FEDERAL ENERGY REGULATORY COMMISSION

JOINT MEETING OF THE NUCLEAR REGULATORY COMMISSION
AND THE FEDERAL ENERGY REGULATORY COMMISSION

AD06-6-000

Friday, June 15, 2012

9:30-11:30 a.m.

FERC Chairman and Commissioners:
NRC Chairman and Commissioners:

Chairman Jon Wellinghoff
Commissioner Philip D. Moeller
Commissioner John R. Norris
Commissioner Cheryl A. LaFleur
Commissioner William C. Ostendorff
Commissioner Kristine L. Svinicki
Chairman Gregory B. Jaczko
Commissioner George Apostolakis
Commissioner William D. Magwood, IV

FERC Staff:

Robert Snow, Senior Electrical Engineer, Office of Energy Policy and Innovation

Ted Franks, Division Director, Office of Electric Reliability

Regis Binder, Senior Electrical Engineer, Office of Electric Reliability

NRC Staff:

Dan Dorman, Deputy Director for Engineering and Corporate Support, Office of Nuclear Reactor Regulation

Marc Dapas, Deputy Director, Office of Nuclear Security and Incident Response

North American Electric Reliability Corporation (NERC) Staff:

Mark Lauby, Vice President and Director, Reliability Assessment and Performance Analysis

P R O C E E D I N G S

(9:38a.m.)

FERC CHAIRMAN WELLINGHOFF: I'll call the meeting to order please. This is the time and place that's duly noticed under the Government in Sunshine Act for the joint meeting of the Federal Energy Regulatory Commission and the Nuclear Regulatory Commission. Please join me in the Pledge of Allegiance.

(Pledge of allegiance recited.)

FERC CHAIRMAN WELLINGHOFF: I want to welcome Chairman Jaczko and his fellow Commissioners here. Thank you all for coming. It's a great pleasure to have this joint meeting. As you all know, FERC and the NRC signed an MOU in September of 2010 to facilitate interactions between the two agencies on matters of mutual interest pertaining to the bulk power system.

Our last joint meeting was on March 16th, 2010 at the NRC and this is actually my third joint meeting that we've had with the NRC. And I am glad that FERC could host this meeting and I hope that we can continue the tradition of having these joint meetings. They've been very productive and helpful.

We have a full program this morning with three excellent panels, one on the operations of nuclear power plants and their impact on efficient, reliable operation of the electric grid; one on cybersecurity activities; and a final panel on station blackout rulemaking and grid reliability standards activities, and we'll also in that final panel include geomagnetic storm issues and the potential challenges to nuclear plants' offsite power due to grid-loading conditions in peak summer times.

We do have a full program this morning, and unfortunately we don't have any breaks scheduled. We do have lunch scheduled, however though, and also we have tours for the Commissioners scheduled of our Market Monitoring Center and our Reliability Monitoring Center, and I think you'll enjoy seeing those as well.

The panelists will each have five to seven minutes to present, and then we'll have about 20 minutes for questions. So with that, I'll turn it over to Chairman Jaczko if you have any opening remarks or questions.

NRC CHAIRMAN JACZKO: Well thank you Jon, and I appreciate being a guest here today of the Federal Energy Regulatory Commission. I think this is either my fourth or fifth meeting, joint meeting like this, and I think it's been a tremendous effort on the part of the two organizations to have these meetings and discuss the issues that are important to both of our organizations.

I think the first meeting between our two organizations happened back in August 2003, when we were dealing with the blackout that affected so much of the Northeastern United States, and of course a number of nuclear power plants. I believe our two Commissions and the hard-working staffs at both of these agencies can take great pride in the open and collaborative working relationship we've developed over the years, culminating, of course, in the memorandum that you discussed.

I look forward to the presentations today. I think they all focus in areas where our staffs have worked together on a number of technical issues, which interface both of our agencies' missions: the reliability of the nation's electric grid, cybersecurity and the prolonged station blackouts at reactors due to external events such as geomagnetic storms.

So I think it's important that we continue our collaborative efforts on these issues, and I want to thank you, Chairman Wellinghoff and your colleagues for continuing this effort and for expanding these efforts really under your leadership.

The challenges posed by all these issues could have a significant safety impact on our nation and our reactor licensees and on dynamic threats that can evolve quickly. So I think it's so important that we continue to have this kind of fruitful dialogue and discussion to ensure that we all carry out our missions effectively and with the interests of the American people. Thank you.

FERC CHAIRMAN WELLINGHOFF: Thank you, Greg. Do any of the other NRC Commissioners have any opening comments? Commissioner Svinicki.

NRC COMMISSIONER SVINICKI: Chairman Wellinghoff, good morning, and I want to thank you and your fellow Commissioners for hosting us here today. This is I think an important opportunity for us to hear about the work between our staffs that goes on certainly on a day-to-day basis, routinely and as issues arise. I share Chairman Jaczko's view that in my experience, it's an extremely effective collaborative relationship, and I'm very pleased we're here today and hope that can continue.

FERC CHAIRMAN WELLINGHOFF: Thank you. Commissioner Magwood.

NRC COMMISSIONER MAGWOOD: Merely to thank the Chairman. I just want to relate my colleagues' thanks for hosting today's joint meeting. This is my first opportunity to participate in a joint discussion between our Commissions. The issues we have together, I think, are very compelling and very interesting and there is a lot for both of us to learn, and I think it's interesting for the public to see a Commission that almost never worries about cost, and a Commission that always worries about costs, have so many things in common. So again, thank you very much.

(Laughter.)

FERC CHAIRMAN WELLINGHOFF: Thank you. Yes.

NRC COMMISSIONER OSTENDORFF: Thank you Chairman Wellinghoff and your Commissioner colleagues for having us today. This is again, along with Commissioner Apostolakis and Magwood, our first meeting down here, and it's I think a very positive sign for us to work with fellow colleagues on issues of common interest. So thank you for having us.

FERC CHAIRMAN WELLINGHOFF: You're very welcome. Okay. My Commissioners, anyone?

FERC COMMISSIONER NORRIS: Welcome.

FERC CHAIRMAN WELLINGHOFF: All right. Then we're ready to get to work. On our first panel we have Dan Dorman from the NRC and Robert Snow from FERC. Dan, go ahead.

MR. DORMAN: Chairman Wellinghoff, Chairman Jaczko, Commissioners, thank you for this opportunity this morning.

If I could get to Slide 3 of our presentation, I'll jump right in and focus on an update on licensing of nuclear power plants, with a focus on power being added to the grid in the near-term and the future.

This slide depicts the locations of new reactor applications before the Commission. There are 10 under active review. We've received actually 18 applications, but the remaining 8 have been suspended for various reasons. Earlier this year, the Commission, the NRC, approved the issuance of the combined operating licenses for Vogtle Units 3 and 4 in Georgia and Summer Units 2 and 3 in South Carolina, and construction is currently underway on those units.

There are also three design certifications currently under review for GE Hitachi's Economic Simplified Boiling Water Reactor, ESBWR, AREVA's Evolutionary Power Reactor, and Mitsubishi's U.S. Advanced Pressurized Water Reactor, and the staff is also reviewing two early site permits for Victoria County station in Texas and for PSE&G in New Jersey.

If I can go to Slide 4. This is an aerial view of the Virgil summer site in South Carolina currently under construction. Unit 1 is the operational unit. This shows the area for Units 2 and 3, which the licensee projects initial operation for Unit 2 in 2017 and Unit 3 in 2018.

The next slide shows the Vogtle site in Georgia, with two currently operating units. This shot shows the area around Units 3 and 4, which are projected for operation in 2016 and 2017. All of these units are Westinghouse AP-1000 designs, which would bring roughly 1,000 megawatts each to the grid.

The next slide, Slide 6, shows the history, the cumulative history of power uprates. The red shows power uprates that have been approved by the NRC. The yellow shows projected uprates for the next several years. You can see that over about the last 15 years, uprates to the allowed power of existing units have brought about 5,000 megawatts to the grid over the last 15 years.

Slide 7 talks a little bit about the operation of the existing plants. Load-following refers to the ability to change the output of a power plant to meet the fluctuating demands of the grid. Nuclear power plants are designed to be baseload-generating plants. Changing electric power output requires changing reactor power either through changing the position of the control rods in the reactor, or by changing the boron concentration in the reactor coolant.

Constantly changing reactor power leads to uneven flux distribution within the reactor and uneven fuel burn. The power changes also increase thermal stresses on the reactor vessel. Economically, it's not attractive to the operators to operate nuclear power plants at fluctuating and low-power levels. All of the power uprate applicants have to demonstrate that the change in the maximum power output from the facility will not result in grid stability concerns in their areas during various operating modes of the plant and of the transmission system. This is a factor that our staff considers in its review of these power uprate license amendments.

In addition, we continue to get support from NERC and FERC staff for enforcement discretion cases at nuclear power plants which involve consideration of grid reliability and its relationship to nuclear safety. As an example, about a year ago Duke Energy requested the staff grant discretion from enforcing requirements of technical specifications for surveillance of containment isolation valves at Oconee Plant Units 2 and 3 in South Carolina.

This request for enforcement discretion was based on impending severe weather. The NRC staff evaluated the basis of their request and contacted the following agencies to fully understand the grid conditions in the vicinity of the plant. It contacted FERC, NERC and the Southeast Region Transmission System Operator, as well as Duke Energy, the licensee for the plant.

The transmission system operator confirmed that the transmission system in the area was stressed due to unusually high temperatures during that period of time, and the power reserves were at a minimum, and Duke Energy had made appropriate efforts to procure available reserves from adjacent operators.

The next slide talks a little bit more about some other interactions with the staffs of the Commissions. We meet on a quarterly basis to share ongoing issues and activities.

NRC operates a dam safety program, which covers nine dams, seven supporting the ultimate heat sink for operating reactors, and two connected with fuel facilities. And over the past 20 years under our memorandum of agreement, FERC has provided support to our dam safety program. We use FERC's expertise and their personnel for our direct field inspections and evaluations of these dams.

Our most recent inspection was at Lake Anna in Virginia in March.

Another example of the coordination between our staffs: last fall, there was an 11-minute system disturbance in the Pacific Southwest leading to cascading power outages affecting approximately 2.7 million customers in parts of Arizona, Southern California and Baja, California and Mexico.

This grid perturbation was a result of a switching error, and power instantaneously redistributed throughout the Southern California system. This redistribution of power created sizeable voltage deviations and equipment overloads that resulted in the automatic shutdown of the San Onofre Nuclear Generating Station's two units in Southern California.

We were invited to participate in the FERC-NERC investigation of this event, which we greatly appreciate, and while our staff's focus was primarily on the impact on the San Onofre station, and our response and the response of the San Onofre station to the event, our staff gained useful insights in the overall grid response to this perturbation. We greatly appreciate that coordination, and that completes my presentation.

FERC CHAIRMAN WELLINGHOFF: Thank you, Dan. Bob, welcome.

MR. SNOW: The first slide, please. Hi. My name is Bob Snow. I'm a senior engineer in the Office of Energy Policy Innovation.

The purpose of my presentation is: (1) to walk through a simplified example of a grid operation of a wholesale electric market; (2) is to show the interplay between the types of resources on the existing transmission grid and the grid operator's action to ensure reliable delivery of firm demand; and (3) to mention a few of the FERC's policy initiatives to help ensure that under our rules alternative resources like responsive demand and electric storage are able to provide flexibility to grid operators.

This presentation uses regional maps of locational energy prices to show how the grid's load, generation, demand-side resources and transmission limitations interact in an area with significant amounts of both wind and nuclear generation.

Second slide or you didn't give me the first slide yet. Ah, there we are. In the organized energy markets regulated by FERC, the energy markets are dispatched to serve firm load using the least-cost resources on both the supply side and the demand side. The dispatch is subject to limitations that our facilities must operate within their thermal, voltage and stability ratings, both normally and after an unexpected event, such as the outage of a transmission line or a large generating plant.

Individual resources submit bids to supply electric energy, or reduce their use of energy. The price bids of generators are shown in this slide. The bids are stacked--are showing resources like hydro and wind bid at near zero. Nuclear plants bid very low also. The low bids signal a willingness to be dispatched at almost any price. Grid operators call on the bid resources from the lowest to the highest until the demand is met.

The resource that meets the last increment of demand is said to have cleared the market, and its bid price is paid to all of the resources at that price or lower for the time period, assuming unconstrained operations. Again, looking at this graph, if the net demand for an hour is the first vertical line on there, on kind of the left hand side of the chart, the clearing price is $30, while it will rise to $180 per megawatt hour, if the demand rose to the right-most vertical line. Therefore, as the demand changes during the day, the prices increase or change. Importantly, if the transmission system is not capable of delivering the output of the lowest cost resources, generation output or load consumption is modified by the grid operator to allow all firm load to be served.

Depending on the location of any transmission constraints, the resources available either generation demand response or storage acting as supply, any one of those could be the solution. And so the characteristics and flexibility of the resources affect which resources are in fact used, so affecting the price that electric customers pay.

Third slide, please. This slide and the next provide an example of how the location of generating resources and transmission constraints affect grid operations. In this slide you see the location of the nuclear plants in the region near Chicago. They have a total capacity of 19.4 gigawatts electric, with 11.4 gigawatts west of Chicago.

The red and yellow color lines on the slide show the location of the major transmission constraints on a hot day in July. Transmission limits are set by the facility ratings and other system criteria. Operating within the ratings and satisfying those criteria are required for reliable system operation.

Next slide. This slide shows the location of the wind resources in the region. There were a total rating of 10.6 gigawatts of wind generation in MISO at the end of 2012 projected, with 10.3 in existence in 2011.

Slide 5. Now that you have a picture of the location of the nuclear and wind resources and of the transmission system, I'm going to go through a system in operation, starting at about one o'clock in the morning on a July day, a hot July day. The color on this graphics are the prices associated with a grid operator action to meet customer demand at lowest prices while operating reliably. The dark blue areas show electric prices near zero dollars per megawatt hour, indicating a combination of low loads, available resources and limited transmission capacity to move those resources to higher-priced areas.

At this 1:00 a.m. slide, you would expect the loads are low and costs are low. If there were no transmission limitations, the power would be pushed everywhere on the system. The entire region would be one uniform color. However, you see the one high price location in red, where prices are $200 a megawatt hour. There are known transmission constraints in a large coal unit in this area. Such generation within flexible and low-cost output must be continued to operate despite the low demand.

Planning ahead for what is expected to be a peak day, the grid operators have to had to run higher cost resources as insurance that the grid will be operating and can provide all service. The ability of demand to increase at this time, such as industrial load consuming more or storing energy, could be of assistance in the blue area, as well as industrial load consuming less or storage in the red area. Nuclear units, of course, are not considered as flexible or dispatchable, as my colleague just mentioned a moment ago.

Slide 6, please. Here at 6:00 a.m., people are starting their day and the demand is starting to increase. The price is not uniform because of limitations on the transmission paths. The blue areas continue to have low-cost generation with a limited transmission available to deliver to the higher cost areas.

Further, the grid operator is running low-cost resources in the blue area. That's kind of an insurance against the transmission or large generator outages near the Chicago load area. Finally, low prices generally provide an economic signal to generators to reduce output or load to increase their consumption.

However, the blue area contains most of the wind plants, as well as the Quad City Nuclear Plant. Both kinds of resources run full-out, regardless of the price signals. We say nuclear power and often wind are not dispatchable. In the orange areas where power costs are about $76 a megawatt hour, more generation and/or load demand or the output of storage was needed to meet that demand.

Slide 7, please. Electric demand increased throughout the morning and by 1:00 p.m., more expensive resources are needed to meet the demand. The price of electricity is high over large areas, but not everywhere. The major population areas are seeing prices of over $200 a megawatt, or other areas are still seeing very low prices, because of the appearance of new transmission constraints, different transmission constraints.

For example, prices are low around the Quad City Nuclear Plant. The closest of these very low-cost areas and high cost-areas mean that power is trapped in the low-cost area by transmission limitations along the interface between the blue and the red areas. It cannot physically move to serve other customers reliably that are paying a very high price. A $200 price reflects the marginal cost to consumers due to these transmission constraints.

Next slide, please. This slide shows the prices at 5:00 p.m. near the peak of the day. Now even more expensive generation has been committed to serve demand.

However, even now, there are locations with low prices. In this case, near the Point Beach and Kiwanis. I'm probably pronouncing that wrong, but close enough, plants that are due to transmission limitations.

As the day continues and demand increases and then drops off, grid operators repeat the exercise of dispatching the lowest cost resources, demand controllable generation, controllable demand and storage, to meet load while managing constraints on the system.

The FERC has been working to ensure that the grid has enough capability and flexibility to cope with a variety of grid conditions at a reasonable cost. We have acted to remove unnecessary barriers to using more flexible resources while ensuring that their compensation reflects their performance and encouraging transmission expansion. We also have removed barriers to participation of alternative resources, such as demand response and storage in the wholesale markets.

Last slide, all right. In sum, the grid operators must manage the flow on the grid to operate the grid reliably, taking into account all significant contingencies, including the outage of large conventional generators. Grid management utilizes the dispatchable and non-dispatchable generation, demand-side resources and storage systems to meet the firm demand at lowest cost.

Having electric prices that vary by location is an essential part of grid management in organized markets. These locational marginal prices induce resources to respond appropriately to transmission constraints, assuming they can respond. If they can't, that's just it. Having more controllable resources, more controllable generation, storage and demand response, especially in the right locations to help maintain reliability and manage the cost of serving customers.

Thank you.

(Microphone interference begins.)

FERC CHAIRMAN WELLINGHOFF: Great. Thank you, Bob. That was good. I don't know what that (noise) is, but in any case, hopefully we can figure out what the noise and stop it. Dan, thank you as well.

We'll go to some questions. In fact, I have a short comment and a question for you, and then I'll go to my colleagues. I believe that the efficiency and reliable operation of the grid is essential, and the operation of various supply resources in that grid in an efficient, reliable way is the way to do that.

But we also need to recognize that we can't look at any particular resource in isolation. You have to look at --

(Microphone interference increases.)

FERC CHAIRMAN WELLINGHOFF: Okay. I'll turn off one of my microphones. I think that did it. It was me all along.

(Laughter.)

FERC CHAIRMAN WELLINGHOFF: But as I say, we can't look at any resource in isolation, and I think you two have illustrated that. We have to figure out how to look at them as a whole. They all have unique operating characteristics. Nuclear power has unique characteristics. Wind has unique characteristics, coal has. Each one has unique characteristics, and certainly nuclear power plants that are operating do have a good track record with high capacity factors.

But there are some aspects of their operation that I have some concern over. Some nuclear power failures appear to be major and persistent. Of the 132 nuclear units that were built and licensed, and this is statistics that I've developed recently that were out there, that's research, 21 percent were permanently shut down because of intractable reliability or cost issues related to reliability.

Further, 27 percent have suffered one or more forced outages of at least a year, which I find to be pretty incredible, and I guess we can look at the SONGS unit now, which is one that may be in that category, and is causing some significant problems in Southern California.

I know that I said that everything's going to be fine in Southern California, but it's only going to be fine because of some extraordinary efforts, taking some mothballed plants out of their mothballs and getting the gas plants operating and looking at demand response and other things as well.

Admittedly when the remaining 68 units work well, their output is commendable, steady and dependable. They average a 90 percent capacity factor, which is very high. However, there seems to be a number of persistent and perhaps unique reliability issues, and I want to just list them and then see if I can get your comments on them.

One is that routine refueling, as I understand it, it is coordinated with the grid operators, but it shuts down the typical nuclear power plant for 37 days every 17 months. Then apparently there have been, in certain instances in locations in Europe and the U.S., prolonged heat waves have shut down or derated nuclear plants because their source of cooling water gets too hot.

Of course, we have the issue of a major accident, natural disaster or even a terrorist attack at one nuclear plant in some instances causes all others in the same country to shut down, and we can talk about Japan there, certainly what happened with the Fukushima situation. So that's one that's out there.

Another issue and we talked about the 2003 blackout, you know, unscheduled outages can result in many nuclear units failing simultaneously and without warning in a regional blackout. At the start of the August 14th, 2003 North American blackout, nine U.S. nuclear units totaling 7800 megawatts were running perfectly with 100 percent output. But after emergency shutdown, they took two weeks to restart fully.

They achieved zero output on the first day that the grid was back up. They achieved a .3 percent output on the second day, 5.7 percent on the third day, 38.4 percent on the fourth, 55.2 on the fifth and 66.8 on the sixth. The average capacity loss was 97.5 percent for three days, 62.5 percent for five days and it took them really, as I say, two weeks before they were fully operating.

So again we couldn't rely upon them certainly to restart the grid--black start issues there. And there are the issues of course of their inability to provide first- or second-tier frequency response support to the grid. So, you know, with these multiple issues that I've outlined, how do you see that we best mitigate these issues so that we can ensure that we can reliably integrate renewable, or excuse me, nuclear power plants into the grid with other types of resources that have different characteristics, and do it in the most efficient way? That's kind of the general question for both of you.

MR. DORMAN: I think that there are multiple considerations that play into the statistics that you've mentioned, Chairman. First off, it is a relatively slow and deliberate process to start up a nuclear power plant, and will continue to be so. And so you're not going to get the kind of quick response black start that you will get from other sources, particularly in a situation like the blackout in 2003.

In some respects I go back to the Hurricane Katrina that came through this region a number of years ago. And in that instance, I believe the Surry and North Anna plants were back online fairly quickly. We do have some responsibilities with FEMA to ensure the offsite emergency response capability after a hurricane like that.

But the power of those plants at that time was limited because of the grid capacity following the damages from the hurricane. So they were--that contributed to their slowness in coming up. I don't recall specifically in the grid blackout in 2003 to what extent that was a contributing factor to the rate at which those nuclear power plants returned.

The other factor that would play in, from our perspective, is when there is a perturbation of a nuclear power plant that shuts down abruptly from 100 percent power, there is some probability that you're going to get some safety-related equipment that may not respond exactly the way we expected, and we want to understand that before we allow that plant to restart, particularly when there may be questions of the stability of the grid.

So those are factors that can contribute to the rate at which you're going to be able to bring nuclear power plants back under those circumstances. Going to the comments on the capacity factor, and the contribution of unplanned outages in particular, you noted the roughly 90 percent capacity factor that the industry operates under today.

If you go back 25-30 years, that was in the neighborhood of 60 to 65 percent. There's been significant progress by the operators in supporting the sustained reliable operation of those facilities. So I think at this point, you're not going to get a whole lot more out of that. There will continue to be unplanned outages to some degree.

The San Onofre situation, obviously, is that's of very high concern to our Commission and our staff, because of the causes that contribute to the sustained duration that that outage will be.

FERC CHAIRMAN WELLINGHOFF: Mike.

MR. SNOW: I agree with your comment that the operators need to have many different tools, understanding the limitation of dispatchable or non-dispatchable, both demand as well as generation. Good planning, good operations, covers all of the events that happened because of either natural or man-made events occurring on the system.

Your comment on the 2003 blackout, I wasn't with the Commission at that time. Actually I spent that day in a control room putting the system back together again in part of that system. So our, the plants, the company I was working with at the time had a couple of nuclear power plants that bluntly stayed up and thank God they did at the time, because they were helping us put the rest of the system back together.

But again, it's good people, good preparation and a lot of different resources allow you to put the system back up. And I don't believe that's going to change any time in the near future. Our requirements, the Commission requirements and the reliability standards identify what these entities need to have in place. We don't tell them how to do it; that's for sure.

And with that amount of planning, that preparation and understanding a lot of the things that can occur, they're prepared to handle. Now it took a reasonable time to get the system back in 2003. But considering the amount of outages, there was very little damage to the system, fortunately. That's why it took so quickly to get back.

The plants being offline, I think we expect that to occur. It's not unusual that that happened. So in the planning you understand that, and make sure you have enough resources.

FERC CHAIRMAN WELLINGHOFF: Chairman Jaczko.

NRC CHAIRMAN JACZKO: I have one question just going to the issue of the electricity market which is something that's a little bit foreign to us, or to me in particular. But one of the assumptions we generally have made is that nuclear units generally operate at a profit ultimately. Whether it's on an hourly basis, I don't necessarily know. But certainly on a daily basis, that they tend to be selling power at prices below the costs, or certainly the routine costs for operation.

Are you seeing markets now in which that's not the case, that some of the nuclear units are operating below, are selling power below-cost on, I don't know if it's on an hourly basis or on a daily basis or any time during that process?

MR. SNOW: As I identified, that nuclear units bid very, very low, sometimes zero, sometimes very -- you know, maybe at their marginal cost. They are price-takers.

Whatever the price the market identifies, the clearing prices that one of my slides identified, they're quite happy with doing that.

At any given hour, at one hour, the locational marginal price at their bus may very well be below their marginal cost. And as a, you know, tiling in for that hour, they may be at a loss. But they operate with the long view in mind, and to my understanding nuclear plants are a good business. People wouldn't be building these plants if they didn't think they were a good business.

So we've not seen anything yet. My crystal ball is cracked and fuzzy on what may happen in the future, but thus far, it doesn't seem -- a given hour, yeah. I think the example I was trying to give you here showed some of those hours on a very hot day in July.

NRC CHAIRMAN JACZKO: Thank you.

FERC CHAIRMAN WELLINGHOFF: Thank you. Any other questions?

NRC COMMISSIONER SVINICKI: Dan, in your presentation, you touched on, I think it was the nine dams that we inspect and that we had the opportunity to have FERC accompaniment of dam experts on those inspections. You did not mention and could you address if there's any cooperative activity going on between the NRC and FERC staff on the generic issue that we have under investigation of upstream dam failure. Are we coordinating with FERC on that, and if so, what does that collaboration consist of?

MR. DORMAN: Yes. The issue that you referred to we've encompassed into a broader issue in our Fukushima follow-up, as you know, to look at the flooding hazard reanalysis for each nuclear power plant. A number of facilities have upstream dams with varying degrees of incorporation into their existing licensing basis, and most of those dams are FERC-regulated dams.

So our hydrology folks will be working with FERC in evaluating the reliability of those dams, the risk of over-topping or of sunny day failures, and the contributors that those would provide, and how to incorporate those into an assessment of the flooding hazard analysis for the nuclear plants.

FERC CHAIRMAN WELLINGHOFF: Phil.

FERC COMMISSIONER MOELLER: I want to thank the NRC staff for being involved in the San Diego outage or Southern California outage report. It highlights the interdependent nature of all of our resources, the fact that, you know, definitions of the bulk electric system are involved. As we move to a system where we're going to be using more natural gas to generate electricity, these kinds of trends will only increase.

The second point is to highlight

the way this agency can affect the NRC is that you mentioned the capacity factors that are now at around 90 percent. If you go back to the late '80's or the early '90's, those were, as I recall, in the mid-'60's.

Now granted, some of the lower-performing plants have been out of the mix, but the reality from my perspective is that the open access transmission policies that this Commission pushed long before we were here in Order 888, and the consequent move towards more competitive wholesale markets, basically forced the nuclear industry to perform better, and I think they did an amazing job to get those capacity factors up to 90 percent.

But they did it in response to competitive pressures, while I would think the NRC would say that safety actually improved--so again, highlighting the dependency or the effects that this agency can have on the NRC and NRC actions on FERC.

A question for Mr. Dorman: I like to think about trends and anticipating challenges down the road. You've obviously got a big one now related to the SONGS plant. But if you were to say the top three or top two trends you see as a professional going forward, that you're maybe not concerned about but you would think we would find interesting, I'd be interested in your answer.

MR. DORMAN: We have, as part of our reactor oversight process, we have a routine process to evaluate trends in industry performance and we recently completed that periodic review and found no significant trend in industry performance.

So from the standpoint of the availability and reliability of the power produced from the nuclear sector, I don't see any significant change in the operating fleet. And we do have the power uprate program that I mentioned, where we see several thousand megawatts being added over the next five to six years to the grid, and then the addition of the new reactors that have already been approved by the Commission. And there are several still in the review process.

So I think if I see a trend, it's in increasing availability, in the few percent increase of the availability of power from the nuclear sector in the coming years.

FERC CHAIRMAN WELLINGHOFF: Cheryl.

FERC COMMISSIONER LaFLEUR: Thank you very much. Very interesting presentation. I always observe that almost all energy issues come down to trade-offs between reliability and security, cost and environment and safety, and that's true of almost everything we look at. And when I look at the existing nuclear fleet, it's doing very well across those dimensions.

You know, it's 20 percent of the energy. We really miss it when it's not there, as in SONGS. It's carbon-free and very low-cost, low marginal cost. So as has been observed, the current fleet is doing very well in the competitive markets and the open access transmission regime, yet it's very, very, very difficult to build a new nuclear plant in this country.

And as we look forward to the evolution of the fleet, you can't keep operating the existing fleet forever. At some point, we'll either we'll lose a lot of the existing fleet. I know there's a lot of reasons for that, but are there things within the design of the markets or the policies under the control of this Commission that we can be working on together, to look to the future of nuclear? Big question but --

MR. DORMAN: Big question. I'll look to my colleague for comment on the markets. That's not my area. I think one of the significant challenges in putting new nuclear and, to some degree, any new energy online is the availability of capital to support the investment. We had a period in the late '70's, '80's, into the early '90's in licensing the existing fleet, where from the time of application for a license to the issuance of the license was measured almost in decades rather than years.

Our Commission made a great effort in the '90's to look at our licensing process and the predictability of our licensing process, and the Vogtle and Summer units were the first tests of that process. But I think from a capital standpoint, it's hard for the investment markets to look at something that takes 20 years to start providing a return on investment as a good investment.

So I think we've made progress on our end. I think in terms of the market impacts on that, I'd defer to my FERC colleague.

MR. SNOW: As Dan indicated, the major aspects on new plants are will there be return on that investment? It's the capital aspect or the market aspect. The Commission has done a number of things in the capacity market, forward capacity markets that gives some indication, at least for the current fleet of gas-fired units that have some certainty.

It might be appropriate to think about what would be the appropriate time frame on a capacity market to match some of the appropriate things or the time frames. 20 years? I think no one's quite that good figuring things that far out, but a little further out might be something to look at.

But just--my response is my personal response, not an official--but the issue is, as Dan identified, his critical issue is capital, can I finance these things, and that really relates to do I have a revenue stream? What's that stream look like?

A similar problem we've heard of and addressed in the gas-fired fleet with multiple year-ahead capacity markets, I don't think--the problem is the same. It's just a different technology, but the problem is the same.

FERC COMMISSIONER LaFLEUR: I guess you can't--three years of forward, a three years' forward look might make sense for a gas plant. It isn't really obviously the time frame of a nuclear. Thank you.

FERC CHAIRMAN WELLINGHOFF: Commissioner Magwood.

NRC COMMISSIONER MAGWOOD: Thank you for your presentations.

Just one sort of comment and a question. You know, as I've talked with nuclear operators over the years and their decision-making processes when they consider adding new units, one of the considerations that comes into play is diversity, and some of them have expressed the concern that as gas prices remain low, there's a tendency for the utilities to add more gas capacity, and that over time, that could tend to make them disproportionately, in their view, relying on gas.

And if there is some spike in gas prices their customers would be impacted, and that's what they've expressed to be part of the rationale for considering nuclear power plants. Is that just the view of a few people in the industry? Is that something that you think industry and FERC view as a valuable part of the decision-making process, or do you think the process really is simply driven by what's the lowest price. If that's the case, what about fuel diversity going forward?

MR. SNOW: Let me again preface this in my opinion, just to -- my approach would be to identify what your goals are going to be as far as reliability, loss of load expectations--there are a bunch of ways of quantifying that.

Single fuel, all your eggs in one basket, a planner is never happy with that approach, be it a power system planner, a transmission planner or a financial planner, for that matter. So diversity is something you would strive for. But that diversity can be across fuel, it can be across geography and it can be across technologies that are used.

So you have a bunch of diversities, and I don't think we want to get, to narrow it down and say if it's gas, it's bad. No. If there are approaches one can take to limit the risk. The reliability standard approach was to identify what you wanted to achieve, and let the very smart people out there come up with varying ways.

Part of that discussion might be that you cover some of that variation, I was trying to make the point in my presentation, of resources. There are two sides of the equation. Generation is one; load is the other. Both of them should be in play. Both of them should be controllable. Dispatchable is the term I used a moment ago. And that if you have a nuclear plant, certain characteristics, that makes economic sense and is a good business venture, it will almost always help the market, if that responds to your question.

NRC COMMISSIONER MAGWOOD: Almost. Let me just ask a follow-up then. Is it in--if you have the choice as an operator to add, say, a nuclear capacity or some other conventional capacity, or natural gas and you can do it for roughly the same price, would you tend to just simply add more gas if you could add more gas, or would you go to another technology, wind or nuclear or something else if you could do it for roughly the same price.

MR. SNOW: If I were the operator that had the power to do those, I always would like to have diversity and a number of options. So I have some amount of each of the resources: a certain amount or renewables; a certain amount of hydro which is another variety of renewables; some baseload nuke; some plants that can vary or are very flexible units that can ramp up/ramp down quickly, that give me that capability.

I'd love to have all of those, if price was not an object. As you kind of identified before, price is part of that equation. So you need to kind of temper that. It doesn't mean price is the only issue. It's reliable service at the lowest cost. That doesn't mean zero or thereabout. It's that good reliability, appropriate reliability at the lowest cost involved.

FERC CHAIRMAN WELLINGHOFF: Thank you. Anybody else, any questions anyone? Going, going, gone. Oh John.

FERC COMMISSIONER NORRIS: I'd like to share with you a concern I have, and I think others have expressed here as well that becoming over-dependent upon one fuel--well gas is a tremendous asset for the generation industry and industry all across the economic sectors. It's a concern we have, and I have, of over-dependence on one fuel source, and the fact that it's pushing out development of new nuclear, renewables and a number of other technologies.

FERC CHAIRMAN WELLINGHOFF: Thank you, John. Yes, George.

NRC COMMISSIONER APOSTOLAKIS: Yeah. The word "reliability" and "reliable" performance has been used several times. I know how the NRC defines that. How do you define that concept?

MR. SNOW: I would kind of defer to the Commission-approved standards on reliable operation, and in the--fundamentally, it's the serving, I'm going to call it the portfolio of generation is able to be delivered to the portfolio of firm load, and with load being a variable and generation being a variable. For all normal conditions, all the expected things you would have, the hot days, the cold days, the reasonable storm kind of things, and for any credible contingency that would occur on the system, that the customer, the end use customer, the wholesale customer, doesn't know anything happened unless of course it was their service connection that the tree came down on. Yes, they're going to be out for that. I'd kind of describe that as one aspect of reliable operation.

The other aspect is that you're going to do this over time. You know, there are going to be some things that will occur. You know, Murphy's alive and well and certainly existing out there and certain things will occur. So that the kind of the loss of load expectation, the probability, I think, in the nuclear industry--my resume doesn't show me, but I started in the nuclear industry many, many years ago in plant design--so I have some idea, at least a dated idea of probabilities used to look at core damage.

I kind of think that concept but in service, keeping that value at a reasonably low number. And as we become more and more dependent on or use the systems more and more, electricity becomes not a commodity but a necessity, So making sure it's reliable in a kind of deterministic point of view, but also look at the probabilities of what's going to happen of all of the events, and keep that probability also low. That would be my definition of that.

FERC CHAIRMAN WELLINGHOFF: Anyone else have anything?

(No response.)

FERC CHAIRMAN WELLINGHOFF: Okay. Well thank you both. Bob, I don't think you ever knew we were going to make you into a markets expert, but you did a good job. Thank you. Both of you did a great job. If we can have our second panel please, Mr. Dapas from the NRC and Mr. Franks from FERC. Mr. Dapas, did I pronounce your name correctly?

MR. DAPAS: Da-Pas.

FERC CHAIRMAN WELLINGHOFF: Dapas, sorry. Mr. Dapas. If you can start please.

MR. DAPAS: If I could have the first slide please. Good morning Chairman Jaczko, Chairman Wellinghoff and other Commissioners. I'm Marc Dapas, and I'm the Deputy Office Director in our Office of Nuclear Security and Incident Response, and as such, that office has program oversight responsibility for the NRC's cybersecurity program.

I appreciate the opportunity to share with you a perspective on some of the activities that we have undergoing in the area of cybersecurity. Let me start out by providing a summary of the regulatory history, framework and associated guidance in this area.

Next slide, please. In March 2009, the NRC issued 10 C.F.R. Part 73.54, known as the cybersecurity rule, which requires each nuclear power plant licensee to provide high assurance that digital assets are adequately protected against cyber attacks. The scope of the cybersecurity rule includes systems associated or considered safety-related, important to safety, have a security interface, or affect the emergency preparedness function.

It also includes offsite communications as well as associated support systems. In connection with the rule, we issued Regulatory Guide 5.71, which provides a framework for identifying those digital assets that must be protected from cyber attacks, referred to as critical digital assets or CDAs. The framework also includes a set of security controls that's based on standards that were provided by the National Institute of Standards and Technology or NIST.

Those NIST standards are based on well-understood cyber threats, risks and vulnerabilities, as well as countermeasures and protective techniques. Before the NRC issued its cybersecurity rule, FERC issued an order, No. 706, which specified critical infrastructure protection or

CIP reliability standards to safeguard critical cyber assets. That FERC order specifically exempted facilities regulated by the NRC from those requirements.

Initially, the NRC staff interpreted that cybersecurity rule to require the -- or our cybersecurity rule, I should say, to require the protection of critical digital assets that if compromised, could directly or indirectly result in radiological sabotage. It's in this interpretive context that the NRC staff initially did not consider many of the balance of plant or BOP systems to be within the scope of the rule, but rather considered these BOP systems to fall within the scope of the FERC CIP standards.

To address this gap in cyber protection for BOP systems, FERC issued another order as you know, 706(b), and that order removed the nuclear power plant exemption clause and clarified that BOP systems that are not within the scope of Part 73.54 are subject to compliance with the CIP standards. The order further indicated that nuclear power plant owners could seek exceptions from the CIP standards on a case-by-case basis, for those digital assets that were subject to the NRC cybersecurity requirements.

In December 2009, the NERC and the North American Electric Reliability Corporation or NERC entered into a Memorandum of Understanding which included the mutual commitment to cooperate in considering those specific exception requests. And as mentioned by Chairman Wellinghoff in his opening remarks, the NRC and FERC signed a Memorandum of Understanding to facilitate interactions between the two agencies, and that included coordination of activities related to cybersecurity.

So to inform the decision on where the jurisdictional line between FERC and NERC should be drawn with respect to BOP systems, NERC sent a survey to all nuclear power plant owners known as the Bright Line Survey. That survey asked licensees to identify which BOP systems are within the scope of the FERC CIP standards, and which ones are subject to NRC's cybersecurity regulations.

So in response to that Bright Line Survey, all nuclear power plant licensees stated that BOP systems, if compromised, affect reactivity and then as such they're considered important to safety and fall under the scope of the NRC cybersecurity rule. Then to further clarify the jurisdictional issue, in October 2010 the NRC Commission stated that as a matter of policy the NRC cybersecurity rule at 10 C.F.R. Part 73.54, should be interpreted to include structure, systems, and components in the balance of plant that have a nexus to radiological health and safety.

The staff then determined, in looking at what systems have a nexus to radiological health and safety, it's those BOP systems that could directly or indirectly affect reactivity at a nuclear power plant, and that as such, are considered important to safety and fall under our cybersecurity rule. I would like to point out that in the many activities and interactions to determine the respective jurisdictional responsibilities, FERC, NERC and the NRC have worked together in a highly collaborative manner.

Then the last activity that I'd like to mention in the context of a guidance development pertains to the Nuclear Energy Institute or NEI 1004, which was developed by the industry to provide additional guidance with respect to the identification of those critical digital assets that are subject to the requirements of our rule.

We recently provided NEI with what we expect to be the last round of staff comments before NEI submits the document for a formal NRC endorsement.

Next slide, please. With respect to program implementation, the NRC cybersecurity rule requires each licensee to submit a proposed implementation schedule for its cybersecurity plan. Those plans and schedules have been reviewed and approved by the NRC and then incorporated into each nuclear power plant license through license conditions.

Unlike other aspects of our security regulations, the cybersecurity rule did not mandate one specific date for full compliance for all operating reactors. This is because the staff recognized that each site is different, and factors such as outages, hiring qualified personnel with a cybersecurity skill set, and the interdependencies with other programs would impact implementation.

So to provide an appropriate degree of flexibility, while also ensuring that key threat vectors are addressed in a timely manner, and that activities which provide a high degree of protection against radiological sabotage are accomplished first, the staff endorsed a graded approach that consisted of eight key milestones, and as indicated on the slide, Milestones 1 through 7 are required to be complete in six months or by December 3lst, 2012.

These milestones focus on activities that provide higher degrees of protection. But with respect to BOP systems, which I know is an area of interest with FERC, when you look at Milestone 2, that requires all CDAs in the BOP be identified and Milestone 5 would require that those CDAs as well as others be looked at for obvious signs of tampering when you're doing your insider mitigation rounds.

With the implementation of Milestone 6, all CDAs and the balance of plant systems associated with target sets will have security controls applied. Additionally, if there are any portable or mobile devices that interface with any BOP CDA such as through routine maintenance, reprogramming of software patching activities, that those devices must be protected against the propagation of any malware.

While the completion of Milestones 1 through 7 provide for key threat vectors and activities being addressed in the nearer term, it's with the completion of Milestone 8 that additional security controls will be applied to every CDA, to meet the full requirements of our rule.

Next slide, please. With respect to oversight activities, in terms of our inspection program we've been working collaboratively with our internal and external stakeholders. That includes FERC, the Department of Homeland Security and NIST, to develop an inspection procedure of what we call a Temporary Instruction.

In the fall, we're planning to conduct a workshop with the industry to discuss that temporary instruction. We also will be training our inspectors, another critical element of our oversight program, and in July 2011, we conducted our first cybersecurity course for inspectors at the Idaho National Laboratory. We intend to conduct the second course in October of this year.

Regarding development of our Significance Determination Process, and that's a tool that we use to determine, as the name implies, the significance of any findings that would derive from our inspection activities, we have drafted an initial SDP framework. We plan to meet with industry and our interagency partners in late August, to obtain any insights they may have, and then in October we will conduct a table top pilot, and we use various findings scenarios, with the goal of issuing that final Significance Determination Process or SDP, before we start our inspections in January of 2013.

Consistent with how we have developed other inspection elements associated with the reactor oversight process, we will be piloting that cybersecurity inspection process. We've already conducted one pilot evaluation at Watts Bar Unit 2, and we're looking at conducting a second pilot at Clinton in August.

Then upon successful completion of the pilot process, we're looking to begin our inspections of Milestones 1 through 7, as I mentioned earlier, in January of 2013, and inspections of the full program implementation, which is reflected in Milestone 8, will begin in late 2014.

That start date coincides with when the first set of licensees are required to have fully implemented their programs. Similar to the comment that I made regarding the collaborative manner in which we've worked with FERC and NERC with respect to guidance development, we've seen the same degree of collaboration and information-sharing in working with those agencies as we develop our oversight program. Those interactions have been excellent. That concludes my remarks. Thank you.

FERC CHAIRMAN WELLINGHOFF: Thank you, Mr. Dapas. Mr. Franks.

MR. FRANKS: Good morning Chairman and Commissioners. My name is Ted Franks, and I am with the Office of Electric Reliability at FERC. Since the last joint Commission meeting, NERC's Critical Infrastructure Protection or CIP standards have been evolving. Today, I would like to give you an update on the standards development and the path forward, as the industry continues to address the directives issued by the Commission in Order 706 and subsequent orders.

Next slide. The standard disclaimer. These opinions expressed in the presentation are mine, and do not necessarily reflect the Commission or any individual commissioner.

Next slide, please. First, I would like to present a brief synopsis of NERC's development of the CIP standards. In January 2008, the Commission issued Order 706, which approved Version 1 of the CIP standards. In approving the standards, the Commission also identified numerous areas of needed improvement, and directed NERC to revise the standards to address these concerns.

Subsequent versions of the CIP standards address directives associated with the removal of terms "reasonable business judgment" and "acceptance of risk from the standards." NERC also addressed requirements associated with senior management sign-off, training, personnel risk assessments, implementation time tables and technical feasibility exceptions.

Versions 2 and 3 of the CIP standards, along with various compliance filings, address some of the Commission directives. However, additional modifications to the standards are still being developed, such as defense in depth, access control, patch management and traffic monitoring. As Marc has already referenced in his presentation, Order 706(b) was also issued to address this regulatory--to address a regulatory gap.

I think this is a good example of the two agencies working with NERC and the industry to ensure the proper regulatory framework was put in place to address this issue. This collaborative effort continues today as we regularly meet with the NRC to communicate cybersecurity issues that could potentially impact the security of the nuclear power plants and bulk power system.

Next slide, please. In April 2012, the Commission issued Order No. 761, which approved Version 4 of the CIP standards. The major change proposed in Version 4 was the method for identifying critical assets. Version 4 applies a Bright Line criteria on the elements associated with transmission generation and control centers. For instance, black start resources and associated cranking paths, which are used to provide offsite power to the nuclear stations after a disturbance, are identified as critical assets.

This method of identifying critical assets replaces the use of a risk-based assessment methodology used by individual entities. The Commission found that the Bright Line would add consistency and clarity in the identification of critical assets. Similar to Versions 1, 2 and 3, the critical cyber assets will be identified as a subset of the critical assets.

These critical assets will then be afforded the protections and controls of CIP 003 through CIP 009. Critical cyber asset identification and the protection and controls of CIP 3 through 9, remain relatively unchanged from Version 3.

Next slide, please. In Order 761, the Commission also provided some guidance on some of the remaining directives from Order 706. This guidance focused on three primary areas. Connectivity, the National Institute of Standards and Technology or NIST standards, and regional perspective.

For guidance on how connectivity should be considered in the course of determining appropriate cybersecurity protections, the Commission stated its support of NERC's intentions to apply electronic security perimeter protections of some form to all bulk electric cyber systems. This guidance is consistent with the language in Order 706, that states "the cyberconnectivity of the bulk power system assets increases the risk of multiple asset cyber attack, and the CIP standards should reflect this.

In Order 761, the Commission reiterated its encouragement to NERC and the industry to include relevant aspects of the NIST framework and standards into subsequent versions of the CIP standards, to better protect the bulk power system with regard to both identification of elements to be protected, and the design of the appropriate protections.

Also in Order 761, the Commission highlighted its Order 706 directive for NERC to develop a process of external review and approval, based on regional perspective, emphasizing the need to avoid any reliability gaps. On this regional perspective issue, the Commission determined that even with the adoption of clear and objectionable criteria, there remains a need for an entity with a regional perspective, presumably the ERO or a regional entity to have the opportunity to identify or adjust the characterization of cyber assets in some circumstances.

In other words, Bright Lines are useful for the identification of assets and systems, but there could be circumstances such as technological development or reliability gaps revealed by events, where assets or systems fall out of a Bright Line, that should be afforded the appropriate levels of protection based on their unique characteristics or role in maintaining grid reliability.

Order 761 also issued a deadline for NERC to submit Version 5 of the CIP standards to the Commission by March 31st of 2013. NERC has indicated that it anticipates responding to all of the remaining Order 706 directives in Version 5 of the CIP standards. In the draft currently under development, Version 5 takes a tiered approach and applies various levels of controls for each category of cyber systems associated with the bulk electric system.

This approach will afford some level of protection for all cyber systems associated with the BES. Two ballots have been conducted, one in January, in which the standards received an average approval of 29 percent. Another ballot was recently completed in May, in which an average of 52 percent approval was achieved. However, the standards need a two-thirds majority approval prior to being sent to the NERC BOT for approval.

FERC staff continues to monitor the standards drafting team progress, and we look to their filing on March 31st or sooner. This concludes my presentation, and I look forward to answering any questions.

FERC CHAIRMAN WELLINGHOFF: Thank you, Tim. I appreciate it. So we're trying to move along on the NERC side with CIP standards. As you can see, it's sometimes a long and torturous process to get there.

My question actually would be on the other side of things for Mr. Dapas, something that we don't have a lot of ability to move forward on, and little statutory authority, and that's in the area of known threats and vulnerabilities, and I'll give you an example.

I guess one would be the Aurora effect. Are you familiar with the Aurora effect?

MR. DAPAS: Yes.

FERC CHAIRMAN WELLINGHOFF: So what authority and what abilities does the NRC have to deal with known threats and vulnerabilities that you would determine on your side of the Bright Line?

MR. DAPAS: We have a process that we go through, and it's called a threat assessment. We have an office or branch that's called our Intelligence Liaison and Threat Assessment Branch, and they engage with the interagency to identify any threats.

And then we work with the Department of Homeland Security in an organization called ICS-CIRT to evaluate the significance of any threat, and then we would determine if we need to issue advisories to licensees communicating that threat, and then we would expect licensees to take action, just like similar to an operating experience program that's in effect within the safety arena.

But we do evaluate those to determine the significance. We learn from the perspective of the other agencies and depending on the significance, if we needed to take more significant action, we could direct licensees to take action. But right now, the current process is we expect licensees to evaluate the significance with the benefits of the insights that we were provided in those advisories, and then take appropriate action.

FERC CHAIRMAN WELLINGHOFF: Can you make those advisories classified?

MR. DAPAS: Some are -- yes. It depends on obviously the content of the threat and we certainly don't want to share information with those who don't have a need to know. We also have a mechanism called the protected web server, which does provide--different licensees that have a need to know do have access to that server and are able to acquire information.

But the salient point I want to make is that we would evaluate the significance of the threat, and then determine what's the appropriate follow-up action and would communicate that to licensees. Then, as appropriate, we would follow-up to ensure licensees have taken action to protect against those threats. And I think we did that in the case with the Aurora example that you mentioned.

FERC CHAIRMAN WELLINGHOFF: Because you had the ability to do it immediately, in essence, and do it in a classified manner as well.

MR. DAPAS: Again, I would offer like if there were a safety issue. It's the same concept there, that we would evaluate what action we need to take to ensure that a facility's security posture is not being compromised due to that threat.

FERC CHAIRMAN WELLINGHOFF: Thank you. Greg.

NRC CHAIRMAN JACZKO: Thanks, Jon. One of the issues that we've been dealing with over the last several years has to do with new nuclear generation and transitioning from an infrastructure control and an instrumentation and control infrastructure that has largely been non-digitally based.

So as we have gone through the process of looking at new reactors, we've generally been dealing with systems that are digitally-based, and as we've gone through that process, and particularly when it comes to reliability and security concerns with the digital instrumentation and control systems, we've generally gotten very--well, we've gotten a little bit mired in the issues of design of these systems, and how much detail do we need to know about the design in order to ensure that the architecture is secure or reliable or whatever the specific outcome may be.

When I look at the nuclear infrastructure, that is a fairly narrowly defined set of infrastructure with a utility, or a sector-specific regulator, the NRC, so we have some measure of ability to heavily influence that architecture in its development so that we can begin to deploy a generation of instrumentation and control systems that should have in theory better cyber protections built into the design process to the extent that we can.

I'm not sure that we've succeeded in that, but at least we have the ability to do that. When I look at the bulk power system, the limited things I know about the bulk power system tell me that that is a very diverse system, with a large number of control systems, a large number of utility entities involved in that entire system.

So do you see right now the ability to properly influence the addition of new control systems, of new transmission, whatever the systems may be, to ensure that as those new resources are brought on board, that they are building in the kind of appropriate thinking about cybersecurity from the beginning, or will this need to be added on later? How do you see that?

MR. FRANKS: Well I guess that is one of the issues that they're running into now, is that the original industrial control systems weren't really designed with security in mind. So now they're in, you know, the bolted-on stage. But going forward, yes, we would very much like to see vendors working with customers, the ability to bake in the security, so you don't have to add it later on, and we are seeing some progress in that area.

Of course a lot of attention has been given to vulnerabilities that exist in the current systems that are in place right now, and they're using that as say leverage and learning experiences on how to move forward to secure the future of control systems. But I think the progress is being made in that direction.

NRC CHAIRMAN JACZKO: So if I could just do a brief follow-up, so who has the authority in that area? Is that -- I mean does someone have authority over all those systems? Is it FERC, is it NERC or do some of those systems fall outside of the authority of any entity?

MR. FRANKS: The simple answer is no. Right now, we don't have that authority to oversee, or anyone that I know of has the authority to oversee the design of a control system. Right now, it's between the vendor and the customer on how secure the system is going to be.

NRC CHAIRMAN JACZKO: Thank you.

FERC CHAIRMAN WELLINGHOFF: Anyone else? Yes.

NRC COMMISSIONER OSTENDORFF: Thank you, Mr. Chairman.

I have a question for both -- two questions, one for both of you and then one for Ted. The question for both of you, I'm going back to Ted's comment about the Bright Line approach, adding consistency to identifying which SSCs fall in the balance of plant.

I want to ask both of you to comment on any challenges that you've seen to date, on what you anticipate going forward with the Bright Line approach for the nuclear power plants.

MR. DAPAS: I guess the perspective I would offer, Commissioner, really independent of the BOP systems. I think one of the challenges is licensees looking at the 148 controls associated with the NIST standards, and trying to determine which controls needs to be applied to each system or critical digital asset, whether that be BOP or whether those be those critical digital assets that are specific to the target sets.

But I do think, you know, we're doing what we can to provide guidance there to assist the licensees in looking at how to provide appropriate protections for the BOP systems. Our whole approach with Milestones 1 through 7, you know, it's graded based on those systems that would have the highest degree of impact on any potential radiological sabotage.

So as you look at it with that graded approach, the licensees have to determine to what extent do they need to implement controls with the various critical digital assets. Some require, I would offer, more controls to be in place than the others, because of the significance of the system in terms of preventing radiological sabotage. Like when you look at power conversion systems, which is a BOP system, that may need to have greater controls than another BOP system that isn't subjected to potentially the same vulnerabilities through a cyber intrusion.

But I do think the Bright Line Survey clearly has delineated, you know, what is the responsibility under NRC jurisdiction and what is the responsibility with FERC? You know, we establish it by going out to the first intertie breaker in the electrical distribution system. That clearly has provided clarity that both the Commission's direction back in October 2010 and the Bright Line Survey results are consistent, and I think that has been significant--so that there's not that uncertainty that exists on which systems need to have controls applied.

NRC COMMISSIONER OSTENDORFF: Ted, did you have anything you wanted to comment on?

MR. FRANKS: Sure. I just want make sure I clarify. So there was a Bright Line that was ordered through or discussed in 706(b). The Bright Line in my presentation was how they are identifying critical assets. I just wanted to make that clarification. It's not uncommon to use the same word for it.

NRC COMMISSIONER OSTENDORFF: I understand.

MR. FRANKS: But your question about, you know, are there any concerns about a Bright Line or limitations. I think a Bright Line is a good start, but there does need to remain somewhat a flexibility, because it's hard to say a one-size-fits-all for everyone. I think it's a good start as far as identifying critical assets.

But there could be circumstances where more protections need to be afforded to certain assets than others, and you may need to make that switch, moving it from one category to another. So that would be my concern, is that just the ability to have a little bit of flexibility to address the assets that need additional protection.

NRC COMMISSIONER OSTENDORFF: So this is kind of really the second question I wanted to ask you specifically on your FERC hat. Look at the non-nuclear generating sources you deal with, whether it be gas, coal, whatever it may be. I think your flexibility response answer to my question, is that from a policy and from a technical and a security standpoint, you're comfortable with there being somewhat different approaches based on the type of generating source?

I don't want put words in your mouth. I just want to understand. I was going to ask, are there any concerns about an approach the NRC is taking that might be philosophically or fundamentally at odds with other non-nuclear generating source of supplies?

MR. FRANKS: No, they should be similar. Again, the goal is to protect the control systems. So not that a one-size-fits-all, but the protection of the, we'll say non-nuclear generation is also critical for the bulk power system. So yes, those same types of protections should be afforded to those as well.

NRC COMMISSIONER OSTENDORFF: Thank you.

FERC CHAIRMAN WELLINGHOFF: Yes. Commissioner Magwood.

NRC COMMISSIONER MAGWOOD: Thank you for your presentations. First, a comment for my FERC colleagues, and I'm sure you've heard something about these events, small modular reactors that the industry is developing. On a visit not long ago, one of the vendors who's developing a small modular reactor informed me that they have decided to not incorporate digital systems in their reactor. Rather, they're going to go completely analog.

The reason for doing that is cyber security. They just simply decided it's just too difficult to keep up with things. So in that respect, I have a question for both of you. You know, we are in NRC accustomed to establishing, you know, a design-based threat or establishing a level of safety that we require, and our licensees are used to working to achieve that level or whatever the issue is.

It seems to me cybersecurity is a constantly-evolving threat, that it doesn't just evolve in terms of the sophistication of the attacks, but really the nature. We find that they come at this situation from different directions. As we go through this process, and let's say by the end of this process you think that we are secure. Are we secure five years later? And how do we assure that we're secure five years later?

Do we have to continue--do we have to give orders on a continuing basis from here on out? Or does this establish a methodology where our various licensees will be able to deal with these evolving threats on their own? I'd like to hear both an NRC and FERC perspective on that.

MR. DAPAS: I guess my perspective would be, drawing an analogy in the safety arena, you have controls in place and when you have new information, you have to assess to what degree are your existing controls sufficient to provide protection.

As you indicated, cyber is a very dynamic and evolving area, and I would offer the expectation going forward would be that as we provide information to licensees they'd have to look at, do they provide an appropriate level of protection with their critical digital assets?

And that may necessitate a change to their cybersecurity plan, and if such, that would be submitted to be reviewed and approved by the NRC. A licensee can't make a change to their plan without NRC review and approval.

And I'll offer, just like currently under our inspection process and other cornerstones with the reactor oversight process, when we have new information there can be times where we initiate an inspection activity to determine, you know, to what degree do the vulnerabilities exist? So I would offer we do have tools in place that we could leverage, to ensure that licensees are implementing appropriate controls as that cybersecurity dynamic or threat would continue to evolve.

And of course, we haven't established, you know, the full operating experience program. I can see it will be structured similarly to how we approached that in the safety arena. But I would offer that we do--we'll be able to ensure that an appropriate degree of cyber protection is provided for with the flexibility that exists to use those tools.

MR. FRANKS: And maybe taking it to a little bit higher level for your question, I don't think you'll ever hear a cybersecurity expert say like 100 percent security is achievable. They describe it more in terms of it's a journey, not a destination; and that there always seems to be instances where the bad guys are maybe just a little bit ahead of the good guys.

Not to sound too negative here, but I think what the standards can do is provide like a discipline, like just an overall culture in the organizations where there's a discipline, so in the event that there is some type of intrusion or attack, that it can be isolated and removed, and then resume operations again.

I think that's what the standards can offer, is that just getting that discipline in place because it's inevitable that you're going to be attacked and possibly even penetrated.

MR. DAPAS: Could I offer one additional perspective, Commissioner? I think how we are approaching cybersecurity requirements associated with new construction where there's been discussion should that be included in the initial design and submitted to the NRC for review, there is a school of thought which is reflected in the staff position that with the evolving nature of cybersecurity and the long lead time between when we receive the submittal and when we would actually issue the combined operating license, that threat can evolve.

And so we wanted licensees to have the ability to take full advantage of the state of the art protections to address those threats. And that's why the staff position going forward is that licensees would subsequently submit a separate licensing document to address their cybersecurity program.

So I'd offer that, you know, in the context of addressing your question about the evolving nature, and do we have a means in place to address that.

FERC CHAIRMAN WELLINGHOFF: Marc, Ted, thank you.

If we could begin our next panel please, the third panel. Mr. Lauby from NERC, Mr. Dorman from NRC, and Mr. Binder from FERC.

Mark, do you want to kick it off?

MR. LAUBY: Thank you and good morning to the Chairman and Commissioners. My name is Mark Lauby. I'm the Vice President of Reliability Assessments and Performance Analysis at the North American Electric Reliability Corporation or NERC.

I think most people here know what NERC is, and so I thought I would just jump to Slide 4, and just mention that NERC's mission is to ensure the reliability of the bulk power system. We develop and enforce reliability standards, analyze system events and risks to reliability, and are accountable as the electric reliability organization to FERC here in the United States and the provincial governments in Canada.

Next slide, please. I wanted to chat real briefly about risk to reliability and how NERC looks at risk. It's beyond just the standards themselves, but also the frequency and severity of risks. And this has been kind of--well, I think they've actually jumped a slide on me, but that's okay. We're way over. We've got a different set here.

Okay. Yes. Well, I'm going to just chat about what I want to chat about.

(Laughter.)

MR. LAUBY: So we talk a little bit about severity of risk itself and the frequency of risk, and how we really, you know, look at beyond just the standards themselves but rather also, you know, things like, you know, clusters of risks around areas where we want to learn and reduce risk, and then areas around high impact low frequency, and that would be where we put geomagnetic disturbances, for example.

We focus on prioritizing those risks and define the problems and the metrics for success. We apply a disciplined approach to that, so that we can really measure where we are today and where we're going, and we want to avoid missteps such as making unknowingly mistakes on complex problems and making matters perhaps worse. So we want to tailor solutions whenever possible.

The geomagnetic disturbance itself, the way we approached this area was initially working with the Department of Energy. We developed a list of different types of high impact, low frequency risks such as pandemics and coordinated attacks. There was a workshop held here in Washington, along with geomagnetic disturbances and electromagnetic pulses.

We mobilized, you know, the industry itself, the executives of the Electricity Subsector Coordinating Council, NERC's board, to address certain key areas, and the geomagnetic disturbance area was one area that we focused on, and a task force was launched with industry experts in September of 2010. You know, we look at this particular risk as important to industry, and there's extraordinary uncertainty around it.

We issued a report, internal report, at the end of February of this year, and we had three key findings.

One of course was that the most likely impact from a severe geomagnetic disturbance would be an elevated risk to voltage instability or collapse. This is really a serious issue from NERC's perspective. You look at what happened in HydroQuebec. That was a voltage collapse;

portions of what happened in 2003 was a voltage collapse. This is a serious issue and something that we definitely want to dig into more deeply.

The second was that system operators and planners needed the analytical tools, and information-sharing, to understand the impacts and develop mitigation strategies.

The third conclusion was that some transformers may be damaged or experience reduced life, depending on design and current health.

So we then developed a plan forward. We had over 20 recommendations of action, and we've kind of laid them out over a time period. The first kind of near-term actions that industry can take is to identify facilities which perhaps are at risk from severe geomagnetic disturbances, and really want to see how we can assess those risks and mitigate them.

So conducting a wide area view by collecting the right kind of information from industry around their transformers and the transformer health, and assess those risks based on certain design parameters and age will be an important step; also, working with the planning authorities and planning coordinators to actually do some of the study work that's going to be needed here.

Also identifying spare equipment, exactly what transformers, for example, that we have and what, you know, what are their voltages and designs is also an important component. We've just recently launched the spare equipment database. Enhancing equipment specifications is going to be important as well. We're working with IEEE and IEC as a starting point, to ensure that we have the right kinds of information there being developed. And of course enhanced training.

From a mid-level perspective, also refining the probabilistic storms themselves: What does a 1-in-100 year storm look like? What's the wave front look like? Working with NASA and the Canadian science agency, we're going to be addressing that and a comprehensive set of tests for transformers themselves, so we understand what are the withstands capabilities there.

For a mid-term set of actions, increasing the number of locations and where we monitor geomagnetic-induced occurrence is important, and also bringing and centralizing that information so that we can do the research and development required, as well as enhancing the forecasting capabilities is an action item.

We also are working with industry to develop open-sourced analytical tools that then can be incorporated into many of the commercial tools that industry uses to simulate impacts is also important so that folks can then know how it works and incorporate, start incorporating it into their usual planning processes.

We are also working with the U.S. Geological Survey and Natural Resources of Canada to develop ground impedance maps, because the whole idea here is the currents follow Ohm's law, and in some places, the same storm will create no impacts and other places it could have impacts. So we need to understand was the resistivity of the soil is.

Long term we're working with NOAA to increase the granularity of forecasts. Right now we get information like it's going to be a K-9. That's a global number. It doesn't mean a lot from an action perspective. Obviously industry does take action, but sometimes then those actions are not required. So getting better and more informed information from forecasting will be important.

Then also then developing, you know, GMD as part of the normal planning process, perhaps in the planning standards, and this is kind of a mid- to long-term two to four years, is going to be very important. And then also looking at our spare equipment and getting a kind of a strategy as an industry, exactly what, you know, what kind of policy should be available, and finalize the IEEE and IEC standards.

For example, I know in Sweden they already specify transformers that have to have, I believe, 200 amps for ten minutes. That's a specification for Swedish transformers. They happen to be a certain variety of transformer.

Then finally, of course, from a regulatory perspective, you know, obviously a no-regrets' approach is really going to be needed here. It's an area that has great uncertainty, and we want to make sure first and foremost that we do no harm.

We believe that developing a plan of action which is what we've started to lay out here, and provide oversight of that plan, and ensure that progress reporting continues to happen to the regulators, so they know the progress of the activity is important, because this is something that will take some time and continue to engage global expertise.

We're not the only ones that experienced this. You know, the Norwegians, the Swedes, the United Kingdom, there are other countries as well, but certainly those are most advanced in reviewing and taking action on geomagnetic disturbances. You know, continuing to engage global expertise, I think, will be important to reaching across the pond, as they say.

Work with industry to introduce and adjust risk controls. I think regulators can help us with that, as well as, you know, so that we can address complex problems like this. There are others as well. And of course, then, continue to monitor and ensure that we refine solutions and get to a final no regret solution. So with that, I wanted to thank the Commissioners and the Chairman for their kind attention.

FERC CHAIRMAN WELLINGHOFF: Thank you, Mark. Dan?

MR. DORMAN: Thank you. In this portion of the presentation, I want to tee up two topics. One is our station blackout rulemaking in the context of our lessons from the Fukushima accident, and the second is our work in the area of geomagnetic disturbances and long-term coping for power.

If I could get my third, I think it's my third slide, lessons learned from Fukushima, there's a lot of topics on this slide. I'm not going to go into all of them. I put those up there to give the Commissioners the perspective of areas that the NRC staff is working to enhance the protection of nuclear power plants, in light of the accident at Fukushima.

But for this purpose, I'll focus your attention on the third and fourth sub-bullets, and I'll start with the fourth one, mitigating strategies for beyond design basis events. In response to the terrorist attacks of 9/11, the Commission required licensees to enhance capabilities to mitigate events that involved the loss of a large area of the plant due to fires and explosions.

In response to the event at Fukushima, we examined the availability and reliability of those systems at nuclear power plants, and found that those systems were generally sound and available, but they were designed to accommodate a localized impact on one unit at a multi-unit site. So we have required our licensees to procure additional equipment, and also to look at those from the standpoint of impacts on reactors and spent fuel pools on multiple units at one site as a result of a large-scale natural event such as we saw at Fukushima. So those orders were issued on March 12th of this year, and the licensees are in the process of implementing those.

In parallel, we've initiated -- we've issued an Advance Notice of Proposed Rulemaking with a number of questions. We had, the comment period is closed and our staff are evaluating the comments. In the Fukushima event, the operators made heroic efforts in the early hours of the event, scouring neighborhoods for car batteries and anything that they could cobble together to provide power to the plants, to provide cooling to the reactors.

The purpose of both our mitigating strategies and ultimately the station blackout rulemaking is that our operators would have the capability to provide the cooling using initially installed equipment at the plant to give them time to bring to bear the mitigating strategies, which would be pre-staged onsite, which would buy time to bring in industry resources from offsite to support sustained operation without reliance on external government resources--which one of the factors in Fukushima was the significant focus of the Japanese local and national governments was on other effects of the earthquake and tsunami that impacted them.

So briefly, those are the things that we have underway in that area.

If we can go to the next slide, please, in the area of geomagnetic effects NRC staff has been participating with other agencies in evaluating the effects of geomagnetic disturbances. We will be evaluating the NERC Task Force Report for any applicability of those recommendations to the nuclear power plants.

If I can go to the next slide, we have been looking at geomagnetic effects for many years. We have no specific regulatory requirements restricting plant operations during geomagnetic disturbances. But the NERC-mandated requirements provide assurance that the transmission system operators provide reliability off-site power sources for the nuclear power plants.

However, in the event of a loss of power in the vicinity of the nuclear plant, the existing agreements between the nuclear plant operators and the grid operators require a high priority for the restoration of the offsite power to the nuclear power plant.

Some plants do have procedures to reduce power output in the event of a solar storm warning of significant severity, and in the event of the loss of the transmission system, the nuclear power plants have redundant onsite emergency diesel generators to provide adequate power to assure core cooling.

The NRC has been looking at the potential significance of electromagnetic pulse to the critical infrastructure. We've reviewed the 2004 report of the Commission to assess the threat to the United States of electromagnetic pulse attack. And going back into the 70's, we undertook a research program to study the effects of a high altitude man-caused electromagnetic pulse on the safe shutdown systems at nuclear power plants.

We've continued that work over the years. The most recent report was issued in 2010, and continues to sustain the conclusion that the reactors can achieve safe shutdown following a man-made electromagnetic pulse event, or a solar or geomagnetically-induced current event of similar magnitude.

The actions that we're taking to address the station blackout rule will provide further capacity to ensure the ability to maintain the cooling of reactors and spent fuel pools in the event of a significant geomagnetic-induced event. That completes my presentation.

FERC CHAIRMAN WELLINGHOFF: Thank you, Dan. Regis.

MR. BINDER: Good morning, thank you. Good morning Chairman and Commissioners. My name is Regis Binder. I'm with the Office of Electric Reliability at FERC. This presentation is intended to give some insights into the complex subject of geomagnetic disturbances. I want to do so by discussing some areas on which there is general agreement, and to discuss some possibilities for moving forward.

In doing so, I'll mention some technical studies and a recent FERC staff technical conference on geomagnetic disturbances. Second slide, please. The disclaimer is that the content here does not necessarily represent the opinions of the Federal Energy Regulatory Commission or any individual Commissioners.

Geomagnetic disturbances: I want to leave you with a few impressions about geomagnetic disturbances that will help understand some of the issues I'm going to go into later in the presentation. There are three basic components of the geomagnetic disturbance. First, the sun creates a coronal mass ejection, which is a gust of ionized particles into space. Now those particles reach Earth sometimes, and when they do, they cause varying magnetic fields on the Earth's surface.

Now those magnetic fields induce voltages and cause a flow of DC-like current, which I'll call GIC for brevity, standing for geomagnetically-induced currents. Now some of the things I want to mention to you are that the CMEs, coronal mass ejections, are not always pointed at earth. Sometimes you hear about them in the news and they never really have a drastic effect on the earth. They may not actually be pointed towards the Earth.

They can have a wide range of energy, and depending on the energy, they can take different amounts of time to reach the Earth, typically two to three days to reach the Earth. Another aspect of them, of the CMEs that's important is the polarity, and that has a drastic effect on how much impact the event has on the Earth's magnetic fields.

Unfortunately, we don't really know the polarity of the CME until it almost reaches the Earth. So there's very little advance warning of the polarity. Also, it's important to remember that the grid has grown significantly, and therefore we have put more antennae up in the air to capture these magnetic fields, and to be influenced by them, and for the GIC to flow on.

There's about eight times as many extra high voltage lines or HV lines today as there were in 1960. So there's a lot more opportunity for the impact. In addition, there are huge improvements and capacity expansions that are expected on the transmission grid in the next 20-30 years.

Some of the threats from geomagnetic disturbances: They can create damage or actually destroy equipment, including large power transformers, generators, breakers if they try to uprate during the event, capacitors. They also cause an increased consumption by the transformers of reactive power or VARs. Ultimately, that can lead to system voltage instability and blackouts.

Also, the GIC when it's flowing through the transformers causes the creation of harmonics on the bulk power system, which you can think of as noise, in addition to the regular sinusoidal voltage and current shapes that are typically found on the bulk power system.

Now all of these effects are caused by the GIC or the induced currents, and they basically cause the transformers to operate in a mode and in a region of their design that they're not intended to.

Next slide, please. There have been some conflicting results in studies and reports recently. The Oak Ridge National Laboratory study predicted that well over 300 EHV transformers would be at risk for failure or permanent damage. The Oak Ridge study was published in 2010. The conclusion regarding the transformers at risk was calculated in the study that used a 1-in-100 year event. That's the strength of the storm.

The study was jointly funded by FERC, DOE and DHS, and there have been other reports, most notably by the Congressional EMP Commission, that have also warned about widespread transformer damage.

Another report that just came out in February of 2012 was the NERC interim report, which Mark has spoken of. The point I want to make here to compare to the Oak Ridge study is the NERC report indicated that the most likely worst case system impacts of the severe EMD event and the corresponding GIC flow was voltage instability.

Next slide, please. Mitigating steps: There are hardware solutions and operational solutions. On the hardware side, capacitors can be put in series with the transmission lines, and that actually blocks the GIC, because since the GIC is like DC current, to a DC current a capacitor is like an open circuit. So basically it stops the GIC from flowing.

However, you have to be very careful when you're installing capacitors on the bulk power system, because you have to be careful about the interaction with the rest of the system. You can get into resonance problems very quickly. So each installation needs to be looked at carefully.

Neutral devices: Devices can be put into the neutrals of the transformers to reduce or block the GIC from flowing in the transformers. The important thing here is to realize for resisters, you're not eliminating the GIC; you're just reducing it. But then that raises the question how much do you need to reduce it and how big of a storm do you need to size the resistor for?

It can increase the withstand capability, and Mark mentioned, I think it was in Sweden, that they do this. You can actually -- the transformer can be designed and built to withstand the GIC flow without significant damage, and there are operational solutions, such as reducing load and load-shedding, and increased reactive generation reserve.

These operating solutions are intended to protect equipment from damage, and to improve the grid's ability to survive a CME, but not necessarily to prevent the creation or the flow of the GIC.

Next slide, please. On April 30th, 2012, we held a GMD staff technical conference here in this very room. As you can see, we had a pretty diverse representation of speakers, including a representative from the NRC, which we were grateful for. Written comments were accepted through

May 21st, and we got a variety of comments from a variety of interested parties, and it significantly helped us to understand all the expert opinions that exist on the subjects.

Next slide, please. In general, what came out of that conference were some issues that there was pretty widespread, I'll say general agreement. By general, I mean unanimous or near-unanimous agreement. One is that there's definitely an opportunity to improve the knowledge about the GMD issues and the solutions, as urgent actions are taken.

Standards are necessary to protect the grid from GMDs, but when I say standards here, that could either be mandatory reliability standards or industry standards like IEEE standards. There's general agreement that grid collapse due to a CME was not acceptable, and significant effort is needed to prevent it.

And also there's agreement that GMD must be addressed regionally, because what one company does to mitigate GIC can influence its neighbors, and sometimes in a detrimental way. And of course, the last item is the vulnerable and critical assets should be examined and protected.

Next slide, please. At a general high level, the potential approaches for GMD are, number one, to encourage voluntary action by industry.

The second option is for industry to develop standards, and again, remember I'm talking about potentially industry standards in addition or perhaps including some reliability standards.

Or there to be a FERC order to develop reliability standards, or there can be some combination of any of those. That concludes my remarks and I look forward to taking questions.

FERC CHAIRMAN WELLINGHOFF: Regis, thank you very much. I have to admit, I didn't attend our staff technical conference on GMD and didn't have an opportunity to read the conclusions. So maybe I can get a quick synopsis here. Mark, could you reconcile for me the Oak Ridge study and the NERC study?

MR. LAUBY: Yes. In the NERC study, we brought together industry experts, you know, both industry stakeholders as well as vendors, manufacturers, and we reviewed the problem in quite a bit of detail. Really what it comes down to is that when the, you know, when you start getting the geomagnetic-induced currents, you have a volts per kilometer. It gets to some level, five volts, six volts, seven volts, and that induces the current.

What we find is the voltage collapse, which because transformers are absorbing so much reactive power when they saturate, you know when a transformer saturates it's like a towel. It has a certain amount of water in it and then after a while the water starts coming out. The magnetics start coming out. It starts absorbing a lot of reactive power, and that happens in a matter of seconds.

While with the thermal impacts, those happen in a longer time frame. And so that's why our view was initially, and in our interim report that voltage collapse is the most likely result, not damage to-- widespread damage to equipment.

Now we know, we recognize that other studies have come up with other results, but our study pretty much lays out what our view is.

FERC CHAIRMAN WELLINGHOFF: So why did Oak Ridge come out with a different result? What was different about Oak Ridge's that was distinct from yours? I haven't read either report and again, like I said, I didn't even go to the staff technical conference. Either you or Regis can tell me the --

MR. LAUBY: Our report looks at what the, how the system responds to transformers absorbing a great deal of reactive power, transformers emitting harmonics. We didn't just go to a certain level of geomagnetic-induced currents and say that at let's say 90 amps, transformers fail per phase. So once you put that piece into the puzzle, then you start seeing what the impacts are.

FERC CHAIRMAN WELLINGHOFF: So I guess the bottom line, is NERC recommending to us that we should protect these transformers or not?

MR. LAUBY: Well, NERC's recommending a plan that I laid out here to address this. Do a high level risk assessment of where the transformer fleet is today, because some transformers are vulnerable here, especially if their health is, you know, they're near the end of their life or there are certain kinds of designs.

In addition, you know, to actually do the study work on individual transformers in a regional way, and take a look at what the impacts are from voltage collapse, as well as for potential --

FERC CHAIRMAN WELLINGHOFF: Would that include assessing ground resistance near individual transformers as well?

MR. LAUBY: That's right.

FERC CHAIRMAN WELLINGHOFF: So in other words, some transformers should be protected and some may not need to be, depending upon how--.

MR. LAUBY: That's right. There's no single solution here. You're absolutely right.

FERC CHAIRMAN WELLINGHOFF: So how long does it take us to figure out which ones we protect and which ones we don't protect, I guess is the other question?

MR. LAUBY: Well, we think really --

FERC CHAIRMAN WELLINGHOFF: Will it take us a year or five years or ten years or what?

MR. LAUBY: Well, doing the study work as we designed--suggested here, assessing the risk, I think we're looking at between two to four years or two to five years.

FERC CHAIRMAN WELLINGHOFF: All right, thank you. Greg.

NRC CHAIRMAN JACZKO: Well, maybe following up a little bit on that issue of equipment damage, there's been an effort in the nuclear industry to see transformers as vital equipment, with long lead time for transformer replacements, to try and make an effort to ensure there's a sufficient supply of backups in the event of failures, whether it be from I guess there's some outstanding technical question of whether transformers themselves would be impacted by this type of event, but by other events.

So I mean from your sense, what is the impact if some of these transformers that are vulnerable are not protected, and you were to have a geomagnetic disturbance that would impact a large number of transformers? I mean how long are we talking to be able to get replacement transformers and be able to restore some of those systems? Anyone?

MR. LAUBY: Well, it's major "what if," and I think the spare equipment database is going to help us understand exactly where we stand. That's one of the reasons why we developed that system. Folks are starting to provide us the information, so we'll understand where we stand as far as the inventory goes.

NRC CHAIRMAN JACZKO: Do you think that there's, I mean just your guess right now, is there sufficient inventory?

MR. LAUBY: I couldn't hazard a guess. I don't have the information.

MR. BINDER: Chairman, if I might offer, it depends somewhat too on what type of transformer, for example, is damaged. If--thinking strictly of a nuclear station--if the grid has a problem, so one of the grid transformers is damaged, there's probably a higher probability that there would be a spare that could be inserted in place. If it's a generator step-up unit, they're much more specific and almost uniquely designed, you know, to the station. So that might be more of a problem.

NRC CHAIRMAN JACZKO: Thank you. Thanks.

FERC CHAIRMAN WELLINGHOFF: Thank you, Greg. Kristine.

NRC COMMISSIONER SVINICKI: My thanks to each of you for your presentations. I will confess that this is a topic on which I was not as well-read, and as a function of having this on our agenda today and the reports and studies that you cited, I have significantly expanded my background reading on this particular topic. So I had a very basic question.

In terms of the phenomena of the coronal mass ejections, and I think there was in some of the studies the term "space weather" and a state of knowledge or detection and measurement of that, so advance warning of what direction these are headed in coming to the Earth, what is the state of knowledge there? Is it something that we have a good sense of the frequency? And again I ask this because, post-Fukushima, NRC is of course looking more closely at these low probability, high consequence events.

And as I read about this particular phenomena, it occurred to me that this is another one of those. Maybe lower probability, but potentially very high consequence events. Is there a good sense of, you know, 1 in a 100 years' storm of a certain severity? What is the state of our knowledge and prediction capability?

MR. LAUBY: That's a very good question and, you know, we're working with NASA who monitors this kind of thing, to develop what are the wave fronts and what are, you know, what are the 1-in-100 year. What you find here is that it depends on where you are what a 1-in-100 year is as well as, for that matter, your geology.

So there's a geomagnetic latitude here, not exactly the same as latitude. So the further north you get, what the severity and the peak condition and the -- not so much the duration but the peak will be different than if you are let's say in Florida. So what we're trying to develop is a series of wave fronts, so that we understand, for example, what a 1-in-100 year might look like in Pennsylvania, compared to let's say in Florida.

Second of all, what's the worse case? Now based on the statistics we have so far, you know, NASA is, you know, pretty confident they can come up with a 1-in-100 year. It gets a little bit messier when you get to 1-in-1,000 and a 1-in-1,000,000. So the idea is to get that 1-in-100 and then get the worse case potential, based on our probabilities and statistics, and use that as a way to kind of develop a sensitivity.

MR. BINDER: Commissioner, let me just add a couple of things. There is, I guess what I'd call perhaps a weak spot in determining the storm that's going to actually hit the Earth, and that is the satellite that's used to determine the polarity that I mentioned, which gives us minutes of warning, that's beyond its useful life, design life right now.

Now there is a replacement that's expected to be launched, I think it was in 2014. But even then, it will still be a single satellite up there. It's not duplicate satellite to measure --

NRC COMMISSIONER SVINICKI: Well and let me guess, budget cuts, right?

MR. BINDER: Well, I think perhaps that has influenced why it hasn't been launched yet. But even with the existing or the anticipated cuts, they expect it to be launched in 2014. But you know, Mark was absolutely correct in mentioning that there's different impacts, depending on locations. The latitude is a big impact and earth connectivity has a big impact.

But it's such a dynamic -- storms are such, these storms are such a dynamic event. Minute to minute the strength is changing, the location is changing, and it's actually the rate of change of the magnetic fields that causes the current.

If the storm just came and stayed at a constant level and didn't change, there actually wouldn't be any induced currents. So it's actually the dynamic flowing of the magnetic field that causes the problems.

NRC COMMISSIONER SVINICKI: Thank you.

FERC CHAIRMAN WELLINGHOFF: Thank you. Cheryl.

FERC COMMISSIONER LaFLEUR: Well thank you all. Reliability and grid security has been one of my top priorities, and I've been involved in this issue, and I really appreciate the Chairman giving it the visibility of putting it on the agenda, and I thought your presentations were very thoughtful. And we're weighing right now, you know, what the right balance is between continuing to do more analysis and getting started on some solutions, particularly with new infrastructure to get it built right.

I think Regis had the chart where we're looking, you said it's a jumping off point to a question. We're looking at different options, including mandating a standard versus letting these things perc up, and let industry work with transition manufacturers, transformer manufacturers on their own, et cetera.

I don't think I've been to a NERC or a reliability meeting in the last two years, but that someone hasn't mentioned the INPO model, and what the nuclear industry has done together to improve nuclear safety over the last 20 or 25 years, as a model for reliability development.

Yet it's obvious, just from this morning, that that's within -- and from my past, that's within the context of a very mandated command and control NRC requirement environment. So it's, you know, both the requirements and the industry involvement. And I'm very interested from Mr. Dorman or our fellow Commissioners, how, you know, what the relationship is between the voluntary work of the industry in developing standards in nuclear, and then the work of the Commission, and if there are things we can learn from.

MR. DORMAN: I think you made a very important point on the complementary relationship, and NRC and INPO obviously have very different focuses and missions in terms of our charter is adequate protection of public health and safety. So we're setting a minimum bar and ensuring that all of our licensees meet that bar.

INPO developed out of the Three Mile Island experience, and said we, the industry, need to set a higher bar for ourselves. We need to set an excellence standard and hold each other accountable to achieve that standard, because the unacceptable performance of one has such an impact on everybody. I think Chairman Wellinghoff noted the experience in Japan, where one site had an accident and all of the plants are down right now.

And so that was an industry-driven by almost a mutual survivability. We need to hold ourselves to a high standard. But I think that is a model that we hold out to our counterparts in other countries, as well as to other industries, as an effective model.

FERC COMMISSIONER LaFLEUR: Thank you.

FERC CHAIRMAN WELLINGHOFF: Yes.

NRC COMMISSIONER MAGWOOD: Thank you. Thank you for your presentations today. I wanted to, and this is actually somewhat of a follow-up on Commissioner Svinicki's line of questioning. But your Slide 5, you mentioned the NERC interim report made reference to a worst case system impact from a severe GMD event. What--can you describe that event for us? I mean what kind of geomagnetic disturbance was this? Was the 100-year storm that we've been talking about, or was this something more severe?

MR. BINDER: Subject to check by Mark who had a lot to do with the report, my understanding was that it was based on not necessarily the strength of the storm, but a certain voltage per kilometer that would be induced in the earth. I believe it was 20 volts per kilometer.

MR. LAUBY: It can go upwards to a total of 20. People allege that it can go upwards to 20, though we find that in most cases if you get to the voltages of six to eight volts per kilometer, that that induces enough current in the transformers that they'll probably saturate and start absorbing reactive power, and then you'll have a voltage collapse.

So it was based on some studies especially done in Canada, in Quebec and Ontario, because they're actively doing this now, putting operating procedures in place now.

NRC COMMISSIONER MAGWOOD: And that was considered to be a worst case scenario?

MR. LAUBY: Well, you know, we haven't gotten all the information yet from NASA exactly what their view is of the worst case. There are people that have chatted about potential worst case scenarios, based on morphology and other scientific calculations. But we're waiting to hear from NASA statistically what's the worst case.

But realize that once you've gotten the voltage collapse, which is not an acceptable result--again, NERC's all about not having any uncontrolled cascading the bulk power system--but then those transformers are no longer at risk. So we need to really look at what is the worst case once we get the, you know, the statistical information from NASA and Space Canada.

NRC COMMISSIONER MAGWOOD: Let me sort of -- this is sort of Dan for you, both maybe a question and a comment. You know, in looking at the post-Fukushima environment, and I think the Fukushima earthquake, as I recall, was something like a once in 10,000 year event, something on that order as I recall, and we've looked at seismic events recently, some VAR studies that were once in 60,000 years, and I can't help but wonder if there's a once-in-60,000 year GMD that is just, it's kind of a game-changing event? And I'm wonder if that's something that since we're looking at the once-in-60,000 year earthquakes, why aren't we looking at once-in-60,000 year GMDs? And I'll just pass it and see if you have a comment on that.

MR. DORMAN: I think the challenge is we have a lot of data in paleoseismic research that gives us insights of what's happened in the earth over tens of thousands of years. Historically, we've licensed nuclear power plants based on hundred year floods, 500-year floods. We're now looking in probable maximums, we're talking probable maximum floods and we look more at the hydrology of what could happen, and the capacity of the system to absorb water and the availability of water to the system.

As we go beyond the seismic and flooding that we're currently working on with the industry, and look at the mandate that we have to look at other external hazards, as we get out into some of those other hazards, defining those probabilistically, going out into more of the tails of the curve, if you will, becomes more challenging in terms of the confidence in data that's available.

I think this is probably one of those cases where if you go back into the 1800's and look at some of the GMD events and the impacts on the telegraph system, is kind of some of the earliest data that we have on GMD. So the kind of paleohistorical data is going to be more challenging to define. Where is the tail of the curve?

So if we're talking six to eight, but we see the possibility of 20, assigning where is that 20, is that 1-in-

1,000 years? 10,000 years? 100,000 years? That I'm not sure we have the information to define that.

NRC COMMISSIONER MAGWOOD: Yeah, I appreciate that. I wonder, and this is a closing comment, I wonder if doing a worst case assessment of the plant systems, to see if there's something there that we just simply hadn't looked at before, a triggering event that would lead to an initiating core damage is probably something we should look at, because again as Commissioner Svinicki has indicated, this isn't something we've looked at much in our world, but maybe we should.

MR. DORMAN: One other note I would make on that is the several decades of research that we have in this area has been focused on the operability of the installed safety systems. As we go forward with the station blackout rulemaking and the implementation of the mitigation of strategies orders, those stand-alone pre-staged equipment, I would expect, would also be even less vulnerable to this kind of effect.

So we are in the process of instituting, from the safety of the nuclear plant perspective, further enhanced capabilities that I think will give us confidence in this area as well.

NRC COMMISSIONER MAGWOOD: Thank you very much. Thank you.

FERC CHAIRMAN WELLINGHOFF: Thank you. Questions? We're out of questions. Thank you.

I thank the panelists. Appreciate it. That ends our panels, which for me were very informative this morning. I'm really very glad we did this. Great topics, great panelists. I want to thank all the panelists for all the information that you provided us this morning. I don't have any formal closing remarks. Greg, do you have any?

NRC CHAIRMAN JACZKO: Well no. I would just thank you again for hosting us, and I thank everyone for the presentations. I think it was a very interesting presentation, and I think it highlights the interdependencies that we have. So much of what we do impacts what you all do, and so much of what you all do impacts what we do.

So I think, as I said at the beginning, these I think discussions are a good way to share information, and make sure we're all working together.

FERC CHAIRMAN WELLINGHOFF: I agree, and it is one whole system. So we have to look at each component part and how it's into the system, and hopefully make it work as efficiently as possible. Anybody else have any closing comments? Colleagues, anyone?

(No response.)

FERC CHAIRMAN WELLINGHOFF: If not, this meeting is adjourned.

(Whereupon, at 11:51 a.m., Friday, June 15, 2012, the Joint Meeting of the Federal Energy Regulatory Commission Commissioners and the Nuclear Regulatory Commission Commissioner was adjourned.)