night at 6:57pm, would only require control centers at Transmission Owners and Operators to meet physical security requirements, but would not necessarily require protection of control centers at all Reliability Coordinators?

How would you reconcile this apparent gap in the draft standard with footnote 6 of the FERC Reliability Directive, which states, "However, the Commission expects that critical facilities generally will include, but not be limited to, critical substations and critical control centers"?

In regard to existing standards for physical security of critical cyber assets which apply to Reliability Coordinators, is it correct that these standards pertain to physical access security and would not give the range of protection contemplated in the standard ordered under FERC Reliability Directive RD14-6-000?

On Peak Reliability

Peak Reliability is the regional Reliability Coordinator for the Western Interconnection, providing the highest level of grid supervision for the eleven states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming with population covered of 78 million. Is it correct that the control centers for Peak Reliability located in Loveland, Colorado and Vancouver, Washington would not be covered under the draft NERC physical security standard? Can you please comment on how this apparent omission could affect public safety in these states?

On Midcontinent Independent System Operator

Midcontinent Independent System Operator is the regional Reliability Coordinator for the upper Midwest, providing the highest level of grid supervision for the all or part of Michigan, Minnesota, Wisconsin, Iowa, Missouri, Illinois, Indiana, Kentucky, North Dakota, South Dakota, Montana, Texas, Louisiana, Arkansas and Mississippi with population covered of 48 million. Is it correct that the control center for Midcontinent ISO located in Eagan, Minnesota would not be covered under the draft NERC physical security standard? Can you please comment on how this apparent omission could affect public safety in these states?

On Southwest Power Pool

Southwest Power Pool is the regional Reliability Coordinator for the southern Midwest, providing the highest level of grid supervision for all or part of Nebraska, Missouri, Texas, Kansas, New Mexico, Arkansas, Louisiana, and Oklahoma with population covered of 15 million. Is it correct that the control centers for Southwest Power Pool would not be covered under the draft NERC physical security standard? Can you please comment on how this apparent omission could affect public safety in these states?

February 7, 2014.

Hon. CHERYL LAFLEUR,
*Acting Chairman, Federal Energy Regulatory Commission, 888 1st Street NE, Wash-
ington, DC,*

MR. GERRY CAULEY,
*President & CEO, North American Electric Reliability Corporation, 3353 Peachtree
Rd., NE, Suite North Tower, Atlanta, GA.*

DEAR CHAIRMAN LAFLEUR AND MR. CAULEY:

We are writing to respectfully request that the Federal Energy Regulatory Commission (FERC) and the North American Electric Reliability Corporation (NERC) utilize their authorities under the electricity reliability provisions of Section 1211 of the Energy Policy Act of 2005 (EPA 2005) to determine whether additional minimum standards regarding physical security at critical substations and other essential facilities are needed to assure the reliable operation of the bulk power system.

We are confident that both FERC and NERC share our concerns regarding the threat of physical attacks on critical substations and other key facets of our nation's bulk power electricity system. Last year's sophisticated attack on the Metcalf substation in California's Silicon Valley was a wake-up call to the risk of physical attacks on the grid. This incident came uncomfortably close to causing a shutdown of a critical substation which could have resulted in a massive blackout in California and elsewhere in the West.

Last week, we met with key electricity industry and government officials involved in developing and implementing the response to the physical threat, including NERC and FERC. We came away from the meeting understanding that progress has been made by industry and government to minimize the risk of physical attacks on the electricity system through voluntary means, including information sharing, the installation of fencing, and cameras that monitor property outside substation fences.

However, we are concerned that voluntary measures may not be sufficient to constitute a reasonable response to the risk of physical attack on the electricity system. While it appears that many utilities have a firm grasp on the problem, we simply do not know if there are substantial numbers of utilities or others that have not taken adequate measures to protect against and minimize the harm from a physical attack. A chain is only as strong as its weakest link. Therefore, we need assurance that all entities that play a significant role in running our bulk power electricity system are taking appropriate steps to protect against and are well prepared to respond to a physical attack.

We believe that Section 1211 of EPA 2005 provides FERC and NERC with authority to address this matter. Prior to enactment of Section 1211 in 2005 electric reliability standards were voluntary rather than mandatory. We believe that Congress did the right thing in 2005 to transition from a voluntary reliability system to one that relies a great deal on mandatory standards developed in close consultation with industry.

FERC and NERC's authority to act on the physical threat to critical substations and other essential facilities is clear and unmistakable. EPA 2005 authorizes FERC and NERC to develop standards "to provide for reliable operation of the bulk

power system.” Reliable operation is broadly defined to mean operating the bulk power system “so that instability, uncontrolled separation, or cascading failures of such system will not occur as a result of a sudden disturbance...” A physical attack on the bulk power system certainly falls comfortably within that definition.

Finally, we understand that any FERC/NERC regulatory process must maintain the confidentiality of certain data regarding threats and vulnerabilities. NERC and FERC already face this challenge in carrying out their overall reliability mission under EPAct 2005, and we believe they can do so in this instance as well.

Thank you for your consideration of this request. We would appreciate receiving responses no later than March 3, 2014.

Sincerely,

RON WYDEN,
U.S. Senator,

HARRY REID,
U.S. Senator,

DIANNE FEINSTEIN,
U.S. Senator,

AL FRANKEN,
U.S. Senator.

FEDERAL ENERGY REGULATORY COMMISSION,
Washington, DC, February 11, 2014.

Hon. RON WYDEN,
U.S. Senate, Washington, DC.

DEAR SENATOR WYDEN:

Thank you for your letter of February 7, 2014, asking the Federal Energy Regulatory Commission and the North American Electric Reliability Corporation (NERC) to determine whether federal regulations are needed to address the risk of physical attacks on our Nation’s bulk power system. I agree that protecting the bulk power system against such attacks is an issue of critical importance.

Since the attack on the Metcalf facility in April 2013, the Commission’s staff has taken responsive action together with NERC, other federal and state agencies, and transmission and generation asset owners and operators. The other federal agencies include the Department of Homeland Security, the Department of Energy and the Federal Bureau of Investigation, among others. Working together, we have explained to utilities the specific facts of the attack on Metcalf and the need for asset owners to increase the physical protection of key facilities. We have also conducted detailed grid modeling to identify the most critical facilities and helped identify protective measures that would be appropriate for particular types of facilities and locations.

For example, FERC representatives have briefed the chief executive officers of many large investor-owned utilities, cooperative utilities, and municipal utilities, as well as of the Independent System Operators and Regional Transmission Organizations, which together serve nearly three-quarters of our nation’s population. We have also briefed the National Association of Regulatory Utility Commissioners (NARUC) and various State commissioners, in addition to the leadership of major electric industry trade associations such as the Edison Electric Institute and, National Rural Electric Cooperative Association the Large Public Power Council, and the North American Transmission Forum. And currently, we are participating with NERC, DHS, DOE, and FBI in a 13-city physical security campaign (including a detailed briefing about the Metcalf incident) intended to reach out to utilities, states, and law enforcement agencies in the United States and Canada.

To date, our efforts have focused on strongly encouraging utilities to make improvements to their physical security, by explaining why and where they should be made. This approach has resulted in improvements being implemented more quickly and more confidentially than a mandatory regulation could have accomplished under our existing authority, as explained below. Also, the measures taken were uniquely suited to the types of facilities and locations, in a way that might be more difficult to accomplish through broad-based regulation.

Nonetheless, I agree that it is appropriate to consider whether federal regulation is needed to ensure the risk of physical attacks on our electrical infrastructure is addressed adequately. Thus, I have asked Commission staff to evaluate this issue with NERC under the authority of section 215 of the Federal Power Act. In doing so, we will make every effort to ensure the confidentiality of sensitive security infor-

mation, recognizing, however, that the Commission is still subject to the Freedom of Information Act even in this area of its authority.

As Commission members and representatives have stated previously, section 215 is a reasonable approach for developing traditional reliability standards, as it uses the technical knowledge of industry through an inclusive stakeholder process to carefully develop standards that truly address long-term reliability issues. However, in the context of national security concerns, the confidentiality of sensitive security information, and the timeliness and certainty of the process, are appropriate concerns. Congress could improve the Commission's and NERC's ability to address the risks related to physical and cyber attacks by enhancing the confidentiality of sensitive security information concerning physical or cyber threats to, or vulnerabilities of, the bulk power system.

A properly-defined exemption from the Freedom of Information Act would be very helpful. Also, I believe Congress should consider designating a federal department or agency (not necessarily FERC) with clear and direct authority to require actions in the event of an emergency involving a physical or cyber threat to the bulk power system. This authority should include the ability to require action before a physical or cyber national security incident has occurred. This authority should not impede FERC's existing authority under section 215 of the Federal Power Act to approve reliability standards developed by NERC through its current processes.

Thank you very much for your interest in this matter. If you have any further questions or concerns, please feel free to contact me.

Sincerely,

CHERYL A. LAFLEUR,
Acting Chairman.

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