FEDERAL ENERGY REGULATORY COMMISSION

JOINT MEETING OF THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) AND THE NUCLEAR REGULATORY COMMISSION (NRC)
(Public Session)

Washington, D.C.

October 21, 2015 9:00 am

9:00 a.m.

888 First Street Northeast

Washington, DC 20426

Participants

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Chairman Norman C. Bay
Commissioner Philip D. Moeller
Commissioner Cheryl A. LaFleur
Commissioner Tony Clark
Commissioner Colette D. Honorable

NRC Chairman and Commissioners:
Chairman Stephen G. Burns
Commissioner Kristine L. Svinicki
Commissioner William C. Ostendorff
Commissioner Jeff Baran

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(NERC) Staff:

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P R O C E E D I N G S

CHAIRMAN BAY: As is typical with our FERC meetings, if we could recite the pledge of Allegiance.

(Pledge of Allegiance.)

CHAIRMAN BAY: Let me begin by welcoming Chairman Burns and the Commissioners from the Nuclear Regulatory Commission to FERC and let me also welcome the NRC Staff to FERC. This is the eighth joint meeting between the NRC and FERC.

Today's meeting like the others in the past provides a very helpful opportunity for us to discuss issues of mutual interest to both the NRC and to FERC.

I very much look forward to the discussion today, and in particular, I want to thank Staff at the NRC and at FERC for their hard work in putting together this conference.

Thank you very much, Staff.

Let me now ask Chairman Burns if he has any comments or opening remarks.

CHAIRMAN BURNS (NRC): Thank you, Chairman Bay for hosting today's joint meeting of the NRC and the Federal Energy Regulatory Commission here at your offices.

This is my first time I have been here in this capacity. As Chairman, I attended some earlier sessions

and I was speaking with you and Commissioner LaFleur before as General Counsel.

I want to recognize the significant effort that both the FERC Staff and the NCR Staff have put into preparing for today's meetings and these discussions.

I am also pleased to note that our two staffs have recently worked together to update our memorandum of agreement that outlines matters of mutual interest related to the electric power and grid reliability and nuclear power safety and security.

I greatly appreciate the cooperative relationship our two agencies have had over the years and I look forward to today's presentations and discussions.

Thank you.

CHAIRMAN BAY: Thank you Chairman Burns. Would any of my colleagues at FERC like to make any opening remarks.

COMMISSIONER MOELLER: Briefly let me welcome the NRC and their staff. The most beneficial part of these meetings is, of course, it is good for us to talk to each other, but it is even more important that our staffs get to know each other in setting these meetings up and then the follow through that comes from it so we can enhance our working relationships.

Thank you to everyone who put in the effort to make this meeting happen.

CHAIRMAN BAY: Thank you, Phil. Cheryl?

COMMISSIONER LaFLEUR: Thank you, Norman, I would also like to welcome everyone. This is my third such meeting and I find they are always interesting and productive.

The nation's current nuclear fleet and prospective is a critical component of the reliability of the electric infrastructure that we regulate very much in the news lately because of some of the challenges and also its potential to contribute to the Clean Power Plan, so it is great to spend a morning just focused on that.

Also we have so much in common with the NRC because of our complementary responsibility for security issues of the parts of the grid that we each regulate.

I'm happy that this morning's agenda is devoted in large measure to those issues. Thank you.

CHAIRMAN BAY: Tony?

COMMISSIONER CLARK: Good morning and welcome to my second and I am happy to have this opportunity.

This has actually been on my mind for a while, the last few days. I am giving a speech to an energy conference tomorrow and a good part of it is going to be

about price formation and what is happening in the markets and I have been planning for some time to be talking about nuclear units and some of the challenges they are facing.

It is interesting to me that we have a number that are under construction that are squarely within NRC's court and we have a number of others that are either recently announced or are in some significant stress in terms of the market side of things that are perhaps a little bit more in FERC's court.

There is a lot to talk about and it is good to have this opportunity.

CHAIRMAN BAY: Thank you, Tony. Colette.

COMMISSIONER HONORABLE: Thank you, Mr. Chairman. To Chairman Burns, Commissioners, NRC Staff, welcome to FERC. This is my first joint meeting and I am delighted and look forward to our dialogue today.

I agree with Cheryl. We have so much in common. Nuclear is gaining prominence particularly with regard to the implementation of the Clear Power Plan course as it should, with regard to our continuing work on reliability, resilience, and also at one point I would like to mention the role that nuclear plays in our energy markets, so I do look forward to our continued work and work going forward, and I am too very pleased

that we were able to complete current MOU. Thank you.

CHAIRMAN BAY: Thank you, Colette. Would any of our colleagues from the Nuclear Regulatory Commission like to make any opening remarks? Yes, Commissioner Svinicki.

COMMISSIONER SVINICKI: Thank you Chairman Bay, and again, I thank my FERC colleagues and all of the FERC Staff for yet another warm welcome here.

As others have observed, I have participated in multiple of these joint commission meetings.

I share the observation of Commissioner Moeller that this only cements the close working relationship between our staffs and I saw some of that happening even before we called to order this morning the introductions and things. That is not a key part of our purpose in addition to shining a public spotlight, of course, on our staff's hard work throughout the course of the year.

Although, I have been to a multiple of these meetings, this is likely the last time I will look across to my FERC colleagues and see Commissioner Moeller here on this Commission.

I read some very interesting article in Green Wire that talked about a number of aspects of your public service here at FERC that I was not acquainted

with, things about "Moeller Vortex" and other strong holiday punches, and things like that, but for a moment I thought our Commission may not be cool enough to be hanging out with the FERC Commission as we are kind of a boring group of individuals, but on a more serious note, Phil, you and I have been colleagues now for it is close to eighteen years that we have worked together on various energy issues.

These are tough jobs and so I really commend you for your long public service here on your work also as a Senate staff person where we first met.

When we think about public servants we think about those role models that have always conducted themselves with such professionalism and integrity and commitment and you are one of those role models.

Thank you for your public service and I wish you and your lovely family every continued success. Thank you.

CHAIRMAN BAY: Thank you, Commissioner Svinicki. I must say that we certainly echo your remarks regarding Phil.

Commissioner Ostendorff.

COMMISSIONER OSTENDORFF(NRC): Thank you, Chairman Bay. I appreciative the chance to be here. This will be my third meeting and I think this relationship

between the NRC and FERC is really important.

It is an example of good government that we work together, especially at the Staff level as the Chairman commented.

I also echo Kristine's comments, Phil, so thanks for your service and best wishes for the future. Thank you for having us here today.

CHAIRMAN BAY: Thank you. Commissioner Baran.

COMMISSIONER BARAN (NRC): Thank you for having us. It is good to be here for my first joint meeting.

I see a lot of friendly familiar faces in the audience, so it is good to be here.

CHAIRMAN BAY: Thank you, Commissioner Baran. Let's begin now with our panel. I would like to thank all of them for participating in today's conference and we will begin with Mark Lauby from NERC. Thank you very much Mark, for being here today.

MR. LAUBY: Thank you, Mr. Chairman and Commissioners. It certainly is a pleasure to be here today.

I'm slotted to chat a little bit about the state of reliability which is actually documented in an annual report that NERC puts together. It is based on a lot of information that we gather on performance of the

bulk power system.

If we could tee up the slides here. From a high level, just to get an ideal what some of the findings we had in this particular state of reliability where a report was looked at.

Basically even though it is dated 2015 this is looking at the data from 2014 and before that time and doing kind of averaging and comparisons excluding whether the bulk power system remains within the adequate level of reliability objectives, and of course, that's actually defined, there is an informational filing with FERC and also called for in the 215 law as to what adequate level of reliability is, there is no load lost due to cyber or physical security events.

There was an average transmission out of various specifying finding, that is to say, when your transmission outages that the loss load, the potential impact on load is reduced over time.

There is also stable frequency response which is an important aspect and an area of study.

Of course, we also see it in continued reduction in the use of energy and emergency alerts, a Level III, which actually means that we are on the cusp of potentially losing load. That is the overall on the performance.

Now we get into the fun stuff with statistics and I apologize, if I get a little bit too much into the weeds, I will try not to, but here you will see a severity risk index that NERC develops where they look at weight and load, generation, and lines that are lost during events.

Then we look especially around that corner near the curb to see what kinds of events we are seeing there and it is really days of years, a day in a given year, and accumulating those going to a logarithmic scale and you will see that in 2014 we had a number of events most of them related to weather and the weather continues to stress the system.

We had a polar vortex, actually two events like that, and thunderstorms that were severe in July in certain parts of the United States. Then, of course, some winter storms, but overall, we found the system is performing pretty much where we expected to be.

Then to get an idea. This again is another statistical assessment, but it looks at a faded color, that's where we were at in our 2014 report which was looking at 2013 and before and now you see where we land now.

To the right-hand side the red circles those are really areas that we are mostly concerned about

where we see a correlation between the types of events of types of causes of events and potential severity.

You look at basically relay misoperations, failed AC substation equipment, and power system conditions, and for those who don't know power system conditions and things like out of step overloads, voltage issues, stability.

Those areas where we see a positive correlation in areas that we focus our attention on we look at areas to potentially improve.

But we do see a significant decrease in actual forced transmission outages or what some people call unplanned. We used to call them forced outages and load loss. So you can see how that certainly seems be dropping between 2012 and 2014 on average.

The frequency response remains stable in all four interconnections.

For those who do not know what an interconnection is, it is really what I call where the heartbeat is all the same, the 60 Hz is all lined up with each other.

You have the West Interconnection, and the Texas Interconnection, the Easterner Interconnection and the Québec Interconnection and each one of those within statistical range remains stable, the frequency

responses, at least stable and not declining, and we like to see some kind of an increase a little bit over time.

I did mention that we are starting now for the first time collecting information about critical infrastructure and again this is performance of the systems or gathering information and we saw that there were three reportable cyber incidences in 2014, but then no loss of load.

Of course, when it comes to physical security we had 47 reports of physical security threats and nine that caused physical damage or destruction of equipment, but none that led to loss of load. The emergency alert, you will see that that seems to be declining.

NERC overall events is very sensitive to particular specific areas and you will see like this big bump in the middle, that's the Acadia and for those people who have been around long enough the Acadia load pocket where we add some additional transmission the industry added more transmission so that that particular system settled down and for a while there they were having to shed load potentially because they could not get enough power into the pocket.

What happened there with load growth happened much quicker than expected and they may have been

related a little bit to Katrina in resettlement.

With that, I will take questions you might have and appreciate your attention.

CHAIRMAN BAY: Thank you, Mark. Chairman Burns, would you like to ask Mark any questions?

CHAIRMAN BURNS (NRC): Just one or two. What do you credit or is there something to credit for the improved performance you just talked about in terms of reduced reduction and forced outages, transmission outages, or the like?

MR. LAUBY: That is a good question. Sometimes you have to be careful that you don't speculate, but overall the environment has changed dramatically in the industry.

You have the Federal Energy Regulatory Commission, FERC, and NERC, working together in the industry developing standards for reliability. They are following those standards for reliability and also as the organizations to put a spotlight in certain areas.

For example, where we are spotlighting misoperations and relays right now or failed AC equipment.

The industry works hard on those particular items in trying to get their arms around it.

It provides a good report as well as ongoing

work on standards. It has provided a good foundation to focus on specific areas.

Another area that we worked I think very successfully on has been in trees and trees and lines and also the undergrowth as well as the underbuild on transmission lines, again, I think has been a success story.

Then a classic example of working together with FERC and NERC in the industry has been the breaker alert that we put out where we found a particular type of breaker that had a failure mechanism, but is something you probably do at NRC quite often as well.

We put a spotlight on it and the industry saw what changes had to be made to that breaker and overall enhanced reliability.

There are a number of different tools in our toolkit that we work through with standards, with webinars, with alerts, and that has really helped.

CHAIRMAN BAY: Thank you, Chairman Burns. Commissioner Svinicki? Anyone else on the Nuclear Regulatory Commission? Yes, Commissioner Ostendorff?

COMMISSIONER OSTENDORFF(NRC): On your Slide 7 with respect to the report on cyber security incidents.

Do you say anything about trends in the area year-to-year?

MR. LAUBY: We were just gathering that information last year. Just be aware, of course, that NERC has been working with a number of industry organizations and government and FERC, it has a number of areas we are working in.

One, for example, is our critical infrastructure protection standards both in the cyber area and now recently based on the FERC order, physical security.

There has been a lot of focus of the industry in that area. There is the Electricity Subsector Coordinating Council which reaches out to DHS and other organizations and continues to monitor through the EI SAC, they changed the name recently, the Electricity ISAC monitors the types of events that are ongoing and shares information, provides a much more comprehensive product.

There are multiple areas we are looking in this area in going forward and we are starting to gather information so see what the trends look like.

COMMISSIONER OSTENDORFF(NRC): Thank you.

CHAIRMAN BAY: Thank you, Commissioner Ostendorff. Commissioner Baran?

COMMISSIONER BARAN (NRC): Following up on Commissioner Ostendorff's questions. What is the

threshold for a cyber security incident being reportable, at least in a public setting? What can you tell about the nature of the three reportable cyber incidents?

MR. LAUBY: We use a particular form that is submitted to the Department of Energy called OE417, as well as we have our own form which is called EOP4 which is Emergency Operations, emergency operations.

When industry hits certain thresholds, a certain load shed or certain impacts that are prescribed in those forms then they submit those forms to us.

CHAIRMAN BAY: Thank you. Commissioner Baran.

COMMISSIONER BARAN (NRC): I only have one or two questions, Mark. One is: Do you have any particular reliability issues associated with nuclear units?

MR. LAUBY: The only one that I can think of, and of course, we gather statistics on generation availability and we work with a number of nuclear utilities.

My major concern is looking forward. As we see clients who, for example, are having problems staying in the market because of the costs of energy and looking at early retirements it has been our concern looking forward as we start seeing how we make up that energy.

For example, with Wisconsin, it was the Kiwani Plant. I think recently there was an announcement of an older plant in the Northeast and I am trying to remember the name.

I want to say it is Pilgrim.

Thank you.

As you start seeing those 800 MW and 900 MW coming off, what aer we replacing them with? Is it going to be gas? Will it be renewables? Will it be energy efficiency so we can continue to have the kind of reserve margins that need.

But as far as ongoing performance side I do not have any concerns.

CHAIRMAN BAY: Just one other question. Is NERC working on any initiatives to address beyond design basis scenarios that could be similar to what the NRC is doing?

MR. LAUBY: Thank you. I appreciate that question, Chairman Bay.

Our work in this area started in 2010, I would say, as far as when NERC became the ERO and we actually had a conference nearby here with the Department of Energy and FERC on what we call high-impact low-frequency events, that was the proceedings of that effort that was actually published in 2010 and

identified three areas to focus our attention on.

One was on the severe impact looking at restoration and recovery, and I would say that that particular thread has continued on, not only in our standards, but then working recently with FERC staff where we have gone out and did a bit of sampling to see how strong their restoration recovery efforts are from extreme events.

A secondary is in looking at spare equipment. Exactly what kind of spare equipment is needed? How do we set the platform for people to share transformers or breakers as a result of severe events and transporting them?

You cannot throw a transformer in the back of your pickup then drive it over unfortunately. It is a big fragile piece of equipment.

Then finally the third area was geomagnetic disturbances, GMD, which has resulted now in a standard where FERC has asked NERC to put together a standard after we did some study work on it, actually two standards where one is operational and the second is in planning.

We continue also looking at severe events that have table top exercises.

For example, the Grid-X that will be coming up

here in another month or so where we actually try to experiment with different types of events where they have a set of scenarios, how do you react on situational awareness information shared.

We work together with industry as well as with FERC and other organizations to do those table top assessments.

CHAIRMAN BAY: Good to hear, thank you, Mark. Colleagues?

COMMISSIONER LaFLEUR: Thank you, Mark, that was excellent. Let me pick up on Chairman Bay's question and focus on a slightly related part of NERC's work.

I know you are doing a lot of work to anticipate changes in the generation mix and how that's going to effect your work especially on Essential Reliability Services which seems to me to be quite relevant to the nuclear baseload.

Could you talk a little bit about that and now it might relate to nuclear?

MR. LAUBY: That is a good question because, again, as I mentioned before, our concern is, of course, as we start going through this unprecedented change in resource mix that you are talking about Commissioner LaFleur.

You also need to start being concerned with

what are you going to replace it with and also where is it going to be?

For example, as we start looking at replacing coal units with gas, maybe nuclear units that perhaps cannot necessarily compete because of the costs, they are replaced with gas or e already replaced them with renewable energy, solar, where is it located?

What jurisdiction is there going to be if you have a lot more renewable energy and it is on the distribution system? How do you balance that when in fact many times operators do not even have visibility into those resources.

We certainly will be continuing to review the impacts of the Clean Power Plan especially because that accelerates this transition.

This transition happens even faster and. What will be the results? What are the potential considerations?

We have two reports that are looking at going forward.

First of all, working the states, the do's and don'ts, you might say that a state can consider when they are developing their energy plan and that will be coming around the first part of January.

Then we are also going to be looking at "kind

of business as usual" and in various scenarios around maybe the Federal Plan and then maybe a high renewable case, cheap gas case.

As engineers we kind of build the system by stressing it, right, so we try to look at different guardrails and potential stress points.

As you look at the grid, the most important thing is that it must remain reliable. I know you are committed to that and the industry is committed to that.

But this is the Christmas tree that we hang all of these other technologies off of, be it a smart grid, microgrids, distributed generation, that grid still needs to remain reliable.

How do we make sure that we continue to do that?

The standards help us do that.

Do we need to make some different changes there?

COMMISSIONER LaFLEUR: Thank you. I know you are focused on some of the things that the previous lost generation contributed to the grid that we are going to have to replace as we get the new units like the Blackstar, Spinning, the voltage regulation and all.

Are there particular things that nuclear is critical to?

MR. LAUBY: There are a couple of areas. One is certainly when you look at baseload.

Baseload, the lowest, there is 24/7. That's one thing that nuclear is really good because it runs and it stays flat out and you can always address that baseload.

But when that goes away, what are you going to replace it with? Will it be gas plants which, of course, are not usually accustomed be baseload and what kind of impacts are they going to be on the forced outage rates, for example, of those kinds of plants?

Certainly baseload.

The others, of course, very helpful with full support.

Frequency response is less so because nuclear plants generally they like to stay kind of flat out. They can make some adjustments for frequency response with nuclear plants, but certainly from essential reliability services the voltage support and baseload.

COMMISSIONER LaFLEUR: Thank you.

CHAIRMAN BAY: Thank you, Cheryl. Phil? Tony? Colette?

COMMISSIONER HONORABLE: Thank you, Mark, thank you for the presentation.

You really succinctly highlighted as being

real progress. It is an important time here to pause looking at Slides 4 and 5 to acknowledge the work occurring in the energy sector as we see a decline in both transmission outage severity and enforced transmission outages.

You took me back a few years when you mentioned the Acadia Load Pocket and you referenced the transmission projects there.

Have they been completed?

MR. LAUBY: Yes, as far as I am aware they have been completed and that is why we don't see the EEAs as often. They actually had to accelerate the construction.

COMMISSIONER HONORABLE: Excellent and whoever worked on that, thank you, because we have seen issues there for sometime. Thank you, Mark.

MR. LAUBY: Thank you.

CHAIRMAN BAY: Thank you, Colette. Now we will turn to our next panelist who is Kal Ayoub from the Office of Electrical Reliability at FERC.

MR. AYOUB: Good morning and thank you. Good morning Chairman Bay, Chairman Burns and Commissioners.

My name is Kal Ayoub and I am the Deputy Director of the Division of Reliability Standards and Security in the Office of Electric Reliability.

The Division's role within OER is still to monitor the NERC reliability standards development process and advise the Commission on reliability standards proposed to the Commission.

In particular, division staff refused each proposed reliability standard and makes recommendations as to whether the Commission should approve or remand it or whether the Commission should direct NERC as a certified electric reliability organization to develop a new standard to address a specific reliability concern or modify an existing standard.

In May 2013 the Commission issued FERC Order Number 779 which directed NERC to develop and submit for approval proposed reliability standards that address the impacts of geomagnetic disturbances under reliable operation of the bulk power system.

The Commission directed NERC to implement the directive in two stages.

In response to Stage I directive from Order Number 779, NERC developed reliability standard EOP-010-1 titled Geomagnetic Disturbance Operations which requires entities to develop, maintain, and implement the GMD operating plan to coordinate GMD operating procedures.

The Commission approved EOP–010-1 in June

2014.

In response to Stage II directive from Order Number 779, NERC developed Reliability Standard TPL-007-1 titled Transmission System Plant Performance During Geomagnetic Disturbances which requires entities to perform GMD vulnerability assessments using studies based upon AC system models and geomagnetically induced current system models.

Entities with systems which do not meet the performance requirements of the standard must develop corrective action plans.

In addition, entities with transformers identified as vulnerable by the standard are required to conduct thermal assessments of those transformers.

All studies and assessments must be based on the NERC benchmark GMD event defined in the standard.

The NERC benchmark GMD Event is a function of local geomagnetic latitude scaling factor and local earth conductivity scaling factor multiplied by 8 volts per kilometer.

The 8 volts per kilometer portion is based on the statistical study of image magnetometer data from 1993 to 2013 with spatial averaging over 500 km^2 to estimate a one in 100 year geoelectric field amplitude.

On May 14, 2015 the Commission issued a notice

of proposed rulemaking proposing to approve TPL-007-1.

The Commission also asked for comments on some proposed modifications as follows.

Modify the benchmark GMD event definition set forth in Attachment One of the reliability standard so that the reference peak geoelectric field amplitude component of the definition is not based solely on spatially averaged data.

To develop revisions to the proposed reliability standard the required installation of monitoring equipment that is due magnetically induced current monitors and magnetometers to the extent that there are any gaps in the existing monitoring and magnetometer network to ensure a more complete set of planning and operational needs.

Develop revisions to the proposed reliability standard to establish specific deadlines for the development of corrective action plans and the completion of activities called for in those corrective action plans.

In addition to the three proposed directives, the NOPR proposes to direct NERC to study and submit informational filings addressing areas including spatial averaging, earth conductivity models, and how they work from geomagnetically induced current monitors and

magnetometers can be made available to researchers.

In the first proposed informational filing which would be due six months following the effective date of the final rule in this proceeding NERC would submit a work plan that includes a schedule for conducting the directed research and for submitting one or more informational filing that will apprise the Commission of the results of the four additional study areas as well as any other relevant developments in GMD research.

In the submissions NERC would also assess whether the second stage GMB reliability standards remain valid in light of new information or whether revisions are appropriate.

This concludes my presentation and I'm happy to take any questions you may have.

CHAIRMAN BAY: Thank you, Kal. We will turn next to Arnie Quinn who is the director of the Office of Energy Policy and Innovation before turning to questions that the members of the NRC or of members FERC might have.

MR. QUINN: Good morning, Chairman Bay, Chairman Burns, Commissioners, I'm here today to provide an update on the market factors influencing nuclear power economics.

The first part of my presentation is pretty similar to the presentation I provided at the last meeting providing some background and context and the latter portion will be an update of some of the revenue and numbers we have seen along with some recent developments that we think will be interesting.

Just as background. U.S. energy markets are regulated both by state and federal regulators.

FERC sets rates for wholesale and interstate service. States set rates for retail.

More than a decade ago some states restructured their jurisdictional utilities to require divestiture of generation from transmission assets.

As a result nuclear power plants operate under a number of market and regulatory schemes.

Some nuclear power plants have traditional cost of service regulation, whereas, others operate subject to competition and market outcomes.

Plants in states that have not restructured and remain part of a vertically integrated utility suite of resources are dependent on state regulatory decisions rather than market prices for cost recovery.

As long as retail rates are developed to allow plants to recover their ongoing costs a plant will remain commercially viable.

To the extent that a vertically integrated utility operates in the region where a system operator operates a wholesale market the utility may receive market revenues for supplying electricity which are typically then offset against that resource's revenue requirement.

Plants in states under one restructuring, sometimes referred to as merchants plants, must rely on market revenues to recover costs.

These market revenues come from transacting in markets administered by system operators like the mid-Atlantic system operator, PJM, or from bilateral power purchase agreements that are in effect for an extended period of time of say three to ten years.

Bilateral agreements depend on finding a willing buyer at a price that the seller deems to be sufficient because both the seller and the buyer are transacting in wholesale markets.

The price will likely be consistent with the prevailing market conditions and each party's individual assessment of the relative risk of market transactions versus a bilateral agreement.

A nuclear generator plant with a power purchase agreement is shielded from market outcomes. As long as that contract is in effect it will become

exposed to market prices as soon as that bilateral agreement expires.

Nuclear plants that do not have a bilateral power purchase agreement depend entirely on market revenues to recover costs and are thus affected by wholesale market outcomes.

An update. Recently some states have explored a hybrid approach. Several states, notably New York, Illinois, and Ohio, are exploring arrangements under which the state regulatory authority requires the load serving entities to enter into contracts with previously restructured generation including some nuclear generation.

I will focus on the rest of the presentation on merchant plants and the associated wholesale price dynamics as these are the circumstances over which FERC has jurisdiction.

Broadly speaking, nuclear power plants receive revenues for two services in the centralized wholesale markets, energy and capacity.

The energy market is designed to select the lowest cost that a resource is needed to serve load because many resources are needed to be postured to provide service well ahead of operation. This evaluation takes place in two time frames.

On the day ahead of operation resources bid to supply electricity for each hour of the next day the market operator determines the lowest cost that a resource is needed to meet expected load in each hour.

The day ahead price then is based on the cost of the highest cost resource needed to serve load, but taking into account all system constraints to the extent possible.

Resources are selected and financially obligated, that is, they receive a payment based on the day ahead price and their day ahead award.

On the day of operation the market operator files a similar process, the day ahead, the market operator adjusts the resource to the best schedules based on differences between actual and expected load and any changes in resource output relative to day ahead.

The real-time price is again based on the cost to serve actual load again taking into account all system constraints to the extent possible.

A resource's real-time payment is based on the real-time price and any differences between actual output and day ahead schedule output.

Most baseload units like nuclear power plants participate as part of the day ahead process.

Any difference between the energy market payment and the resource's cost of providing electricity is used to recover fixed costs.

In regions of the country where the state does not play an active role in ensuring that the fleet of resources is sufficient to meet peak load centralized capacity markets have developed to ensure resource adequacy on a forward basis.

Capacity markets are bid-based markets. In theory, existing resources bid their going forward fixed costs and new releases bid the cost and enter the market.

When no new resources are needed to meet expected peak load the capacity prices based on the highest going forward cost of an existing resource.

When new resources are needed to meet expected forecast load, then the capacity price is based on the cost of the new entry.

The capacity markets are designed to ensure that new resources can recover their costs over the life of the asset from a combination of energy and capacity payments.

In regions where state regulated vertically integrated utilities operate within centralized capacity markets, the state typically plays a predominant role in

ensuring resource adequacy in areas like California and the Midwest.

The centralized markets may have a backup or a backstop capacity market mechanism.

Any generator in PJM, the mid-Atlantic market operator, that relied on wholesale electricity markets as their primary source for revenue experienced the highest level of revenue in 2014 that they received over the last several years after two years of lower resources.

Revenue is dependent on the location of where the resources is located. This chart shows both one of the lower-priced regions in PJM along with a kind of averaged revenue across all of the PJM regions.

A number of market dynamics have been putting downward pressure on wholesale electric prices.

As described earlier energy prices are based on the marginal cost of serving load, thus, as natural gas and to a lesser extent coal prices have fallen, the marginal cost of serving load has fallen, and as a result, energy prices have fallen as well.

In addition the lumpiness of new entry into electricity markets has historically created periods where the market oscillates between excess supply and relative market shortage or supply shortage.

In periods when there is less excess supply, energy prices tend to increase on average, however, low load growth has meant that the current period of supply surplus is lasting longer than typical.

Finally, I will talk about some recent market reforms that may have an effect on nuclear generators market revenues.

These reforms include changes to the energy market rules to improve price formation and changes to capacity market rules to address performance concerns.

In the Commission's first action on price formation it stated that the goals of price formation are:

One: To maximize market surplus for consumers and suppliers.

Two: To provide correct incentives from market participants to follow commitment and dispatch instructions, make efficient investments in facilities and equipments and maintain reliability.

Three: To provide transparency so that market participants understand how prices reflect the actual marginal cost of serving load and the operational constraints of reliably operating the system.

Four: To ensure that suppliers have an opportunity to recover their costs.

In the capacity markets several market operators have introduced reforms to enhance the incentive capacity resources have to perform during periods of system need.

These reforms have followed several episodes including extreme winter weather in 2013 - 2014 where resources were not available for a variety of reasons including lack of fuel availability.

These reforms which differ slightly between the two markets, PJM and ISO New England, assess penalties to resources that are not performing when the system enters a shortage event.

As a result of the penalty structure capacity replaces will likely rise to reflect investments needed to ensure performance and the additional risk resources take on to accept a capacity's supply obligation.

Whether a resource receives higher net capacity revenue will depend on whether that resource actually performs when needed.

These market reforms are designed to be resource and technology neutral. At a high level the intent of the reforms is to ensure that the value of the resource provides to the system to serve load and maintain reliability is reflected in both the energy and capacity prices.

Some of these reforms could provide or prove to enhance revenue for nuclear plants, but that was not the design objective for any of the reforms.

That concludes my presentation. I am happy to take questions.

CHAIRMAN BAY: Thank you, Arnie. Let me ask our colleagues from the Nuclear Regulatory Commission if they have any questions?

Chairman Burns?

CHAIRMAN BURNS (NRC): Thank you, Mr. Chairman. A couple of questions to Mr. Ayoub.

When you talk about in terms of the corrective action plans and they are identified as not meeting the standard, could you describe for me the nature of what is expected to be done? What do they need to do for the entities?

MR. AYOUB: If I could back up a little bit. When they determined that they have a par transformer, but a high side connection of 200 Kv, or above, to the grid with a ground white connection the grid planners would provide the owner of that transformer a maximum gig calculation and then the entity would take that calculation, and then if it is over 75 amps per phase, or higher, they have to come up with the mitigation plans, they have to see if it affects the equipment.

If it does, then they have to come up with corrective action plans which is up to the entity. It could involve blocking devices or adding more serious capacitors, it would entity specific.

CHAIRMAN BURNS (NRC): Thanks. You mentioned that you are in the process of the rulemaking, the notice of the proposed rulemaking, and recognizing that may still be underway, but what type of reactions are you getting to your rule?

I think I may know the answer.

MR. AYOUB: It is mixed emotion.

CHAIRMAN BURNS (NRC): Yes, a good way to put it.

MR. AYOUB: I would say NERC and some industry members support NERC standard as is and there are other non-profits or other organizations that do not support the standard.

CHAIRMAN BURNS (NRC): One question. This is talking about the capacity market reforms. When would you expect to start seeing the impact of these reforms?

What is the expectation?

MR. AYOUB: That is both a question in both PJM and ISO New England the markets operate a three-year forward market.

Both have run one auction already under the

existing rules, so it will be three years from now when the revenue starts to get collected.

Also then penalties to be assessed. In PJM, though, they also ran transition auctions.

For the next two delivery years, they've allowed resources to convert from base capacity into, what would they call that, into performance capacity, so any resource that shows to convert from base capacity to performance capacity would receive an additional payment starting next the next delivery year and then the one following that as well.

CHAIRMAN BURNS (NRC): Thank you, Mr. Chairman.

CHAIRMAN BAY: Thank you, Chairman Burns. Commissioner Svinicki?

COMMISSIONER SVINICKI: Let me start by thanking those presenters. It is very interesting topic areas.

I have a question for each of you. I might be a little bit academic or philosophical, so I apologize.

Mr. Ayoub, since the nuclear accident in Japan in Fukushima, NRC has, of course, turned its focus much more intensively to what we call beyond design basis events also, events of low probability, in some cases almost vanishingly small probability, but high consequence so there needs to be some consideration

given to these events.

One of the struggles, of course, is how accurately your models and forecasts and predictions track with the state of knowledge or state of science when you are talking about low probability high consequence events.

In the case of the geomagnetic disturbance vulnerability assessments how would you characterize how well the models and predictions that are available track with both the probability and consequence predictions for those events?

I have warned you.

Mr. Quinn, get ready for yours. How do you strike a balance?

Obviously, there is an imperfect connection between reality and models and what kind of experts do you go to? Where do you turn to?

MR. AYOUB: I am not an expert on the models of the GMD modeling, but we have looked. It ranges. So when you look at the work that the standard drafting team did on their modeling and they use especially averaged method and looked at all the magnetometer data, they modeled on one of the hundred year event, and they determined that the NERC benchmark event would be eight volts per kilometer and that is what entities have to

design for.

On the other hand, you have the Los Alamos study which was recently filed with the Commission. They did their own study.

They did not use especially average method and they determined that entities based on the one in the third year event the benchmark would range from an 8.4. volts per kilometer to 16.6 volts per kilometer with an average of 13.2 volts per kilometer and the notice of proposed rulemaking does mention this as well.

Even the GMD white paper that was produced before the standard was finalized used the same models but did not use especially averaged model or a method and they determined it was 20 volts per kilometer.

It ranges.

That is the intent and if you look at the notice of proposed rulemaking and the Commission does speak to that, that it is an evolving science at this point at NERC, that is the purpose of the informational filings that NERC would have to produce after the final rule becomes effective.

COMMISSIONER SVINICKI: That tracks very consistently with the way NRC's experts are dealing with this, monitoring the state of the knowledge, bounding uncertainties, sometimes averaging using the

mathematical and computational tools that we have and then just trying to stay on top of the evolving state of knowledge.

Mr. Quinn, this is a very different subject matter, but I do appreciate your presentation as well.

Are you permitted to answer this as an analyst? I am not asking for a FERC position, but as an independent expert and analyst, is some aspect of regulation fundamentally necessary in order to have the energy supply diversity we value as a nation or do you think the capacity market reforms that are emerging or in place now will be sufficient to have diversity over the long term like a decade or two decades?

MR. QUINN: We focus philosophically as an agency very much on trying to ensure that the prices that come out of both the energy markets and the capacity markets reflect the value that is provided to the wholesale markets.

What a number of the reforms have been doing lately have really attempted to make sure that those prices are very reflective of the value and sometimes the value --

COMMISSIONER SVINICKI: Monetizing the value of diversity?

MR. AYOUB: I would not say it is monetizing

the value of diversity. It is monetizing the value of what the system needs.

If the system needs resources during shortage events, because if you have a shortage event you increase the chance that you are going to have involuntary curtailment's, involuntary curtailments are expensive, you want to make sure that energy prices reflect the value that consumers place on avoiding those involuntary curtailments.

It is a very uniformed focus on system valuation and system needs. If it is resource adequacy and it is done where resources are providing the service when the system is in stress, but they got a payment upfront for capacity, the focus is that the payment structure gives the resources an incentive to not just take that payment and do whatever, but takes that payment and makes an investment if appropriate and then performs when the system actually needs them to perform.

Our focus in our markets is system needs and evaluation. That is different than a load serving entity's kind of risk management perspective on how they want to hedge potential for changes in fuel prices over time or changes in their load expectations.

That kind of risk management activity we generally expect the load serving entities to do for

themselves.

Our markets focus on a very resource neutral, technology neutral, system focused valuation.

COMMISSIONER SVINICKI: Thank you.

CHAIRMAN BAY: Thank you, Commissioner Svinicki. Commissioner Ostendorff.

COMMISSIONER OSTENDORFF(NRC): Thank you, Chairman Bay. Thank you both for your presentations. Very informative.

I would like to pick up where Commissioner Svinicki was, Arnie, with you on the market.

Certainly, the last few years we have seen a number of nuclear plants shut down and some of those have had significant material issues, Santa Onofre, and Crystal River, some of them are based primarily almost entirely on economic factors, Yankee, Kiwani, and now an announcement recently on Pilgrim.

In the wake of the Pilgrim announcement here in the last couple of weeks various spokespersons for the nuclear industry in the United States have made comments, so I will ask you to comment as far as any perspectives you might offer, that now Massachusetts has lost the bulk of its carbon free emissions generating capacity at the Pilgrim plant produces around 80 some percent of their carbon free emissions capacity, and

that there are other industry spokespersons who have said that the failure, that the Pilgrim announcement was really a manifestation of the failure of a market in that area.

I am curious if you care to comment on the carbon emissions aspect, the "market failure" that has been coming out of the nuclear industry spokespersons the last couple weeks?

MR. QUINN: I will go so far as to say our energy markets and our capacity markets do not attempt to capture environmental benefits right now.

To the extent that we are talking about regulations like a sodium dioxide and nitrogen oxide emissions where there is a market for those emissions credits where there is the side market that places a value and that kind of an environmental regulation, those emmision credits find their way into the wholesale market prices as people incorporate the cost of compliance with environmental regulations into their energy market bids.

On the carbon basis, that just has not been the regulation of the United States up to this point. We now have a clean power plan.

We will see how states decide that they want to comply with the Clear Power Plant because they have a

lot of options.

To the extent that any other states start to take actions that put an explicit price on carbon emissions that can easily find its way into the wholesale markets.

We had four technical conferences and one of the things that all of RTOs said was, "If a state does more command-and-control they can accommodate that, but it is accommodated in a way that it just basically puts limits on plants when they can be dispatched.

That can kind of find its way into energy prices, but if a state does something that is more explicit on the cost of carbon that is easy to incorporate into the RTO markets.

They do that right now again with SOx and NOx, so if it stays moot for compliance that way the environmental benefits in terms of carbon free emissions for nuclear plants will start to find their way into energy prices.

COMMISSIONER OSTENDORFF(NRC): Thank you.

CHAIRMAN BAY: Thank you Commissioner Ostendorff. Commissioner Baran?

COMMISSIONER BARAN (NRC): Thank you both for your presentations.

Arnie, I know that not every RTO in ISO has

forward capacity market, but outside of PJM, and New England, are the RTOs focused on the issue of generators actually generating when called upon in shortage situations and other RTOs that are taking steps to address that issue?

MR. QUINN: Yes, that is a really good question. The other way we do this in terms of incenting performance strengths in periods of system stress is through administrative pricing in the energy markets.

We have got a philosophy that we really want generators not to exercise market power ever, but especially during periods of system stress for the potential exercise market are very high.

We have rules that mitigate that market power, but you want prices to be high and reflect the value to consumers of avoiding an involuntary curtailment and so we have administrative pricing rules that set the price as soon as the RTO enters specific categories of reserve shortages.

Those prices can be very high. They can be of the $500, $1,000, $1,500 range. Some of them can be low as $50 and $75. They are usually calibrated to match the reliability concern of the nature of the shortage.

Administrative shortage pricing is another way

we can incent performance when the system really needs that performance and some of the price formation reforms have focused on that element of energy markets.

COMMISSIONER BARAN (NRC): What impact has that had or would you expect it to have on nuclear generation?

MR. QUINN: To the extent that a nuclear generator is like other baseloads is kind of running all the time.

During those moments when the system enters a shortage event and the prices get very high, I would expect every resource running at that time to get paid and I would include nuclear generators as well.

One of the reforms we just proposed in our notice of proposed rule in September was to ensure that some RTOs have adopted an operating standard that if they see a shortage for say ten or fifteen minutes, they would not invoke this administrative pricing because in their view if they thought they were going to get out of the shortage fairly quickly pricing it didn't feel like it made sense to them.

Our notice proposed rule says anytime there is a shortage the RTO should price it.

They can decide to calibrate the prices to reflect what they think the reliability concern is, but they should price it in some way.

Again, any resource that is running and baseloads that run all the time would fall into that category and we could pay that shortage price.

COMMISSIONER BARAN (NRC): This may be more of a question really for Mark, but have we seen weather-related reliability issues with nuclear generation?

MR. QUINN: In terms of the fuel availability concerns we saw during the winter, both in New England and New York, I do not have a strong memory for whether any of the nuclear power plants had any issues.

I know that there was a flood on the Missouri River, in terms of like that extreme winter weather, but I do not have a memory that we had any instances.

I know that a couple coal plants might have had either coal delivery issues or coal pile issues.

MR. LAUBY: I am not aware of any specific issues. I know that you have to worry about off site power and start up the local diesels during cold weather, if in fact it was those kinds of conditions due to heavy snows, but I am not aware of any.

COMMISSIONER BARAN (NRC): Thank you.

CHAIRMAN BAY: Thank you, Commissioner Baran.

COMMISSIONER BARAN (NRC): Arnie, just one question and it is for you. I have been thinking of our recent

price formation recognizing an important principle, that is, that resources should be compensated for the value that they provide when they provide it and as result the Commission has explored an alignment between real-time settlement intervals and dispatch as well as recognizing shortage events when they occur.

As a result would that principle then be useful to a baseload unit like a nuclear unit that can continue to generate electricity during shortage events and during those shorter dispatch intervals?

MR. QUINN: I think it is definitely going to be the case, the reform that ensures that shortage pricing is invoked even when it is short time framed, a shortage event will help that, again, those set of units, all the units that are on during that shortage event including the nuclear generators.

The other reform that we proposed which would ensure that some markets average the price over an hour and then compensation is based on average prices and average output over that hour.

Data reform will be more important for resources that have output that fluctuates a lot within the hour, so say, a combustion turbine that turns on very quickly to address an issue and then turns off almost as quickly.

That reform will help those resources and in fact are meant to align the incentives for those resources for a baseload resource that is kind of running pretty flat out over the hour.

I think it will probably be less of a revenue impact for them.

CHAIRMAN BAY: Thank you, Arnie. Colleagues?

COMMISSIONER LaFLEUR: Thank you both. I thought you both did a great job synthesizing a tremendous amount of information in a short time.

I would like to bottle Arnie's and take it wherever I go as people are asking questions about markets.

I do have one clarifying question just to bring something out from each of you.

Kal, I know on following up on Commissioner Svinicki's question, obviously, one of the challenges we have in geomagnetic disturbance regulation is trying to come up with sensible and fair standards in a time when we don't have all the information.

Could you talk a little bit about some of the work that's going on to get more information because I know you mentioned requiring more monitoring and more information that way.

MR. AYOUB: At this point in the proposed

rulemaking the Commission would be requesting NERC to file information filing based on that work.

It is more of a research that once the final rule gets into effect to determine what NERC has done in that realm, up to now, and just going back to Commissioner Svinicki.

It is not an issue really of the model necessarily. It is more the input to the model.

The question right now is more for NERC to go back and think about alternatives to their assumptions into the model.

Right now the input is the spatial averaging of primary kilometer squares.

In the notice of proposed rulemaking the Commission asked NERC to look at any other assumptions that could go into this model.

It is more of an informational filing to see what NERC does in this realm.

COMMISSIONER LaFLEUR: It is my understanding that there has been a lot more real-time monitoring of geomagnetically induced current in Europe and Canada, so if we get more monitoring in the United States we should, as a result of the standard, have more real data.

MR. AYOUB: And that was a question

Commissioner under NOPR as well whether there should be more data collection, more magnetometers installed as well.

COMMISSIONER LaFLEUR: Thank you. Let me bring out one thing on the market presentation.

Arnie, could you talk a little bit about these markets. You mentioned how they price in SOx and NOx allowances and so forth.

We do have examples like with the regional greenhouse gas initiative where the states have tried to price carbon.

They did not set it at a high enough price to save Pilgrim, but they have tried to build it and how the markets, if we get carbon trading, how that might go into the markets because we have a little experience in the "regu states" and California that are already trying to put carbon in their markets, right?

MR. QUINN: Exactly, yes, that is a good clarification. Both in the northeast and in California where there is a carbon price, our rules explicitly allow the resources bids to reflect the cost of that carbon.

I am most familiar with what the price has lately been in California and they have been fairly low in kind of the single digits to like $12, to say, $15,

the last time I checked.

The biggest thing we have to do for our markets is just to ensure that when we mitigate resources down to their cost that that emission cost is included in that cost because it is a real cost.

COMMISSIONER LaFLEUR: The expectation is that with a Clean Power Plant carbon trading could be more prevalent and prices go up because it will be more valuable.

MR. QUINN: That is right. You are right that our markets already work that way. There is not a lot that the markets have to do to change to reflect that carbon price if a trading platform exists outside of the market.

COMMISSIONER LaFLEUR: Thank you very much.

CHAIRMAN BAY: Thank you, Cheryl. Phil?

COMMISSIONER MOELLER: Thank you, Mr. Chairman. Just a brief response to Commissioner Baran's question.

The main cold-weather events of particularly the first few months of 2014, Commissioner Clark hates the term "Polar Vortex" so that's why I am referring to them as "cold polar events".

COMMISSIONER CLARK: You will have to explain why that is.

COMMISSIONER MOELLER: I will let you do it. He's from North Dakota. It is my recollection there were

about five events, two were particularly tough, but the bottom line was that a nuclear fleet performed outstandingly well, better than any other fuel type.

I think it was at 98.5% and that was because of one non-weather-related trip of one plant in this area. That is my vague recollection.

The bottom-line takeaway is nuclear was there when we needed it.

COMMISSIONER CLARK: Thanks. Just a couple of questions for Arnie.

Arnie, I was curious on your slide that you gave on net plant revenues in PJM, I am curious if you know off the top of your head what this would look like if we had a chart that showed say ISO New England or New York.

The reason I ask is I know ISO New England the greater percentage of the time the clearing unit in those regions, was there a similar trend in terms of recovering net revenue in New England or did the continued low gas prices suppress that market?

MR. QUINN: The short answer is I don't know because I did not look at New England.

It is nice that PJM's Market Monitor actually explicitly does kind of a net revenue for a new nuclear plant in PJM and so the data is very handy in PJM.

I have not checked New England as well. Some of what, and you mentioned 2014, was just higher energy prices probably during that January - February timeframe.

To the extent New England, their reliance on dual fuel -- well, when oil is not $45 a barrel, you would expect dual fuel, the heating oil prices to kind of push energy prices up as well in the winter.

In the last year or so the oil prices have, especially last winter, I think kind of really equilibrated heating oil and natural gas. You have seen a more moderated energy price.

COMMISSIONER CLARK: I was going to try not to get you in any trouble, but after hearing Bill's and Kristine's questions, I decided that I would throw you one and see how you would handle it.

MR. QUINN: My trouble is your trouble.

COMMISSIONER CLARK: Point taken. There have been discussions, and I think Bill mentioned this, that this may be a "market failure," that some of the nuclear units are going off-line for market reasons, and the Commission has been undergoing a price formation effort which I fully support and it is good that we have that sort of checkup.

On the flip side, can an argument be made,

setting aside what we should be doing in terms of tweaking the markets to make sure we have proper price formation that specifically within a restructured region where the state has chosen the spinoff and create merchant plants of any type that in the bigger picture units going off-line because they are more expensive than whatever the newer more efficient lower-cost unit is, is actually not a market failure, but exactly how the market was designed.

That might cause other problems in relation to Clean Power Plant and we are losing these certain carbon free resources, but from a market design standpoint, it is not actually market design failure.

MR. QUINN: What I was trying to talk about is the risk management element that our markets do not do.

To build on your question, largely, you are right that our markets are designed to be in almost risk management neutral.

It really does look for in the space of time where our markets are running for that forward year in a capacity market for the next day and a day ahead market the lowest cost set of units, right, then they don't attempt to say, "I am worried about future environmental regulations," or "I am worried about a change in gas prices over time and so I want to do some sort of risk

management to preserve a set of resources that might be higher cost right now, but valuable in the future if uncertainty evolves in a way that they would become more competitive."

You're right that our markets are designed to pick the lowest-cost set of resources right now based on the existing set of information.

If consumers want to protect themselves they have to do that through bilateral arrangements that they do in concert with our markets, but our markets are not going to do that.

COMMISSIONER CLARK: Thanks.

CHAIRMAN BAY: Thank you, Tony. Colette?

COMMISSIONER HONORABLE: Thank you, Mr. Chairman. I briefly wanted to echo the points made by both Phil and Tony on the importance of nuclear in the markets and also the conundrum we face with the operation of the market.

I appreciate the way Tony phrased the question. It is interesting.

As we were having a little side bar conversation at my behest actually, as Tony was trying to pay attention, regarding your comment with regard to the New York, Illinois and Ohio effort, to require that LST's contract with merchant plant operators.

I am always interested in solutions to ensure fuel diversity in the markets and in particular of this resource nuclear, going to Phil's point, that shows up when it is needed and operates when needed.

I encourage all of us to continue thinking about ways to resolve that. Yes, it is an operation of the markets of how it was intended but are we harming ourselves there? I pose that for future thought.

And, Tony, did you tell us why you do not like the term "polar vortex"?

COMMISSIONER CLARK: I just consider it to be January.

CHAIRMAN BAY: Thank you, Colette, and thank you Tony, and thank you Kal and Arnie.

Our next panelist is Jennifer Uhle who is the deputy director for engineering of the Office of Nuclear Reactor Regulation at the NRC.

Thank you Jennifer for being here today.

MS. UHLE: Thank you and good morning to both Chairmen and to both Commissions.

Let me first to go my title slide here and warn you that my slides are a number of separate topics.

I will be flipping through different topics. If you don't see a connection between them you are probably not supposed to see one.

If we go to my first slide. This slide shows the projected electric capacity of the nuclear industry.

Being a function of license renewals, this is more of a cartoon so do not be looking at this to give you the exact right answer.

Currently, there are 99 nuclear power units operating in the country.

Most plants that commenced operation in the 1970s and 1980s and NRC licenses were granted for a period of 40 years.

NRC's regulation does allow for a period of a renewed license in 20 year increments provided the regulations can be met and safety is insured and there is no limit to the number of license renewal periods a licensee may get, but again, our focus is to ensure that the plant would operate safely so certainly, yes, as the age increases there will be more questions about aging management.

What you have on the slide here is the red line and it is the capacity with absolutely no license renewal. That would obviously show that we would be coming down at quite a steep break.

The green line shows the capacity with the already approved license renewals done.

The orange line we have a number of licensees

that have committed to come in for license renewals and we have a lot under review right now and that is the orange line.

Just to show the difference the red line would be if all units were renewed.

As of say mid 2015, the NRC has issued renewed licenses for 78 units at 47 different sites in the country, although two have shut down for decommissioning.

Thirty-eight of the operating units have entered their period of extended operation which is operating beyond 40 years.

Of the 23 units, if you do the numbers that are still operating with their current license, sixteen are already under review for license renewal and we have letters of intent from five different licensees for another six units to be renewed.

The regulatory requirements for license renewal ensure that the important long live passive system structures and components can continue to perform their function during the 20 year period of extended operation.

Under a renewed operating license the licensee is responsible for all the existing NRC regulations as well as the additional regulatory requirements related

to aging management.

Licensure reviews cover both technical review as well as an environmental review.

The licensing review and the inspection program that we have at the Nuclear Regulatory Commission ensure that plant safety is insured for active and passive components during the entire operating life of the facility.

By 2030 the average age of the currently operating fleet will be, I would say, roughly 50 years old. It is actually 50.2 and rounding down is appropriate.

Nine Mile Point, Unit I, and Gannae in New York as well as Dresden Unit II in Illinois will be the first plants to reach 60 years of operation in 2029.

Licensees have indicated that some will pursue a second 20-year period of license renewal.

We refer to that as subsequent license renewal and that would mean operation from 60 to 80 years.

The NRC is working to develop the regulatory basis of several technical issues that must be addressed for subsequent license renewal.

For example, reactor pressure vessel neutron brillment because the vessel would see a much higher fluence of fast neutrons.

Electrical cable condition assessment, irradiated assisted stress pros and cracking of the vessel internals and then concrete degradation.

This work is being done in collaboration with a number of partners, The Department of Energy, the industry, and our international counterparts.

The NRC will finalize our subsequent license renewal guidance prior to the anticipated receipt of the first subsequent license renewal application.

Along with license renewal the agency is licensing new reactor designs. You see five designs that are either certified or under review that utilities are considering.

The three that are certified are the advanced boiling water reactor or ABWR and you can see its power rating.

The advanced passive 1000 or AP 1000, although that is a trick question there because it's really 1110 MW and not 1,000 and the economic simplified boiling water reactor or ESBWR.

There are five units under construction across the country at three sites in the United States.

The Wattsbar site is located in Southeastern Tennessee. The Vogel site is in Georgia and the VC Summer site is in South Carolina.

The construction of Wattsbar Unit II, it is a Westinghouse design pressurized water reactor, it was suspended in 1985.

The construction permit was reactivated in 2008. We expect to issue the operating license to the Tennessee Valley Authority shortly and TVA expects commercial operations to start no later than the second quarter of 2016.

The units under construction at Vogel and Summer are the advanced passive 1000, AP 1000s. The combined operating licenses for Vogel and Summer units were issued in February 2012 and March 2012 respectively.

The NRC is actively reviewing applications for fourteen units at eight sites and has issued a license for one reactor and that is Fermi III in Southeastern Michigan.

These applicants have not made firm commitments to build.

Nine additional applications have been withdrawn or suspended by the applicants because their business plans have changed.

Vogel and Summer are using modular construction. On the left hand side of the slide you can see the 2.4 million pounds module comprising the

steam generators and reactor refueling canal and is being placed inside the Summer Unit to contain the vessel.

This was done in July 2015.

This lift is projected to be the heaviest lift during construction of the AP 1000 units and this lift was done at Vogel in august.

On the right-hand side of the slide, you see the first shield building panel being placed just outside of the first ring of the Vogel Unit III containment vessel and this was taken in August 2015.

The steel composite shield building is a first of a kind construction technique that is being used in the United States.

The NRC has been preparing to review also small modular and advanced reactor designs.

We do expect to receive our first application for design certification of a small modular reactor in December 2016 for the new scale design.

The NRC Staff is preparing guidance to facilitate this review.

We do expect an application for combined operating license for the new scale design in late 2017 and the potential site is in Idaho.

There are three other vendors of small modular

reactors.

There's Holtach, Westinghouse, and MPower, they all have held pre-application conferences with the staff at the NRC, although we do not have a confirmed application date for those three designs.

While we are reviewing applications for license renewal and for new designs and some utilities are building some plants are decommissioning.

Since 2013 four plants encompassing five reactors have begun the decommissioning efforts. These plants are depicted on the map and they include Crystal River which is in Florida, Kiwani Power Station that we had mentioned in Wisconsin.

Santa Onofre Nuclear Generating Station in Southern, California and Vermont Yankee located in Vermont.

Two additional licensees have announced plans to permanently cease operations. In the future, Oyster Creek which is located in New Jersey which is a 636 MW electric plant will be shut down in the 2019 timeframe.

Then, of course, recently the Pilgrims Nuclear Power Station located in Plymouth, Massachusetts. It is a 688 MW electric unit will be shut down no later than June 1, 2019.

Economics, of course, is a key driver that

influences a licensee's decision to shut down a power plant and I have a few tidbits here, but since you enjoyed such a great presentation by Arnie, I don't want to try to repeat any of what you said.

The NRC continues to ensure public health and safety during the entire process of decommissioning. Once the plant permanently shuts down, the fuel is moved to the spent fuel pools, and it must be cooled for roughly five years before it can be moved into dry task storage.

With the exception of the removal of authorization to operate the regulatory requirements remain the same, therefore, licensees come in with a number of license amendment requests and exemptions from our regulations so that the regulatory requirements on the plan are more commensurate with the lower risk profile of the plant.

We are developing regulatory guidance to enhance the efficiency of reviewing license application requests for decommissioning units and we expect to issue an advance notice for public proposed rulemaking for a decommissioning rule later this month and a public meeting will be held in November to obtain public comments on that advanced notice.

The proposed final rule is scheduled to be

provided to the Commission in 2019.

Let me switch to another topic and talk about some of the regulatory requirements we have put in place as a result of the Fukushima event.

The NRC's initiatives to address lessons learned from the Fukushima event have and will continue to result in significant safety improvements at U.S. nuclear power plants across the country.

The importance of being able to respond to a beyond design basis external event is one of the main lessons learned from Fukushima.

NRC required by order that mitigation strategies be implemented by the end of 2016 and these strategies are to protect the plant against beyond design basis external events.

The strategies provide additional layers of defense in depth above and beyond what was previously required to protect the plant from the effects of external events such as earthquakes, tornadoes, hurricanes and floods.

The strategies must be capable of mitigating the external event with a simultaneous extended loss of AC power as well as a loss of normal access to the ultimate heatsink.

The strategies are flexible. They rely on

portable equipment that must be protected and stored in a harden facility.

The strategies will maintain core cooling, containment integrity, and spent fuel pool cooling for an indefinite period of time.

The industry has established two national response centers that can deliver additional equipment to any site within 24 hours including portable pumps, skid mounted diesel generators, electrical cables, and hoses.

The necessary connections for this equipment they are standardized and they are installed at all of the plants.

To date 29% or roughly 30% of the plants are in compliance with the mitigating strategies order and all sites have received additional equipment on site.

By the end of 2015, 51% of the plants will be in compliance and the final compliance date is December 2016.

We are doing a rulemaking to develop a new regulation to codify the mitigating strategies order and to add other safety measures such as enhanced on-site emergency response capabilities which was another lesson learned from Fukushima.

In November 2015 the proposed rule will be

published in the federal register and federal register for a 75 day public comment period.

We expect that the proposed final rule would be submitted to the Commission in December of 2016.

Safety has been continually enhanced as the regulatory action stemming from the Fukushima lessons are learned and implemented.

NRC continues to look for ways to improve our efficiency and effectiveness, to accelerate completion of all the post Fukushima initiatives.

The NRC in the industry have made substantial progress in implementing the lessons learned while lamenting these enhancements though the NRC has not lost sight of the importance of continuing to focus on plant operating reactor plant safety.

We will again switch topics to discuss the effect of electromagnetic pulses on nuclear power plants.

As you all know an electromagnetic pulse can be created by a nuclear detonation high in the atmosphere and can cause very widespread disruptions as we try to depict on this slide.

On a smaller scale, of course, there are other portable electromagnetic pulse weapons that are available in.

EMPs, electromagnetic pulses, can damage electronic devices and can threaten the electric grid and there is a question about their effect on nuclear power plants.

You can also have electromagnetic disturbances coming from geomagnetic events or geomagnetic storms specifically coronal mass ejections which is probably much more familiar with it as it doesn't want to roll off my tongue all that well.

It is a massive burst of magnetized plasma from the sun into space and it creates a long-duration electromagnetic pulse of lower field strength than say an EMP would.

They can significantly affect the grid because they create geomagnetically induced currents in electrical transmission lines.

The concern for nuclear power plants is that these geomagnetic induced currents can cause grid voltage fluctuations and can overstress high powered transformers at the plant.

FERC and NERC, of course, you have long recognized this concern and have pursued rulemaking to minimize the impact on the infrastructure including nuclear power plants.

In cases of a man-made EMP or a CME, coronal

mass ejection event, the primary concern for the plants is loss of off-site power.

A secondary concern at least for the coronal mass ejection is the potential damage to the nuclear power plants large step up transformers that normally connect the plant to the grid.

Those transformers would be damaged and would preclude the plant's return to power in the event of a large coronal mass ejection.

In the late 1970s the NRC became concerned with these events and the Agency has studied these phenomena and have produced three separate reports. Two of them are publicly available.

The main finding from the report, especially the first one in 1983, and then it was backed up with the same conclusion in 2009 and 2010, that the pulses weaken as they travel through the concrete structures of the nuclear power plant and that the equipment inside those structures are not affected and therefore can continue to keep the plant safe.

This issue was brought up as a generic issue about, I would say, five years ago. Based on the reports that we had conducted and were finalizing in 2009 and 2010 the generic issue program has a certain safety threshold that we used to screen issues and these

issues did not rise to a safety level important enough for us to further assess it in the generic issues program, and that is, again, because the attenuation of the pulses as they go through the concrete structures in the plant and that the equipment is still available to provide cooling to both the quarry and the spent fuel pools in keeping the plant safe.

To summarize. There are several NRC requirements that ensure plant safety in the event of a loss of off-site power.

General design requirements ensure that the plants have an appropriately robust electrical system that can withstand severe weather and provide emergency power to maintain safety.

A particular regulation requires plants to be able to perform its critical safety functions with a loss of all AC power.

Regulatory guidance provides criteria for the design of safety systems so that the components can function even with specified levels of electromagnetic interference.

I also discussed in my talk the post Fukushima actions that have also enhanced the capability of the plants to mitigate a beyond design basis external event and that is coupled with a loss of off-site power for an

extended period of time and loss of normal access to heatsink.

The Agency recently completed an action on a petition for rulemaking from a member of the public concerned with extended loss of AC power from the geomagnetic disturbance.

We highlighted that plants have multiple reliable emergency backup power sources and robust fuel supplies to respond to the event.

This capability has been enhanced by our Fukushima actions to require plants to be able to respond to an extended loss of AC power event.

The staff continuously monitors for viable threats to the nuclear power plants including geomagnetic storms in collaboration with FERC. Licensee training programs and procedures ensure that their staffs take appropriate action under these abnormal conditions.

NRC Staff also participates in national planning initiatives for dealing with geomagnetic storm events and considers this information in our regulatory process and you all, of course, participate in the same ones.

We would like to commend FERC's and NERC's staffs for the rulemaking activities that are underway.

The rules would certainly enhance a nuclear power plant's safety and we also invite you to comment on our advanced notice of public rulemaking on decommissioning that will be issued later in November.

This concludes my remarks and I would be happy to take any questions.

CHAIRMAN BAY: Thank you, Jennifer, for that very interesting and informative presentation.

I am very impressed with the beyond design bases planning that the NRC does, so my one question for you is: When you are thinking about high-impact low-frequency events, is there certain methodology that staff at the NRC uses to determine what kind of response might be appropriate for regulators to take?

How do you do that cost-benefit analysis?

MS. UHLE: The first point, the nuclear industry, and by industry, I mean, the NRC, the regulator, the DOE, nuclear energy as well as the utilities have used what is called probabilistic risk assessment techniques.

The first application of those techniques specifically probabilistic risk analysis was in WASH 1400 back in say the mid to late 1970s and since then we have continuously developed that technique and what it does is it takes a look at the probabilities of various

initiating events and propagates that through the reactor systems and takes a look at availability rates of the equipment to determine what the likelihood or what the probability of core damage is.

Those are techniques that we have and that we use constantly at the Agency are very helpful and then in addition the Commission had set safety goals in a safety goal policy statement again back in the 1980s and essentially said that the goal was to keep the impact of nuclear to be less than .1% of the cause of deaths from cancer.

What does that mean to us?

That means that it is roughly nuclear power should not increase the likelihood of cancer to a human being above the natural rate of cancer more than two in one million people per year.

That is a very very safe threshold and because we have that threshold that helps us compare directly to that to make the decision about whether something needs to be considered in our regulatory framework.

CHAIRMAN BAY: Thank you, Jennifer. Colleagues?

COMMISSIONER LaFLEUR: Thank you. That was excellent. I was really interested to hear about your work on EMP and GMD and also really gratified to hear

about all the new license applications.

I did not realize there were so many. I have a question about the existing fleet and hopefully it is not too dumb.

But as we look at fleets and parts of the electric system that are challenged either economically or in the markets is challenged by competition with gas and others, and this is true for both the whole baseload and nuclear, it is the single unit older plants that have more difficulty making it so fewer megawatts to spread all the costs of complying with the new rules over, with New England where I was very familiar with the Yankees all of which are gone now, putting aside Pilgrim, I mean Seabrook and Milestone are a whole different phenomenon than the Yankees in the way they are designed and operate.

It is my impression that most of the fleet that is left out there around the country is way more in the bigger newer multiunit or there are a lot of little plants we should be worried about?

I do not mean their safety. I know you have that under control, but kind of how they are going to fair in the future, can you give me any sense of that?

MS. UHLE: You are exactly right to say that sort of the dual unit and there are some sites that have

three units.

Where Vogel and Summer are being built they will have four units each they tend to be more economical for the licensee in large part because they are sharing a number of regulatory requirements and also sharing expertise in their operations.

A big concern for a single unit licensee is the security requirements. It is one of the more expensive aspects of our regulatory process.

The emergency preparedness activities that are required are also very expensive, so when they can be shared across multiple units, then of course, it is a more economical situation.

However, there still are a number of single unit plants out there, and as you did indicate correctly, if we thought there was a plant that did not meet our safety standards we would shut it down immediately and no questions asked.

We do ensure that all the plants are safe, but certainly those that were smaller in power when they were originally designed and our single units are economically viable.

COMMISSIONER LaFLEUR: Thank you very much.

CHAIRMAN BAY: Thank you, Cheryl. Phil?

COMMISSIONER MOELLER: Doctor, thank you very much

again for the presentation. I really liked these discussions over the years because they really highlight the fact that although we are very much related in what we do the NRC is primarily a safety regulator and we are primarily economic regulators and that is why it is important for us to have these discussions on the economics and the safety.

My questions was going to be along the lines of Commissioner LaFleur's, the smaller units seem to be the ones that are most vulnerable.

I will change it a little bit. You may not be familiar with this at all, but one of the plants that I knew fairly well is between Portland, Oregon and Olympia, the Trojan Plant that was decommissioned, I am guessing about 15 years ago, again, relatively a small plant.

What is that site like now if you have any idea?

MS. UHLE: I would turn and ask my colleagues in the back but I believe that decommissioning --

COMMISSIONER SVINICKI: I can answer that. I was there a few years ago.

A VOICE: I would not say Commissioner Svinicki is a colleague, but thank you.

COMMISSIONER SVINICKI: Very interesting. I have

visited a number of the decommissioned sites and it is a very different experience depending on what faith of decommissioning they are in.

When I visited Trojan which was no more than two or maybe three years ago, but for the nation's lack of a disposal site for spent nuclear fuel there's almost nothing there.

There is personnel on site and so there is a security perimeter around the independent spent fuel storage installation, but they have taken it basically down to the ground.

There is some subsurface concrete that they have remaining in place, but it really points out the fact that but for a disposal site that that location at Trojan could certainly be greenfielded.

COMMISSIONER MOELLER: Thank you very much.

CHAIRMAN BAY: Thank you, Phil. Tony?

COMMISSIONER CLARK: Thanks for the presentation. I am curious about the small modular reactors because there have been so many in the utility industry that have looked at that as a something that has great potential because there are just so few utilities that have the scale to be able to build the larger units.

I see there are a couple of applications that are soon going to be in the door.

Are there statutory or rule guidelines that give us a sense or just historically the timeline that applications like that take to work themselves through the process or is it sort of like our certificates, when we do citing that it is really dependent on the quality of the application when it walks in the door and the record that develops over time.

MS. UHLE: Yes, it is definitely dependent on the quality of the application, although recently I was talking to some people in the Office of New Reactors, andn Gary Hollikin, is behind me who is the deputy of the office.

The expectation for a review of say the new scale plant which is likely to come in December 2016 would take about three to four years.

I will just turn to make sure that my recollection is correct.

MR. HOLLIKIN: Our plan would be 39 months for the review of the design and the utility application would be a separate matter and that would probably be about three years.

COMMISSIONER CLARK: Very good. Thank you.

CHAIRMAN BAY: Thank you, Tony. Colette?

COMMISSIONER HONORABLE: Thank you and I do appreciate the excellent presentation.

I have one question and one comment. My question is really Slide 5 with regard to the subsequent licensure process.

I am wondering to whom or where do you look at the NRC for best practices regarding the subsequent licensure process, maybe even internationally, are there places around the world that have already gone down this path or is there a body of work here that you can look to as guidance domestically?

MS. UHLE: Yes, and pretty much the units the United States have been operating longer than oversees for the most part.

We have a lot of guidance in documents available for the first round of license renewal.

COMMISSIONER HONORABLE: No, I am speaking of the second.

MS. UHLE: What we are doing is one of the documents is called the generic aging lessons learned document that helps the licensee develop an aging management program for those passive components that are subject to age-related degradation that we are concerned about and what we are doing is we are adding on to that document because with more neutron fluence or with more radiation to the concrete, of course, they can perhaps have new degradation mechanisms or more severe

degradation mechanisms than the original license to 60 years.

We have a number of research activities underway that we do in collaboration. The plan is to update that document with all the guidance and that is getting for another year or so, I think, before we would say, well, maybe two years, before completion.

COMMISSIONER HONORABLE: My second point is just to acknowledge your continued focus and priority on safety as that is very important across the energy sector.

Being from Arkansas you are aware we had an incident a couple of years ago at our A & O facility quite devastating with a fatality, the loss of life.

Any time where this could occur in a prior life and heading a national association we are focused on pipeline safety.

It may be more unusual in this arena to have fatalities but it is certainly still good to continue to focus on it to ensure that the folks on the front lines operating grants are concerned and focused on safety.

Thank you for that.

MS. UHLE: Our mission is for nuclear safety. The event at Arkansas Nuclear I, the plant that you are discussing, it was a heavy lift associated with the non-nuclear side of the plant and in it there was a

problem with the lifting device, the crane, a person was killed.

That really is under the OSHA side. We have memorandums of understanding of OSHA, so our main focus is nuclear although certainly we did do root cause investigation.

Our Licensee was required to do a root cause investigation because of the consequences on the nuclear side of that event.

COMMISSIONER LaFLEUR: Thank you for mentioning that. Honestly, that was the first time that I became even remotely acquainted of our role in such a circumstance.

I appreciate your clarification to highlight the fact that there are a number of entities working well together to ensure nuclear safety.

CHAIRMAN BAY: Thank you, Colette. Chairman Burns, do you and your colleagues have any questions?

CHAIRMAN BURNS (NRC): This is a clarification from Jennifer. On your Slide 2 on projected capacity dependent on license renewals, that slide, essentially that is an assumption of basically the single license renewal.

A 60-year projection. Based on a 60-year lifespan.

MS. UHLE: Thank you for that as I had failed

to note that.

CHAIRMAN BURNS (NRC): Just to make sure that that is clear. Also a comment on Commissioner Honorable's question about the interaction of international experiences.

What Jennifer is saying is we are probably ahead in terms of the renewal process just because the age of the fleet in the U.S., and what I know from my experiences, has been in terms of talking with fellow regulators around the world is that they are actually very interested in some of the research and some of the learnings that we are getting and in the experience we may have because some of them are actually, for example, my French colleagues they are actually dealing with their going beyond 40 just reaching 40 and going beyond 40 at this point. Thanks.

COMMISSIONER SVINICKI: A comment really. I had an opportunity to visit a new gas generating plant.

That may seem very odd freelancing for a nuclear safety and security commissioner, but it was such fundamental learning for me because you get to see the points of departure.

If you only look at nuclear you are a little bit -- frankly, I was overwhelmed, that one thousand megawatts can just be, I kind of term it, you can just

think it up and do it in a timeframe that on the nuclear side is so different.

To any of my FERC colleagues who had not had an opportunity to either visit the new construction of the AP 1000s in Georgia and South Carolina, I'm sure that the licensees there would welcome, and again, it's just so interesting to be able to compare and contrast there if you haven't had a chance to do that, or frankly, any of our operating units and it is the same thing in the value of this type of meeting where we get to peer into each other's world.

I encourage that.

CHAIRMAN BAY: Thank you, Commissioner Svinicki.

COMMISSIONER LaFLEUR: Maybe we should do a field trip next year.

CHAIRMAN BAY: Thank you and thank you very much Jennifer.

Our next panelist is Dan Phillips from the Office of Electric Reliability at FERC. Thank you, Dan.

MR. PHILLIPS: Good morning, Chairman Bay, Chairman Burns and Commissioners.

My name is Daniel Phillips and I work in the Division of Reliability Standards and Security in the Office Reliability.

In July this year the Commission issued a proposed rulemaking for the proposed revisions to the critical infrastructure protection reliability standards or CIP standards that were submitted by the North American Electric Reliability Corporation in response to FERC directives in Order Number 791.

Order 791 approved Version 5 of the critical infrastructure protection standards but also directed modifications.

In the current proceeding, FERC has proposed to approve the NERC revisions to the CIP standards and find that they adequately address the directives in Order 791 by eliminating to identify and assess and correct my language, providing enhanced security controls for low-impact assets, providing controls to address the risk posed by transient electronic devices such as laptops and thumb drives, and address in an equally effective and efficient manner the need for a NERC glossary definition with respect to communication networks.

FERC also proposed to direct NERC to develop modifications to CIP reliability standards CIP 6 addressing protection for communication network components and data between control centers and to develop a reliability standard that would address supply

chain risk management.

I will now discuss each of the five major technical issues that were addressed by the NOPR.

In Order 791, the Commission concluded that a clause requiring responsible entities to develop processes and procedures to identify, assess, and correct deficiencies that was present in seventeen of the proposed Version 5 requirements was unclear and did not adequately describe how the requirements could be implemented and enforced.

The Commission directed NERC to address those ambiguities by modifying or removing the language and in response NERC has proposed removing the identified, assessed, and correct language from those requirements.

NERC explained that it has made changes to the reliability assurance initiative in its risk-based compliance monitoring and enforcement program to directly accomplish the goals of the identify, assess, and correct language by focusing resources on those areas that pose the highest risk to reliability, so the Commission has proposed to approve these revisions.

In Order 791 we also discussed the need to enhance proposed security controls for low-impact as cyber assets.

One of the major innovations approved by the

Commission in Order 791 was a tiered-protection and model based on facility or asset impact local to the bulk electric system which is used to determine the necessary protections for cyber assets.

The highest impact assets are required to implement nearly all of the CIP standards while meeting impact assets and lower impact assets are only required to apply a subset of those requirements.

In Order Number 791, the Commission raised concerns that the proposed requirements for low-impact best cyber systems did not require specific controls or alternatively contain clear objective criteria that could be used by an auditor to assess an entity's performance under the standards.

The Commission directed NERC to develop modifications to address the ambiguities with the proposed requirement and to manage potential inconsistencies in implementation.

NERC has addressed the Commission's directive by proposing modifications to provide security criteria which will aid in evaluating whether the utilities have met their compliance obligations in four discrete areas relating to cyber security awareness, physical security, electronic access controls, and cyber security incident response plans.

The Commission has proposed to approve the revised controls in CIP 3 to address the low-impact assets.

Another directive in Order 791 addressed the need to develop requirements to protect transient devices used to transmit or transfer executable code and best cyber systems.

NERC has proposed modifications to ensure the responsible entities develop plans and implement cyber security controls to protect transient cyber assets and removable media.

The proposed requirement is mandatory for high-end medium impact as cyber systems and requires responsible entities to address protections for transient cyber assets and removable media managed by themselves as well as third parties.

The security controls addressed asset management authorization security vulnerability mitigation, the introduction of malicious code, and unauthorized use mitigation.

The Commission has proposed to approve these requirements, however the Commission also asked for comments with respect to the limited applicability of the requirement particularly its emission of security controls for transient device used at low-impact best

cyber systems.

Depending on the information provided the Commission may direct NERC to develop a modification to the reliability standard.

The fourth tissue from Order 791 concerns protections for bulk electric system communication networks.

In Order 791 the Commission approved the removal of communication networks from the best cyber asset definition, but also directed NERC to develop a new definition for communication networks and to develop a new reliability standard to address the change.

The Commission explained that the new or modified standard should require appropriate and reasonable controls to protect non-programmable aspects of communication networks.

NERC addressed the communications directive in this area by developing a modification to protect non-programmable components used to control centers at high-end meeting impact facilities.

The proposed standard requires physical protection for cables and other programmable components and contains options for encrypting data in connection with monitoring when physical protection cannot be accomplished.

In the notice of proposed rulemaking the Commission has proposed modifications to the standard due to the limited applicability of the provisions.

The Commission sought comment on this proposal.

Lastly, the Commission has proposed to direct NERC to develop a new or modified reliability standard to provide security controls addressing supply-chain risk management.

Activities for industrial control system hardware, software, and computing in network services associated with bulk electric system operations.

The Commission explained that recent attacks on supply-chain vendors and critical structure sector highlighted the gap in protection in the CIP standards.

The Commission is also to provide general guidance, namely, that any standard should be forward-looking, objective driven, and encompass the activities and the security development life cycle such as acquisition, delivery, and integration.

The Commission stated that any controls developed to address this topic would have to respect Commission jurisdiction, not require the abrogation or renegotiation of contracts, be flexible and provide clear and enough guidance on compliance obligations.

And the Commission has sought specific comments on the general proposal anticipated features of any new standard, the timeframe for developing the standard, and also the types of outreach the industry feels may be necessary to reasonably address the reliability gap.

Comments to the NOPR were due on September 21 of this year and staff is currently reviewing those comments.

This concludes my presentation and now will turn it over to Brian.

CHAIRMAN BAY: Thank you. Brian.

MR. McDERMOTT: Thank you, my name is Brian McDermott, I am the deputy director for NRC's Office of Nuclear Security and Incident Response.

It is my pleasure to provide you with a brief overview of NRC cyber security plan implementation this morning.

The topics that I will address this morning include NRC's cyber security requirements, phased approach and implementation by our licensees, the current status of those implementation activities and then wrap up with some additional cyber activities that are ongoing.

The NRC issued the current cyber security

requirements in 2009 and since then the Staff has approved cyber security plans for each operating nuclear power plant in the country.

Currently our licensees are implementing their plans in two phases. The phased approach to implementation was used to ensure that the most significant system and threat vectors were addressed quickly.

The scope of the NRC's requirements cover what we call critical digital assets or CDAs. These include digital devices that can have an adverse impact on safety, security, or emergency preparedness functions and digital devices that can impact reliability which is the subject of the memorandum of agreement between NRC and FERC.

NRC staff has continued to coordinate and share information with FERC and NERC representatives over the last year.

Through frequent interactions, we have sought to ensure awareness of our respective cyber security activities and align on areas of potential overlap.

These interactions have been very beneficial and we greatly appreciate the cooperation.

The graphic on this slide represents the defensive architecture concept that was implemented as

part of the first phase of NRC cyber security requirements.

The most significant safety and security critical digital assets are protected in layers on the left that layers three or four.

Communications from the CDA's to less secure portions of the network or to the Internet are protected by either air gaps or one-way communication devices ensuring protection from the Internet originating threat factors.

Slide 4. Moving into a little more detail regarding implementation.

Reactor licensees completed the first phase of their implementation activities as of December 2012.

The NRC inspections began in 2013. We are scheduled to complete all of those initial inspections this December.

The most common findings from our reviews involve the licensees approach to portable media controls.

Those issues primarily track back to some incomplete industry guidance which was not endorsed by the NRC prior to its dissemination.

We would like to highlight that the lessons learned from the first phase of implementation are

influencing both the NRC's staff and industry actions as we move towards the second phase of implementation.

Another area of learning for us was the approach to the CDA assessments. Initially, the NRC and industry plan on the universal approach to assess the 148 cyber security controls for each CDA.

However, as we gained experience in the initial phase of implementation both the NRC and industry recognize that the one-size-fits-all approach would not be practical.

For a level of effort perspective the number of CDA assessments associated with the initial implementation numbered fewer than 20 for a single reactor site.

For the full implementation a second phase. Industry estimates that more than 2000 CDA would require assessments of those 148 controls.

The desire to right size the CDA assessments led to the development of what we now call the consequence-based approach to CDA assessments.

The consequence-based approach was originated by NRC and embraced by industry and what it allows is the licensees can consider the potential consequences of the cyber compromise before they perform the assessments.

The consequence-based screening differentiates between CDA's that have an immediate impact on the required functions and those that would have a delayed impact on those functions.

The so-called direct CDAs have an immediate impact and therefore require a full detailed assessment and implementation of applicable controls.

The indirect CDAs are those for which a cyber compromise can be identified and mitigated prior to impacting the required function.

These CDAs receive a base level of cyber controls that meet or exceed the current critical infrastructure protection standards.

Over the last year the NRC staff has been actively engaged with industry representatives on the development of guidance for this streamlined approaches.

A revision to an industry guidance document known as NEI 1310 is underway and will provide licensees with simplified templates for abbreviated reviews of multiple categories of those direct impact CDAs which require the full assessments.

That reduces the level of effort necessary to complete this.

All licensees are scheduled to complete the second phase of implementation for cyber security plans

by December 2017.

NRC staff is currently working on inspection procedures for our reviews and we are also developing guidance in preparing our inspectors, and training for our inspectors, so that when the sites have fully implemented their plans we are ready to begin our inspection oversight work.

To help ensure that the NRC and industry or prepared for the second phase of implementation we completed two limited scope pilot inspections in 2015.

We are planning additional pilot activities in 2016 that will examine the full scope of activities required by a licensee's plans.

The results of these pilots will help the staff refine the inspection procedures and hopefully will provide insights regarding any gaps that might exist regarding the industry's understanding of the requirements.

Getting an early understanding of any gaps that might exist will allow the NRC and the industry to resolve those issues before the full implementation inspections begin in 2017.

The NRC cyber security roles and more explicitly the licensees cyber security plans which we have approved include a number of operational and

management controls intended to mitigate the risks of a cyber compromise.

While a few of these controls were addressed in the first phase of implementation a significant number still need to be addressed during the second phase of implementation by our licensees.

Among these are controls to mitigate the risks associated with the acquisition of systems and services.

The specific controls listed on this slide are intended to work together to mitigate the risk that accompanies the procurement of new hardware, software, or IT services.

For example, the supply chain protection element includes establishment, a trusted distribution paths, validation of vendors, and inclusion of tamperproof product seals.

In addition, the licensee's actions to address potential supply chain issues the NRC staff actively works with federal partners to monitor the cyber threat environment.

Our next step is related to operational management and controls include engaging our external stakeholders on what additional guidance might be necessary to fully implement those requirements and the best approach to developing that guidance whether it be

NRC originated or industry originated with NRC review endorsement.

During the full implementation inspections, the NRC inspectors will be reviewing how licensees have ultimately implemented actions on site to meet these requirements.

Finally, I would like to briefly mention some additional cyber security activities that are also in progress.

The cyber security event notification rule was approved by the NRC Commission in 2015. The staff anticipates that the final rule will be published in the Federal Register within the next few weeks.

The rule includes requirements for licensees to report significant cyber events to the NRC's operation center within specified time frames and to log other less significant events at the site.

This reporting structure is very similar to how the NRC has approached requirements for reporting physical security events.

The staff is also continuing efforts identified in the 2012 cyber security roadmap which provided a prioritized approach to examining potential need for cyber requirements at several categories of NRC licensees.

The reactor facilities were addressed first as a first priority and those activities as I have been discussing are well underway.

In March of this year the Commission approved a rulemaking to address cyber security for fuel cycle facilities. The draft regulatory basis was published in September.

The comment period closed in October and the staff is scheduled to deliver the proposed rule to the Commission in mid 2016.

The office of Nuclear Reactor Regulation is currently undertaking its reviews of research and test reactors and the Office of Nuclear Material Safety and Safeguards is looking at potential cyber issues associated with a very broad set of radioactive materials licensees.

This concludes my presentation and I look forward to questions you may have.

CHAIRMAN BAY: Thank you, Brian. Let us start with questions from our colleagues at the NRC.

Chairman Burns?

CHAIRMAN BURNS (NRC): Thank you. Just a couple questions for you regarding the ongoing evaluations in the area.

You talk about the new reliability standards

addressing supply chain, risk management.

Maybe giving you a little more granularity on what the main issues are that you are trying hope to address that stance.

MR. McDERMOTT: The proposal in the NOPR, I really characterize it as a conversation starter.

If you are familiar with NERC's processes, we can provide sort of the objectives that industry needs to meet but we cannot necessarily write the standard.

The four biggest risks that I see in this space are adversaries taking advantage of legitimate third-party access adversaries taking advantage of unnecessary functionality in software products and adversaries taking advantage of seeking security processes and things like that for business processes and then legacy products and the problems with what to do after certain systems cannot be patched anymore.

CHAIRMAN BURNS (NRC): The other area in terms of the standards with respect to modifications regarding protections for communication networks, again, can you give me a little more granularity on what the concerns are there and the objectives of the network?

MR. McDERMOTT: I don't know if you have seen recently the director of national security James Clapper who was speaking before Congress, he started talking

about sort of the biggest risks that he sees in the future and one of those was the data modification type of tax on critical infrastructure.

The risks, basically, the standards right now as they are currently framed, the protection stops at sort of your perimeter, and so any data or traffic that you are sending across the line to another control center or a generating plant or a reliability coordinator, this sort of stops with your internal plant network.

What we are talking about is protection beyond that where you are protecting the data between those facilities.

The proposal itself is scoped to be a control center with focus given ot some of the concerns that were raised at our technical conference about latency issues when you are getting down to sort of plant type command signal.

Did that help?

CHAIRMAN BURNS (NRC): That helps, thanks.

CHAIRMAN BAY: Thank you Chairman Burns. Commissioner Svinicki?

COMMISSIONER SVINICKI: Thank you both for your presentations. It is clear for both agencies that cyber security is a complex area, the threat environment is

very dynamic and I don't think that we will ever be able to as regulators say, "Our work here is done. We conquered this one."

That being said, I do feel very confident in the work that the NRC expert staff has done. We are very very integrated with our U.S. intelligence community partners, with U.S. law enforcement, with the FBI.

Our Commission as a demonstration of the importance of this issue meets routinely with members of those communities to hear directly, not that our staff is not engaged at the staff level, but it does give me confidence that we have received feedback from those intelligence and law enforcement communities.

But in terms of our nuclear regulatory framework for cyber security when they look across the areas of concern in critical infrastructure in the U.S., we have gotten I think a moderately solid thumbs-up that we have in place the things we need.

That being said, there are human beings in the loop and much as with physical security, if people are going to pop a door open or be careless or do something reckless or simply just let their guard down, then you're going to have challenges and your very type of perimeter might become a little bit more penetrable than

it otherwise is.

Brian, in discussing the NRC approach to the identification and analysis of critical digital assets, I would say he was very fancy and diplomatic the.

The truth, the plain spoken way of discussing our lessons learned is that we got well into this with the nuclear power plants which is again the facilities that have the potential to have a higher consequence for us, maybe more so than the materials and fuel cycle facilities, so we prioritize getting our cyber framework in place for the nuclear power plants.

We got into that implementation and we found that in terms of the number of assets and the amount of the 148 point analysis which was resulting in or had the potential to result in a 100-page analyses for something probably akin to this microphone on off switch, so we decided that maybe we hadn't found the sweet spot in terms of the application of the requirements given their degree of consequence and that result is in the consequence-based approach.

Now we are doing better and we have an approach that we think makes more sense.

I don't know though that we found the ultimate in a perfect so sweet, so I'm sure that will keep a feedback loop there.

Mr. Phillips, what is FERC's assessment in terms of working with NERC and your regulated entities about finding the right sweet spot for the right graded application of these requirements?

MR. PHILLIPS: I actually had the privilege of sitting on the drafting team and sort of an observer capacities and we have been working very closely with NERC and the utilities that sit on the drafting team over the past two to three years to sort of hash out how to appropriately split the protections between the high medium and low impact.

Most of that is done right now and is a in situ requirement and an attachment sort of laying out the criteria for what makes this, what are the characteristics that makes this high impact to the grid and there's been a lot of conversations about that and costs.

We now kind have a more durable framework to look at implementing controls because we have done that work because the more controls you start to lay on, the more expensive it can be if you don't apply the controls as sort of the highest risk for areas where risk is aggregating.

COMMISSIONER SVINICKI: Will your system provide for the kind of feedback to try to keep perfecting that

graded application as much as we are trying to do?

MR. PHILLIPS: I think so. Unfortunately we have not reached a steady state with the standards just yet so in the event that there are future changes to the standard there will always be an opportunity to work with the industry on that to make sure that we get it right.

COMMISSIONER SVINICKI: Thank you. I just had one comment. Commissioner Honorable was mentioning the value sometimes of stepping back and thinking about how far we have come and our successes.

He will be much too modest to mention this, but for our Commission.

I want to thank Commissioner Ostendorff for the leadership role he took back in 2010 in helping us to establish direction to the NRC staff to set up the regulatory memorandum of agreement on the cyber issue so that we could do as a result of the Bright Line survey and at least minimize the redundancies and overlap in the regulatory framework between FERC and NRC.

There are too many stories in Washington about agencies and departments that cannot work well together and step all over each other.

This is a real success and for our commission, I thank Commissioner Ostendorff for the leadership that

he showed on that issue.

CHAIRMAN BAY: Thank you Commissioner Svinicki. Commissioner Ostendorff.

COMMISSIONER OSTENDORFF(NRC): Thank you, Chairman Bay and thank you, Kristine. Just a couple comments.

One, over a year ago since our last joint meeting with you all as colleagues had a chance to observe an NRC inspection of a cyber security rule implementation at Limerick Plant and I was very pleased to see a member of your staff from FERC there.

She was participating in the event, in the multiday inspection up in Pennsylvania, and I go back to Commissioner Svinicki's comment, I think it is a good example of working together.

It is one thing to sit here in Washington, DC or in Largo, Maryland and have a phone call or an email about something.

It is another thing entirely go to a national nuclear power plant and do the physical inspection associated with the cyber rule, so I appreciate FERC's leadership and staff work and fully participating in those opportunities.

I had some cyber security responsibilities when I was an official for the National Security Administration before coming to the NRC, so I am not an

expert in this at all, but I have been around it for a period of time and I have been around the Naval reactors program from my submarine experience in the Navy.

I will just tell you when I compare the nuclear safety issues that I have seen personally in my professional career to cyber security, the cyber security issues in many cases are much more complex.

Brian hit this very well in his presentation and I just wanted to kind of piggyback on Brian's presentation because, I think, as Commissioner Svinicki noted we started out with this rule that was too darn hard to execute.

It was a stack of paper as Kristine mentioned and it was only through an extensive number of NRC and industry meetings, workshops, hard work, with the papers out over the table to kind of see what is a better approach because the first one was, as the Kristine mentioned, too cumbersome.

I would say from my personal viewpoint as a commissioner for the last five and a half years having watched all of the staff dealing with Fukushima related-safety issues, it is my personal observation as I think the engagements and the cyber security arena had been more complicated and more necessary to get to an appropriate regulatory standpoint.

Just a personal viewpoint but I do offer it FERC and to Commissioner colleagues that one cannot spend enough time engaging with the people to have to execute this industry at the industry level that is so important that I think it is been our lesson. We are not there yet. We are making progress, but it has been a long road. Thank you.

CHAIRMAN BAY: Thank you, Commissioner Ostendorff. Commissioner Baran?

COMMISSIONER BARAN (NRC): Dan, I just had a couple of questions to follow up on Chairman Burn's questions on the protection of communications, network aspect of the proposed CIP Standard.

Can you give us a better sense of what falls into the category of low impact cyber system?

MR. PHILLIPS: Not saying everything, but most substations I would think fall into that category.

There are some control centers and there is also a generation under 1500 MW would fall into that category.

COMMISSIONER BARAN (NRC): In the notice for proposal rulemaking my understanding is that FERC there said that that determined that there was a concern about not covering the low-impact control centers.

Can you talk a little more about the concern?

Is the idea that someone could take a thumb drive with malware in it and go out to a kind of low impact substation and then they are into the network?

MR. PHILLIPS: Are you asking with respect to the transient device controls or with respect to the communication?

COMMISSIONER BARAN (NRC): I an speaking on the communication side.

MR. PHILLIPS: The low-impact control centers currently would be included in the proposed modifications to sit six because basically those control centers are needed to communicate with other control centers to maintain reliability and feasibility into what is happening.

With respect to the low-impact control centers for transient devices, we propose to approve the controls that were developed for low-impact within CIP 3 but then there is this hanging question as to whether there is enough risk to warrant also included transient device protection in CIP 10 for those low-impact facilities as well.

COMMISSIONER BARAN (NRC): For the portable devices is that the type of concern that you're focused on there?

MR. PHILLIPS: Right, yes, so the low-impact

controls in CIP 3 don't actually mandate any protection from malicious code detection, so the idea there would be to make sure that common attack vector would be transient devices being brought into those low impact facilities for configuration.

COMMISSIONER BARAN (NRC): Thank you.

CHAIRMAN BAY: Thank you, Commissioner Baran. I also wish to acknowledge the efforts of our own staff here at FERC and the Office of Energy Infrastructure Security who coordinate and collaborate and share information and with DHS, DOE, and other government agencies, states, and an industry and law-enforcement and ICE also has been effective in helping to promote best practices in industry.

I have one question for Brian and that is, I was really impressed to hear about the inspections that you had been doing and that you're completing this year in 2015 and I am wondering whether there were any lessons learned from those inspections that you would be willing to share with FERC?

MR. McDERMOTT: Certainly. I mentioned during my presentation the issues associated with industry guidance on the portable media controls in the industry published guidance that we had aligned on prior to its use.

That was the largest issue. There were some others that came up behind that, though, issues such as how the licensees deal with the kiosks they used to monitor the portable media.

It is not just having licensees put controls in place to ensure that you have control over those portable devices of any type that can be used to bring malicious code into the site, but what do you to analyze them or how you go about that.

A threat vector there is that if you have your device that monitors the portable media connected to the internet so that it remains updated with the latest virus signatures and so forth, how is that controlled or are there other ways to do that?

That was just an example.

A lot of implementation type issues. Largely what we saw out of the initial inspections was the ability to reduce the number of extensive CDA assessments that are needed by the licensees.

There are a lot of opportunities to group equipment together to do these templates that I mentioned that really simplify the analysis because there are components out on the plants such as a pressure transmitter and they are all over the place, hundreds of these devices.

They may have digital chips in them and they may have a set of software running on them, but they are not connected to networks. They are not wirelessly enabled. The only equipment that gets connected to them is maintenance equipment.

How the industry deals with that maintenance and test equipment is another one of the issues that popped up during those initial inspections and we addressed those things through frequently asked questions process or through revisions to the guidance working with industry.

CHAIRMAN BAY: Thank you, Brian. Colleagues?

COMMISSIONER LaFLEUR: Thank you very much. I don't have any questions. Just a quick comment.

This is obviously one of the biggest things we work on and for all of the nation's critical infrastructures, not just the ones we regulate, cyber security challenges are dynamic and rapidly evolving and I always say in speeches that the nations bulk electric system and nuclear fleet are the only two parts of our critical infrastructure that are subject to mandatory standards so here we are together.

I just thought it was extremely interesting how many parallel themes there are in our work on this and I will just pick out a few.

The first is having different generations of regulation and learning from them and then learning as we go, we are already on CIPS 6 and I always say this is like the iPhone.

Once you think you have bought your kid the last one, they come out with a new model and we have already been talking about what we need to do next so that's healthy particularly since this thread is changing so much.

The second thing I heard from both Agencies is the increased emphasis on prioritization of the assets we are protecting and our case looking for which assets their loss through a cyber security incident could have the greatest impact on the bulk electric system and it sounds like you have done prioritization also as you have gone forward.

Third is our merging interests in supply chain management and that next stage of protection it sounds like we can learn from you there and I thought it was fascinating so I need to hear what you have done.

Thank you very much.

CHAIRMAN BAY: Thank you, Cheryl. Phil?

COMMISSIONER MOELLER: Thank you, Mr. Chairman. A quick question for Mr. McDermott based on what Commissioner LaFleur said.

You hear Mr. Phillips talk about our proposed rulemaking and the fact that we had introduced the concept of supply chain protection.

Frankly, it kind of surprised the industry and their initial reaction is, "We are already doing a lot of that," so there is obviously an information gap that at a minimum we have to address.

But I'm curious to the reaction that you have had to bring up supply chain issues. Of course the arguments being that we can't control that.

That's in someone else's control, and yet, you have chosen to address too, so I am just curious to your reaction.

MR. McDERMOTT: NRC has long established requirements for quality assurance associated with safety-related components.

In some ways those quality requirements provide a level of protection, but the cyber security and the supply chain issues go deeper is my personal opinion.

This is an area where we have laid out in the cyber security plans types of controls they need to have in place, but at this point there is no detailed guidance.

When I mentioned the fact that we will have to

work with industry that is going to be really two parts to that.

One is communication and outreach peace. We do a manual threat briefing for our cleared stakeholders, clear licensees.

We take that opportunity to talk to them about all kinds of threats, so one of the things we will need to do is provide what information we can to them to help make the case for them on the cyber supply chain.

But the other pieces in how we work with them in developing what additional guidance may be needed.

For us at times the industry will develop the guidance rule and we will endorse it and at other times the NRC staff will originate the guidance.

That is part of the discussion that I mentioned is really necessary for those management controls that comprise the portion of their cyber plans that have not yet been fully implement.

COMMISSIONER MOELLER: Another area ripe for cooperation going forward between the Agencies.

I had a chance on Thursday at our last open meeting to say farewell to my colleagues, but with this, this is my last chance to say farewell to colleagues at the NRC.

Best of luck to you and particularly fondness

for Commissioner Svinicki given our time on the Senate staff together.

Thank you, Mr. Chairman.

CHAIRMAN BAY: Thank you, Phil. Tony?

COMMISSIONER CLARK: Thank you, Mr. Chairman. I do not have any questions but thanks for the presentations, the discussion of supply-chain management was especially timely for me certainly.

Thanks.

CHAIRMAN BAY: Thank you, Tony. Colette?

COMMISSIONER HONORABLE: Thank your, Mr. Chairman. This is certainly well plowed ground. I too want to just make a comment to acknowledge that very hard and diligent work represented here today.

First, but not above, but our FERC staff, our FERC team, and Mr. Chairman, I was very pleased that you reference the energy infrastructure and security team led by Joel Mcclellan and they are working very hard and work very hard to keep us abreast of the issues that we face in this area with regard to cyber security and for me personally.

I recently had a briefing from him with regard to nuclear matters, so I am very pleased that we are staying on top of things.

I want to take this opportunity to acknowledge

NERC and the hard work that is happening at NERC to develop these standards.

This work is very complex. It is dynamic. It is constantly moving at the threats that are evolving and I was very pleased, as I think Mark does a fine representation of the passion and commitment displayed by NERC and I was very pleased Mark to hear you reference the work of the Electric Subsector Coordinating Council.

I have had the pleasure of participating in that effort in my former life as a state regulator and it is coordination and cooperation at its finest which we desperately need in this sector.

Last, but not least, our colleagues at NRC. Thank you for your work. I agree with Cheryl that it really is comforting to see how we are in lock step, if I might say.

The work is not perfect, but particularly with your reference on Slide 82, this work being priority risk based, we have made that movement here at FERC in our reliability and cyber standards this year.

It is an important step that we make together, so I want to acknowledge your hard work and that you for that.

CHAIRMAN BAY: Let me thank once again all of

the panelists for the presentations this morning. Thank you NERC. Thank you to FERC staff and thank you NERC staff.

That concludes that the open aspect of our joint meeting.