UNITED STATES OF AMERICA

+ + + + +

JOINT MEETING OF THE

FEDERAL ENERGY REGULATORY COMMISSION (FERC)

AND THE NUCLEAR REGULATORY COMMISSION (NRC)

ON GRID RELIABILITY

+ + + + +

PUBLIC SESSION

+ + + + +

WEDNESDAY

MAY 28, 2014

+ + + + +

The Commissions met in the Commissioners' Conference Room, 1st Floor, NRC Headquarters Building, One White Flint North, Rockville, Maryland, at 9:00 a.m., Allison M. Macfarlane, NRC Chairman, presiding.

Before the U.S. Nuclear Regulatory Commission:

Allison M. Macfarlane, Chairman

Kristine L. Svinicki, Commissioner

George Apostolakis, Commissioner

William D. Magwood, IV, Commissioner

William C. Ostendorff, Commissioner

<u>PRESENT</u>:

FEDERAL ENERGY REGULATORY COMMISSION:

CHERYL A. LAFLEUR, Acting FERC Chairman

PHILIP D. MOELLER, FERC Commissioner

JOHN R. NORRIS, FERC Commissioner

TONY CLARK, FERC Commissioner

WILLIAM H. ALLERTON, FERC

J. ARNOLD QUINN, FERC

THOMAS BURGESS, NERC

BRIAN SMITH, NRC

P R O C E E D I N G S

9:02 a.m.

NRC CHAIRMAN MACFARLANE: Good morning everyone. So we're a little cozy here with two Commissions. We're going to be conducting a Joint Commission meeting with the Federal Energy Regulatory Commission to discuss topics of mutual interest to our agencies.

In recent years, I believe we've been having joint meetings between our Commissions about every two years. The last one occurred, I think, just before I came on the Commission. So I'm looking very much forward to today's presentations and discussion.

I'd like to welcome Chairman LaFleur and her fellow Commissioners to the NRC. We have -- our two agencies have an existing memorandum of understanding that facilitates interactions between our agencies, on matters where we have mutual interest pertaining to the nation's electric power grid reliability, including cyber security-related issues.

We have a very full agenda today. We're going to have several topics to discuss, and we're going to have a luncheon and a tour of the NRC Operations Center, the brand new NRC Operations Center. I was just down there yesterday. Again, it's very nice, you'll like it.

The first part of the meeting is open, and is going to focus on grid reliability, nuclear power plant license renewals and dam safety, and the second part of the meeting will be closed to the public, and for that portion of the meeting, we're going to relocate to the second floor of this building. So we'll take a little break to do that.

On the agenda for the first part of the meeting, related to grid reliability, we're going to be hearing from Mr. Thomas Burgess from the North American Electric Reliability Corporation; Mr. J. Arnold Quinn from the Federal Energy Regulatory Commission; Mr. Bill Allerton from the Federal Energy Regulatory Commission, and Mr. Brian Smith from the Nuclear Regulatory Commission.

For the second topic -- oops, that was the second. For the second topic on dam safety, we're going to have Mr. Allerton and Mr. Smith. So we're going to conduct a question and answer session after each topic. Let me ask Chairman LaFleur if she has any opening remarks.

FERC ACTING CHAIRMAN LaFLEUR : Well thank you very much Chairman Macfarlane, and thank you for hosting us. It's wonderful to be here and meet so many folks from the NRC, and I'm happy to have a lot of FERC staff here with us. It's very important for us at FERC to have strong relationships with other agencies at the federal and state level, that regulate the same companies we do, other aspects of the same work that we do, and that's particularly true of the NRC, with our long-standing MOU.

The meeting today focuses on several aspects of mutual interest. I particularly am interested in the report on the state of the nuclear fleet, current and future. We've been talking about that actually quite a bit at our recent -- our own open meetings, because the fleet accounts for 20 percent of our electric generation resource mix in the country, very important to reliability. It's more than half of the carbon-free generation in the country.

So we've very interested in all the things that both of us do that affect the long-term vitality of that resource. So happy to be here.

NRC CHAIRMAN MACFARLANE: Great. Would any one of my fellow commissioners like to make any opening remarks?

NRC COMMISSIONER SVINICKI: Just briefly, Chairman. I just want to welcome our Commission colleagues and Chairman LaFleur here as well. As she has noted, this is not only an acknowledgment of our long-standing and close working relationship, but I think it's very timely as well. I look forward to today's presentations and welcome.

NRC COMMISSIONER APOSTOLAKIS: Yeah. I join my fellow Commissioners in welcoming you here. I think the idea of us meeting periodically is a great one. I would also like to welcome the staff members from both FERC and NERC, who will give us presentations on the issues of mutual interest, and I'm looking forward to our discussions. Thank you.

NRC COMMISSIONER MAGWOOD: Thank you, Chairman. I'd like to also add my welcomes to Chairman LaFleur and the other Commissioners. It's our turn to host you. Sorry, we don't have the space that you do in your facility, but we do make do.

And again, I'd also like to welcome the staff of FERC and NERC, and I wanted to also have a special shout out to our Office of the Secretary, Rochelle and her folks, for working so hard to pull this together. I know this was a big effort. So good work, and thank you. Thank you, Chairman.

NRC COMMISSIONER OSTENDORFF: Thanks for coming. This relationship between our two agencies is very important, and I think this is a really timely meeting. Thank you.

NRC CHAIRMAN MACFARLANE: Would any of the FERC Commissioners like to make any opening remarks?

FERC COMMISSIONER MOELLER: Of course, of course. Well thank you again for having us. These are not only helpful because we get a chance to talk to each other and develop the relationships, but I also think it forces the staffs to work together, and sometimes that's even more beneficial than actually the public meeting. So again, thank you for your hospitality.

FERC COMMISSIONER NORRIS: Great to be here. Thanks for hosting us. I look forward to our conversation.

FERC COMMISSIONER CLARK: Good morning, and thanks for the invitation to be here. I understand I'm in Rochelle's chair. Someone already told me that, so thanks for borrowing -- letting me borrow your usual spot. I'm the newest to the Commission, so this is my first one of these that I've had an opportunity to attend.

I think the last one was maybe after I was confirmed, but literally days before I took office. So I've been in for a full two years. But thanks for the use of your space, and look forward to a good meeting.

NRC CHAIRMAN MACFARLANE: Great, thank you.

Okay. I think we're going to turn to our first topic right now, which is grid reliability, markets and extended loss of all AC power. So I'm going to turn it over to Mr. Burgess from the North American Electric Reliability Corporation.

MR. BURGESS: Thank you very much, and it's really a pleasure to be here and Chairman of the NRC and Commissioners, Chairman of the FERC, Commissioners, it's a pleasure to be here.

My name is Tom Burgess. I'm the Vice President of Reliability, Assessments and Performance Analysis, and in that capacity, we oversee the development of reliability assessments and gauge the performance of the -- reliability performance of the bulk power system.

So what I'd like to do today is provide you with a brief overview of the report, which summarizes what we refer to as the state of reliability. That is, a premier report which describes the behavior, the reliability, characteristics of the bulk power system of the prior year.

That report contains key findings, and it's based on a solid, technical framework that arises from merging data analysis, event evaluations, root cause reviews, and represents an integrated review of reliability.

Next slide, please. We should be having slides. There we go. So it's an independent review of performance. It attempts to identify trends and issues that potentially raise risks for the bulk power system reliability. We use that to formulate recommendations, and use that as a risk basis to provide recommendations to what we refer to as the Reliability Issues Steering Committee, which ranks and prioritizes the efforts that we undertake to improve and enhance reliability.

It is an input stream to the development of standards, the most important standards that we want to pursue. An initiative that we've undertaken, which is referred to as the Reliability Assurance Initiative, is also a risk-based approach to assuring reliability. Ultimately, it merges the concepts of event analysis, reliability assessment and even the cyber environment.

By providing an advanced indication or identification of trends and emerging potential risks, we believe that we can get in front of those risks, and initiate actions that can help alleviate the effects of those risks, or lessen the severity of those conditions.

Next slide, please. The first key finding is that the bulk power system has a sustained high performance level. This chart is a composite index chart, which is comprised of all the days of the year sorted from highest to lowest, in terms of severity.

The severity is an index comprised of transmission loss, generation loss and load loss. So that severity risk for every day of the year then is charted, and we can do a year-by-year comparison of the performance of the bulk power system on those measures.

In '13, our performance was as good as it's ever been in the years that we have been measuring reliability performance. So that is a good measure. The second thing is that we also track -- in the small box there, we track the high stress days which are occurring on the grid, and in this case we have no high stress days that exceeded five on our index.

AC transmission circuit availability remains very high at over 97 percent, and AC transition transformer availability remains high, at over 98 percent. So all in all, a good performance on the bulk power system.

Next slide, please. We also monitor frequency response. Frequency response is a very important measure that allows us to understand the behavior of bulk power system generators. We're observing steady frequency response across all of the four interconnections that we monitor.

The Eastern interconnection has a slight downward trend, but it is not statistically significant. So this is an area where we want to continue to monitor the activity and the behavior in the Eastern interconnection. We've also shown on these charts of the various interconnections an interconnection frequency response obligation for each interconnection.

There are some instances where the behavior has fallen below that interconnection frequency response. So those are areas that we're going to continue to investigate and try to understand common threads, common trends, common modes that we may be able to act upon.

A couple of pointers is that we have initiated -- we received approval of BAL-003 it’s a frequency response standard, which sets minimum frequency response obligation, and it allows for uniform calculation of frequency response or frequency bias. So that is beginning to emerge.

One point to note is that currently, Texas has probably the largest concentration of variable energy resources in the mix, and that gives rise to some of the dispersion in the data points there.

Next slide, please. What we have provided here is I want to talk about two key findings that we've observed. One is protection system misoperations, and failed AC substation equipment.

With respect to misoperations, these are -- these cause more severe transmission events than otherwise would be the case. There's a significant probability of their occurrence, and they are correlated with transmission severity. So the lines to the right have a high correlation with transmission severity.

There's about 2,000 operations per year and an average ten percent misoperation rate. However, that ranges in some regions from as low as five percent, which is a good performance rate, to 16 percent. So the root causes that we've identified have to do with settings, logic and design; have to do secondly with communication failures and thirdly with relay failures themselves.

This information comes to us from a series of different databases that we've analyzed. We have a database on misoperations themselves and the mitigation steps that are being implemented. We have a transmission availability data system database which is applicable to 200 kV and above assets, and then we have an events analysis work that indicates that approximately 40 to 50 percent of all the system events that occur have some involvement in misoperations.

So this is a priority that's been identified by the Risk

Committee. We do have reliability standards that are underway, to try to help address this, and we have a close working coordination effort with the North American Transmission Forum, to try to identify the three root causes and what we might do about addressing them.

Next slide, please. With respect to the other high correlation to transmission severity item, which is transmission system or substation equipment failures, we have formulated -- we've identified this. We've put together a task force to try to validate the findings and identify root cause, formulate some recommendations and solutions.

We anticipate that they would be producing this report by the end of this year, in December '14. We have seen some improvement in a particular metric that we have been monitoring, and I'd like to highlight one instance where we have identified a root cause, we have initiated some action, and that has to do with 345 kV SF6 puffer breakers.

We've identified a failure trend and initiated a Level 1 alert. There's about 1,000 breakers across the system which are of this type, and we've collaborated with the North American Transmission Forum, and we have gone in and done maintenance activities.

Since that service alert, we have not encountered any further of these type of failures. So we'll be continuing to monitor that, to make sure that that alert is effective.

Next slide, please. The final key finding that we have identified is that the use of EEA Level 3 had begun to decline, and that's a good news story. EEA-3s are those where firm load shed is imminent or in progress, to preserve liability of the local area.

Oftentimes, this is an issue with real time adequacy, whether that be fuel supply, generation supply or on the transmission system. There were only seven in 2013 and only one of those was involved with actual load shed.

We also monitored other types of load shed, eight load sheds that were used to mitigate actual or post-contingency transmission systems. All of those were less than 300 megawatts, and only one exceeded four hours. So we're going to continue to monitor this. This is a good news story and less EEA-3s being required.

Last slide. So just to summarize, these findings and these trends are used to integrate with risk control projects, to refine our security metrics and address integrating variable resources, and a historic change in the resource mix. We use event analysis, actual event analysis and root cause analysis to make sure that we are properly reviewing and evaluating our data.

So with that, I would be welcome to consider any questions.

NRC CHAIRMAN MACFARLANE: Great, great. Thank you very much. All right. I'm going to start off with a really -- with a quick question. As a result of the Fukushima accident in Japan, we have asked our power plants to install additional backup systems to provide AC power in the event of loss of offsite AC power, and they're doing so.

But I'm interested in whether you guys track whether or how well restoration of power after loss of power is done.

MR. BURGESS: Restoration and recovery is an important area that we have done a number of activities on. One of those had to do with a GridEx II event that we convened last fall, really to test the system to breaking, and then engage both our preparedness, our communications and then our recovery steps that occurred beyond that.

Actually having a metric, though, on the actual conditions, the actual restoration in the system, we do not have currently that kind of a metric. That's probably something that we should investigate.

NRC CHAIRMAN MACFARLANE: Yeah, it would be helpful, especially for those of us who live in this area, and constantly lose power and don't get it restored for a week or more. It's of personal interest. Commissioner Svinicki.

NRC COMMISSIONER SVINICKI: Thank you, Mr. Burgess. Your evaluation is done at a pretty high granularity level. As a non-expert in this area, I read in the trade press and other places about difficulties in the kind of investment in the bulk power system that is needed, difficulties in siting and adding capacity, and then challenges with the fuel -- the capacity mix, now that there's more intermittent power.

How do I square those generalized concerns with what appears to be the outcome of your analysis, which is that we should reside pretty high confidence in the bulk power system reliability?

MR. BURGESS: Okay. A couple of aspects to that. The one -- the first is that the one area that was responsible for the majority of the EEA-3s is in the SPP region, and in the SPP region, they have in fact implemented a variety of transmission reinforcements.

Those have had the effect of relieving some of the stress and the pressure on the system, and so we've seen a decline. There's been some other changes in that area that are widening the dispatch horizon, the dispatch areas. So that has had a beneficial effect as well.

With respect to variable energy resources, we are beginning to see the emergence of the effects of variable energy resource impacts on the bulk power system. Last fall we completed a joint study with the California ISO, which highlighted attention on that very topic, and what might need to be done.

So as a consequence of that, we have initiated a work effort this year and next year, to develop better insights and technical understanding about what we're referring to as essential reliability services.

So that is all those characteristics and behaviors of reliability that needed to be attended to as the resource mix changes and the penetration, if you will, of variable resources continues to grow.

NRC COMMISSIONER SVINICKI: Thank you.

NRC CHAIRMAN MACFARLANE: Commissioner Apostolakis.

NRC COMMISSIONER APOSTOLAKIS: I'm interested in the misoperations issue, where you say that one out of ten operations is a misoperation and the causes are typically design errors or miscommunications. Now these are not recent results. Surely, the industry must have known about these things for decades; is that correct?

MR. BURGESS: That's true. There's a couple of factors that we've been monitoring. One is that there's been an emergence of electronic-type relays, and those electronic-type relays have a lot more flexibility and capability, but they have different kinds of failure modes. So that we're seeing a rotation of electromechanical into electronic types of devices. So that's one factor.

A second thing is that we do have standards which are relevant to misoperations, and part of that process is that for each and every misoperation that occurs, is to come up with a cause and a resolution, mitigation if you will, of that misoperation.

So while we've seen that, we haven't seen the kind of decline that we believe is important to ensuring reliability, and that's why we're taking additional steps to try to improve the performance, and reduce the misoperations rates.

NRC COMMISSIONER APOSTOLAKIS: So the one in ten is not acceptable?

MR. BURGESS: I don't believe it is.

NRC COMMISSIONER APOSTOLAKIS: In our world, that's an extraordinarily high number. Okay, thank you.

NRC CHAIRMAN MACFARLANE: Commissioner Magwood.

NRC COMMISSIONER MAGWOOD: Thank you for your presentation. Just very briefly wanted to follow up on something you said earlier. You mentioned there was a joint study with the California ISO. Could you just briefly summarize what came out of that study?

MR. BURGESS: A couple of key findings that emerged out of that were that as the proportion of variable energy resources grows, and the conventional resources begins to decline, we had a different reliability behavior on the part of the entire fleet, if you wanted to think of the composite fleet.

So for example, we begin to have less actual spinning frequency response, frequency devices that are out there. So there's less spinning mass. So that's one characteristic.

The other characteristic is with a lot of distributed solar, for example, that we're anticipating by the end of the next decade, we would expect to see less control over those kinds of devices, and consequent high levels of ramp rates being required, and fewer conventional resources to actually accomplish that.

So as the mix changes and there's a greater amount of variable energy resources available or in the mix, these essential reliability services like active control, ramp capability, frequency response, those begin to be strained.

So what we're attempting to do is to provide the sort of technical framework to understand when do we get to the point that we need to insist on more frequency response or greater ramp capability, etcetera, so that that -- those conditions don't propagate to the neighboring regions.

NRC COMMISSIONER MAGWOOD: I think European countries have a little bit more experience with this. They've gone a little bit further than we have with the use of variable sources.

Are there some lessons learned?

MR. BURGESS: There are, and one of the reasons for initiating this in a full-scale effort is that we want to avoid some of the lessons that have been learned in, for example, Germany, where most of the variable resources are located in the north. The load centers are in the south, and the system has become very fragile as a result.

So what they have encountered is with the new generation of variable resources, that being windmills, with the right kind of inverters they can mimic some of the essential reliability services. But they have to retrofit about ten gigawatts of old machines. So that's at a cost of hundreds of millions of dollars.

So we're hopeful that we can provide the right framework, the right guidance so that we avoid those kind of retrofit needs.

NRC CHAIRMAN MACFARLANE: Okay. Commissioner Ostendorff.

NRC COMMISSIONER OSTENDORFF: Thank you, Chairman. Thank you for your presentation. I want to go back to a comment that Commissioner Apostolakis made on the misoperation. We've very familiar with on the nuclear power plant side operator training and the Institute for Nuclear Power Operations what they do for training evaluations across the nuclear fleet.

I personally am not familiar at all with what happens outside the nuclear fleet as far as operator training and industry standards. Could you comment very briefly on the non-nuclear generation side, as to how they approach training and dealing with the operation issues that have previously been queried?

MR. BURGESS: Well, an important component of the root causes that we have identified does in final assessment land on human performance. So we have increased our attention on human performance. We have an annual event analysis, situation awareness and human performance conference that tries to marry up lessons learned and best practices in that arena.

So we have done so. We have not formalized that in the sense of specific I'll say training.

NRC COMMISSIONER OSTENDORFF: Okay, thank you.

MR. BURGESS: You're welcome.

NRC COMMISSIONER OSTENDORFF: Thank you, Chairman.

NRC CHAIRMAN MACFARLANE: Thank you. Chairman LaFleur, do any of your folks have questions or comments?

ACTING FERC CHAIRMAN LaFLEUR: Well, in the interest of time, I'll turn first to my colleagues.

FERC COMMISSIONER MOELLER: Very briefly, could you describe your relationship with NERC with the Transmission Forum? The forum we encouraged was basically modeled on INPO for transmission issues, and we don't have much time. But I think it's helpful to describe the Forum and the relationship you have with the Forum.

MR. BURGESS: Thank you very much. Yes, we are -- we have been nurturing our interaction and work with the Forum.

The misoperations area is one area where they have provided -- they're beginning to provide some best practices and lessons learned, and ways to deal with that.

So our relationship is one of viewing them as a partner that can help accelerate the promulgation of guidance and techniques that allow the actual registered entities to perform better. So we encourage that.

FERC COMMISSIONER CLARK: Just quickly. I'm curious, following up on some of Commissioner Magwood's questions. With regard to VERS and you talked about lessons learned with regard to VERS and conventional sort of base load power plants. Are there lessons learned around the world between high VERS integration and specific to nuclear, heavy nuclear sort of regions of the world or country? I'm curious.

MR. BURGESS: Yeah. I'm trying to think of any such instances, and none are coming to mind at the moment.

ACTING FERC CHAIRMAN LaFLEUR: Ontario I thought was one that had a lot of nuclear and a lot of wind and very little in between.

MR. BURGESS: There we go.

ACTING FERC CHAIRMAN LaFLEUR: They've struggled a little bit.

MR. BURGESS: They have struggled.

NRC CHAIRMAN MACFARLANE: Okay, great. All right. Anything else?

ACTING FERC CHAIRMAN LaFLEUR: No. You

can move on. Thank you.

NRC CHAIRMAN MACFARLANE: All right, great, excellent.

ACTING FERC CHAIRMAN LaFLEUR: Thank you, Tom.

NRC CHAIRMAN MACFARLANE: So next is Mr. Quinn from FERC. Go ahead.

MR. QUINN: Good morning. Thanks for the invitation. I'll talk a little bit about the market factors influencing nuclear power economics.

First slide. As a result of the shared jurisdiction between federal and state, nuclear power plants operate under a number of market and regulatory regimes, and to a large degree these regimes dictate that plant's exposure to wholesale electricity market outcomes.

Plants that are in states that have not restructured remain part of a vertically integrated utility, and those resources depend on the state regulatory decisions for their cost recovery. So as long as state retail rates are set in a way that will allow cost recovery, those plants are fine.

Plants in states that underwent restructuring however, I'm going to call those merchant plants, must rely on market revenues to recover their costs. These market revenues come from transacting in the markets administered by the centralized market operators. In the Mid-Atlantic states, that's PJM, and they do this in a couple of ways.

Some of those plants sign bilateral contracts. The bilateral contracts last from, you know, a fairly long period of time, say three to ten years, and the price for that bilateral contract is dependent on finding a willing buyer and a seller that gets a sufficient price, because both the buyers and sellers are transacting in our organized markets, the price for that bilateral contract typically will be influenced by market outcomes.

But while that contract is in place, the nuclear power plant that's operating under that contract is insulated from market outcomes, until the contract rolls over. Nuclear plants that don't have bilateral power purchase agreements depend entirely on the wholesale markets for their revenues, and thus they're entirely dependent on those market outcomes for cost recovery.

In the rest of what I talk about, I'll focus on those plants, because those are the plants over which FERC has jurisdiction.

Next slide. I'll talk a little bit about what those wholesale markets look like. Broadly speaking, nuclear power plants provide two kinds of services that are compensated, energy and capacity. The energy market is designed to select the lowest cost that a resource is needed to serve load.

Because many of the resources that are providing electricity need to be postured for service well ahead of time, the energy market works on two time frames. On a day-ahead of operation, resources bid in to supply electricity for each hour of the next day, and the market operator determines the lowest cost set of resources needed to meet expected load for each hour of that next day.

The day ahead energy price is based on the highest cost resource needed to serve load, taking into account system constraints. Resources are selected are financially obligated, in the sense that what they're paid is that day-ahead price times whatever their day-ahead award is.

On the day of operation, the market operator basically follows the same kind of procedures. Resources bid in. A price is set based on the constraints in the system, and then a resource's real time payment is based on that real time price, at any difference between what their real time award is and what their day-ahead award was.

For the most part, base load resources like nuclear power plants operate on that day-ahead basis, because they're one of those units that take a long time to get going and to be postured. Any difference between the energy market payment that that resource gets and their operating costs are revenues available to recover fixed costs.

In regions of the country where the state does not take an active role ensuring that the fleet of resource is sufficient to meet peak load, centralized markets have been developed to ensure that there is a resource adequacy on a long-term basis.

These are called capacity markets. They're bid-based markets. In theory, existing resources bid into these markets, based on their going forward fixed costs. New resources bid into this market at the cost of new entry. When there are no new resources needed in an area to ensure resource adequacy, then the capacity price is based on the highest cost existing unit.

In areas where there are new units that are needed to ensure resource adequacy, the price is based on the cost of that new unit. This is little over-simplified, because there are some new resources, things like unit uprates or demand response, that can be lower cost than some of the more expensive existing resources, and at times they'll displace those new -- or those existing resources.

In the end, the capacity markets are designed to ensure that the combination of energy market revenue and capacity revenue is sufficient to allow a new entrant to recover its costs over the life of the plant.

Next slide, please. Any generator that has relied on the wholesale energy markets as its primary source for income has experienced lower revenues in the last several years, which is part of the reason we're talking about this today. The market monitor for PJM estimates that a nuclear generator's net energy and capacity revenues have dropped from more than $300,000 per megawatt year in 2010 and 2011, to about $220,000 per megawatt year in 2012, and $240,000 per megawatt year in 2013.

There are a number of market dynamics putting downward pressure on wholesale electricity prices. There is currently a very robust debate about the relative importance of those potential drivers, and I'll note that FERC staff hasn't come up with an independent opinion on which of those drivers is more important than the others. But I'll talk about those drivers next.

Next slide, please. So as I mentioned, energy prices are typically based on the marginal cost of serving load in any hour or any moment in time. Thus, as natural gas prices, and to a lesser extent coal prices have gone down, so has the marginal cost of serving load and thus so has the price for electricity.

In addition, the lumpiness of new entry means that the electric market has historically gone through periods where there's been excess supply and then relative supply shortages.

In periods where there's less excess supply, energy prices tend to increase on average. But the current experience with relatively low load growth means that we've stayed in the current period of excess supply for longer than we typically have.

Finally, some owners of nuclear generation also point to an increase in wind output, particularly during low load periods, as contributing to low energy prices. These assertions appear to identify several distinct issues. The first is simply that wind generation is a low marginal cost source of electricity. So any increase in wind output tends to displace more expensive generators, and then as a result, depresses the energy price.

Further, wind generators tend to be located remote from load, and electricity prices are designed to reflect the constraints on the system. So any generator that's on kind of an export constraint part of the system will experience low prices that are meant to signal the fact that that transmission system is constrained.

When wind output grows faster than the transmission designed to deliver it, and any other market reform is designed to kind of operate around the way variable energy resources work, you'll get that kind of increase in transmission constraint and that depression on electricity prices.

Finally, the production tax credit probably contributes to both of these factors. First, it supports entry of new wind generators. So it's just increasing the supply of low cost units on the system, and second, the production tax credit creates an incentive for that wind plant to stay on while energy prices get really low, and as a result, they're kind of insensitive to the signals that the prices are sending to them.

Finally, capacity market prices have faced downward pressure from low cost alternatives like demand response and generation uprates. These alternatives have been displacing relatively expensive existing resources and reducing the need for new entry, such that capacity prices have been lowered lately.

Some of these market dynamics may reverse in the future. For instance, with the implementation of the EPA's match regulations, we're likely to see some generation retirement, and as a result some increases in capacity prices, and probably for that matter energy prices.

In addition, transmission investment and some market reforms are reducing that bottleneck on transmission. So some of the energy price depression is also starting to go away. But the degree to which any of these future changes will result in a full recovery of revenue levels is just uncertain at this point. That completes my presentation. I'm happy to answer questions.

NRC CHAIRMAN MACFARLANE: Great. Thank you very much. I appreciate it, and I appreciate you being very timely. So as a nuclear safety regulator, we don't prognosticate about the future of nuclear power. We make sure that the existing facilities and the ones that are under construction are being run safely.

Nonetheless, I think your analysis is very interesting, and just a quick question on your last slide about the energy market drivers. You spend a lot of time talking about wind. How much generation is wind? You make it sound like it's ten percent or more.

MR. QUINN: Yeah I think -- I probably focused on wind, because that's been the nature of the debate lately. I think -- I really do feel like FERC staff hasn't come up to an independent assessment of which one of those drivers are more important, and that's really where the debate is these days.

NRC CHAIRMAN MACFARLANE: But wind is less than one percent of electricity generation?

MR. QUINN: Well, I think it -- the nature of the discussion is that especially in low load periods, in places like the Midwest, it can be a substantial portion, 30 percent of the electricity that's being produced, and as in those kind of isolated hours, all electricity prices can actually go negative, which is a little counterintuitive.

But it essentially is a generator paying to stay on the system, and the nature of the debate lately has really been focused on kind of those low load periods, and the degree to which it's wind generators that are driving kind of the overall lower energy prices, or it's just these other drivers like low gas prices and low coal prices and low demand growth.

NRC CHAIRMAN MACFARLANE: Well yeah. I think it seems demand is an issue. You have a depressed area, you know, a restructured market, a demographic shift to the South and East, right.

MR. QUINN: No. There's no question at all. I think all of the drivers I discussed and probably more contributes to the overall lower revenues that we saw in the last two years. This last winter, generally electricity prices were fairly high. It will be interesting to see kind of what the results are at the end of the 2013, and that's --

At the end of the day, that's the nature of electricity markets as well, is that we go through these kind of periods of relative shortage and relative excess, and you can go for relatively long periods where you have fairly moderate prices, which are generally good for consumers, but can put stress on generators.

Then you'll have these isolated moments where prices get very high, and to some degree that's the -- the system has been designed so that's where a lot of cost reoccurs.

NRC CHAIRMAN MACFARLANE: Okay, thank you. Commissioner Svinicki.

NRC COMMISSIONER SVINICKI: Well, the beauty of these independent Commissions is that they're designed to be contrarian. So I'm going to have a prognostication question. But I agree with Chairman Macfarlane. This isn't really an area that we focus on.

So laying aside your description of the rate regulated, because that seems more straightforward. So my question has to do with the merchant environment. It seems to me, based on the market dynamics as you've described them, you could draw two conclusions with near 100 percent certainty, and I'm going to ask you to challenge me on that if it's not true.

The first conclusion would be that in the merchant environment, no new nuclear, including small modular reactors, based on the economics that we've heard of what they might cost, no new nuclear would be built in that market environment with the conditions we have right now.

Then the second conclusion is that it's a near certainty that there would be additional existing nuclear plant retirements in the U.S. So I -- based on the market dynamics existing as they exist right now, as you've described them, those two things seem nearly unavoidable conclusions. What's your reaction to that?

MR. QUINN: I'm a fact and data-driven person by nature. So I'll state the fact that no new nuclear power plant has been proposed in our regulated wholesale markets in the last eight years. Though some have come under development, none have been completed.

The one caveat I'll make is that it's my understanding, and subject to check, that some uprates of nuclear units may have been kind of supported by the wholesale electricity markets, in particular the capacity markets. So certainly the fact that no brand new nuclear power plant has been built in the wholesale electricity markets, despite the fact that at least one set of units were at least under development at one point.

As to whether we'll have retirements, there's absolutely been the case that we have seen some retirements in the last years.

We absolutely have owners of nuclear power plants telling us that they feel that there is financial strain, and that they are actively considering whether they will need to retire their generators, and that that decision is coming in the near term.

I guess where I'll push back a little bit is the degree to which those issues are plant-specific issues. So you have a unit that happens to just need a lot of maintenance.

It's coming onto a cycle where it needs to, you know, do the kind of maintenance that you do to any kind of power plant to keep it going, and is facing kind of more expensive investment, near-term investment decision, and is asking itself whether -- well, the revenues it will receive over the next say three to five years make that new investment profitable or not.

You know, for units that are kind of humming along and not facing that big, new investment decision, it's not clear yet whether those kinds of units are facing that kind of stress.

NRC COMMISSIONER SVINICKI: Thank you.

NRC CHAIRMAN MACFARLANE: Thank you. Commissioner Magwood.

NRC COMMISSIONER MAGWOOD: I just wanted to first thank you for your comments. Very interesting presentation. Just to follow up on something. You were talking about the low margin of cost of wind and how that was affecting some of the base load plants.

You didn't mention portfolio standards, and I'm curious as to how that comes into play. Can you discuss that a little bit?

MR. QUINN: Sure. I'll be happy to do that, and I think it's absolutely fair to say that renewable portfolio standards and kind of the renewable energy credits that go along with them play a very similar role to what the production tax credit plays.

So to the extent that there's a kind of a dollar value on every megawatt of production, the kind of incentives to operate during these low load periods work exactly the same for a renewable portfolio standard that they do for the production tax credit.

NRC COMMISSIONER MAGWOOD: It's not specifically a nuclear problem. It's more of a base load plant issue?

MR. QUINN: Yes, that's exactly right.

NRC COMMISSIONER MAGWOOD: And so as from a FERC perspective, as you take market away from base load plants and they become less cost effective, what does that do? And maybe this gets back to Mr. Burgess a little bit. What does that do to the reliability?

MR. QUINN: I'm an economist, so they don't usually let me talk about reliability.

(Laughter.)

MR. QUINN: So I'll answer a different question that an economist gets to answer, which is kind of what can we do to make sure that resources that are providing reliability on the system are getting compensated, and that's absolutely something that the Commission is right now actively considering, both how our capacity markets are designed, and whether the full value of a base load plant is included in the payments they're getting from the capacity market.

But also whether we have the right set of products out there, that will incent the resources that can provide reliability, are getting paid and can survive to provide those services.

NRC CHAIRMAN MACFARLANE: Okay. Commissioner Ostendorff?

NRC COMMISSIONER OSTENDORFF: I must applaud Chairman LaFleur for her training of the staff to stay in their lanes. No. I'm sure you have an open environment to discuss whatever you want to discuss, so I thought that was a great comment.

I wanted to kind of touch on topic that others have already addressed. But after the January 2014 "polar vortex," there's lots of discussion about base load generation and the impact in the Mid-Atlantic, in the New Jersey-Pennsylvania area, with a load temperature spike in demand for natural gas, affecting natural gas powered electricity plants, transmission problems because of lower temperature.

Those kind of issues and some of the nuclear industry said as a result of that experience in January of this year, they had concerns as to whether or not the base load capacity was appropriately valued in the United States, and that's a very broad statement.

But I'm curious as to your thoughts on that kind of remark that we have all been hearing, I believe.

MR. QUINN: Yeah, I think that's -- we've heard exactly the same set of comments. One of the things I'll note is that any nuclear generator that was providing electricity in those hours, the electricity price in some of those hours was $1,000 per megawatt hour.

So if you were a base load unit and you were operating, you were receiving $1,000 a megawatt hour and you know, your marginal cost was down at, you know, 15 or 20 dollars a megawatt hour. There was a lot of money there to be earned, to recover some fixed costs.

So the electricity markets are designed to provide that kind of reward for service when the system is stressed, and it's a very direct reward. If you were on, you get paid; if you were not on, you do not get paid.

The next question then though is that the only -- is that simple source of revenue enough, and does -- do we have to make some other payment that -- probably through our capacity markets, that reflect that inherent kind of value? And that's something that the Commission and staff are currently actively thinking about.

NRC COMMISSIONER OSTENDORFF: Thank you. Thank you, Chairman.

NRC CHAIRMAN MACFARLANE: Chairman LaFleur.

ACTING FERC CHAIRMAN LaFLEUR: Well, thank you. I want to pick up on the exchanges with Commissioner Magwood and Commissioner Ostendorff. We are actively looking at FERC at really all the competitive markets, but particularly the capacity markets, because were in an investment cycle for generation in the country, with so much change in resource mix, and it's important that the markets function to attract and retain the resources we need.

And the markets by design are fuel blind, but we do at times identify capabilities, such as ramping capability that a market might need. Picking up on the discussion of whether base load is being under-compensated in some theoretical way, I'm interested from Tom or Arnie to comment on what are the sort of reliability increments that the nuclear fleet provides?

It's obviously doesn't ramp up and down with the wind. That's the opposite of what it does. But it certainly has its own characteristics, and I'd be interested in your comments on that, from either an economic or a reliability standpoint.

MR. BURGESS: You want to go first?

MR. QUINN: I'll go.

MR. BURGESS: He can go.

MR. QUINN: So I think probably one of the things that we saw during last winter was this kind of element of fuel security that, you know, a lot of the stress that we heard about in our technical conference was simply arranging the delivery of fuel on a day-ahead basis, when you're not exactly sure which units are going to need to run, when those marginal units are gas units.

And even we heard some stories about some of the coal piles going down, and constraints on the railroad system. And so, you know, fuel security and knowing that you've got a stock of fuel onsite that's available and will be there for the entire length of a weather event, provides something you don't have to pay -- it's another thing you don't have to pay attention to.

MR. BURGESS: From a reliability perspective, that's exactly one of the things that we hope to understand better with our essential reliability services evaluation, and that is that when I say the resource mix is changing, it's changing in a lot of different ways.

One is that we're rotating from coal-fired to gas-fired. So we've now got about 40 percent, 40 plus percent that is gas-fired, and around 30 percent that is coal-fired. So one of the things that is associated with the resource mix is how much of that is base load. How much of that is mid-merit, that can accommodate ramps or accommodate changes in the needs of the system, and then how much of that is peaking or non-controllable VER-type assets.

That's an important question. We don't have the answer for that right now, but that is an important thing that we want to look at.

FERC COMMISSIONER NORRIS: You touched on a number of things that get me excited, so let me just start down the list here. First of all Kristine, you are -- the answers to your questions Arnie is doing a great job of providing analysis which the answers to your questions are yes and yes.

NRC COMMISSIONER SVINICKI: I appreciate that clarity.

FERC COMMISSIONER NORRIS: Absolutely. It's been a concern of mine, I mean and Bill, thanks for your comment about the base load of this. I mean I like it. The metaphor for me is how much do you need a good resting heart rate, and that's what nuclear provides. I think you can draw all kinds of metaphors for that. But as a society, we've kind of devalued that and -- but when you call upon it, it needs to be there.

And so it's critical to me that we look at -- there seems to be confluence of factors that are impacting nuclear generation facilities right now. Arnie touched on the ones economically, the market, the low gas prices, the production tax credit.

Those are factors that we're looking at, to try and unravel. I find it much easier to unravel, but hard to put it back together to figure out how to get these plants through this period, but -- and I may be breaking rules here and you don't have to answer this question, but I'm going to follow up with you or at least confirm for me.

Another factor is one of the biggest expenses of nuclear facilities are CAPEX, and one of the bigger segments of that are security-related CAPEX. In 2006, according to NEI, we spent about $60 million on CAPEX expenditures. It ramped up to $750 million in 2010. Now it's dropped back down in 2012 to 360.

Do you -- so that's, I think, a factor in this as well. As costs are going up, I think post-Fukushima some of the standards you've put in plant, rightfully so. At the same time, you've got gas prices driving prices down, wind driving prices down. A number of plants going through relicensing as well.

So how do we keep this resting heart rate alive or recognize the importance of it in capacity, in our markets, to keep these plants here? They're very critical to our base load, keeping our electric system in place.

So would that reflect your understanding, that there has been a peak of security related CAPEX in 2010? Do you see that coming down now or leveling off? You can follow up with staff on that as well. But I'm curious as to how much of a factor that will be in the next few years, as we get nuclear through this stressful period economically.

NRC COMMISSIONER OSTENDORFF: I'll just speak, John. Personal opinion, individual Commissioners or others may have different views. I personally think that the physical security posture at U.S. nuclear power plants is robust, and that there does not need to be an enhanced spending profile for that, for physical security.

In parallel, I think the cyber security domain is very complicated. Licensees are in the process of implementing a cyber rule that we passed in 2009. We're inspecting to that rule, as of January 2013. So I think some of those expenditures are perhaps in the cyber domain, which we all are concerned about. But that's just my personal view.

NRC CHAIRMAN MACFARLANE: We're going to talk about cyber later, so in the interest of time, I think we should --

FERC COMMISSIONER CLARK: This probably goes in the comment bucket more than question one. But Arnie, if you want to respond, feel free. I think you correctly assessed that the challenge that nuclear units face is especially acute in these restructured regions of the country. So a lot of it has to depend on the regulatory regime that the state itself has chosen region to region.

It seems to me that perhaps an elegant solution that fits within our markets that we've dealt with a long time is the issue of portfolio standards, and typically we've -- states that have adopted them have gone the renewable portfolio standard route, which itself can cause challenges for nuclear units that are maybe looking to clear and receive bilateral contracts, or receive bilateral contracts.

So an elegant solution might be just pivoting to a clean energy standard, if the concern of the state is emissions and particularly if we're moving into a 111(d) world, where carbon emissions are going to be regulated. These would seem to be some of the most valuable units we have.

Has there been any movement that we've observed to clean energy standards in states, which would seem to solve a lot of these concerns and problems, and might increase the revenue stream for nuclear units while maintaining the valuable environment benefits that they have.

MR. QUINN: Yeah, that's a good question, and I think we've heard discussion from a couple of our state regulatory colleagues about at least the discussion of whether they can sign contracts. The kind of state signing contracts with the nuclear fleet in their state has definitely come up.

You know, I think the portfolio standard version of that might make it simpler. The problems that we've heard, that our state colleagues struggle with is, you know who -- and especially in restructured states, who they have authority left over to direct a bilateral contract being signed with, you know.

So some of the states feel a little hamstrung outside of a portfolio standard saying okay, I have these, you know, these four nuclear power plants. I, the state regulator, have decided they're critical for kind of our energy infrastructure. I continue to have jurisdiction over that, and I want someone to sign a contract with them.

Then they look up to find out who that someone is, and they can't quite identify who they still have jurisdiction to require the contract to be signed with.

FERC COMMISSIONER CLARK: I'm just wondering if it would operate in a similar manner, as any of the RPSs do in states that have restructured, where the obligation would be on the load-serving entity, and then they would enter into whatever contract they have to --

MR. QUINN: Right, yeah. That seems like a possible way around any limit on jurisdiction.

NRC CHAIRMAN MACFARLANE: Okay, all right. Just as a time check, we're now ten minutes behind. We'll try better next time. Now we're going to hear from the NRC, Mr. Brian Smith. Go ahead.

MR. SMITH: All right, thank you Commissioners. The purpose of this presentation is to provide updated information regarding the NRC's activities in the areas of nuclear power plant license renewals, projections of new units and mitigation strategies for extended loss of all AC power.

Next slide. The Atomic Energy Act and NRC regulations limit commercial power reactor licenses to an initial 40 years, but also permits such licenses to be renewed. When these licenses are renewed, they are extended for an additional 20 years. To date, the NRC has renewed -- the NRC has issued renewed licenses for 73 units at 44 sites.

NRC has received notice that three of the units with renewed licenses have ceased or plan to cease operations prior to their renewed license expiration date. Specifically, Kewaunee ceased operations last year. Vermont Yankee plans to cease operations this year, and Oyster Creek in 2019.

By the end of this year, 38 of the units renewed will have entered the period of extended operation, meaning they will have been operating for more than 40 years. Currently, the NRC has renewal applications for 18 units at 11 sites under review. Nine additional units at seven sites have submitted letters of intent, indicating they will submit applications for license renewal.

Additionally, the NRC recently received the application for the Fermi license renewal, and it is currently undergoing an acceptance review. The agency is currently considering issues associated with subsequent license renewal, that being the renewal of operating licenses beyond 60 years.

The NRC also expects the first subsequent license renewal application in 2018. However, we have not yet received any letters of intent. The first units expected to operate for 60 years will occur in 2029, and these units include Nine Mile Point Unit 1, Dresden Unit 2 and Ginna.

Next slide. There are five designs that are either certified or are in the review process that are being considered by combined operating license applicants. Of these five, the two that are certified are the advanced boiling water reactor or ABWR, and advanced passive 1000 or AP 1000. A design certification is valid for 15 years from the date of issuance. It can be renewed for an additional

10 to 15 years.

Next slide. This slide depicts the locations of new reactor applications, as well as the combined operating licenses issued for the Vogtle Units 3 and 4 in Georgia and V.C. Summer Units 2 and 3 in South Carolina.

The NRC has received 18 combined license applications. Eight are under active review and the others have been suspended for various reasons. The eight applications under review plan to use four of the designs listed on the previous slide.

Next slide. Construction activities are currently underway at three sites in the U.S.: the Watts Bar site located in Tennessee, the Vogtle site in Georgia and the V.C. Summer site in South Carolina. The construction of Watts Bar Unit 2, a Westinghouse designed pressurized water reactor, was suspended in 1985.

The construction permit was reactivated in 2008, and the plant is expected to begin commercial operations by December 2015. The units under construction at Vogtle and Summer are Westinghouse AP 1000s. The combined licenses for the Vogtle and Summer units were issued in early 2012. Each site has one unit scheduled to begin operation in December 2017, and one unit in December of 2018. Combined, these units will add over 5,000 megawatts to the grid.

Next slide. The picture on the left shows the first nuclear concrete placement for the Vogtle Unit 3, which was completed a few days later. The picture on the right shows the first nuclear concrete placement for the first V.C. Summer unit completed in March of 2013, approximately 7,000 cubic yards of concrete replaced.

The NRC implements a stringent construction inspection program during the period between licensing and initial operation. It is primarily implemented by the Region II office in Atlanta, Georgia.

Region II dispatches as many as five resident construction inspectors to a new reactor site during the pre-operational phase of construction to oversee the day-to-day activities of the licensee and its contractors.

Additional inspections will be performed by personnel from Region II, other regional offices and headquarters technical staff as needed, to ensure that the as-built facilities conforms to the conditions of the license.

Next slide. The nuclear island structures include the containment, the shield and auxiliary buildings. The fixture on the left, from March of 2014, shows the placement of the 1,100 ton CA-20 module into the Vogtle auxiliary building. This module is more than five stories tall, and will house plant components such as the spent fuel pool and rad waste storage tanks.

The picture on the right shows Summer's auxiliary building construction and preparation for the lift of the CA-20 module, which was recently completed.

Next slide. Reactor designers are developing a number of small light water reactor and non-light water reactor designs. These designs can be used for generating electricity in isolated areas, or producing high temperature process heat for industrial purposes.

These are some of the potential small modular reactor designs NRC might see in the future. Small modular reactors can be either non-light water reactors, like those on the left, or light water reactors like those on the right.

The light water reactors on the right are integral pressurized water reactors. These reactors combine primary and secondary systems into a single assembly, which means that the steam generators are integrated inside the reactor pressure vessel.

NRC staff is currently engaged in pre-application activities, and expects the design and certification application for the NuScale design to be submitted in late 2016.

Next slide. On this slide and the next, I will address the issue of extended loss of all AC power mitigation strategies. At the Fukushima nuclear power plant in Japan, flooding from the tsunami disabled internal electrical power systems. After the earthquake, it cut off external power sources, leaving the plants with only a few hours' worth of battery power.

Nuclear power plants need electrical power, even when nuclear reactors are shut down, to run any equipment that cools the reactor core and spent nuclear fuel. The NRC issued a mitigation strategy order in March of 2012, requiring all U.S. nuclear power plants to implement strategies that will allow them to cope without their permanent electrical power sources for an indefinite amount of time.

Mitigation strategies are strategies to maintain or restore core cooling, containment, and spent fuel pool cooling following beyond design basis external events. The mitigation strategies are expected to use a combination of currently installed equipment, for example, steam-powered pumps, additional portable equipment that is stored on site, and equipment that can be flown in or trucked in from support centers, also known as flex equipment.

The three-phase approach involves the initial coping of the event, relying on installed plant equipment, transition from installed plant equipment to on site flex equipment, and finally the site obtains additional capability and redundancy from off site equipment until power, water and coolant injection systems are restored or commissioned.

Next slide. In the area of order implementation, NRC staff issued interim evaluations in late 2013 and early 2014. Also, the NRC staff is conducting reviews at licensees' facilities. NRC staff will issue final safety evaluations between late 2014 and 2018. NRC staff will then conduct post-compliance inspections at each site.

NRC staff is also pursing a rulemaking that will permanently write into the agency's rules the requirements already imposed by the mitigation strategies order. The final rule will ensure that if a plant loses power, it will have sufficient procedures, strategies and equipment to cope with the loss of power for an indefinite amount of time. That completes my presentation.

NRC CHAIRMAN MACFARLANE: All right, thank you very much. Okay, and you've saved us two minutes. Points to you Brian. All right. Chairman LaFleur.

ACTING FERC CHAIRMAN LaFLEUR: Well, thank you very much. That was really interesting. Thinking about just the conversation we had earlier on economics, there just seemed to be a big difference between the economics of an existing plant, and how expensive and difficult it is to build a new one.

I think I heard you say that you're exploring potential post beyond 60 year operation of the plants. I'm interested in a little bit more about that, and what we think the -- I know this is kind of on the edge, but like what's the engineering life of these -- this fleet that we have?

Because I remember when we never -- we thought 40 was it. Obviously, we're past that now, and they're not easily replaced. So I'm interested in how you're looking at that.

MR. SMITH: All right. There's a number of factors here. I'll touch on a couple of them, but then maybe ask a person from the staff to come up and answer in a little more detail. We look at things from an ongoing standpoint, an aging management standpoint, and we have lessons learned from the past that we look at when we evaluate the license renewal applications.

We also have a maintenance rule that requires certain active components to be monitored and maintained during the life of the plant, and then for the passive features, we have the ongoing analysis of those components as well. John.

MR. LUBINSKI: Hi. John Lubinski. I'm the Director of the Division of License Renewal in NRC. Currently, with respect to subsequent license renewal as we're referring to it, we have a paper with the Commission at this point that was issued in January of this year, which really scoped out the staff's recommendation for how to proceed.

So there are some regulatory issues associated with that that are still under consideration by the Commission, so I won't speak to those. But what I will speak to is the technical issues that Brian referred to.

As we looked at aging management, and that's really the specifics we're looking at from license renewal, when we got to 40 years, what we looked at is do you have an aging management program that's able to identify the degradation mechanisms and the effects of those mechanisms before they become a safety issue.

When you look beyond 60 years, the question is whether or not those programs continue to remain adequate or need to be enhanced. From the standpoint of the aging management programs, that could be a monitoring program, that could be mitigation. That could also be repair and replacement, and then it comes down to the economics is the cost of replacement.

If those components can't be determined that they can go beyond 60 years or getting beyond 60 years, you don't have an adequate aging or monitoring program, it comes to the point to decide whether or not the cost of replacing that component is offset by the continued operation.

ACTING FERC CHAIRMAN LaFLEUR: Thank you. Colleagues.

FERC COMMISSIONER MOELLER: Yeah. I've always thought that there was great promise in small modular reactors for the future of the nuclear fleet, but I guess the challenge is they've had a really hard time getting the cost down disproportionately lower than the unit size. It's more of an economics question. But thoughts on when those designs might become more economically palatable, with where the markets are going now, for any of you?

MR. SMITH: That's not my area.

NRC CHAIRMAN MACFARLANE: We're the safety regulator. We don't do economics.

FERC COMMISSIONER MOELLER: Understood, okay. Well, all right. Some questions fall flat.

NRC COMMISSIONER SVINICKI: Bill, could I just make a comment on that though, is that it's important to note the NRC staff's presentation of that we don't even have any applications for design certification in-house.

So although we won't evaluate the economics, there's still significant uncertainty about what the approved form of a design might look like once it goes through our very rigorous review process. So even that's unknown right now.

NRC CHAIRMAN MACFARLANE: Yeah, right. The latest information we've gotten is that they've all delayed submitting the design certification applications.

FERC COMMISSIONER MOELLER: Thank you.

ACTING FERC CHAIRMAN LaFLEUR: In other parts of the world, are some of them in operation?

NRC CHAIRMAN MACFARLANE: No, unless you count the floating reactor in Russia. But otherwise, no. Other questions? No? Over to you guys. Anybody? Comments?

NRC COMMISSIONER MAGWOOD: Just a quick comment. Chairman LaFleur mentioned the 40 year initial license period. It's often thought that that was considered to be an engineering lifetime for the facilities. It really wasn't. There's a lot of history of why that 40 year value was chosen, but it had more actually -- even though we're not an economic regulator, it had more to do with economics than with the physical capabilities of the facilities to continue operating.

I think the experience we've seen from the license renewal periods that we've undergone so far demonstrate that these facilities are -- they're not the facilities that were built 20 to 30 years ago. Many of the components were replaced over periods of time.

We have the aging management program, to make sure that larger passive components, you know, everything from reactor pressure vessels to containment buildings, are monitored and we understand what the conditions are.

So our program is really built around observing the aging of these larger components, and making sure that the active components are well-maintained. In that respect, you know, the lifetime of the plants is really limited by -- I think as Brian said, by how much the licensees are willing to pay to continue those kinds of activities.

NRC CHAIRMAN MACFARLANE: Yeah. I think this is an area of active debate and discussion, and internationally, there are different views on this topic. Anybody else? Okay, all right. Then we're going to move over to dam safety, and we're going to hear from our two speakers first before we have questions. We'll start off with Mr. Allerton from FERC.

MR. ALLERTON: Okay. Thank you for allowing me to speak very briefly about dam safety. My day-to-day function at the Commission is to administer the dam safety program. We have a large number of dams in our inventory, over 2,500. The largest dirt embankment is in California that we regulate, Oroville Dam and of course mom and pop facilities. They could be a one foot high dam.

The challenge is to implement a scalable dam safety program that's applicable both to large and small owners. This coming Saturday, May 31st, is a very important day in the history of dams. 125 years ago, South Fork Dam failed in Johnstown, PA, and it killed over 2,200 people. There's a -- so a lot of lessons to learn from that dam failure. In 2012, FEMA declared May 31st National Dam Safety Awareness Day, to encourage individuals in communities on responsibilities and best practices of dam safety.

So I encourage any of you that are in the area of Johnstown, PA to drop by the museum. It's a very interesting museum with a lot of history and lessons learned on dam safety.

So first I'd like to report that there's a very cooperative agreement going on between NRC and FERC, in implementing dam safety. The federal guidelines for dam safety issued by FEMA require that all federal agencies that own, operate and regulate dams to have good management practices for planning, design, construction, operation and regulation of dams.

These guidelines also require annual inspections be performed by qualified dam safety engineers, and both FERC and NRC have comprehensive dam safety programs. You'll hear from Mr. Smith who follows me about the successful relationship in performing annual dam safety inspections by FERC for NRC, through an MOU.

By using FERC expertise in overseeing our inventory of over 2,500 dams, NRC benefits in using FERC inspectors by not having to maintain a separate dam safety program for the very limited number of dams that they have.

I would also like to mention that both FERC and NRC serve as members of the Interagency Committee on Dam Safety, ICODS, in which we share resources and expertise to further our understanding of dam safety.

ICODS meets quarterly and allowing all the federal agencies that own and operate and regulate dams to share their expertise. Recently, the Fukushima incident has resulted in NRC and FERC working even more closely together, and Mr. Smith will comment on this further in his remarks.

FERC also is incorporating risk-informed decision-making into the FERC dam safety program, and in April, both NRC and FERC co-sponsored a very successful workshop on improving or moving the state of the practice forward and the use of probabilistic flood hazard analysis. Based on comments that we received, it was a very successful workshop, and we hope to have more workshops like that in the future.

So that concludes my remarks, and if there's any questions, I'll take them or turn it over to Mr. Smith.

NRC CHAIRMAN MACFARLANE: Okay, Brian.

MR. SMITH: Thank you, Bill. I would like to highlight three areas where we have interacted with the FERC on dam safety issues. The first is the inspection of dams on nuclear sites. The second is our interaction with FERC on the dams upstream of the Oconee site, and the third is our interaction with FERC on the reevaluation of flooding levels at nuclear power plants.

Next slide. As Mr. Allerton indicated, the federal guidelines for dam safety has guidance with respect to performing dam inspections. There are nine dams on nuclear facilities that fall under these federal guidelines. Seven of these nine dams are at nuclear power plant sites, and these are Catawba, Comanche Peak, Farley, Harris, McGuire, North Anna and Summer.

The remaining two dams are at uranium recovery sites, and these are Crow Butte and Smith Ranch. The dams at the nuclear power plants are primarily used to impound water for emergency core cooling, and the dams at the uranium recovery sites are used for the storage and evaporation of processed water.

These dams are inspected every two years for the power plants and every three years for the uranium recovery sites. NRC inspections are performed by FERC, and the FERC inspector is accompanied by an NRC staff member. The performance of these inspections has been coordinated with FERC since the early 1990's.

The slide is a photograph taken of a dam at the Smith Ranch uranium recovery site in Wyoming. The two individuals in the picture are a FERC inspector and an NRC employee. The picture shows the inspectors finding a crack in the embankment of the dam, which was subsequently repaired. The purpose of the slide is to illustrate that these inspections are effective in ensuring the adequacy of the dams.

Next slide. There are dams upstream of several nuclear power plant sites. In some cases, failure of these dams could result in inundating the nuclear site and surrounding area with water. In the 2000's, the licensee for the Oconee site performed assessments of the consequences of upstream dam failures at their site.

These types of assessments potentially have implications for the nuclear site and for emergency planning in the surrounding community. The most significant dams upstream of the Oconee site are owned and operated by the nuclear utility and regulated by FERC.

NRC staff has been working closely with FERC on these flooding assessments. In addition, we continue to work closely with FERC on assessing potential mitigating actions being considered by the utility, and interactions have been very effective.

Following the accident at Fukushima nuclear power plant resulting from the earthquake and subsequent tsunami, the NRC requested licensees in part to reevaluate the flooding hazard at their sites, using updated flooding hazard information and present-day regulatory guidance and methodologies.

Flooding can occur at a nuclear site for a variety of reasons, including extreme precipitation and upstream dam failures at sites located near rivers or lakes, or for coastal plants, storm surge from approaching hurricanes.

Many nuclear sites are located on waterways controlled, operated and regulated by other federal agencies such as the Army Corps of Engineers, the Bureau of Reclamation and FERC.

In order to perform these reevaluations, the NRC and our licensee need information pertaining to these waterways. Recognizing this, the NRC staff reached out to its federal partners on the Interagency Committee on Dam Safety or ICODS, as Bill mentioned. As a result of these interactions, we have ensured that we are aligned with our federal partners. Our interactions with FERC on this topic have been very beneficial.

These flooding reevaluations are ongoing at each nuclear plant site, and once completed, the NRC will ensure that the licensees take appropriate actions, as needed, to continue to protect public health and safety from a flooding event that could impact the site.

In addition, we have found participation in the semi-annual FEMA senior leadership meetings on dams to be beneficial, and look forward to the next meeting in July, which will be held at FERC. In summary, we have worked well with FERC on areas of mutual interest, including our dam inspections and all flooding reevaluations.

We look forward to working with them on these issues in the future. This concludes my presentation.

NRC CHAIRMAN MACFARLANE: Thank you, Brian. Thank you guys. Okay. We'll turn it over to FERC for questions.

ACTING FERC CHAIRMAN LaFLEUR: Well, thank you very much. I have to admit that when I first saw this topic on the agenda, I thought dam safety; why is that even a topic? But then I started thinking of the dams upstream of nuclear units. But what really strikes me is that, you know, the dam safety part of FERC is not our --

Maybe it doesn't get as many headlines, but we do have inspectors all around the country, and the work that we do with the hydro units is in many ways analogous to the work that NRC does with the nuclear units.

Our hydro resources are also aging, invaluable and not easily replaced, probably harder to replace than a nuclear plant. At least some of those are being built. Small hydro we're seeing a big growth in. I'm interested in whether there are -- is like a sharing of best practices or, you know, beyond just the direct work that you do together on a dam that affects a nuclear unit?

Are there ways that we can learn from each other, because we have such a -- this part of our operation a similar mission. NRC is like the preeminent safety regulator around, because of the criticality of what you do. Are there things we can learn or have learned in this program?

MR. ALLERTON: Well, my comment is as we're trying to move the dam safety program to risk-informed decision-making, there's a lot of things that NRC -- that we can leverage off of in doing that.

Of course, it starts with potential failure modes, how could the project fail, the risk reduction measures that can be implemented, probabilities of failure for the different events, you know, the instrumentation, you know, what can be done.

So there's a lot of things that we can learn from NRC in moving our program to risk-informed decision-making. It's really a big hurdle to educate engineers that have been quote "standards-based" in their career, and then moving them towards risk-informed decision-making. It's a really big challenge. Any comments?

MR. SMITH: I know sharing information's always very important, and we feel it's very important to have our staff go out with the FERC inspectors as well, to all the inspections, to better educate our staff as well. We mentioned the ICODS group. We're active participants in that; the senior leadership meeting on dams as well.

So we're trying to stay engaged on this topic and we're going to pass along information as much as we can.

ACTING FERC CHAIRMAN LaFLEUR: Thank you. Commissioner Hydro is here.

(Laughter.)

FERC COMMISSIONER MOELLER: Thank you, Madam Chair. A question primarily for Mr. Smith. We had the incident, I think it's been two years now in the Nebraska plant, and those rather dramatic pictures of it essentially being surrounded by water. Were there lessons learned or successes or any other perspective from that event, that you think are relevant going forward?

MR. SMITH: I'm going to have to ask for some assistance on this question from someone on the staff. I'm not as familiar with that event.

MR. HILAND: Pat Hiland. I'm the Director of the

Division of Engineering. Yes, we had a number of lessons learned from that event, particularly in the area of preparation. What is your preparation for the maximum flooding event that you can have for your site? When we went back and looked, there were preparations in place. The procedures weren't always up to date. The material wasn't readily available.

Although the site was well-protected, if you saw there, there was a donut around the site that they almost made it through the entire event. But it was broken, I think, at the very end. But we had a special panel, what's called an 0350 panel that was established for the Fort Calhoun site.

That panel was in existence for I believe almost two years, and all of the corrective actions were in place before we permitted the plant to restart.

FERC COMMISSIONER MOELLER: Thank you.

NRC CHAIRMAN MACFARLANE: Questions? All right. Well I'll have a quick question. So what do you, in your view, both of you, view as the biggest challenges going forward? As Chairman LaFleur pointed out, you know, a lot of this infrastructure is aging, and so what are some of the biggest challenges or concerns you have?

MR. ALLERTON: Well as I mentioned, identifying the potential failure mode of the project. I didn't want to talk about this project, Wanapum Dam at Columbia River in Washington, and a very unfortunate incident there. It was a potential failure mode that we weren't even focused on. No one really in the world was focused on, and then we got down and looked at it.

There were just a number of -- it wasn't really one big thing that caused the failure. It's just a number of things that kind of aligned. The stars aligned in it and it failed. So from a dam -- from my perspective, making sure that we are appropriately focused on what the potential failure mode is for the project.

The next big challenge for me is, as I mentioned, educating engineers from a standards-based to risk-informed decision-making. That's a big challenge. It's going to take a number of years to implement it, and it starts with training and I think those are the two biggest challenges I face, that the Commission faces.

MR. SMITH: From the NRC perspective, I would guess that it's the flooding reanalysis that all the licensees are going through now, and in particular for those licensees that when they do the analysis and determine that they're now beyond their design basis.

And so it would be the review of the plans that those licensees have to address those issues and going forward.

NRC CHAIRMAN MACFARLANE: Okay, great. Commissioner Svinicki.

NRC COMMISSIONER SVINICKI: I appreciate that both of your were complimentary of the good work done by the Interagency Committee on Dam Safety. But as I have met with the NRC staff on this issue, I've become aware that NRC has a little bit of a fundamental point of departure in our framework for looking at dam failures, and it arises from our mission.

At bottom, it's this. It's for many other federal agencies involved in looking at dam safety, they would be looking at the progression of perhaps a dam failure, and then evacuating populations of concern.

NRC is required to frame the issue a little bit differently, because what we have to do for nuclear power plants is look at how the site would be inundated and then we have to maintain some sort of set of responders at that plant, to take the actions that are necessary subsequent to the inundation.

As a result of looking at both probability, but maybe more significantly consequence at a nuclear power plant, we don't have the basic luxury of saying we can remove worker populations. So we need to have people that can survive that event on site, and take the subsequent actions.

So as a result of the high consequence of perhaps not being able to do that, we look at some probabilities that are a bit lower than other agencies, or we need to have a regulatory framework that analyzes and considers some lower probability events.

So I wonder if either of you would address how it is, if that's been any point of friction in the interagency work that NRC has to basically look at, and then characterize some events and probabilities that other agencies might lay aside as an extreme event outside their framework?

Is there anyone or anyone in the NRC staff that wants to point to that? I don't think that it's been a point of disagreement, but it has certainly been a point of departure from my understanding.

MR. ALLERTON: I guess I could comment a little bit.

It again involves the Oconee nuclear facility. In general, the dam safety community is probably at a 10 to the minus 4 probability of failure. In the NRC world, you're 10 to the minus 6, 10 to the minus 7.

So there's a little bit of difference in there. The way I understand that NRC is implementing protections of facilities from a dam failure is not to look at -- assume the dam fails, but then look for worse case scenario.

What needs to be done to protect that facility by building maybe a moat around it, so that facility remains dry and if there's workers there, they'd be able to continue to do their job. So that's my view of what's going on.

NRC COMMISSIONER SVINICKI: Okay, thank you.

MR. COOK: This is Chris Cook. I'm chief of the Hydrology and Meteorology Branch, Office of New Reactors. This was a topic that came up when we were developing the guidance, the Japan lessons learned interim staff guidance that was there, that was looking at dam failures that we were applying the post-Fukushima Recommendation 2.1 activities.

And so the discussions of certainly of this came up, and certainly what you mentioned was one of the points, was you know, looking at a nuclear power plant, the fact that we did not want to evacuate the site; we wanted to maintain people that were there, and looking at both ways to protect the site as well as maintain the essential core functions that were there.

So that that was one of the differences that came up, versus say evacuation plans, oh we could just remove people. So that was indeed a fact that came out with the discussions, and one of the things that we looked at incorporating into our guidance.

NRC COMMISSIONER SVINICKI: Okay, thank you. Thank you, Chairman.

NRC CHAIRMAN MACFARLANE: Commissioner Apostolakis.

NRC COMMISSIONER APOSTOLAKIS: Mr. Allerton, you mentioned risk-informed decision-making six, seven times in the last minute of your presentation. Glad you actually stopped, because I wasn't able to control my happiness with all this?

MR. ALLERTON: We missed you at the workshop.

NRC COMMISSIONER APOSTOLAKIS: Now one of the things that we have to deal with here, as we develop methodologies, risk-informed methodologies for flooding, is the probability of failure or the frequency of failure of dams, and I -- when I visited Oconee and the Jocassee Dam, I was told that some university had done a study and came up with some number.

Is there a more concerted effort to develop an acceptable methodology for estimating the frequency with uncertainties of failures of various types of dams? Is somebody trying to do that, or has it already been done?

MR. ALLERTON: Yeah. The biggest problem in the dam safety industry is incident reporting, and in the nuclear world, you have a good procedure for reporting, recording failures, you know, what caused the failure. But in the dam safety world, there isn't really a good or one entity that's recording all this data.

On the National Dam Safety Review Board, we're trying to make that happen. But it comes down to who owns the data, who's going to pay to maintain it, and there's always this concern that the owner has about liability, about accurately explaining what the failure mode was, and there's always -- they want to keep the information close to hand and not make it available to others.

We're trying -- the hurdle is having one central depository of all this information, so you can do a really good statistical analysis of dam failures, and incidences, and really -- I guess we're really only in modern times, only have about 100 years of good record making on --

NRC COMMISSIONER APOSTOLAKIS: So there is such a repository or you're talking about having a repository?

MR. ALLERTON: There are about three entities out there that record this information. We're trying to get just one person or entity to do it. We haven't been successful to date, but that's really been the big hurdle. So in the nuclear industry, you don't have that issue, but we have it.

NRC COMMISSIONER APOSTOLAKIS: Yeah. Mr. Smith, can you comment on that?

MR. SMITH: No sir.

NRC COMMISSIONER APOSTOLAKIS: Do you know what the probability of the failure of a dam is?

MR. SMITH: We rely upon the information provided by the other agencies.

NRC COMMISSIONER APOSTOLAKIS: Oh my God.

(Laughter.)

NRC CHAIRMAN MACFARLANE: Commissioner Magwood.

NRC COMMISSIONER MAGWOOD: It's always tough following him. Just a quick -- well first, let me comment. You know, before -- really before Fukushima I hadn't given a great deal of thought to dam failures. Certainly after Fukushima, you know, it's one of the scenarios that comes to mind for U.S. nuclear power plants, when you think about how do you get a large quantity of water to attack a plant very quickly. Obviously, dam failure is one that comes pretty immediately to mind.

So since Fukushima, I've visited several dams near or upstream of U.S. plants, and both FERC regulate and Army Corps. I found -- one thing I walked away with is this is an extraordinarily complicated issue. It's far more complex than I think many people realize.

So I mostly comment I appreciate the fact that, you know, FERC's expertise has come into this discussion. I think it's very important we work closely together on this, because we do have people, as you've heard, that have -- who have expertise in many aspects of hydrology and other things. But we're going to really have to rely very much on your expertise and on the Army Corps, you know, as we think about these issues going forward.

One question I do have for you. You know one, we are not the only country that has both dams and nuclear power plants, and I haven't really heard much conversation about dam failures in other countries. Have you engaged this with overseas, with any of our overseas partners?

MR. ALLERTON: Yeah. There is -- there's an entity called CIATI. It's a Canadian firm that gets together owners across the world that own dams, and this is where the interaction and leveraging off what everybody else is doing. So there is a good exchange of information that goes on, and from my perspective, not hearing too much about dam failures, means we're probably doing a pretty good job.

My worse nightmare is to wake up and find out that maybe a FERC dam is not performing good. So I think that's good. I think the dam safety community -- as a whole, I think we are -- we have a good record. I don't know how else to respond to your question.

NRC COMMISSIONER MAGWOOD: Maybe I should be more specific. I wasn't I think saying I didn't hear much about dam failures. I guess dam failure analysis, though. How are other countries approaching the analysis of dam failures? Do they look a probabilistic approaches or how are they discussing this?

MR. ALLERTON: Well again, it starts with your failure mode. What's the failure mode for the project?

As far as we look at sunny day type failures, what would happen if the dam just vaporizes and what happens with that slick of water as it comes down?

We also look at the various loading conditions, seismic, flood loading and determine if that dam can safely pass that flood loading if it were a seismic loading. And if it can't, look at what the impacts would be downstream.

NRC COMMISSIONER MAGWOOD: We'll leave it at that. Thank you, Chairman.

NRC CHAIRMAN MACFARLANE: Mr. Ostendorff? Okay. All right. I think we have come to the end of the open session this morning. I appreciate very much everybody's presentation and the discussion.

I think it was a great opportunity to discuss a number of topics of mutual interest to us. So I'm glad we had that opportunity. I guess we'll do it again in two years, at least that portion. Chairman LaFleur, did you want to make any comments?

ACTING FERC CHAIRMAN LaFLEUR: Well just to say thank you and I think we just scratched the surface of a lot of the topics that are of mutual interest.

So it's good that at the staff level and in other more informal ways, we have ongoing relationships between the two years. But because it's quite clear that we're all involved in on big ecosystem that delivers power, including through nuclear. So thank you very much.

NRC CHAIRMAN MACFARLANE: Great. For those FERC folks who aren't going to the closed meeting, there will be the tour of the Operations Center at 1:30, and they will meet where Rochelle?

MS. BAVOL: In the lobby in Three White Flint.

NRC CHAIRMAN MACFARLANE: Okay. You'll meet in the lobby at Three White Flint, which is across the street, across Marinelli, just that way. It's the new building just next to the Metro. So you'll meet in the lobby there at 1:30. Okay. All right. Well with that, I adjourn the meeting.

(Whereupon, at 10:41 a.m., the meeting was adjourned.)