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U.S. NUCLEAR REGULATORY COMMISSION

BRIEFING ON DIGITAL  
INSTRUMENTATION AND CONTROLS

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TRANSCRIPT OF PROCEEDINGS

Public Meeting

Before the U.S. Nuclear Regulatory Commission:

Gregory B. Jaczko, Chairman

Kristine L. Svinicki, Commissioner

William D. Magwood, IV, Commissioner

William C. Ostendorff, Commissioner

## APPEARANCES

## Panel:

C. Keith Paulson  
Senior Technical Manager, Mitsubishi Nuclear Systems

Tom Sliva  
Vice President, New Plant Project Management and  
Construction, Areva

Tom Ray  
Oconee Nuclear Station Engineering Manager, Duke Energy

Scott Patterson  
I&C Manager, Pacific Gas and Electric (Diablo Canyon)

Gerard Holzmann  
Director, Lab for Software Reliability, Jet Propulsion  
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## 1 PROCEEDINGS

2 CHAIRMAN JACZKO: Well good morning everyone. The  
3 Commission meets today to receive a briefing on the digital instrumentation and  
4 control systems. In recent years, actually I think going back to about 2006, we  
5 began a process to really shore up our regulatory infrastructure to ultimately  
6 develop the necessary technical expertise, licensing processes and safety  
7 oversight approaches for digital instrumentation and control systems. These  
8 digital systems offer the potential to improve performance and safety but I think  
9 those benefits will only be realized if the systems are properly designed and  
10 ultimately successfully implemented. I want to commend the staff for their  
11 excellent work on digital I&C issues particularly in developing sound guidance to  
12 help licensees and applicants meet our safety requirements.

13 We have come a long way I think from the first meeting that the  
14 Commission had on this issue in 2006. We've developed a very robust  
15 infrastructure; have completed work I believe on almost all of the task working  
16 groups that were set up to deal with these issues. And so I think today presents  
17 a very different picture than from where we were five years ago. But this is  
18 certainly an area given the importance of these systems and the continuing  
19 obsolescence of existing analog systems, that's an area where it is important to  
20 continue to work and ensure that we have an appropriate process and a process  
21 that keeps up with the rapidly changing pace of systems in this area. So I look  
22 forward to the presentations today and offer my colleagues an opportunity to  
23 make any remarks.

24 OK, great, we will begin then with Keith Paulson who is the senior  
25 technical manager at Mitsubishi.

1 MR. PAULSON: Thank you very much for this opportunity.  
2 Mitsubishi appreciates the hard work that the Commission has put in on their  
3 design over the course of the several years that we've been working with them  
4 on this. And also for the fact that they've been very frank and open and although  
5 have not given us indications of what they would like to see in the design, they  
6 always comment effectively on our designs and have pointed us in better  
7 directions as we move forward. And I think we're making good progress as an  
8 overall statement with respect to our review, so thank you.

9 First slide I would like -- just a brief history review, I don't want to  
10 spend much time on this because I recognize that some of this is familiar to you  
11 already. But I did want to point the progression with respect to I&C activities.  
12 Mitsubishi started the process of being interested in submitting a design control  
13 document in 2006. We came to the staff early in 2006, I don't remember the  
14 exact date but it was around March or April in that timeframe, to identify our  
15 interest in using the USAPWR design which is a derivative of the APWR in Japan  
16 and using that as a basis for future U.S. plants. We had no customers of course  
17 at the time and that was an issue that we had to deal with.

18 In November of 2006, Mitsubishi gave its first I&C presentation to  
19 the NRC staff. And this was a series of what we call pre-application reviews  
20 where we were trying to introduce the design to the staff and show not only the  
21 consistency of the design with respect to designs that they were used to seeing  
22 in the U.S., but also to provide an opportunity to show some of the differences  
23 and some of the places where actually in Japan they moved ahead and I'm going  
24 to get more into that later on. Take that as just a note if you want to talk about it  
25 more later on, we can do that.

1                   In March of 2007, we presented a series of topical reports on I&C,  
2 in fact throughout 2007 even before March we had provided some of our topical  
3 reports. We felt that the topical reports approach was very important for us  
4 because of the need to demonstrate first of all the sincerity of Mitsubishi, it's  
5 capability of building a nuclear power plant but also some of the advanced  
6 technologies that have been introduced in the Japanese design that maybe in  
7 Japan anyway a bit ahead of what has happening in the United States. The  
8 topical report was our avenue of doing that and hopefully getting some of these  
9 issues that are normally required to move forward in a design control process,  
10 design certification process, getting those out of the way as early as possible.

11                   As you can see that first year although we submitted roughly 12  
12 topical reports, a third of those were devoted to I&C in one way or another, three  
13 of them they're listed here and in the software program manuals, which we  
14 provided in December. And in that same December timeframe we also  
15 submitted our design control document for review and approval.

16                   We received in February 2009, the first RAI's for the design control  
17 document on I&C and began wandering through the magic land of I&C approval  
18 with the NRC. Next slide, thank you.

19                   The early review of the Mitsubishi systems in general of the DCD  
20 but specifically the I&C, was impacted, it started out slowly but was impacted for  
21 some obvious reasons. I'll have to say the staff was very honest when we came  
22 in and talked to them about moving forward with the design control document  
23 indicated that you guys were pretty well booked at that time with other reviews  
24 and we were coming in late without customers I am add. And that was almost  
25 two negatives that we had to overcome along the way. We recognized that and

1 did our best and continue to do our best to take account of that and recognize  
2 that in the process that's going on in the review. So Mitsubishi's position, was  
3 pretty low ranking at the time.

4           We also had because of the availability of the reviewers and one  
5 time, a couple time change in the review team, that also had some impact  
6 because there's a natural bringing up to speed so to speak of the new  
7 individuals. However, I'll have to admit that was aided and improved significantly  
8 by the NRC because they did have one reviewer, senior technical reviewer, that  
9 was part of the process the whole time and that does make a difference in terms  
10 of minimizing the impact of that relearning or learning process to get up to the  
11 same level of knowledge as the previous individuals.

12           So if I had to identify a status on this I would say, there has been  
13 substantial improvement from our point of view. We've had many, many good  
14 technical meetings over the course of the last six months. Not that they weren't  
15 before that, but we've been able to focus more on what the specific issues are  
16 with respect to the design that Mitsubishi is providing. And we've had a number  
17 of meetings over the course of the last couple of months that you may be aware  
18 of that have focused specifically in those areas and I'm going to next identify  
19 some of those areas that have been the primary focus areas for the Mitsubishi  
20 design.

21           Current issues impacting the pace of Mitsubishi's review are  
22 primarily two and these probably won't be too surprising to you, maybe the most  
23 surprising will be the first one, this is the process of developing a satisfactory  
24 software program and in our case software program manuals since we have one  
25 for our platform also. And having a basis for that we readily admitted that we

1 were behind in terms of understanding what that specifically required and it took  
2 us a couple of times to kind of get what was being looked for. The staff was also  
3 clear that they were looking for more than we had provided in the first couple of  
4 tries that we had. And finally after seeing templates that had been provided to  
5 other suppliers that had been approved, it helped us at least in the process of  
6 moving forward from that point in time. And, in fact, this month we have provided  
7 a third try at software program manuals, and have had a basic level of  
8 understanding on our part and an acceptance by the NRC part that at least in  
9 some of the samples that we have provided, we've reached the right level of  
10 information in the software program manuals. So there's has been a good  
11 process there where although it took a little bit of learning on our side and using  
12 some past history that had been developed by some of the other suppliers we  
13 think we've made progress there in where we want to be.

14           Next slide. The second issue is a fun one and that is the time  
15 required based on the design that Mitsubishi had presented in the design control  
16 document was complicated, it was complicated for a number of reasons.  
17 Probably the two that were most significant was we had what we called an  
18 engineering tool attached to the primary system which was continuously  
19 operating which gathered information about the reliability and availability of  
20 certain systems. And we thought that was valuable to have on a real time basis  
21 but it does complicate it because it's not a safety level system.

22           The second area was that our operational VDUs use a bi-  
23 directional approach rather than a mono-directional approach. So we had two  
24 issues that the staff believed were complicating the design and could cause  
25 significant delays in the overall review. From a status point of view, we've made

1 modifications in the design. Those modifications we think provide the basis for  
2 moving forward even though we have not completely eliminated the bi-directional  
3 aspects. We have prevented we believe in the design any possibility of the  
4 control of spurious signals from interrupting safety systems and that's what's  
5 being reviewed right now. Although we have no final indication from the NRC,  
6 they are reviewing it and have been at least positive with the progress that we're  
7 making in this area.

8           OK, I would like to move on now quickly to lessons learned. I think  
9 that there are a number that we can use and I also will try to take lessons learned  
10 and move forward with respect to some possible benefits that those lessons  
11 learned may have taught us and some ideas on things to be doing in the future.  
12 As you know the issue of digital I&C is not digital I&C systems for control and  
13 protection are not new; they've been around for many, many years and have  
14 been in the review process for many years to the point that the staff took an  
15 aggressive move with the interim staff guidance activities for interdivision data  
16 communications for defense-in-depth and diversity and the licensing process and  
17 putting those into a process that now provides good guidance with respect to  
18 moving forward on I&C designs. The lessons learned there we believe is from  
19 our point of view anyway, we believe that these ISGs were meant to fast track  
20 the I&C approval process. Probably hasn't happened yet, but that is certainly a  
21 good start and one of the things that we're hoping to look for are ways of taking  
22 advantage of what exists today as a broad knowledge with respect to I&C and  
23 how to move forward with respect to actually achieving the fast track.

24           Just a couple of other quick ones, a concern of ours because I think  
25 it has happened to us, but also possibly to some of the other suppliers and that is



1 because of schedule pressures with respect to customers and so forth, maybe  
2 we've made decisions that weren't the best to simplify our systems in order to  
3 move the regulatory process forward. I don't want to get into that too heavily but  
4 it's something to keep in our minds I think as we move forward with additional  
5 evaluations of how to make the review of I&Cs more complete and maybe faster  
6 with respect to moving forward with some of these issues like bi-directionality and  
7 of course from our point of view the definition of what is necessary from a  
8 software program manual point of view and the level of detail that is necessary in  
9 that document.

10 And the last lesson learned that I want to mention is that from the  
11 point of view of how the staff and Commissioners of course look at I&C as an  
12 important issue. And I was interested in your opening comments that you did  
13 focus on operating plants as well as new plants. I think that's an issue with  
14 respect to how staffing in the future from your point of view, and the importance  
15 of I think an issue that is going to be difficult for the industry to deal with as we  
16 deal with obsolesce. So let me move on from that, I wanted to mention just a  
17 couple of quick things about the Mitsubishi design that --

18 CHAIRMAN JACZKO: I'm going to ask you if you can wrap up, I  
19 think you're on your last slide so if you can try to wrap up so we can keep it  
20 moving.

21 MR. PAULSON: Mitsubishi has already implemented digital I&C;  
22 that's a benefit so there's a complete design available. The Japanese regulatory  
23 activities have been completed basically for the design. That doesn't mean that  
24 it's something that the NRC doesn't have to worry about but clearly it provides a  
25 basis because they use many of the same bases for evaluation although the

1 process is different but things like IEEE and so forth are fundamental in their  
2 design process. And availability of complete design information should help  
3 future activities.

4 Just two as I said, fast tracking on the last slide, this is some of the  
5 areas to address or possible areas that could be addressed that as to rekindle  
6 the ISG efforts using the information that we have complete design and so forth,  
7 using risk informed decision making as a basis for making decisions rather than a  
8 more deterministic approach, using the complete design information that exists in  
9 the industry now as looking for ways of getting beyond the DAC process and  
10 looking more at the ITAAC process for acceptable design whether it's by bi-  
11 directionality or uni-directionality. Prudently expand the staff to look at what's  
12 happening with respect or what could happen in the future with respect to  
13 activities both on the operation on the new plant side. To focus based on  
14 industry commitments focusing on independently not collaboratively and in this  
15 new plant area, and the last is a point I want to be considered and I hope that  
16 some of the other analyst pick up on this is to reconsider the operating plan  
17 upgrade requirements to focus on front loaded risks rather than what seems to  
18 be a risk that's loaded later in the process, which is not true of the Part 52  
19 process.

20 CHAIRMAN JACZKO: Thank you.

21 MR. PAULSON: Thank you.

22 CHAIRMAN JACZKO: I'll now turn to Thomas Sliva, vice president,  
23 New Plant Project Management and Construction at Areva.

24 MR. SLIVA: Mr. Chairman, thank you, we're pleased to be here  
25 with you again. When I listened to Keith's comments on Mitsubishi's design

1 experience with new plants under Part 52 in the design certification process it  
2 very much parallels Areva's own when we started on the relatively long road to  
3 the acceptance of our digital design for new reactors. And we were really looking  
4 at the 2006 benchmark taking to heart, you know, the industry goal. Total  
5 industry goal with an emphasis on review that would be stable, predictable and  
6 would be done in a timely fashion; and I think in 2006 everyone agreed that was  
7 possible, everybody agreed that digital technology was a good thing and its  
8 application to the commercial nuclear industry would also be a good thing.

9           We started our design with digital technology, not just looking at it  
10 as a replacement for the analogue systems where we were going to digitize the  
11 existing analog configuration. We really wanted to take advantage of digital  
12 technology to enhance those systems and provide some functionality that the  
13 analog predecessor couldn't provide. Along that way we realized that there were  
14 several difficulties in communicating with the regulator on how digital technology  
15 fit into the paradigm of safety, how digital technology could be demonstrated to  
16 be proven to be as effective and reliable as analog technology.

17           And in April of 2006 after starting the process very much in the  
18 same fashion as Mitsubishi did in the submittal of topical reports in preparation  
19 for the submittal of the design certification in 2007, we started frequent  
20 interactions with the staff to try to explain the details of our digital design, how  
21 that digital design relates to the analog components that it was supposed to  
22 replace and how that visual technology was inherently safe and that the futures  
23 being introduced by that technology would improve the overall reliability,  
24 effectiveness of control and potentially the safety of the plant. Along a path very  
25 similar to Mitsubishi, we worked with the staff on trying to finalize the end goal.

1 What did we have to demonstrate with the detail of the design, where the design  
2 was coming from and how it functioned in order to give the staff the comfort to  
3 make a safety determination. And along the same time line as Mitsubishi we  
4 reached some conclusions on the complexity and how to simplify our design,  
5 basically a two step process that really concluded in the summer of 2010, where  
6 we felt we had reached equilibrium with the staff, where we simplify our design,  
7 where we did offer solutions or we felt we offered solutions to the staff on some  
8 of the issues they felt were extraordinarily complex in looking at digital  
9 technology. And I think we reached a basis of understanding of how to proceed  
10 forward with the review. When we go to the next slide, our slide 3, again – in  
11 new reactors I found we loved timelines, you know, it's running a marathon, not a  
12 sprint. Part of what we struggle with with the staff, and I think with the  
13 Chairman's comments, we have improved the guidance. But the guidance has  
14 been issued during the review process.

15           So, I think it forced both the reviewers and the designers to make  
16 some mid course corrections that perhaps challenged the timeliness of the  
17 review, perhaps put issues on the table that were not considered when the  
18 review process was started in its infancy in 2006.

19           And this timeline shows, basically, the issuing of the guidance,  
20 which I also agree with Keith and with the Chairman's assessment, that it's  
21 basically very good guidance; it helps clarify the positions on digital I&C, but  
22 if you look at the timeline, much of the guidance was issued during the review  
23 process. I think that with the change of personnel both on the staff and  
24 sometimes in our design organization impacted the timeliness of the review,  
25 added some confusion points, and I think they made more difficult to solve the

1 issue of complexity of digital system systems, and how they related to the analog  
2 systems that by virtually being analog, were relatively more simple.

3           We lost ground every time there was a change in guidance, lost  
4 ground every time there was a change in reviewer, lost ground every time we  
5 had a design change with one of our designers here. So, I think that also  
6 contributed to the length of time. What we have found is that to keep pace with  
7 that it really did require frequent interactions with the NRC staff, which the staff  
8 has responded to. And we went to monthly meetings and then weekly phone  
9 calls to review process and closure plans, and how both the staff reviewers and  
10 our designers were progressing on the closing of digital I&C issues.

11           Again the frequent interactions, I think, by and large, were good. I  
12 think they were caused by a shifting mosaic, we didn't start with a well defined  
13 endline; it started with a goal of what that endline would be, and in the process of  
14 clarifying what that endline should be, there were the mid course corrections  
15 necessitated along the lengthy review process.

16           Right now, we're at a path again, in strikingly similar fashion, to my  
17 colleague from Mitsubishi, where Areva's design is working towards we think final  
18 closure.

19           We have agreed with the staff that the final items that need to be  
20 demonstrated in design for the staff to make a safety determination. We have  
21 committed, in a letter, when we would submit the appropriate design material.  
22 I'm happy to say, at this point in time, even though there are slight corrections, in  
23 that closure plan, from Areva's standpoint, we are on schedule for delivering the  
24 promised technical information per commitment.

25           Some of the sticky problems, again, and I think this shows

1 consistency in where we are in digital technology, are very similar to Mitsubishi's  
2 in our design where we're really struggling with the resolution of criteria for the  
3 correction of the service unit.

4           We have proposed a solution to the staff that doesn't have constant  
5 two-way communication involved with this service unit device, we think that will  
6 be proven acceptable to the staff's requirements for this, but again it's a similar  
7 issue to what our colleagues had on two-way communications.

8           We are also struggling with the level of detail required under Part  
9 52 to validate the design in the design certification process. How much detail  
10 does it require the reviewer to make a safety determination on the design,  
11 recognizing that perhaps the designs is not 100 percent complete at the time of  
12 its review.

13           So, we're working with the staff on adjusting this. Like our  
14 colleague, we are struggling with the level of detail that we are going to have to  
15 provide to close out the I&C issue and get a determination on the safety of our  
16 system for the new plants.

17           The issues I think, across the board are the same. The defense-in-  
18 depth issue is very key to our conclusion of the design, where we recognize  
19 analog backup is not required, however, demonstrating that the digital  
20 technology in and of itself in the configuration presented, does provide diversity  
21 in defense-in-depth, as a challenge on how to sort through and right now we're  
22 working on that as a part of our closure can.

23           Of course, we're making preparations to go with the staff, as  
24 requested, and present to the ACRS once we have finalized our closure plan on  
25 the digital design. I think, you know, the most perplexing thing that we come up

1 with when we look at closure, is the level of detail required to make sure that as a  
2 regulator you're comfortable with the technology being presented, and that it  
3 satisfies the safety criteria that are outlined in the different forms of guidance that  
4 we're working to. I think that's the biggest challenge in front of us and the staff as  
5 we push the Areva I&C design and design certification to closure.

6 In closing, I would like to say, digital technology, is, we think,  
7 somewhat magical. It does provide opportunities for functionality and reliability  
8 that we believe, were not available in analog predecessors. Digital technology,  
9 we feel, for the entire industry is important because of the obsolescence issues  
10 faced in older analog systems and the fact that the rest of the world is reliant  
11 upon digital technology. It's now the standard across the board in every industry  
12 in the modern world.

13 So, right now we are committed at Areva to working closely with the  
14 staff on the closure plans. We are committed to ensure that we close out the I&C  
15 issues in an effective manner. And what we want to do in that effort, as we close  
16 out our existing I&C issues, is to preserve the potential for digital technology, to  
17 improve the functionality, reliability, and potentially the safety of the plants, and  
18 still achieve a design that's understandable and meets safety requirements as  
19 put out in the various forms of guidance by the Nuclear Regulatory Commission.

20 So, I thank you for the opportunity to speak and look forward to  
21 working with you on the final closure of the I&C issues on new reactors and  
22 design certification.

23 CHAIRMAN JACZKO: Thank you. And I'll turn it to Tom Ray, who  
24 is the Engineering Manager at Oconee Nuclear Station.

25 MR. RAY: Thank you for allowing to me to speak today. I'm Tom

1 Ray, the engineering manager at Oconee Nuclear Station. I'll talk specifically  
2 about the implementation of our reactor protection system and engineered  
3 safeguards. I know it's of great interest in industry as far as Oconee's progress  
4 on that.

5 Current project status, this is the 13<sup>th</sup> digital project that we've  
6 performed at Oconee. The SCR was approved in January 2010, just over a year  
7 ago. Implementation for RPSES, as we called it for unit 1 in April, 2011 -- April 2,  
8 to be specific is when we actually start the implementation project. Unit 3 will be  
9 in April 2012, and Unit 2 will be in October, 2013.

10 We tried to put a year between each of the implementations to allow  
11 us to plow lessons learned back into the project, so we don't end up having to  
12 quickly make changes on those types of things. Since the SER was approved,  
13 we've completed all design packages. Site acceptance testing was completed on  
14 Oconee Unit 1. Unit 3 site acceptance testing will begin in June of this year,  
15 immediately following our outage. All installation procedures have been  
16 approved and post-modification procedures have been developed.

17 Looking specifically on Slide 3, on our testing activities, factory  
18 testing activities was performed prior to the issuance of an SER, due to the  
19 needs to incorporate the results of factory acceptance testing into the SER to  
20 demonstrate the design capabilities of the system. The site acceptance testing  
21 mirrored the scope of the factory acceptance test. We did use a slightly different  
22 method as in we provided inputs and tested it all the way through to the final  
23 output, to demonstrate the diverse methods of testing the system. The site  
24 acceptance testing simulated the inputs and then the outputs were actually  
25 monitored on a operator aid computer, an enunciated panel, indicating lights and



1 measured outputs signals so we did a full string test at the site acceptance  
2 testing.

3           The SAT procedures had to develop steps to specifically identify  
4 acceptance criteria that needed to be met in order to consider the system  
5 acceptable for use. The site acceptance criteria testing, actually tested the  
6 system, from all conditions from cold shutdown all the way up to 100 percent  
7 power-- we didn't just test it at a full power situation. And our site acceptance  
8 testing was observed by Region II inspectors.

9           On slide 4, looked specifically at our operations and maintenance  
10 activities, classroom training was developed for our operators and our  
11 maintenance technicians, for our I&C technicians we had to do three weeks of  
12 classroom training, an additional two weeks of qualification -- task qualification  
13 work was performed for those technicians to get them fully qualified on the new  
14 system. Our system engineers attended the maintenance training, classroom  
15 training, with the maintenance technicians, so they could sit side by side, hear  
16 the questions, see what types of issues that they looked like they were going to  
17 have going forward and be prepared for those who have issues once we put the  
18 system into service.

19           Training was specifically based on the type of work each group of  
20 would be performing on the system. Maintenance actually looked at  
21 troubleshooting activities: how the system operates, the types of troubleshooting  
22 activities you can do on the system, what types of outputs or diagnostic  
23 information the system provides. Same with the system engineers. Operator  
24 training focused more on operating of the system and types of failures that the  
25 systems could see.

1 All the operations and maintenance procedures have been  
2 originated and validated. They're currently in engineering for a qualification final  
3 review. For the operator training, we have -- at Oconee, we have recently  
4 installed a second simulator, so we have two simulators. One of the simulators  
5 was upgraded with the new RPSES system. It has capability of swapping back  
6 and forth between the old system and the new system. So, we are in the  
7 process of training all of our operators on the new system. And all of that training  
8 will be completed prior to the shutdown implementation.

9 MR. RAY: Slide 5. Specifically on the maintenance activities. For  
10 maintenance training, we procured a training simulator, it cost us about \$1 million  
11 to do that but we saw a lot of advantage on that. The maintenance technicians  
12 provided a lot of feedback on that simulator. Simulator not only allows them to  
13 do training, but actually put their hands on the system, and so they can actually  
14 match it up with classroom training.

15 The training simulator is the full channel for the alpha channel, and  
16 then the other three channels are simulated so they have a full channel with all  
17 the components to be able to work with it. Not only does this allow us to do  
18 training upfront before the system is installed, after the system is installed and  
19 operating, should we have issues with the system, it'll give us a training simulator  
20 that can go do "just in time" training on priority and troubleshooting activities.  
21 When we develop troubleshooting plans for any issues that we have with the  
22 system, we'll be able to take those to our training simulator and actually run them  
23 through the training simulator to look at issues such as proximity of components,  
24 and what problems that can cause, how we'd actually take parts of the system in

1 and out of service, and the like, such that it's all done in a training environment  
2 prior to actually getting on the actual system.

3 We've currently trained about 20 I&C technicians and they will be  
4 fully qualified prior to implementation which starts in two months. All the training  
5 on the current system is on site and fully set up in a training environment. At the  
6 end of February, it will be packed up and then moved to the station in preparation  
7 for implementation in April.

8 On Slide 6, you see that in the SER there's about 40 inspector  
9 follow-up items that are outlined. The inspector will follow up on -- broken down  
10 into six key areas -- we'll have follow-up activities associated with software plans,  
11 the maintenance software plans, and any training that we do for the software,  
12 and the installation and changes that are allowed on the software. We have a  
13 configuration management inspections to -- that will be going on. Key switch  
14 controls is an important one, how we control access to the system both hardware  
15 access and software access.

16 They will be in looking at our operations and maintenance  
17 procedures, how we've outlined them, how we do our testing, how we put the  
18 system in service and remove it from service, and the like. We have a number of  
19 activities that they will be observing associated with our cyber security,  
20 associated with system access control, how we use the test machine, the system  
21 unit interface, the cabinet alarms, how we actually implement actions associated  
22 with how we unlock and get into in any time you access the system will generate  
23 an alarm so that needs to make sure that's incorporated. Then we'll also have  
24 cyber security self-assessments in audit plans that they will be looking at. And

1 the last area we'll be looking at is coming in and observing our post-modification  
2 testing.

3           With the post-installation monitoring, we have developed directives  
4 to ensure the system engineering is involved early in the design process. We do  
5 that so that system engineers can identify those key functions and make sure  
6 that they have access to be able to monitor. All of our digital upgrades are  
7 considered safety modifications and as a result, by our directives, require post-  
8 installation monitoring plan. That monitoring plan will identify all the activities that  
9 the system engineer needs to monitor in the first year of operation – the first  
10 cycle of operation of that system, to ensure that the system is operating properly.  
11 And then after our first cycle of operations, the monitoring will drop to our  
12 standard system monitoring plans for our critical systems.

13           Slide 8. Looking at overall how we control our digital processes.  
14 Since 1997, we have had a digital upgrade directive that goes through how to  
15 actually control a digital upgrade. Software configuration management directives  
16 were implemented in 2005, as a result of -- from previous digital upgrades. The  
17 directives incorporate industry operating experience and things that came out of  
18 V&V activities or verification and validation activities. And the directives have  
19 been updated a number of times, incorporating industry lessons learned around  
20 digital upgrades. At this time, that completes my discussion on the  
21 implementation of our RPSES at Oconee. Thanks.

22           CHAIRMAN JACZKO: Now, I'll turn to Scott Patterson, who is the  
23 I&C manager at Pacific Gas and Electric.

24           MR. PATTERSON: Thank you today for the opportunity to speak  
25 before such a distinguished group about a project that's very important to PG&E

1 and the industry. My presentation will cover the background -- some background  
2 information on a process protection system replacement project, about where  
3 we've been, where we are in the licensing process, and the challenges that we're  
4 facing.

5           In 2003, Diablo Canyon established an I&C obsolescence  
6 management program to address aging I&C equipment. We selected a common  
7 hardware platform that we could use in many different areas in the I&C world,  
8 specifically for safety and critical control equipment applications. The common  
9 platform has many advantages, but it does create the question of diversity. So,  
10 one question that we had at that time was, "How much diversity is enough?"

11           We currently have a microprocessor based Westinghouse Eagle 21  
12 process protection system that was licensed and installed in 1994. The system  
13 was installed prior to branch technical position 7-19 and NUREG-6303.

14           So, another question we had was could we just replace the system  
15 through the 50-59 process since it was a digital to digital upgrade. BTP 19 and  
16 6303, however, did not provide us with enough guidance to understand the level  
17 of diversity that would be acceptable. It was evident that clarification was needed  
18 to determine an acceptable architecture with sufficient diversity, whether or not  
19 we went back for prior approval.

20           In 2006, PG&E had two meetings with the NRC staff to discuss our  
21 approach and conceptual design. Platform diversity was the main topic, but also  
22 the likelihood of a large break LOCA in conjunction with a common cause failure,  
23 seemed to be very small, so we questioned whether or not we really needed to  
24 add the complexity required to automatically respond to these type of events. At  
25 the time, the only way to get formal feedback was to formally submit a license

1 amendment request or a topical report. So, for PG&E, this approach was  
2 considered very risky and expensive. We needed a method of obtaining  
3 acceptance of a conceptual architecture and approach before committing the  
4 expenditure necessary to develop a license amendment that might be rejected.  
5 Slide 3.

6           Digital upgrades have been a hot topic in the industry and with the  
7 NRC. In 2007, as you know, the I&C Steering Committee established the task  
8 working groups to address areas of concern that would be beneficial -- where  
9 additional guidance would be beneficial. Task working group number two  
10 addressed the question of how much diversity is enough. And during those  
11 discussions it revealed the issues that concerned both the regulator and  
12 licensee. Participating in that task working group enabled PG&E to better  
13 understand diversity requirements and to develop an architecture that appeared  
14 acceptable to PG&E and the NRC staff. Our experience with the task working  
15 group confirmed our belief that a deterministic approach to evaluating diversity  
16 would involve less project risk than attempting a risk-informed approach.

17           The ISG-6 Phase 0 pre-submittal meetings were exactly what we  
18 were looking for. Back in 2006, it provided a venue for us to discuss the  
19 conceptual architecture, along with other areas that needed clarification, like  
20 cyber security and data communications. The meetings provided a forum for  
21 open discussion with the staff and allowed us to refine our approach. Formal  
22 feedback was provided for each meeting for several important concepts. They  
23 gave us confidence to move forward. This interaction with the staff was  
24 invaluable to our understanding of the licensing process, what was important

1 from a regulatory standpoint, and to reduce our project risk. We submitted our  
2 diversity defense-in-depth evaluation in April 2010, based on these meetings.

3 Our diversity defense-in-depth topical report is pending approval,  
4 and we are proceeding with application development. We've completed a  
5 conceptual design document, a functional and interface requirement  
6 specifications and those have been approved and issued to the vendors.  
7 Contracts have been let to vendors to proceed with ISG-6 Phase 1  
8 documentation needed for our LAR submittal. We are using ISG-6 to guide us in  
9 determining the information needed to be provided with our submittal. And now  
10 that Revision 1 is approved, we can refine our documentation.

11 Our next Phase 0 meeting is this Thursday in San Luis Obispo,  
12 California close to our Diablo Canyon, and we'll be discussing several items  
13 including how to structure and format our licensing amendment report.

14 So what is next? We expect to have everything completed and  
15 ready for our submittal this summer. We have two vendors involved in our  
16 project, with topical reports that are currently being reviewed. These vendor  
17 topical reports approvals are essential for our project to be successful. In 2012,  
18 we'll be establishing our ISG-6 Phase 2 documentation, and submitting those  
19 with an expected approval of our license amendment in 2013 to support an  
20 installation in 2014. Slide 6.

21 Nuclear power is very special and requires more thought to make  
22 sure that all areas of concern are resolved. So it is expected to take longer than  
23 a non-nuclear project. However, if this process is unpredictable and risky, the  
24 utilities will delay replacement beyond maintainable life of installed equipment.  
25 So it's very important to provide a process that is easy to follow, provides the

1 right level of detail of review, and does not accessibly burden either the NRC  
2 staff or the licensee.

3           So here are some of the challenges that we're currently facing.  
4 Staying on schedule is the first one. It's always hard to stay on schedule when  
5 you're depending on resources that are not under your direct control. ISG-6 took  
6 much longer to get approved than it was forecasted originally because of the  
7 detailed discussions that went on. Vendor topical reports and our diversity  
8 defense-in-depth topical report are taking longer than originally was expected.  
9 There's also been some internal budget challenges that have delayed key  
10 projects that -- we had one project that had to be installed prior to our process  
11 protection system replacement -- that project got delayed so that also delayed  
12 our process protection system project.

13           The ISG-6 process has not been refined; it's just basically come out  
14 in Revision 1, so I expect as us being a pilot plant we will require more interface  
15 with the staff and more information needed than will be necessary in the future  
16 after the process is refined. The required level of detail is, as Areva had  
17 mentioned, is still kind of a question for both the NRC and the licensee. For this  
18 process to be more predictable a better understanding of what information is  
19 required and what level of detail is needed. ISG-6 has attempted to help with  
20 this, so as a pilot plant, that level of detail will be tested.

21           Budget is another concern. Utilities have many competing projects  
22 and emergent issues that change the cash flow and affect schedule. This has  
23 been an issue in the past as I said previously, and is currently being challenged  
24 by several emergent issues that come up for the plant. Demand for money for  
25 other critical projects may affect our current schedule. Another area of challenge



1 is continuity and availability of resources, and I did hear that in a previous  
2 speaker. The longer the project goes, the harder it is to keep the same  
3 researchers involved. Changing resources requires that they be trained, brought  
4 up to speed and integrated in the process, and along with these new people  
5 come with new ideas, new questions, and that could slow the process down.

6           Digital upgrades are complex and require a specialized skill set.  
7 Finding enough of the right people to assemble a team and keeping them is not  
8 an easy task. Competing projects also affect resource availability not only for  
9 PG&E, but vendors have the same issue. New plant designs require many of the  
10 same resources, and the opportunities outside of the United States are causing a  
11 resource drain throughout the industry.

12           To conclude, PG&E tends to communicate lessons learned from  
13 this ISG pilot plant process. And also to provide the most value in making  
14 improvements to the ISG-6, interactive discussions must continue between  
15 PG&E and the staff. That's been probably the most valuable asset we have had  
16 through these task working groups. The discussions during these meetings are  
17 extremely valuable in achieving the guidance that we currently have. These  
18 critical discussions must continue to get the greatest benefit.

19           The ultimate goal for PG&E is to replace our process protection  
20 system with a new, more reliable system. In addition, the goal is also to provide  
21 feedback to ISG-6 process, to help improve guidance that will reduce project risk,  
22 and provide a more predictable and stable licensing environment. And it will  
23 improve nuclear safety. That's all I have.

24           CHAIRMAN JACZKO: Okay. We will now turn to Gerard  
25 Holzmann who's at the Laboratory for Reliable Software at the Jet Propulsion

1 Laboratory in the California Institute of Technology.

2 MR. HOLZMANN: Thank you. Maybe, by way of introduction, I  
3 should say that my approach to the issues that are being discussed here is a little  
4 different from that of the previous speakers. I'm a computer scientist, a software  
5 engineer. That means I'm one of those people who actually enjoys reading code,  
6 and writing code, and analyzing code. I've done so for the last couple of  
7 decades, first in the telecommunications industry at Bell Labs and now at JPL.  
8 And if you study the issues in software development, the number of trends has  
9 very quickly become evident, especially in the last few decades.

10 One is that there is an exponential increase in the size of software  
11 applications pretty much across the industry, no matter which applications you  
12 look at, whether they are desktop applications or mission-critical applications or  
13 safety critical applications, the size and the complexity of the software is  
14 increasing very rapidly. That's a very interesting trend for me as a computer  
15 scientist to see and to study the implications of that. The other thing you can see  
16 -- of course, I'm interested in finding ways to develop software that is safe and  
17 reliable. Of course, there are many, many good ways to apply those techniques,  
18 but that means also looking at ways of finding the defects in software. And what  
19 you can see is it seems to be a rule of thumb that most people accept that there  
20 is a relation, seems to be a linear relation, between the size and complexity of  
21 code and the number of latent defects.

22 Now, a latent defect is a technical term that's a term for the number  
23 of defects that escape all the testing and checking at reviewing phases that are  
24 normally applied. More rigorous in critical applications than in non-critical  
25 applications. So typical -- latent defects and residual defects are those that you

1 don't catch, so they show up when the system goes in operation. At JPL, of  
2 course we look at deep space missions, the residual defects are the ones that  
3 show up in flight, and that's where we don't want to have them show up. We  
4 want them to show up in testing, in the test beds.

5           Now, there is a relation between the size of software and the  
6 number of residual defects that we find -- which you can see documented in the  
7 databases that we develop for the missions that we fly. Doesn't mean that we  
8 can't fly missions or that all the missions fail, as you know, most missions do  
9 actually succeed. The ones that fail are of the most interest to me, to study why  
10 they fail, especially when they fail because of software, and we have a number of  
11 those types of issues.

12           Not all missions are developed to the same standards of rigor.  
13 Human-based missions like the shuttle missions, of course, have the highest  
14 standards of rigor and they do see residual defects, and they follow the same  
15 trends that we see in the other applications. I would like to bring up my Slide  
16 number 2 summarizing those issues. One thing that concerns me is that  
17 software test methods that are routinely applied in industry pretty much date from  
18 the '60s and have not kept pace as much as they should have with the increasing  
19 size and complexity of software. We're trying very hard to change that, and there  
20 are new developments that are very encouraging, but they've not yet been  
21 universally embraced in critical software development. So we're trying very hard  
22 to change that.

23           One assumption that we make at JPL when we design missions is  
24 that all software has defects just like any other system components will have  
25 defects. There's no perfection in hardware, there's no perfection in software.

1 Hardware components have breaking points, they wear out, they have  
2 tolerances, and the better you understand these tolerances and the types of  
3 ways in which components have failed, the more reliable you can make systems  
4 operate. Slide 3.

5           So software we understand to be a component of a system, and we  
6 have learned in many other disciplines to make reliable systems from unreliable  
7 components. We do that in the telecommunications industry, and send data  
8 reliably over imperfect channels, noisy channels, channels with loss or distortion.  
9 We've learned how to do that; we can build reliable hardware systems by using  
10 redundancy in defense-in-depth strategies, and we can learn to do that in the  
11 software. But, in software these principals are applied very differently because  
12 the types of failures that you see in software are fundamentally different from the  
13 types of failures you see in hardware.

14           So, software failures, of course we studied that. We've collected,  
15 we've built databases of software failures in NASA missions dating back several  
16 decades. You see a number of common patterns emerge, and of course it's  
17 important that you can recognize these patterns because that's your leverage for  
18 preventing those types of failures going forward. So, many of the failures that we  
19 have seen in the past we can prevent with the proper risk avoidance techniques.  
20 And that spans the entire software development lifecycle, starting with  
21 requirements capture, into high-level design, low-level design, coding, testing,  
22 and mission operations. There are lots of things you can do to prevent defects  
23 from becoming catastrophic failures in operation.

24           So, one type of defect, on Slide 5, is unintended coupling. So, this  
25 issue has been studied by others. One well-known book that studies that issue is

1 by Charles Perrow. He is a sociologist, but he studied the types of failures that  
2 can happen in complex systems, for instance the Three Mile Island near-  
3 meltdown. He studied how these failures come about, and one of his  
4 conclusions was that if you have a complex system, typically many of the  
5 components are designed to be independent. By design they are meant to be  
6 independent, and when failures occur there can be hidden dependencies that  
7 show up and if you have combinations of failures it is almost impossible to  
8 reason ahead of time through the consequences that can occur when a specific  
9 combination of failure happens and introduces certain kinds of coupling.

10           We see that in our space missions as well. If you look at the most  
11 dramatic types of failures that we've seen where we lose missions, generally it is  
12 because of unintended coupling between system components that were never  
13 meant to be influencing each other. So that's an important thing because if you  
14 now use proper design techniques and proper analysis techniques you can look  
15 for those types of coupling and make them less likely.

16           Next viewgraphs talks about another common cause of failure in  
17 complex systems, which is risk conditions, and that's caused by the use of  
18 concurrency, multi-threaded systems, even sequential stand-alone systems that  
19 are meant to be deterministic, the environment always provides an element of  
20 non-determinacy, a concurrent asynchronous agent that can introduce events  
21 into a system that can cause failure. It is very, very difficult to detect those types  
22 of failure with standard software testing techniques.

23           Next viewgraph is my last one, and that is basically summarizing  
24 the lessons learned from these observations, knowing that complex, the more  
25 complex they are, the larger they are, the more vulnerable they are to residual

1 and latent defects. If we want to claim safety of a system, for instance for a  
2 spacecraft that we want human beings to fly on the spacecraft, we have to  
3 provide a really strong case that we believe that we have confidence in the safety  
4 of the system and that means that we must provide strong evidence. A strong  
5 claim requires strong evidence.

6           And I've outlined some elements of those types of evidence-based  
7 safety claims that should be present and that one could look for. The types of  
8 things that we're using at JPL and at NASA are based on the use of standards,  
9 rigorous standards, and surprisingly many coding standards that are used for  
10 critical software development are not based on risk-avoidance. They are more  
11 stylistic and general in nature. At JPL we have developed coding standards that  
12 are risk-based that try to exclude the types of failures that we have seen in  
13 practice by preventing those types of coding patterns from being used in software  
14 in the software that we develop. And we look for those types of -- we look for  
15 compliance with these coding standards with tools, like we do mechanical  
16 compliance checking, and that requires familiarity with state-of-the-art tools.

17           The use of static source code analysis technology, it's fairly general  
18 now. It hasn't really reached all of the mission-critical and safety-critical  
19 industries, really to my surprise, because it's a well-known technology. State-of-  
20 the-art static source code analysis tools have been on the market for about a  
21 decade now. They are extremely effective in catching residual defects, things  
22 that don't tend to show up in software tests in test beds. And so evidence that  
23 they have been used in critical software development is really important. And  
24 any use of formal design and code verification methods, which is my own  
25 expertise in developing these types of tools, that allow you to do design

1 verification very early in the design cycle.

2 That concludes what I had to say.

3 CHAIRMAN JACZKO: Thank you. We will now turn to

4 Commissioner Magwood for the start of questions.

5 COMMISSIONER MAGWOOD: Thank you Chairman. As I listened  
6 to representatives from Areva and Mitsubishi talking about the process they've  
7 gone through -- and reaching back to 2006 is I think when you first got started in  
8 this process -- I can sort of hear the agony in your voice as you talk about the  
9 steps you've taken to try to get to this point. That sounds like a long time, but I  
10 remember having conversations about digital I&C systems in fact somewhat with  
11 NRC staff back in the late 90s, and a lot of these issues were coming up in those  
12 conversations, even back then. And obviously we didn't solve them back in the  
13 late 90s, otherwise we wouldn't be talking about them now. But it's clear that this  
14 is something that represents such a major shift in how we approach control  
15 systems in nuclear plants, that this agency has sort of taken a very careful and  
16 conservative approach to that change, and I think that's appropriate given the  
17 technologies we're dealing with. I think in the aerospace industry -- not so much  
18 with space flight but more with aerospace generally -- there seems to be a little  
19 bit more of an aggressive approach to incorporating technology. I think it was  
20 even perhaps in the early 80s that we started hearing about electric jets. I think  
21 the F-16 was the first one they called the electric jet, and that was kind of a big  
22 breakthrough and everyone was really excited about that in aerospace. But even  
23 though there were a few Luddites that seemed to think that maybe we're moving  
24 too fast and you never know what could happen with the software, in the  
25 aerospace area they kind of punched through that and now it's pretty standard to

1 have very advanced digital control systems in aircraft.

2                   Now, another place where there is a lot of digital technology being  
3 used is overseas, and a question I have for both of you two is, when you look at  
4 what's been implemented in Japan and in France and in other countries, did you  
5 find that the process of engaging with NRC was substantively different in how our  
6 reviewers looked at these digital technologies versus how reviewers in Japan  
7 and France have in the past looked at them and perhaps are looking at them  
8 today? Keith, maybe you'd like to start.

9                   MR. PAULSON: That's a good question. The issue in Japan was  
10 focused more on a recognition of paths for acceptability. Let's just take as an  
11 example what went on in this area of bi-directionality. It seemed that there was  
12 an acceptance of certain approaches to dealing with bi-directionality that we're  
13 still discussing with the staff. I can't tell you whether or not they reviewed it as  
14 thoroughly as the staff believes they have to, but I think that there is a basis there  
15 for getting feedback with respect to what they looked at and why they concluded  
16 that what went on was consistent with an acceptable approach moving forward.  
17 That would be a suggestion that I -- if you look at my last overhead, that I think --  
18 there is a suggestion there of some interaction as to how some of these more  
19 difficult issues were solved or addressed or what the stopping point was with  
20 respect to their acceptance of a specific design.

21                   MR. SLIVA: I agree it's an interesting question to address. Our  
22 experience, because we were approaching I&C design in actually four different  
23 Western countries, France, England, Finland -- which we now consider in the  
24 West -- and the United States. The interesting thing about the regulators is  
25 everybody has a slightly different pet peeve, so to speak. So, trying to achieve



1 consistency among the four sovereign entities that are looking at the same basic  
2 design has been a struggle. The common thread, though, is that the level of  
3 detail required, which again varies. The process in France is much more akin to  
4 the Part 50 process that we went through with the Gen-2 plants. The level of  
5 proof therefore established to go forward with the design is less detailed than  
6 we're asked to provide to the U.S. NRC. Finland is somewhere in between. It's  
7 kind of our modified Part 50 process with some proofs for Part 52 thrown in,  
8 where there are some aspects that have to be proven in extraordinary detail to  
9 justify going forward with design. There are other aspects of working with the  
10 Finnish regulator that allow more of a Part 50 evolutionary process prove-as-you-  
11 go type of mentality, and England just has almost a completely different  
12 approach, though the concerns in the United Kingdom are closer to the concerns  
13 raised by the NRC staff than the other two Western regulatory bodies. So, we  
14 found it varies from country to country, and the greatest difference is the level of  
15 detail on the design that we've been asked to provide in the different sovereign  
16 jurisdictions, to satisfy the particular safety-authority regulator. We really have  
17 not found complete equilibrium among the regulators, and the acceptability of  
18 some aspects of the design in the United States is some items that are being  
19 questioned, for example, in the United Kingdom.

20           Commissioner, I wish I could give you a better answer, because it  
21 would make my life a lot easier, because I do have oversight of some aspects of  
22 the European projects as well.

23           COMMISSIONER MAGWOOD: I appreciate that. And Mr.  
24 Chairman, I know my time is up, but I'd like to ask one follow-up. Again, for both  
25 of you, if you can make just very brief responses -- both of you have mentioned

1 that or alluded that there is technology that you leaving behind in going through  
2 the process of having your systems reviewed by NRC. Are the changes that  
3 you're making to simplify your systems, are they the sorts of changes that, as we  
4 go forward in the future, and as you have more time over the course of say a  
5 decade or so to look to technology and meet the concerns of the reviewers, are  
6 these things that can be reintegrated back into the system after the fact, and that  
7 you can regain some of the functionality that -- if they are ultimately approved --  
8 that you would like to see?

9 MR. PAULSON: Once again you are spot on I think in one of the  
10 issues that we're dealing with. But I think the answer to that is yes, I think it can  
11 be, and in fact some of the changes that we've made for example like the  
12 engineering tool, the attachment of the engineering tool continuously as opposed  
13 to periodically is one that we can reevaluate along the way. I would hope also  
14 that there is a reevaluation of some of the design modifications we're making to  
15 justify certain aspects of the design that could ultimately be simplified based on a  
16 probability approach or a more detailed analysis. The staff has never said that  
17 our approach is not acceptable. What they've said is it will take a lot of detail to  
18 review the design, and what I'm hoping as we go through that process is we'll  
19 enlighten ourselves on ways to improve and simplify the design even more.

20 MR. SLIVA: I agree with Keith's remarks, and we've had exactly  
21 the same experience with the staff. The staff has not rejected any aspects of the  
22 design. They have remarked to us that to go forward with the design -- we made  
23 some modifications aimed at simplification that would require a significant  
24 amount of time, and the proofs we would have to submit with the design would  
25 probably be fairly difficult for us to do in a timely fashion. I do think, though, that

1 we are looking at ways to continue to develop our designs so that those features  
2 can be reintroduced with the proper level of proof as some of the regulations and  
3 comfort is developed with digital design in the future.

4 COMMISSIONER MAGWOOD: Excellent. And I thank all of you for  
5 your testimony today. It's been very helpful. Thank you Chairman.

6 CHAIRMAN JACZKO: Commissioner Ostendorff.

7 COMMISSIONER OSTENDORFF: Thanks Mr. Chairman, and I  
8 add my thanks to Commissioner Magwood. This has been very informative. I  
9 have three questions I'm going to try to get out here. I want to do this very  
10 quickly, and pick up where Commissioner Magwood was headed in the concern  
11 that comes across in the slides in your presentations about perhaps some sub-  
12 optimization of safety features as a result of the regulatory process. I want to ask  
13 Mr. Paulson and Mr. Sliva, is there one example -- if there is one -- from your  
14 experience at Mitsubishi and Areva, where as a result of regulatory process you  
15 feel like you have sub-optimized a specific safety feature that was part of your  
16 I&C design?

17 MR. PAULSON: I mentioned the engineering tool. The evaluation  
18 of the engineering tool is something that I think is worth doing, especially having  
19 continuous evaluation of the availability of systems because of its continuous  
20 attachment. We have detached that specific system as part of the acceptance  
21 and simplification process. As I've said, I don't think anyone on the staff has said  
22 that's either bad or good. It's just when it was attached it became a more difficult  
23 process to review. So, I would say yes I think that there is the potential for  
24 continuous evaluation of the performance of systems with the engineering tool  
25 attached as something that may be worth looking at in the future.

1           COMMISSIONER OSTENDORFF: Without that engineering tool, is  
2 the function now performed through some other mechanism?

3           MR. PAULSON: It's not performed continuously. It is still there,  
4 and we will -- part of the discussion with the staff is how often that we can go  
5 back in and recalibrate or reevaluate the systems.

6           COMMISSIONER OSTENDORFF: Thank you. Mr. Sliva?

7           MR. SLIVA: I don't think we would say that we've sub-optimized  
8 safety. Taking advantage of digital technology, we had technology that I think  
9 proposed a quantum leap from the systems that people are familiar with in even  
10 the most advanced Gen-2 plants. In that huge leap that we proposed in our  
11 design, we perhaps as designers just assumed -- just as the Jet Propulsion Lab  
12 does -- that people would enjoy reading code. Well, maybe everybody doesn't  
13 like the concepts of advanced digital I&C technology. It takes a little bit of time to  
14 understand how that could be proven to be both reliable and effective, because --  
15 you know, "Gee, this analog phone worked just fine. I could talk to my mother  
16 every Sunday, just like I could on my digital phone today. I may not maybe know  
17 where she is on my analog phone, but I could still speak with her." So, we think  
18 that it's incumbent upon us to demonstrate functionality of digital technology and  
19 how that it could enhance the overall reliability and safety of the plant. I would  
20 not say that the simplifications that we've made have compromised the safety of  
21 the plant in any way, shape, or form. Certainly the staff has not pushed us in that  
22 direction. In similar experience to MHI, Areva has now modified its approach  
23 where we accomplish the same functions perhaps not on a continuous basis,  
24 perhaps not the way an I&C engineer would love to see it performed, but  
25 certainly we perform the same functions in other fashions. So I certainly don't

1 think in any way the safety of the plant was degraded or anything. We just need  
2 to demonstrate, I think, that the technology could enhance the portfolio of  
3 reliability of the plant. And we're working on those proofs.

4 COMMISSIONER OSTENDORFF: Thank you. Mr. Patterson, in  
5 your slides you talk about ISG-6 and concern about the level of detail required.  
6 Are there other specific improvements or enhancements to the ISGs --  
7 recognizing that they have been an evolutionary set of documents -- any other  
8 ISG improvements that you think ought to be made by the staff?

9 MR. PATTERSON: Well one area that we're looking at is the  
10 sequencing of documents that's required. Right now ISG-6 specifies a Phase 1  
11 set of documents, a Phase 2, and then some Phase 3 for audit at the end. So  
12 hopefully in the process of going through this we can look at the high-level  
13 documents that you develop first and get a sequence of those. The NRC can't  
14 review all of them at once, so what sequence of those documents is the best way  
15 to do that? And then that would actually streamline the process for the project  
16 and maybe shorten the project.

17 COMMISSIONER OSTENDORFF: Okay. Mr. Ray, do you have  
18 anything to add from your experience at Oconee?

19 MR. RAY: No I don't have anything specific to add to that.

20 COMMISSIONER OSTENDORFF: Mr. Chairman, I have got one  
21 more question. Dr. Holzmann, I wanted to ask you a question here. From what  
22 you understand -- and I realize you're in the space community and so forth, not  
23 necessarily following the nuclear community -- but from what you've heard today  
24 and from what other experience you may have had prior to coming here today,  
25 do you have any suggestions to the NRC staff on how to look at the software

1 code issues that you have been working on with JPL?

2 CHAIRMAN JACZKO: Yes, well, I think I'm here mostly to  
3 articulate caution, against underestimating the implications of using complex  
4 hardware for critical applications, but there are techniques that can be followed,  
5 so the emphasis in my presentation was on evidence based safety cases. So I  
6 would emphasize not to underestimate the importance of that.

7 COMMISSIONER OSTENDORFF: Thank you, Mr. Chairman.

8 CHAIRMAN JACZKO: Commissioner Svinicki?

9 COMMISSIONER SVINICKI: I want to thank all of you for your  
10 presentations as well, and I think I'll follow on a little bit on some of the questions  
11 that were asked. We did hear the term -- I think at least one of you mentioned  
12 the term "obsolescence." And as I think about the Commission meetings in my  
13 time here that I've attended on Digital I&C, my sense was some of the  
14 Commission's early urgency on the issue going back to 2006, and I think this is  
15 especially for the operating fleet, was this issue of obsolescence of analog  
16 systems and supply chain issues. And so if I go back to the SRM that the  
17 Commission issued in 2006, you know, it talks about developing the project plan  
18 and establishing a regulatory framework that, you know, would allow licensees  
19 and applicants to forward fit these digital enhancements. And I think there was  
20 some urgency about that.

21 I also see that somewhat enshrined when I look at ISG-6 on the  
22 licensing process where it says that we're trying to develop a system here where  
23 we will review compliance with the regulations and that public health and safety  
24 will be protected. Then it goes on to say it's not intended that the review or audit  
25 activities by the reviewer, include an evaluation of all aspects of the design and

1 implementation of the I&C systems, so as I think about the comments about level  
2 of detail that I'm trying to think from previous Commissions, I think it was along  
3 the flavor of, "Are we getting to a framework where if you're submitting a design  
4 to the NRC for a digital watch, are we looking at whether or not that watch  
5 provides accurate time and is reliable as opposed to critiquing your design of the  
6 watch that you sent us."

7           So I think, Mr. Ray and Mr. Patterson, I might ask you what your  
8 sense is in terms of the kind of level of review that we're doing. And the other  
9 comment I'd make is that NRC has a really good practice of doing pilots, and I  
10 think the real challenge often, even after successful pilots, of the review of  
11 something, is taking the lessons learned from that because the level of review  
12 that we do in a pilot kind of review is, you know, the deep dives where we look at  
13 the areas that are most relevant to our regulatory review, but we've got to  
14 synthesize that learning. You do a different review in two pilots than you might  
15 do in 30 license amendment requests, or I could see a future again with this  
16 obsolescence issue where NRC might have a fleet operator come in with a fleet-  
17 wide amendment to make digital upgrades. And so I would ask you of your  
18 sense of our review, of level of detail, of our readiness, given the obsolescence  
19 urgency of where we need to be as an industry and a regulator, and just throw  
20 that open for some general commentary in my remaining time.

21           MR. RAY: I can go first on that. From Oconee's perspective there  
22 was a great level of detail in the review. We submitted 36,000 documents --  
23 pages of documentation to be reviewed. Even though the number of official  
24 questions, about 111 official questions, a lot of back and forth between the staff --  
25 the two staffs, I think they had a very good working relationship. We actually set

1 up a file server so we could pass documents back and forth, keep the reviewers  
2 in the loop of everything that was going on. There was some, you know, evolving  
3 guidance at the time, so we had to stay on top of that. But being a first plant, we  
4 understood the amount of review that needed to be done, but it was significant.  
5 The SER came out later than we wanted it to in order to meet our first schedule,  
6 we ended up delaying the project one refueling cycle about 18 months, one unit,  
7 the last unit, I think it ended being delayed two years, and the cost ended up  
8 being almost twice as much as we originally expected it to be. But looking back  
9 on it, I would say the relationship between the two staffs was very good. They  
10 worked through those issues of being a first time plant. And it's understandable,  
11 and I would hope that before we have set up processes that are more efficient to  
12 allow the two staffs work through those quicker.

13 COMMISSIONER SVINICKI: Mr. Patterson, did you draw anything  
14 from the pilots in terms of preparing for your activities?

15 MR. PATTERSON: Well, we're still in the process of developing  
16 the documentation and the level of detail necessary for that. But based on the  
17 conversations during some of the task working group meetings and  
18 understanding the regulatory side, the viewpoint from them, and having them  
19 having to make a reasonable assurance claim on the result, I can understand  
20 because of the complexity of digital they want to know more and more about the  
21 digital platforms and software to be able to be comfortable with that. And I think  
22 once we get through a few of these vendor topical report approval, and they  
23 become more familiar with that, they can back off and be more comfortable with  
24 that assurance. The first few that go through, obviously they're going to take  
25 more time to do a more thorough investigation of what's going on. There's



1 always a question of are they looking at more of the design or more of the  
2 regulatory effect of you know, of the design. So it's an equilibrium. I think once  
3 the knowledge level comes up, and obviously if the complexity level comes  
4 down, it will be a much easier determination, and less level of detail will be  
5 required.

6 COMMISSIONER SVINICKI: And from the new reactor perspective  
7 would either of you like to comment?

8 MR. PAULSON: I must preface this by saying it is from maybe a  
9 little more commercial approach to this, but let me put that aside because I do  
10 think there is a comment that is relevant here because we have done some  
11 studies as to what is slowing the process of upgrades. As you know, we have  
12 the capability. We've done a lot of digital upgrades already in Japan, and they've  
13 gone very well. We think that there are possibly two basic issues, and I think I've  
14 picked up on this with Mr. Ray's comments also in his process. One was that  
15 they focused on the risk, and the other was cost, and you can't separate the two,  
16 actually. They have a tendency of running together. My understanding of the  
17 process, and I'd be glad to give the floor to someone that understands this better  
18 than I do, but my understanding of the process is that there was much more  
19 detail required in terms of final design information for some of the previous --  
20 specifically the Oconee upgrade. And then there is -- as part of the 52 process.  
21 Not that we don't require a lot of detail there, too, but detail of final design  
22 information is not required. And I understand that some of that was required for  
23 the Oconee process. And then, too, that there was no final approval until the  
24 factory acceptance test, which is much later in the process and also adds that  
25 element of risk late as opposed to early for a utility. You know, we've looked at

1 cost on that, and just a rough cut says it's probably 33 to 50 percent increase in  
2 cost based on the additional time associated with the additional work that has to  
3 go on upfront, the risk associated, and the probable delay that that will cause,  
4 maybe as much as a year. And I think you said 18 months, so that's probably  
5 wasn't a -- maybe even an under estimate looking at 12 months. I would say  
6 Mitsubishi would say two issues that we can improve upon, based on the 52  
7 process, would be risk and then ultimately final cost.

8 MR. SLIVA: And I really don't have much to add because our  
9 experience has been the same. We had the privilege of supporting Duke in their  
10 application and I think that Tom Ray framed our experience correcting in his  
11 presentation. We learned a lot from that first effort.

12 COMMISSIONER SVINICKI: Thank you. Mr. Chairman?

13 CHAIRMAN JACZKO: Well thank you and I think it's been a very  
14 interesting session. I remember going back to the year 2006 is a very different  
15 picture than we have now but it's funny because a lot of the discussion seems  
16 the same as we were having in 2006. I'm not sure why that is, but, of course, in  
17 2006 we had an Oconee application that had originally come in, been withdrawn  
18 because it just wasn't possible to get through the review process. We were  
19 relying on branch technical position, whenever it is 19-7, whatever it was, which  
20 was -- again I think presented an ability to do a review, and I think again, but  
21 didn't necessarily provide an optimal review so the staff had a lot of work I think  
22 to address a lot of issues, has documented all the interim staff guidance that  
23 have been developed and preceded. So I look at the situation and I imagine we  
24 had a meeting with the different set of vendors here we might have a very  
25 different meeting. In the course of the last five years the staff has reviewed

1 applications for several digital systems, so we've obviously approved Oconee, we  
2 have approved Wolf Creel, the field programmable gate array which I can say,  
3 but can't understand, and we, of course, approved the ESPWR or at least at staff  
4 level and Westinghouse digital system so I am always wondering, and I don't  
5 want my colleague, Commissioner Ostendorff is a lawyer by training, so this is  
6 something I learned from lawyers. Sometimes, I'm not sure, you have to be  
7 careful with difficult situations, and difficult situations, and I think the term is  
8 something like difficult situations make for bad law or something like that. I'm not  
9 sure if the situation we have now and perhaps MHI and Areva are difficult  
10 reviews or if it's a problem with the review process itself and I'm not sure how we  
11 distinguish that. And obviously Oconee we did complete the review and work  
12 through that. It really was the first time for a new digital protection system. I'm  
13 wondering if you can comment on that. What do you think was different about,  
14 perhaps I don't know if you're familiar with Westinghouse and GE Systems, or  
15 what you could say was different about those that the staff was able to work  
16 through those reviews in a way perhaps that one would get the impression from  
17 this meeting staff isn't able do what the others. I don't know if you want to  
18 comment on that?

19 MR. PAULSON: Once again I don't want to overstate my  
20 understanding of what went on with the Westinghouse review, but what I do  
21 understand, maybe in a very cursory fashion, is that there was a lot of  
22 commitment in that document to future DAC approaches. The design that we're  
23 putting forward basically is up and running, and so the design is much more  
24 detailed so you can't rely on a future promise. And that to a certain extent  
25 extends the upfront review process which we've taken into account and accepted

1 that because we think it will improve the review process once our customers get  
2 their point of trying to finalize their plant design and how much we'll ultimately  
3 end up with addition ITAAC or whatever. Or a later process where  
4 Westinghouse will have to address those DACs somewhere later on and could  
5 cause problem, so we've taken that risk up front which is where we think to do,  
6 so I think that's one of the issues.

7 CHAIRMAN JACZKO: Mr. Sliva do you have any thoughts?

8 MR. SLIVA: That's a difficult question to address I think because of  
9 the timing of the different submittals and obviously not having detailed knowledge  
10 of the competitor's submittal, I will say, from Areva's standpoint we submitted  
11 what we thought was a state of the art design. It was projected forward from the  
12 technology that was licensed at the operating plants at Oconee, this is the next  
13 generation because we are looking at the next generation of reactor. And I think,  
14 probably as a total industry, we weren't adequately prepared for the challenges  
15 of taking into account the complexity of that technology and then being able to  
16 work backwards from it to arrive at, in some cases, what now appear to be a very  
17 simple analog system that we were comfortable with. And provide safety and  
18 liability for, you know, decades. We've learned a lot through the review, I think  
19 we've learned a lot from the staff. I think the staff has learned a lot from us.  
20 Certainly has developed into a very interactive process and while taking longer  
21 than anticipated probably on that watershed 2006 meeting, I think, going forward  
22 I do see us completing the process. And I think when we come to the next round  
23 of licensing of I&C applications the entire industry will benefit from what we are  
24 learning now. I can't really put it into context to the other two designs, but from  
25 Areva's standpoint, I think we underestimated the challenges on industry in

1 presenting digital technology into the environment we have.

2           CHAIRMAN JACZKO: Well thanks a lot, I appreciate that. I know  
3 this certainly has been an area of challenge and newness and with that there is  
4 always difficulty, but as I said I think we've come a long way. Mr. Paulson one  
5 thing I did just want to ask you about; I know in your original presentation you  
6 talked about 2006, 2007 earlier submittals. But just, I think that there is  
7 something I just want to make clear for the record. We didn't actually docket and  
8 accept for review the MHI application until sometime I think in early 2008  
9 because at the time there was no budget to review the application. So, you know  
10 in fact, and I think Commission Magwood you may have made the comment, the  
11 clock doesn't really go back to 2006 for MHI I think it really starts sometime I  
12 think when the final schedule the staff provided was sometime in June or so, or  
13 May/June of 2008 and that's really when the review actually began in earnest for  
14 the MHI application. So, it's not been a five year process necessarily there, but  
15 more of a concerted effort in three years.

16           One of the questions, and I thought I would ask this generally.  
17 There has been some discussion about level of detail in design reviews. I know,  
18 I think in their October letter of 2010 ACRS made a point of commenting on the  
19 detailed review. One of their recommendations was that parts of, in particular  
20 this reference the ISG-6, the licensing process, and one of the comments they  
21 made was that in section B of that document that it should be revised to include a  
22 discussion that while process is important it is not a substitute for a detailed  
23 review of the hardware and software architectures to ensure that they meet the  
24 fundamental principles identified in this section.

25           I'm wondering if you're familiar with that particular aspect of the

1 interim staff guidance on the licensing process and if you have comments on  
2 ACRS's position. Do you think ACRS is in the right place, or not, on their idea  
3 about detailed review and if that's consistent or inconsistent with what you're  
4 talking about for detailed reviews. I was wondering if you have any comment on  
5 that.

6 MR. PAULSON: I don't think their fastidiousness is misplaced by  
7 any means. I think that as Tom said, that there is an issue here of us  
8 understanding the complexity as we go through the process and it's a learning  
9 process on our part for sure. And the fact that ACRS has asked for a level of  
10 detail to satisfy themselves is not surprising to me at all based on their attitude  
11 toward this new technology and the fact that that's their job is looking at that  
12 independently, so I'm not surprised although it's still a struggle.

13 MR. SLIVA: I agree with Keith's assessment. It's not a surprise  
14 and it is a struggle.

15 CHAIRMAN JACZKO: Any others want to comment? Dr.  
16 Holzmann, I don't know if you have familiarity with some of the positions that our  
17 advisory committee has taken or if that statement I read rings true to you or you  
18 see that as an appropriate approach to dealing with some of these issues.

19 MR. HOLZMANN: No, I'm not familiar with the details of the  
20 process or what is required right now. I'd be surprised if the elements that I  
21 emphasized were part of that process. Probably a review of that process would  
22 not be misplaced in my view.

23 CHAIRMAN JACZKO: Well, again, I want to thank everyone for  
24 being here and providing your thoughts and your insights and we will now turn to  
25 the staff. Thank you very much.

1 [break]

2 CHAIRMAN JACZKO: Bill, we'll start with you.

3 MR. BORCHARDT: Thank you. I'd just like to acknowledge the  
4 activities and the efforts of the Steering Committee, as they help to coordinate  
5 the NRC staff's activities across the various program offices. I think they were  
6 instrumental in making sure we had a consistent approach between new reactors  
7 and the operating reactors. Had the very important support from the Offices of  
8 Research and NSIR -- NSIR is related to cyber security. So, I think what they've  
9 done is made sure that we've come out with a very technically correct position.  
10 They've helped us to move forward, make good progress, and we're looking  
11 forward to transitioning to make this more of a routine mainline activity. Jack will  
12 begin the staff briefing.

13 MR. GROBE: Thank you Bill. Good morning, Mr. Chairman,  
14 Commissioners. This morning we will update you on the progress that we've  
15 made in stabilizing the digital instrumentation and control regulatory  
16 infrastructure. I'll talk briefly about the activities of the Steering Committee and  
17 the task working groups. Pat Hiland is the director of the Division of Engineering  
18 in NRR. Pat will talk about successes and challenges in the operating reactors  
19 arena. Tom Bergman is the director of the Division of Engineering in new  
20 reactors and he'll do the same: successes and challenges in the new reactor  
21 arena. Stu Richards is the deputy director of the Division of Engineering in our  
22 Office of Research. And Stu is going to present an overview of the progress that  
23 we've made in implementation of our five-year research plan. That research plan  
24 was developed in collaboration with the project offices and the Office of  
25 Research, and he will particularly highlight the issues that the Commission has

1 expressed its specific interest in. And then finally, Dr. Steven Arndt is one of our  
2 senior level advisers in the digital instrumentation and control, and he will talk  
3 about the international activities that we have undertaken and the advantages  
4 that we've gained from those activities. Slide three, please.

5           Four years ago -- it's surprising that it was four years ago -- the  
6 Commission directed the staff to establish a project plan to facilitate the  
7 deployment of digital technology at operating reactors and in new reactors. And  
8 the project plan was to include short range and long range objectives and goals,  
9 and we should seek industry input on that project plan. The executive director  
10 established the Steering Committee comprised of executives from NRR, New  
11 Reactors, Research, Nuclear Security and Incident Response, as well as the  
12 Office of Nuclear Material Safety and Safeguards for fuel cycle facilities.

13           The goals of the Steering Committee were to interface with the  
14 industry, to oversee and facilitate resolution of technical and regulatory issues,  
15 and to ensure effective interoffice coordination within the agency. Under the  
16 guidance of the Steering Committee, a project plan was developed to establish  
17 regulatory stability for new and operating reactors as well as fuel cycle facilities.  
18 The development of that project plan included extensive engagement with the  
19 industry -- all aspects of the industry -- and other public stakeholders. It actually  
20 took quite some time to finalize the project plan. The outcome of that was very  
21 positive. We had very clearly defined problem statements that everybody agreed  
22 to and understood and that facilitated effective progress in developing specific  
23 milestones, deliverables, and accountabilities to address those problem  
24 statements.

25           The Steering Committee established seven task working groups.



1 And those were comprised of staff from across the agency. The industry  
2 developed an executive oversight committee, as well as working groups to  
3 interface in parallel with the various infrastructure that we established. During  
4 these past four years, the NRC has augmented its staff with over two dozen  
5 digital experts and those experts came from digital vendors, operating  
6 organizations, nuclear operators, other industries including automotive,  
7 aerospace, and military, as well as entry level staff coming out of the universities.  
8 We have a highly qualified, robust, and capable staff that is addressing the digital  
9 challenges we see today.

10           The task working groups conducted over 100 public meetings with  
11 our external stakeholders and directed nearly 30 FTE of direct effort from the  
12 staff in developing the short term deliverables, completing those, as well as many  
13 of the long term deliverables. Interim Guidance has been developed in all seven  
14 areas. Slide four, please.

15           That Interim Guidance, as you'll hear shortly, has been used  
16 effectively in both operating and new reactors. Pat will talk about successes at  
17 Oconee and Wolf Creek, as well as the ongoing work, and Tom will highlight  
18 successes with the Westinghouse AP1000 and the General Electric ESBWR, as  
19 well as ongoing work.

20           This past January, we had a meeting with the industry executive  
21 group and the staff in the industry agrees that the Interim Guidance has improved  
22 the predictability, stability, and effectiveness of our reviews. The Interim  
23 Guidance is, of course, one approach to resolving the key technological issues  
24 associated with the use of digital technology. It's commonly referred to as the  
25 fast lane, but it also clarifies those critical attributes of the technology that need

1 focus for industries -- or for applicants that choose a different approach to solve  
2 those problems.

3           The licensees are satisfied with the Interim Guidance and also look  
4 forward to additional opportunities to refine that Interim Guidance through the  
5 public comment process as we translate the Interim Guidance into durable  
6 regulatory infrastructure documents. The Steering Committee and the industry  
7 executives have agreed that it's time to sunset the expanded or enhanced  
8 oversight that we've been providing. The staff continues internally with active  
9 interaction between the various offices. Pat and Tom and Stu meet biweekly on  
10 issues of interest to the Divisions of Engineering in the various offices and  
11 frequently, if not always, those biweekly meeting agendas include digital issues.

12           Pat and Tom will initiate executive level meetings with the industry.  
13 The industry has agreed to begin with quarterly meetings and this will be the  
14 continued interface and structure that we'll have in place to replace the Steering  
15 Committee activities. In addition, we're establishing a technical advisory group,  
16 and this is not a unique aspect of the way we do business in the NRC. We have  
17 many technical advisory groups. Typically they're led by our senior level  
18 advisors and this one will be led by Dr. Arndt and Mr. Santos, and Sushil in NRR,  
19 New Reactors and Research. The focus of that technical advisory group will be  
20 to facilitate continuing consistency across the offices, support resolution of  
21 emerging issues, and coordinate staff level initiatives. At this time, I'd like to turn  
22 it over to Pat to talk about operating reactors.

23           MR. HILAND: Thank you. Slide five. As we mentioned, you know,  
24 the infrastructure, we believe, has been improved through the Digital I&C  
25 Steering Committee. We just issued, as noted before, Interim Staff Guidance

1 number six. We call it revision one, but our draft revision was 55, just before we  
2 issued it. And so, it was quite an accomplishment over the two or three years  
3 that we worked on it to reach a consensus that made it a final document. But, of  
4 course, involved in our process are topical reports. The topical reports as you're  
5 aware are there to streamline both the staff as well as industry's review time.  
6 And I'm going to talk about a few that we currently have under review.

7           New technology, you've heard, Wolf Creek, which is the field  
8 programmable gate array design. That was approved about 18 months ago for  
9 installation for the main steam and feedwater isolation system at the Wolf Creek  
10 plant. Oconee is an analog to digital system that we approved -- and I believe  
11 we're one year and one day from that approval. I think it was January 31 of last  
12 year that that system -- or that amendment request was approved. That uses a  
13 Teleperm process. That had a topical report submitted and I'll just mention the  
14 reviews that we did on the update of that process. Slide six.

15           We currently have some ongoing reviews in process. Grand Gulf  
16 has elected to use a General Electric nuclear measurement analysis and control  
17 device, commonly referred to as a NUMAC. That NUMAC is going to be the first  
18 time use in a boiling water reactor 6 -- BWR-6 system is going to be used in its  
19 oscillating power-range monitoring system.

20           Crystal River. Crystal River plans to come in with an extended  
21 power upright in the future, and along with that, they're contemplating the use of  
22 digital systems and a fast cool down function that will be needed to support the  
23 extended power uprate. They've come in and talked, and you'll hear me talk  
24 about a Phase 0 meetings -- in a Phase 0 meeting to discuss that concept.

25           At Columbia. Columbia also has elected to upgrade their nuclear

1 instrumentation system with the General Electric NUMAC. And we held a Phase  
2 0 meeting with that licensee last month.

3 Watt's Bar, the Nuclear Unit 2. That review has included three  
4 safety-related digital systems. It's ongoing, but those three systems -- the  
5 Westinghouse Eagle 21 for the reactor protective system, an engineered safety  
6 feature system. The Westinghouse Common Q for the post accident monitoring  
7 system, as well as the Sorrento digital high-range monitor. But in addition to the,  
8 safety-related systems, our Standard Review Plan suggests that we look at those  
9 systems that are also important.

10 I've termed it balance of plant, but the three systems that we're  
11 looking at are a loose parts monitoring system. The rod-position indication  
12 system, as well as a Foxboro control system. All three are certainly important.  
13 Slide seven.

14 Some new platforms that we are reviewing. The first one is HF  
15 controls. They're HFC-6000. Our technical review is complete. It's currently  
16 scheduled to be out through the licensing phase in the spring of this year.

17 The advanced logic system from Westinghouse does use a field  
18 programmable gate array technology. That is scheduled to be issued by us in  
19 the fall of 2011. And this is one of those systems that will support Diablo  
20 Canyon.

21 And then lastly, the Spinline-3, it's another platform that uses a field  
22 programmable gate array technology. We're just in the start of our review of that  
23 and we've completed our acceptance review of the Spinline system. Slide 8.

24 Update the topical reports -- one of the lessons learned at Oconee  
25 was the topical reports that had been referenced on that submittal were about 10

1 years old. And some of the components in their microprocessor had changed.  
2 They'd gone up to a different level of revision. And when we started to look at  
3 them, we identified that these were manufactured under a different engineering  
4 processes and verification processes. So it did cause some additional review of  
5 a topical report that had been reviewed and approved 10 years ago. But right  
6 now we have two topical reports that previously had been approved but they're  
7 going through a review -- the Westinghouse Common Q is going to be used on  
8 Watts Barr Unit 2, that's under review. As well as the Invensys, it's the Tricon  
9 topical report. And we've targeted the spring of this year. And again, this is the  
10 second digital system that Diablo Canyon is choosing to employ.

11           The software validation tool, SIVAT: SIVAT verification and  
12 validation tool, we first were introduced to that tool when Oconee first came in  
13 with Areva for their submittal. SIVAT was a new tool, one that we've never  
14 approved before. While we've not -- we weren't able to approve it in the original  
15 Oconee submittal we have received the topical and our technical review is  
16 complete. And I expect that acceptance and safety evaluation report to be  
17 issued shortly. This is the first time that we've approved a code verification tool.  
18 Slide nine.

19           As we've mentioned, Diablo Canyon will be a pilot. As you heard,  
20 our third Phase 0 meeting is this Thursday and we're all set to look at the  
21 Oconee -- Oconee lessons learned have been incorporated into the Interim Staff  
22 Guidance No. 6. We actually had a workshop in May of 2009, with industry, to  
23 go over some of the lessons that we had learned through Oconee and hopefully  
24 we'll learn more in the pilot program to even further streamline our processes.

25           As I mentioned earlier, this is -- I hadn't mentioned, but the Diablo

1 Canyon is a digital-to-digital replacement. They currently have the Eagle-21, and  
2 as you heard earlier, they're going to the ALS and Tricon systems. We expect  
3 their amendment request, as we heard, this spring, to be issued. And we're  
4 going to use the pilot to further enhance our review processes. Slide 10.

5 Challenges. I call them areas of focus. Moving forward, what are  
6 the operational issues. Mr. Grobe continuously challenges me: "What am I going  
7 to do next? What are you going to do when these are out in the field and up and  
8 operating?" Well, we've looked at that a little bit: 50.59 that allow licensees to  
9 change out systems without our approval, if it meets certain criteria. We had  
10 approved an industry standard NEI-0101 and the numbers alone tell you it was  
11 developed 10 years ago. We've worked with NEI and have suggested that we go  
12 back and revisit that standard, and make sure that it is up to date with the current  
13 requirements that we expect.

14 Also in the maintenance rule -- the maintenance rule and its  
15 application to risk inform maintenance activities in the plant. As you know, we  
16 have no real risk guidelines in the digital world. And so, that might be an area  
17 that we'll need to look at with how that process is used in operating plants.

18 As well as the inspection and start up testing of the revised  
19 facilities. Region II -- and we have supported our regional inspectors with our  
20 design engineers; have developed an inspection plan that they will implement on  
21 Oconee. And we hope to take -- well we will take lessons learned from that on  
22 Diablo Canyon.

23 And then, technical specifications are another area that could be a  
24 challenge in the future, particularly in the determination of operability when a  
25 system or component is degraded. With that, I'll turn it over to Mr. Bergman.

1           MR. BERGMAN: Good morning. Slide 11 please. As you know,  
2 the staff has completed its safety review of the AP1000 and ESBWR designs and  
3 we're awaiting approval, so we can issue those proposed rules. Both those  
4 designs are modern, fully integrated digital I&C systems, and both those reviews  
5 were conducted without controlling the overall schedule for the designs. Next  
6 slide please.

7           With respect to ongoing reviews, we have two design certifications  
8 still under review with the EPR and APWR. In general, there isn't a digital I&C  
9 review as part of a combined license review, they incorporate the certified design  
10 by reference. South Texas is the exception to that generalization, they dictate  
11 departures from the certified design. We have essentially completed the staff's  
12 review. We will be briefing the ACRS next week, we will be explaining our  
13 acceptance of that design as well.

14           We've continued to -- all these applications did use, and the staff  
15 used the ISGs as appropriate for the individual application. We've continued our  
16 dialogue on DAC for I&C systems which we briefed you, and the ACRS briefed  
17 you in November. Subsequent to that, we've continued those discussions. They  
18 did issue a letter in November that would indicate is a licensing construct. We've  
19 achieved a common understanding as to what it takes to use DAC and make the  
20 safety finding during licensing proceedings. There still remains the open issue as  
21 to their precise role post COL. Next slide please.

22           As we discussed in that meeting, we have submitted the complete  
23 DAC I&C inspection procedure, draft inspection procedure, to the ACRS for their  
24 review. We are continuing to test that inspection procedure with the South Texas  
25 applicant, with the next inspection, which is on the planning phase to be

1 completed in early March. And as we committed at that meeting we do have a  
2 I&C staff from my division, as well as a participant from the I&C staff in the Office  
3 of Nuclear Reactor Regulation, participate on those inspection activities. Next  
4 slide please.

5           The challenges and I am not trying to trivialize the issue, because  
6 the story might be a little silly, but as we've been through these challenges on  
7 some of these reviews, it actually takes me back to when I coached little league.  
8 And we would have practices and let's say all the players weren't necessarily  
9 fully engaged in the game. But come game time, you know, they'd say, "Hey I  
10 want to play shortstop." Now, my answer was just, "No," because it was a safety  
11 issue. But the guy I --

12           CHAIRMAN JACZKO: That's a regulator in the making, right...

13 [laughter]

14           MR. BERGMAN: -- wasn't very satisfying to the child. But the  
15 friend I coached with, he had a much better answer, which is, "Don't tell me,  
16 show me." Show me in practice you know how to do it, and then we'll talk about  
17 doing it in the game. So we understand that the applicants have tremendous  
18 capabilities and their staff are highly qualified and have great confidence in the  
19 designs and that designs very similar to these have been approved for use in  
20 various places in the world, including the United States. But that isn't a basis  
21 upon which we can certify a design.

22           We need the application that we're reviewing to provide the safety  
23 basis that shows it meets the NRC's safety requirements. And that -- the  
24 principal document in that is the design control document. It's important because  
25 -- right now we have a lot of dialogue with the applicants. Even if we use that



1 dialogue to fill in the gaps, the design control document provides the basis for  
2 safety, not just today, and it provides the regulatory control mechanisms over that  
3 design, for the life of the facility. And when we're talking Part 52, you know the  
4 time between certification and termination of operations could easily be 80 years.  
5 So, things are going to change, the designs are going to change, the vendor is  
6 going to turn this design over to the COL holder. We're going to have staff  
7 changes, they're going to have staff changes. The public needs to understand  
8 what was our basis upon which we determined this design was safe. And that is  
9 included in the licensing basis that we certify today. So we do focus on the  
10 safety, making sure that the documentation provided to us demonstrates the  
11 safety of the design. And the principle impediment to making that safety finding  
12 has been, in our view, the clarity and completeness, or what you'd sort of call  
13 quality issues in the application itself. When we've identified errors or omissions  
14 in those applications, we generate requests for additional information. We issue  
15 a lot of what we call RAIs, we issue a lot of RAIs. They can be very complex,  
16 depending on the gaps in the application. Frequently that results in an incomplete  
17 answer, which is the second round of RAIs, this also represents rework, not just  
18 for us, but for the applicants themselves, and rework is inherently inefficient. But  
19 in order for us to make the safety finding, we do need a clear and complete  
20 licensing basis.

21           On complexity, again, we understand how some additional  
22 complexity enhances operations. I mean, that's a good thing. And the design  
23 still needs to meet the safety requirements and when we talk safety  
24 requirements, we really are talking fundamental safety principals and again you  
25 heard these in November from the ACRS; independence, redundancy, defense-

1 in-depth and diversity, determinism, and those are embodied in our regulations  
2 and guidance and those safety principles are really consistent around -- with all  
3 regulators, it's not unique to us and they're certainly consistent with ACRS  
4 positions.

5           Now, simplicity is not a requirement. It is a design principal, and  
6 Steve will get into international activities in more detail, but the multi-national  
7 design evaluation program is about to publicly issue a common position on  
8 simplicity in I&C design, where all the participants in that program have endorsed  
9 this common position, including the staff from the United States, France, and the  
10 Japanese regulators. So it is moving there, and, in fact, if there's a trend in  
11 safety system I&C design, it is towards simplicity, with complexity there where  
12 necessary for the safety functions. And that's basically the path we've been  
13 driving. And, to their credit, both Areva and MHI, as they acknowledged this  
14 morning, are changing the designs, so that they can demonstrate they meet our  
15 safety requirements.

16           On the last point on schedule, sometimes I fell like inserting "or"  
17 there, you can get an efficient schedule or a thorough review and to me it really is  
18 an "and," it can be safety "and" timely. Obvious, or in general, simple systems  
19 are going to get quicker review, because it's easier for the applicant to  
20 demonstrate the safety of the design and it's easier for us to reach the same  
21 conclusion. But we can license complex designs. They are, in general, going to  
22 take more time, simply because it requires more information to make the safety  
23 case. Complex designs that fully follow our guidance, without exception, get a  
24 shorter review than designs that depart from that guidance. And that isn't unique  
25 to I&C, anywhere in the plant, where you depart from established methods,

1 you're getting basically custom work, and that takes longer. I mean the poster  
2 child for that would be the AP1000 shield building A truly custom feature outside  
3 of the I&C system.

4 But I don't want to focus too much on safety and complexity,  
5 because, again, I think the real driver on the schedule, from the staff's  
6 perspective, is the quality, the completeness, the clarity of the licensing basis that  
7 they presented to us. Thank you very much. Dr. Arndt? I'm sorry, Stu.

8 MR. RICHARDS: Good Morning I'm Stu Richards with the Office of  
9 Research and thank you for inviting us to be at the table today. It's a great topic  
10 to talk about. The Office of Research, you know, we do research for the program  
11 offices our customers on digital I&C issues and we also aid in the development of  
12 new and revised regulatory guidance.

13 We should be on slide 15. Our research is guided by our digital  
14 research plan. It's a five year plan covering the period from 2010-2014 and as  
15 Jack already mentioned, we reviewed this with the program offices and they  
16 agreed and concurred in it, we presented it to the ACRS and through that  
17 presentation to the ACRS we also provided it to the public and we did get some  
18 public comments.

19 The research plan is broken down into four areas. The first safety  
20 aspects, as the title implies, looks at how digital systems can impact the safe  
21 operation of our facilities. That includes failure modes, we look for new analytical  
22 techniques that may aid NRC reviews. And we look at digital system modeling  
23 and PRA research. Security aspects look at the unique security issues that  
24 result from the use of digital systems and the impact that external threats might  
25 have on the digital systems that are put into our nuclear power plants.

1           Advanced nuclear power plant concepts, that has to do with the  
2 Next Generation Nuclear Power Plant, NGNP, and we're looking at advanced  
3 instrumentation and advanced controls. And finally, knowledge, management,  
4 research, collaboration, captures things such as capturing digital I&C knowledge,  
5 supporting collaboration, both domestically and internationally, and operating  
6 experience.

7           Next slide please. We work closely with the national labs on digital  
8 I&C research. The labs bring both the combination of knowledge of nuclear  
9 power plant operations and digital systems. So they're well-prepared to work  
10 with us in this. As you can see, there is a list of a number of labs that we work  
11 with and just briefly -- Oak Ridge has been involved with us with digital diversity  
12 and defense-in-depth, highly integrated control room work, communications  
13 within digital systems, FPGA, failure modes and updating Reg Guides, which  
14 includes research and test reactors. Sandia has brought to the table a unique  
15 capability on cyber-security, so they've done some cyber-security testing for us.  
16 They've also looked at the impacts of electromagnetic pulses on digital systems.  
17 PNNL has also been involved in the cyber-security, and they helped us to  
18 conduct an expert elicitation on digital system failure modes that we'll talk about  
19 a little bit more in a minute. Both Brookhaven and Idaho have been involved in  
20 PRA work and INNL has also been involved in advanced reactor work.

21           Our work with the labs is also complimented by work with the  
22 universities and interactions with our international partners. For example, we  
23 have worked with the University of Virginia, the Ohio State University. We have  
24 collaborated with the IRSN in France, in the Korean Atomic Energy Research  
25 Institute and the Halden Project in Norway.

1                   Slide 17 please. The next two slides list four of our products that  
2 we've provided, to provide a sampling. We have a much longer list of products  
3 we could provide if asked. But the first one is -- you know, I got to tell you it's  
4 one of my favorite NUREGs. So, recommend it to you for your reading, if you  
5 like. It was produced by Mike Waterman, who's here with us today, but it has to  
6 do with diversity in digital systems and what this did is it went on and looked at  
7 what was done in international nuclear power plants, but also looked at what was  
8 done in other industries within the United States, including aerospace, aviation,  
9 the chemical industry and the rail industry and then it developed an evaluation  
10 technique, in effect scoring the different diversity measures that you use, and you  
11 know, for better or for worse coming up with a number. We can argue about how  
12 you weigh things, but it is a way of taking in all of those diversity measures and  
13 trying to come up with an indication of where you stand relative to other  
14 industries. So it is interesting reading to see how other countries have done it  
15 with nuclear power plants and how the other industries have incorporated  
16 defense-in-depth and diversity and this information was also used in  
17 development of ISG-2. so it helped us that way.

18                   The next NUREG-7006 has to do with the field programmable gate  
19 arrays, it looks like design practice is for FPGAs and based on the program office  
20 request, we're presently working on turning some of that information into a  
21 Regulatory Guide, and we're also using that to work with a consensus standards  
22 development that's going on in this area also.

23                   Next slide please. NUREG-6991 design practices for  
24 communications and highly integrated control rooms. When we're talking about  
25 communications here, that's communications between digital systems, between

1 channels, between safety and non-safety so it's the idea of sharing digital data  
2 within. This NUREG looked at how on the digital systems, the communications  
3 aspect of digital systems was addressed in international plants. It also reviewed  
4 consensus standards on this topic area and it was used as part of the  
5 development for ISG-4. And the last bullet on slide 18 mentioned before that  
6 we've done some cyber security at SNL. They did assessments on the Tricon,  
7 the Teleperm, the Common Q systems, assessing you know, their vulnerability to  
8 hacking, if you will. And this is supporting some of our licensing reviews and  
9 some of the development of guidance. Additionally, research led the  
10 development efforts for Reg Guide 5.71 on the cyber security programs, that was  
11 quite an extensive effort. Slide 19 please.

12           The next three topics are to address issues that the Commission  
13 specifically asked us to bring to the table today. The first one has to do with  
14 software failure. Just -- for me this was an eye opener, when it was explained to  
15 me that software in itself, basically does not fail, so when we're talking about  
16 software failure we're not talking about the software suddenly not cycling like a  
17 valve, not turning on like a pump, not changing state like a relay, what we're  
18 talking about is that the software -- either the requirements to develop the  
19 software are incorrect or the requirements if correct were inappropriately  
20 programmed into the software or, as a system that's updated or modified over  
21 time, that you introduce reduce those flaws. So software failure -- the software's  
22 going to do what the people tell it to do. The question here is, what degree of  
23 assurance do we have that that software has been properly defined and  
24 implemented, and maintained through its lifecycle.

25           One of the techniques that we went to look at is the failure modes,

1 effects and analysis technique, to see if that would provide some insights on  
2 software. We found that FMEA is useful for hazard review, which is more of a  
3 high level review that's done early in the development process. We did conduct  
4 that expert elicitation clinic that I talked about in 2010 where we brought in  
5 experts from different industries and from around the, you know, well we had  
6 some international participation, I believe it also included Dr. Holzmann, who  
7 talked to you this morning.

8           We have worked with IRSN and France on this issue, and  
9 specifically for FMEA, we found that it's useful as far as hardware goes within  
10 digital systems and it may be helpful for hazards analysis, but it isn't particularly  
11 useful for software. There is one example in Korea where they did use FMEA on  
12 a very small portion of a critical part of the software, but again, this was a very  
13 limited application.

14           Slide 20 please. So, FMEA is not particularly useful in applying it  
15 toward software. The reason for this is that there's simply too many  
16 combinations of inputs, and the order in which those inputs could occur in a  
17 software system, the number is just huge. Additionally, as I mentioned before,  
18 software faults seem to driven by the system requirements, implementing those  
19 requirements into the software and then maintaining it. We have two products in  
20 this area, one is a NUREG with the French that is in review, has not been issued  
21 yet. And the other is a series of three research information letters, that's coming  
22 out of the expert elicitation that we did. The first of those was issued in January,  
23 and we're working on the other two. Next slide please.

24           Just as with our traditional operational experience that we apply to  
25 operating plants now, we recognize the value of OpE for digital systems. The

1 challenges are several in this way. There have been some digital systems in  
2 U.S. nuclear power plants, but those are not what you would call the current  
3 generation of modern plants. Some people mentioned today the combustion  
4 engineering core protection calculator, which is in CE plants. The General  
5 Electric 21. But they have limited applicability to what we're looking at putting  
6 into plants today.

7           Because of the limited data and the current state-of-the-art  
8 regarding software failure modes, it makes the use of quantifying OpE to be  
9 somewhat challenging and not particularly meaningful at this point. Nonetheless,  
10 operational experience is important. We have been able to look at individual  
11 events, understand what happened, and bring that information into our regulatory  
12 guidance and the work that we're doing. We do have a memorandum of  
13 understanding with the Electric Power Research Institute, and with that  
14 memorandum of understanding we have been able to have access to events and  
15 lessons learned details from industry, which has helped us in our regulatory role  
16 and we hope that will continue.

17           Next slide. We're also reaching out beyond the domestic industry;  
18 the first thing listed here is COMPSIS, that's computer safety -- computer  
19 system's important to safety, which is an NEA sharing of information, we're  
20 working with them. I mentioned already that were working through EPRI with the  
21 Koreans and we hope to also have dialogue with the French. Non-nuclear digital  
22 operating system experience is also very important. We do have a working  
23 relationship with NASA and through that we've been able to gather a lot of  
24 information that we haven't analyzed yet, but it holds some promise for the  
25 future, to learn some things from that. The last bullet on Slide 22, we are



1 gathering an inventory of the kind of equipment that's being used out in the  
2 nuclear industry, so we can better apply OpE, when we do have it available to us.

3 Nest slide please. The last two slides I have address the use of  
4 PRA in digital systems. As it's been mentioned already we currently have a  
5 deterministic process but in 1995 the Commission PRA policy statement said we  
6 should use PRA, to the degree that the state of the art allows it. So we are  
7 working on seeing if we can develop that and to use that as part of our, you know  
8 our risk tools. We have completed -- as the second bullet notes, five NUREGS  
9 on various aspects of trying to look into using PRA. Both dynamic modeling and  
10 static modeling. This work did identify a set of desirable characteristics, but it  
11 wasn't able to basically deal with software, so that is still a challenge. Hardware,  
12 I think we're having more luck with, not so much with software, and Slide 24  
13 please.

14 The research that we have done so far, has identified some  
15 additional things that we're working on, specifically defining or better defining the  
16 failure modes. We need to work on the methods and data needed to address  
17 software reliability. We need to have better data on hardware failures, and in  
18 moving this ball forward, Brookhaven working with our staff, has reviewed  
19 existing quantitative software reliability methods, and we're in the process of  
20 approaching a proof of concept study to see if some of those methods can be  
21 applied. But nonetheless there's a lot of work that remains before this can be  
22 applied to any of our nuclear plant PRAs. And with that I will turn it over to Steve.

23 DR. ARNDT: Thank you Stu. Today I'm going to talk to you at a  
24 very high level, make a couple examples of some our international interactions in  
25 the area of digital instrumentation and control. We are extremely active in the

1 international community. Of all the different international activities we have in the  
2 United States, this is probably the single largest technical interactions that we  
3 have. We have multi-lateral programs, we'll talk through those a little bit, bilateral  
4 programs with a number of different countries. And we also actively engage in  
5 the international standard setting process; extremely important because we have  
6 vendors that are working to a number of different standards, the IEEE standards,  
7 the IEC standards, and to a lesser extent the IAEA safety guides.

8           So being part of that program is extremely important, to both  
9 improve our consistency across the international organizations, but also to  
10 understand why people are designing things in particular ways.

11           We're also very active in understanding what other industries are  
12 doing. You heard both from Dr. Holzmann and others today that there's a lot of  
13 work going on in other organizations, both in the regulatory side and the actual  
14 development side. Next slide please.

15           In our multi-lateral programs, the largest by far is the Multi-National  
16 Design and Evaluation Program. We are active both at the staff level, at the  
17 management level, and the executive level in that program. As you know, it's  
18 broken down into technology-specific issues, such as digital I&C and also  
19 specific vendor applications. We're active on both sides of that.

20           We chair the digital I&C Committee. It's been very active. It is  
21 currently finished with and awaiting public distribution of four common positions  
22 in the area of data communications, diversity, simplicity, that was talked about  
23 earlier, and also software tools, which is a very big issue, as you've heard. They  
24 are also working on a number of other specific policy issues or common positions  
25 that are ways in which you can actually understand what common technical

1 understanding is between the various regulators. As we all know, it's easy to talk  
2 about it, but once you have to write it down, that's when you really figure out what  
3 the differences are, so we've been very effective in that area.

4 In the areas of the specific vendors we've had the opportunity to  
5 work through a number of the differences between our different regulatory  
6 structures. Our technical positions, as we talk to each other, we find are very,  
7 very similar.

8 We also have had the opportunity to work for other multi-lateral  
9 programs, such as the European I&C program, which is a Western European  
10 regulators organization. It's an outcropping of the old four country agreement  
11 that was put together in the late '90s when we were developing our current SRP  
12 to try and get a feel for what other regulators were doing and that program is an  
13 ongoing program as well. Next slide please.

14 In terms of bilateral changes, I've listed a few of the countries that  
15 we've been most active in, but we've been active with a number of countries. For  
16 example, Taiwan, as you know, has an ABWR that they're licensing and building.  
17 We've had a number of interactions with them, very positive interactions in their  
18 review of the ABWR, but also in their use of some of our regulatory structure.  
19 They use our ISGs, and we were there last fall to discuss with them what we  
20 meant when we wrote them and they also gave us feedback on how they've had  
21 challenges and successes in their use.

22 In China, we've had a lot of discussions associated with the licensing  
23 of AP1000 and EPR. But we've also had a lot of discussions with their  
24 experience in using digital systems. As you may or may not know, the T1 plant  
25 which is a VVER has a fully digital Western control room designed by Siemens

1 and we're getting data on that operational issues.

2 In England, we've had a lot of interactions with NII both on the  
3 regulatory structure and how they're resolving technical issues associated with a  
4 number of the new plants. Next slide please.

5 As I mentioned, we're doing a lot of work associated with  
6 international standards. Some of this has been input to updates to the  
7 standards, it's been working on driving consistency between the standards  
8 bodies. IEEE which is the basis of most of our regulatory structure, IEC which is  
9 the basis of many of the other regulatory structures are structured a little bit  
10 differently. But there's a lot of common positions, and we have been strongly  
11 encouraging what is known as dual logo standards, where the same standards  
12 would be published by both organizations. We're had some success in that, in  
13 the area of cable monitoring and electrical distribution associated with  
14 earthquakes. We're having some success in terms of diagnostics and  
15 surveillance testing, and we're working toward other areas. In terms of IAEA,  
16 they are redoing their safety guide for digital systems this year. And one of our  
17 staff was just there two weeks ago to help them work through various issues and  
18 try to get the first draft of that document put together. Next slide please.

19 So, in brief, what we're getting out of this is not merely a better  
20 understanding for ourselves, and a better understanding of what other regulatory  
21 bodies are doing, but also a wonderful opportunity to share experiences, an  
22 opportunity to influence the design process, through standards and through  
23 standardization and harmonization, but also increased access to what the  
24 research programs are doing. You've heard Stu talk about our work with KAERI  
25 and with other organizations to look at the research aspects, what needs to be

1 done, as well as what is being done and where you can go in the future.  
2 I know I'm slightly over, but I'll make one more point: We are very proactive as  
3 individuals, as professionals, in the organization. We're not just regulators by  
4 night. We're also researchers, analysts, and we're very active as a staff in terms  
5 of understanding what is going on in the cutting edge. Point of fact, one of my  
6 personal research activities is in pro coupling which you heard about earlier with  
7 Dr. Holzmann. With that, Bill.

8 MR. BORCHARDT: That completes the staff's presentation. We're  
9 ready for questions.

10 CHAIRMAN JACZKO: OK, thank you. We'll start with  
11 Commissioner Magwood.

12 COMMISSIONER MAGWOOD: I'd like to thank all of you for your  
13 comments. It was very helpful to understand where things stand. Let me start  
14 with you, Steve. One of the things, I'm glad you mentioned Dr. Holzmann,  
15 because he had some thoughts about advanced methods for verifying software.  
16 And I wonder if you could give us your thoughts about where the state-of-the-art  
17 of verification really is today and whether we're using it and whether others  
18 overseas are using it. And just give us some perspective.

19 DR. ARNDT: Okay, I don't want this to be a long dissertation, but,  
20 in short --

21 COMMISSIONER MAGWOOD: It could have been a dangerous  
22 question to ask.

23 [laughter]

24 DR. ARNDT: In short, a lot of the things Dr. Holzmann talked about  
25 are already embedded in our review process; in some cases, in a more simplistic

1 and rote fashion, as opposed to the automated tools that he's advocating.  
2 Things like code review, things like validation of standards, things like  
3 understanding exactly the issues that go into what makes things complicated and  
4 how they're coupled and the independence between systems. There are  
5 certainly some areas where we can improve and learn from other industries. In  
6 terms of the nuclear community, we're probably on par, if not ahead in most  
7 areas from other regulatory bodies; there's obviously a couple of exceptions  
8 associated with that, but we're by and large on par with our regulatory  
9 counterparts. As you know, we update our regulatory guidance on a regular  
10 basis. And we're, I think scheduled to update our SRP, Standard Review Plan  
11 for digital, next fiscal year and Office of Research and others will be inputting into  
12 that area, to see whether or not we should move some of these more advanced  
13 tools into our regulatory process.

14 COMMISSIONER MAGWOOD: Thank you. One other question  
15 for you. One issue that comes up quite prominently in these discussions is, I  
16 think almost everyone here has mentioned at least briefly, is the bi-directional  
17 communication between safety, non-safety systems. And just again, looking  
18 overseas, has there been any different view on this matter, that specific matter,  
19 from other regulators versus how we've been looking at it? Is there some insight  
20 you can gain as to, you know, why they think the way they think and why we  
21 think the way we think, and if you can give us some view on that as well?

22 DR. ARNDT: Okay, I'll start and maybe Tom can finish on this one.  
23 I think our technical views are very, very similar, the basic technical safety issue  
24 is that it's a lot easier to assess something that doesn't have bi-directional. What  
25 you're concerned about is an action, or a lack of action on the non-safety side

1 causing a disturbance on the safety side. And if you only have one-way  
2 direction. it's a lot easier. If it's two-way directional, there's a lot of technical  
3 ways to ensure that is not going have a problem including how you pass  
4 messages and whether or not you allow memory to be accessed by one system  
5 or another and things like that.

6           The various countries have very similar approaches. As Tom  
7 mentioned, it's more challenging to review those systems if they have more  
8 complex solutions to that particular technical problem. Some regulatory bodies,  
9 either as a matter of policy or as a matter of proficiency, will have more a  
10 stringent requirement than the NRC. By and large, we look at it from a, "If you  
11 give us enough evidence that you've done a good job, then we are willing to  
12 move forward." The regulatory structure makes it more difficult if that information  
13 is not yet available in the Part 52 as opposed to the Part 50 arena. But there's  
14 really very little technical difference between the technical sides internationally.  
15 There's a lot of issues associated with schedule and policy and how we best  
16 implement the particular regulatory structure in that particular country. Did you  
17 want to add?

18           MR. BERGMAN: I mean, I can't comment on the technical aspects,  
19 this is definitely not a technical area of mine. It is the adverse effects, I do  
20 understand that, but we haven't said you can't have bi-directional  
21 communications. Mr. Sliva in his presentation, you know, said that as well. In  
22 fact, ISG-4 is specific to communications, including bi-directional communications  
23 in one of the NUREGS as well. It's the ability to demonstrate that you're not  
24 adversely affecting the safety function, when that's uni-directional that's very  
25 easy to demonstrate. In fact, according to my staff, the entire write-up, the

1 Westinghouse AP1000 design is strictly uni-directional communications. The  
2 licensing basis justification for that fit a page-and-a-half, and the review was  
3 measured in hours. We still don't feel we have a complete licensing basis for bi-  
4 directional communications exist, and those review are taking months and  
5 hundreds of hours by comparison.

6           So, it's a question of can you demonstrate how to keep it uni-  
7 directional? And it really becomes problematic where software are providing that  
8 protection. The equivalent of a diode, I don't really know how one works, I know  
9 it's excess electrons and deficient electrons, but the people who need to know  
10 how a diode works, and when we see something called an isolation device in a  
11 design and say, "How does that work?" And they say, "It works like a diode."  
12 "But how?" And they say, "Well, it's software-based." And we say, "Well, how  
13 does the software provide the same types of functionalities as a diode?" Which  
14 is just based on physics. And they can't answer the question because the  
15 software hasn't been written yet, so when you say, What is my licensing basis?  
16 How do I know that that's going to provide that same function and not get  
17 changed over time? We need to know that in order to say, you're right, you do  
18 preserve the uni-directional communications from a safety standpoint of not  
19 causing an unintended fault in the safety system.

20           COMMISSIONER MAGWOOD: This actually leads to a question I  
21 have for you and your answer's actually kind of interesting because I think I  
22 heard you say earlier, and sort of made me reflect on something I heard from the  
23 vendors when they were talking that it's -- to sort of paraphrase what somebody  
24 said earlier, it may very well be true that the evidence that something works does  
25 exist and maybe even has been talked about, but until you see the DCD it



1 doesn't really matter, in effect. And I wonder when you're talking about, you  
2 know, whether you can have the software diode -- I would love to see what that  
3 might look like -- how -- what do you need to see, as a reviewer, to confirm that  
4 that will actually work? Do you need to see the code? Do you need to see the  
5 entire code reviewed in detail? Or is there something short of that you can get  
6 that will convince you that this software diode will actually work?

7           MR. BERGMAN: That hasn't been completely determined, I mean,  
8 ideally you can have a sufficiently detailed description of functional -- the  
9 functions it will provide, such that it can, but when it comes to software it isn't  
10 clear whether or not that will be sufficient, or the code itself does become part of  
11 the licensing basis. Because if it's providing a protective function, we need to  
12 know that it's going to maintain stability over, again, the life of the facility. It  
13 doesn't mean it can't be changed, but we may need to reengage in the future if it  
14 does change, so at a minimum you're going to need enough functionality  
15 description to say, "I'm confident that provided the software's developed in  
16 accordance with a quality process, it will always provide that functionality, or with  
17 a high degree of assurance, provide that functionality." So you may not need the  
18 full code, but we haven't been provided a substitute yet that provides that  
19 assurance.

20           COMMISSIONER MAGWOOD: Let me ask the, sort of the hanging  
21 question there then, that I'm sure the vendors will hate, is there a reason we  
22 shouldn't require the full code before approving a design?

23           MR. BERGMAN: I actually have written software in my  
24 background, and the thought of putting -- I mean, these systems are very large, I  
25 mean, million lines of code. What would we do with it? It's very hard to interpret

1 another person's code if you weren't intimately involved. That would be, in terms  
2 of licensing, that would be very problematic as how do you understand when a  
3 change has been made that triggers a 50.59 which triggers a license  
4 amendment. We really need to see how they're going to provide through quality  
5 processes controls over the software.

6 MR. GROBE: I'm glad Tom mentioned 50.59, the licensing basis  
7 needs to be sufficiently descriptive such that the licensee can feel comfortable  
8 moving forward under 50.59 to know what changes they can make without  
9 coming back to us and what changes they need come back to us. We have  
10 reviewed code. At Oconee, one of the functions -- it was important to the safety  
11 involved reviewing certain sections of the code. The real answer to your  
12 question is it depends; it depends on how the licensee is choosing to design, how  
13 the vendor is choosing to design the specific attributes to the system and how  
14 critical that attribute is to the safety decision.

15 COMMISSIONER MAGWOOD: Is the code subject to inspection?

16 MR. GROBE: We haven't gotten there yet. That's an interesting  
17 question.

18 [talking simultaneously]

19 MR. GROBE: Within the context of 50.59, I think --

20 MR. BERGMAN: Not within 50.59, but certainly we have the  
21 authority as a regulator to inspect what they used to build their plant and that  
22 would include software.

23 COMMISSIONER MAGWOOD: And you're not enthusiastic, so I  
24 assume that that's something we would actually do if we felt it was necessary?

25 MR. BERGMAN: If we felt it was necessary, yes. I think getting to

1 50.59 -- my bigger concern probably is as these systems change with time, will  
2 the licensee have the capability to understand whether the changes -- how they  
3 affect safety. That's really the first step. I mean, we can check, but -- and verify  
4 what's being done, but we're not 100 percent in there, we do rely on the licensee  
5 understanding the ramifications of that, and that's probably the bigger question.  
6 When you get a new board or you get a new disc, do you understand all the  
7 implications upon the designs, especially for these highly integrated designs  
8 where you've got controllers embedded in pretty much every component out in  
9 the plant, all the sensors. How does that all tie together, what's the effect on that  
10 integrated system when I change one piece part of it? Again, if you're overly  
11 reliant on software, I think Dr. Holzmann's point about latent defects are key, you  
12 can only know so much.

13           And as an example of that -- and I can't say the design because it's  
14 always hard to talk about this without proprietary but, the initial design for the  
15 prioritization module had so many inputs, to fully test it, to eliminate latent  
16 defects, would have required approximately 10 to the 18th tests. Now, I did  
17 some crude math over the weekend and that would be a billion tests a second,  
18 which isn't achievable, it would take 30 years. Now they simplified that design  
19 down to where only five -- a little over 500 tests would be necessary to fully test  
20 every possible combination of inputs. The design still has the same capability  
21 from a safety perspective, but you've eliminated the uncertainty over how much  
22 of the design you can actually test in terms of hidden faults within that one facet,  
23 it's not even a complete design, it's just one facet of the design.

24           COMMISSIONER MAGWOOD: That's an interesting insight,  
25 thank you very much. Thank you, Chairman.

1 CHAIRMAN JACKZKO: Commissioner Ostendorff?

2 COMMISSIONER OSTENDORFF: Thank you, Mr. Chairman. I  
3 found this very helpful, especially the discussion bi-directional versus  
4 unidirectional. And I know a little bit about the diode. A long time ago, I can  
5 remember when I went in my fourth submarine -- my fifth submarine, we went  
6 from a computer inverters for rod control to SCR fired systems for the SXG  
7 plant, and it was a huge technological leap to understand when you're training  
8 your reactor operators and the watch officers, so I can appreciate the complexity  
9 challenge here as these changes were made. I'm going to start out, I think, with  
10 Steve and Stuart and ask a question on the international/other industry area, and  
11 then come back to Tom and Pat on a question.

12 I'm very pleased to hear about the extent of the international  
13 involvement, it's extraordinarily helpful and I'm very pleased to hear what those  
14 activities to date have been. I guess the question is, is there any conceptually  
15 different approach that is very different from how another country is approaching  
16 some of these digital I&C regulatory issues compared to what we're doing here in  
17 the United States?

18 DR. ARNDT: There is one conceptually different thing and it varies  
19 to a certain extent between different countries, it's a lot more dramatic in other  
20 industries, and that is involvement in the early part of the design process. In the  
21 aviation industry, the regulators are involved very, very early in the design  
22 process, and sitting with the designers and working through those issues. That is  
23 very different from what we do. We expect the licensees and the vendors to  
24 work through the design issues and the basic fundamental concepts and then  
25 present us a design for review. Some other industries, in particular in some other

1 the countries, are more involved in actual development. So, that's a different  
2 design concept or review concept. The other one --

3 COMMISSIONER OSTENDORFF: Before you leave that one, this  
4 kind of ties back into Commissioner Magwood's comment, are you seeing in  
5 other countries that there's an expectation of greater maturity of design prior to  
6 regulators taking this to look at it?

7 DR. ARNDT: I don't know that it's more a mature design, but it's an  
8 earlier involvement in the design process as opposed to a review of the  
9 adequacy of the designs.

10 The other difference in some countries is the use of third party  
11 dedicate -- third party assessors, such as in Germany the use of the TUV  
12 organization to assist by dedicating -- not dedicating, but assessing a system, so  
13 they actually do some of the testing, as a third party tester on some of the  
14 assessment, it would be similar to the -- what was done in the Air Force a  
15 number of years ago with the software maturity model and things like that. So,  
16 it's a slightly different structure, but by and large of those two aspects, the review  
17 process is very similar, obviously a different review structure in some countries.  
18 Stu, do you want to amplify on that?

19 MR. RICHARDS: That was the only point I was going to bring up,  
20 but if you're asking do they use the same, basically the same basic I&C design  
21 criteria as we do, you know, Steve talked about the review process, but if you're  
22 just talking about the hardware and software, is that part of the question?

23 COMMISSIONER OSTENDORFF: Well it could be, you know,  
24 regulatory approaches or, you know, you mentioned I think earlier one of you  
25 mentioned the quantification of software liability, you know, is there a different

1 approach being used in other countries on reliability that is significantly different  
2 from the NRC's views?

3 MR. RICHARDS: My understanding is that it is not. One of our  
4 tasks has been trying to find somebody who's been able to quantify software  
5 reliability and we haven't identified anyone. Again, it's deterministic, it's like  
6 Steve said, and Dr. Holzmann, what you do is you make sure that there's a lot of  
7 processes in the development on the front end of the system to try and eliminate  
8 as many of the defects as possible and make the system fault tolerance, even if  
9 there are faults, the system's still going to work. But there's always going to be  
10 latent faults in these software programs.

11 DR. ARNDT: I think the one exception to that would be the British, they  
12 tend to be a little bit more risk-informed than us, but that's a structural reason  
13 because they compare risks across technologies, not just nuclear but other  
14 energy generations. But by and large the way we do it in terms of assessing  
15 regulatory acceptance criteria is very similar.

16 COMMISSIONER OSTENDORFF: Okay. Let me turn to a  
17 question -- I've going to start off with Pat, then go back to Tom, but it's the same  
18 kind of question. We've heard from the previous panel some notion of perhaps  
19 complexity of systems, especially systems that are in use in other countries, not,  
20 basically making it through the NRC's regulatory framework the way they  
21 experienced overseas. And, you know, from the NRR's standpoint and then from  
22 NRO, I'd be interested in any comments you might have on that topic as to  
23 whether or not there's been any -- I used the phrase with the previous panel,  
24 question about sub-optimization of digital I&C systems based on having to alter  
25 the design of the system to fit the regulatory framework used by the United

1 States NRC.

2 MR. HILAND: I'll just give you an example. You heard us talk  
3 about the Wolf Creek and the field programmable gate array review that we did.  
4 When that originally came in, they were referencing FAA standards. They did not  
5 reference the IEEE standards that are endorsed, not just endorsed, but required  
6 by our regulations, IEEE 603. Now, as you are aware there's nothing wrong with  
7 that, but we would have been very challenged to go and compare the FAA  
8 standards that they referenced in that original submittal to what we would find  
9 acceptable under our standard of review plan guidelines. The end result was  
10 that the manufacturer went back himself, the design engineer, and did that work,  
11 and then several months later presented it with referencing the IEEE standards.  
12 I'll just throw that out as an example for an item. Tom?

13 MR. BERGMAN: We're not -- I'm not aware of where we -- and it  
14 just doesn't seem like the NRC to say reduce the level of safety. The problem is  
15 with complexity is we haven't been convinced that there's a safety enhancement  
16 with the complexity, and even if there is, even if it's equivalent level of safety,  
17 we're OK with it. We had discussions principally over the summer -- we're just  
18 looking at the trajectory of the two reviews and the desired schedules by the  
19 applicants. We were saying, "If you continue on this design path, we just don't  
20 see how we're going to meet the schedule you want. We can continue the  
21 review on the design we have in front of us and the schedule needs to change, or  
22 you can change the design such that you can make the safety case easier and  
23 we can maintain the schedule you've got." But certainly if an applicant, any  
24 applicant, came to us and said, "Hey, this feature actually enhances safety,"  
25 that's something the NRC is going to listen to with open ears.

1                   COMMISSIONER OSTENDORFF: Thank you. One final question.  
2 Jack, I'm going to ask you this and Bill, you may want to chime in, this deals with  
3 human resources of the NRC staff, I know there's been a lot of hiring over the  
4 last five or six years, and a lot of ramping up, bringing on some very talented  
5 people to work in these areas, are you satisfied that we have an appropriate level  
6 of expertise in this area going forward?

7                   MR. GROBE: It's a continuing challenge, you know, some of our  
8 staff are more advanced in their careers, I think, we try to make sure we don't  
9 say "old," but we just lost Bill Kemper to California, he's our reviewer in the field,  
10 he's going to be teleworking and assisting us with the Diablo review and that will  
11 be his last activity before he retires. So, continuing that pipeline is a challenge,  
12 but right now we have sufficient resources and I think I can speak comfortably for  
13 New Reactors as well, that the reviews are progressing, the development work  
14 that we need to do, the interaction with Research is progressing, so we're in  
15 good shape. It's a continuing challenge.

16                   COMMISSIONER OSTENDORFF: Thank you. Thank you, Mr.  
17 Chairman.

18                   CHAIRMAN JACKZKO: Commissioner Svinicki?

19                   COMMISSIONER SVINICKI: I want to thank you all for your  
20 presentations, I'm puzzling over something that since I heard it I've been kind of  
21 fixated on. Pat, I don't know -- it confuses me that Jack Grobe would have to  
22 continually ask you about how you intend to occupy yourself. I would think that  
23 the Division of Engineering in NRR isn't really in danger of having a whole lot of  
24 idle hours that you just have to while away, so there's some story there perhaps  
25 I'll learn about it at another time. But one other thing, I think, I would more



1 seriously ask you to clarify is that, in response to Commissioner Magwood's  
2 questions he got a couple of responses, just to paraphrase like on the issue of  
3 looking at code or inspecting the code and the answer was, "Well, we really are  
4 still looking at that issue." Now we have approved some things, so what am I  
5 missing there in terms -- we have some significant unanswered questions about  
6 our approach, but yet we've approved some amendments and things.

7 MR. GROBE: It was a fascinating question that we really haven't  
8 tackled yet. We're in the middle -- the context was inspection, what our  
9 inspectors in the field are going to do --

10 COMMISSIONER SVINICKI: But it was also in the review,  
11 because there was discussion, I think Tom said, "Oh, I wouldn't want to look at all  
12 that code," and then Jack, you said, "Well, we have reviewed code and it has  
13 been the basis of our approval of some things."

14 MR. GROBE: Where a licensee and the specific issue is the -- at  
15 Oconee, it had to do with the service module and how that was connected and  
16 the communications. The independence of the communications was assured  
17 through a certain set of code and that was the way the licensee wanted to design  
18 the system so we looked at the code to make sure that it met the safety  
19 requirements. I made some notes here that I hadn't thought about before and we  
20 have part of the ROP is an inspection called the SSDI and I'm struggling right  
21 now for the acronym, that it's our triennial design inspection, very complex  
22 inspection, we're going to have to develop an expertise to look at changes in the  
23 digital system. That expertise, at a code level possibly, and that expertise I don't  
24 think exists right now in the Regions, so that's --

25 COMMISSIONER SVINICKI: Couldn't you start by looking at the

1 integrity of the configuration management and controls? Wouldn't that be your  
2 starting point instead of just diving right into the code?

3 MR. GROBE: That's right, that's exactly the foundation for the  
4 SSDI. It's the configuration management and how the licensee has chosen to  
5 manage that, and then diving down deeply into the design, it's a very deep,  
6 narrow inspection where certain things are validated. That we have the DAC  
7 inspection that is being piloted right now, as well as the pre-op and operational  
8 inspections that are ongoing at Oconee, so there are three different kinds of  
9 inspections that we're going to have to continue monitoring and then developing  
10 the expertise -- continuing to develop the expertise in the Regions.

11 COMMISSIONER SVINICKI: Okay, thank you for that. And Pat, as  
12 you described, the reviews underway right now and the other things that you  
13 might have on the horizon, I would ask you two questions. The first is it sounds  
14 like those are all -- they can differ substantially one from the other and you  
15 mentioned that Diablo is a digital to digital conversion, I'm not sure I knew that  
16 before you said that, so you have a lot of variability there, is that a challenge in  
17 terms of your resource modeling for going forward? The second part is how  
18 much do you know in terms of letters of intent and other amendment requests  
19 that you might be receiving over like a 2 to 5 year timeframe?

20 MR. HILAND: Let me address the first -- the last question first,  
21 letters of intent, I have no letters of intent. We did, in one of our digital I&C  
22 Steering Committee meetings, the industry's representative mentioned that he  
23 had in his fleet 17 sites that he had planned to go with digital upgrades once, you  
24 know, the dust has settled and there's predictability in our process. If next  
25 month, somebody sends me in 17 amendment requests --

1                   COMMISSIONER SVINICKI: He didn't say, "Here I've got them in  
2 my briefcase."

3                   MR. HILAND: No, he didn't say that, he said he's not going to --

4                   COMMISSIONER SVINICKI: At 30,000 pages apiece that would  
5 be pretty bad.

6                   MR. HILAND: That's right, if that type of an increase in applications  
7 came in I certainly would be challenged. Right now with the reviews we have  
8 about 6 to 8 on ongoing reviews of topical that are ongoing in the group plus we  
9 have the Diablo Canyon and a few other minor ones that are ongoing and I have  
10 sufficient resources for the next two years. But looking out, using 2 to 5 years, if I  
11 get information that industry is going to increase and come in in multiple, I could  
12 probably handle two major upgrades with the current staff along with the routine  
13 work, 3 to 4 would be a challenge. Anything more than that would be a real  
14 challenge with me. I think I answered your question?

15                   COMMISSIONER SVINICKI: Well, I asked about they can all look  
16 quite different, so the variability, how do you develop a resource model for that?  
17 Does it vary substantially depending on what you're looking at doing, what kind of  
18 -- what the review would entail?

19                   MR. HILAND: We have, as you know, a Standard Review Plan.  
20 Chapter 7 in the Standard Review Plan, to date it covers all of the applications  
21 that we've received over any -- and that Standard Review Plan is up to the  
22 branch chief and staff in discussions with me, is what areas they should cover  
23 and what areas are not applicable. So, we're fine with the guidance documents  
24 today.

25                   COMMISSIONER SVINICKI: Okay. Well it sounds like, from your

1 answer to the first part of the question, that if the dust settles in ways that people  
2 feel positive about, you might be a victim of your own success, and suddenly  
3 there would be a lot of interest in submitting things. That's very challenging for  
4 us, obviously we can't fluctuate and so it may be an area that would potentially  
5 lend itself to an NRC engagement with industry about, you know, they'll need to  
6 do some coordination, maybe, and look at pacing those out in a way that's going  
7 to make some sense from a resourcing standpoint. It sounds like you haven't  
8 yet begun those discussions, but you're beginning to get some sense that they  
9 may be necessary?

10 MR. HILAND: Yes, I agree.

11 COMMISSIONER SVINICKI: Okay. And another area that was  
12 touched on, I think, by our representative from Oconee, was talk of reactor  
13 operators, of training, of simulators, and I know it wasn't technically a topic for  
14 today, but I'm sure someone could give some sense of how we're keeping a  
15 pace on issues for operator licensing, and digital control rooms, and things that --  
16 it's just something that I haven't heard about in awhile and I don't know that we  
17 have our direct expert at the table, but just generally, are we working through that  
18 process with applicants and operators?

19 MR. HILAND: I'll start. Region II has a responsibility for direct  
20 operator licensing. Of course the program office exists in NRR, but ever since  
21 we issued the license amendment request and we knew what the schedule was,  
22 the Region developed what they call a project plan for inspection. That project  
23 plan looked at the simulator, or will look at the simulator activities and then  
24 underneath that is a very, very detailed inspection plan. It's not the -- if you look  
25 in the inspection manual, there's one module that says, "Go look at modifications

1 every two years and spend about 100 hours on it.” That’s not the inspection plan  
2 that they’ve created for Oconee. As a matter of fact, it could be 10 times that  
3 amount of effort on Oconee. Now, we did send one of our design engineers,  
4 during the site acceptance test, down with our inspectors and as you heard in the  
5 Safety Evaluation Report, we highlighted some 40 plus items that we suggested  
6 the inspection staff in Region II look at. I don’t know all the details of the  
7 simulator, but I know the operating examiners are aware that the simulator has  
8 been upgraded, I just don’t know the timing of when they’re going to follow up  
9 and do their onsite review.

10 COMMISSIONER SVINICKI: All right, thank you. Jack, did you  
11 want to add something to that more generally or in new reactor space, just  
12 following the issue of preparing to be able to license operators for a new digital  
13 control room?

14 MR. GROBE: I wasn’t going to add something on the specific  
15 operators, but the translation of that is to our staff as well and I can’t remember  
16 which Commission meeting it was on digital -- we’ve been having them roughly  
17 every six months -- but we presented the Technical Training Center’s plan for  
18 upgrading to digital training for our own staff, and the utilities are doing the same  
19 thing, and it’s going to have to be a key component of our ongoing licensing of  
20 specific operators as well as inspection.

21 COMMISSIONER SVINICKI: OK. Thank you. Thank you,

22 MR. GROBE: Tom, did you have any --

23 COMMISSIONER SVINICKI: Oh, Tom?

24 MR. BERGMAN: I’m not the right person, it would be the Division  
25 of Construction Inspection and Oversight Programs. It is the training of operators

1    though, construction of the simulator, is very important to meeting a construction  
2    schedule. We do have a nice graphic that illustrates that timeline and we can  
3    just send up to you that with the specifics for the plants that are entering  
4    construction.

5                    COMMISSIONER SVINICKI: Okay, thank you, thank you --  
6    appreciate that. Thank you, Mr. Chairman.

7                    CHAIRMAN JACKZKO: Tom, maybe I'll start with you, you briefly  
8    touched on the issues with the discussions with the ACRS on DAC and the DAC  
9    closure process. Could you give a little bit more of a detailed update on where  
10   that stands, and what you think the remaining issues are that need to be  
11   resolved?

12                   MR. BERGMAN: Well, again, I think the remaining issues are  
13   really with the post-COL inspection activities of the DAC. The remaining designs  
14   that have yet to come to the ACRS have either a few or no DAC. The ESBWR  
15   was -- the ABWR -- it's hard to quantify because you can count so many ways.  
16   ABWR has a lot of DAC, so they may be interested in that, but that's the one  
17   we're piloting -- testing the inspection procedures on. The ESBWR has a large  
18   number of DAC, but until we enter the construction phase, there's probably not  
19   going to be further engagement on it. So, again, not only us but the applicants  
20   now understand the specific concerns of the ACRS, so when the designs are  
21   presented to them for ACRS approval, they make sure the application and the  
22   explanations in that meeting make it clear how the safety finding can be made  
23   with the existence of DAC.

24                   CHAIRMAN JACKZKO: Do you anticipate there being potential  
25   scheduling challenges, if, in the future, ACRS is looking to see if we're in a post-

1 COL, DAC close out, ITAAC closure process -- will there need to be a scheduling  
2 coordination with ACRS, if ACRS is going to have a role in reviewing some of this  
3 DAC closure?

4 MR. BERGMAN: Yes, the nature of that role would affect how  
5 difficult that is, I mean, we coupled with NRR license renewal power updates. We  
6 fully booked the ACRS calendar, and so scheduling anything new is always a  
7 challenge, but we have a very good relationship accommodating each other's  
8 needs because things have moved around. I mean, where the staff ended was,  
9 "Hey, you know, let us do informational briefs with South Texas on what we  
10 learned during the inspections and see if that satisfies the ACRS concerns." And  
11 certainly those types of briefings are not that difficult for us to support and to  
12 schedule with the ACRS.

13 CHAIRMAN JACKZKO: Well, I appreciate that and I certainly -- I  
14 would rather see us trying to resolve this as much as possible now, because I  
15 would hate to get into a situation in which we're going through a very complicated  
16 review process for ITAAC closure and then we have some unresolved interests  
17 on the part of ACRS, and so I think it's something we'll take a look at and  
18 perhaps in one of these upcoming design briefings.

19 MR. BERGMAN: And I think we are briefing them on the results of  
20 this inspection in March and May timeframe, so we'll get some feedback from  
21 that presentation if that approach, initial feedback, one data point -- is sufficient.

22 CHAIRMAN JACKZKO: One of the issues, maybe Jack, you can  
23 comment on this, as you start to sunset the Steering Committee and move to a  
24 new kind of more traditional regulatory model for digital instrumentation and  
25 control issues, maybe you can just talk on how we will continue to ensure

1 technical consistency or review consistency between the Part 50 side of the  
2 house and the Part 52 side of the house?

3 MR. GROBE: Thank you. When we formed the Office of New  
4 Reactors, that was previously all under the Office of Nuclear Reactor Regulation,  
5 we established a joint procedure in both offices on technical consistency. And  
6 we used that aggressively in the digital arena, it establishes different levels of  
7 review by the two offices, up to complete and full parallel reviews, to peer  
8 reviews supporting the other offices, and lower level reviews, depending on the  
9 importance of the document that's being reviewed. Some of the topical reports  
10 that have been submitted to support new reactors are also applicable to  
11 operating reactors, and Pat and Tom have worked out a way in which the  
12 reviewers work together, and those procedures have existed -- one of our senior  
13 level advisors in NRR is responsible annually to put together a report on  
14 technical consistency between the offices, Ken Karwoski in our Division of  
15 Component Integrity, and he does a lot of evaluation and serving of the staff and  
16 the branch chiefs both in NRR and NRO to ensure that that's a robust system,  
17 that it doesn't have any gaps in it. So, it's an area that we particularly focus on.

18 CHAIRMAN JACKZKO: Well, certainly as we go forward that will  
19 obviously be an important area and I encourage you to continue focusing on that.  
20 The last question, and Tom, maybe this is probably an unfair question, but I'll  
21 probably ask anyway --

22 MR. BERGMAN: Sure you don't want to ask Stu that?

23 [laughter]

24 CHAIRMAN JACKZKO: Stu, do you think we'll ever --

25 [laughter]



1 CHAIRMAN JACKZKO: -- think we'll ever approve a design with bi-  
2 directional communication?

3 [laughter]

4 CHAIRMAN JACZKO: I wouldn't vote for it.

5 [laughter]

6 MR. BERGMAN: Again, I think we can, and, you know, we'll see  
7 what the future bears, we know there's more applications coming in over the  
8 horizon and small modular reactors may take that further with multiple units  
9 feeding into one control room. So, again, it's possible, we just haven't seen a  
10 licensing basis that makes the case yet.

11 CHAIRMAN JACKZKO: Well thanks, I appreciate that and we'll  
12 certainly continue our dialogue with the applicants I'm sure in that area. I would  
13 just note I think that it does raise a whole interesting set of questions I think, as  
14 Commissioner Svinicki raised about, to what extent source code would ever  
15 become part of licensing basis or inspectable and I know having done my own  
16 code development that it becomes a very personal activity and it's very rare you  
17 can imagine a situation perhaps 10 years later -- whoever developed the code, it  
18 takes a tremendous process to ensure consistency in modifications and updates  
19 to that code and somebody looking at it, brand new, from my experience in this  
20 area, would very likely recode the entire process because this is often too difficult  
21 to sometimes figure out what a particular software developer was doing when  
22 they were coding something and it takes a tremendous process to ensure  
23 knowledge and understanding of that code base to be able to modify it and  
24 maintain it in that way. So it's certainly an interesting area, but I think more that, I  
25 think as Commissioner Svinicki indicated, that the more that we're relying on the

1 processes there to ensure appropriate change processes and consistency in the  
2 code, probably the safer we'll be -- well not safer, but the better off we'll be.  
3 That's always a difficult word.

4           Again, I want to thank you all for your presentations. As I said at  
5 the beginning, I think we have come a long way, I think, from the first meeting we  
6 had on this subject in 2006 and I think it's really a good sign to see that we're  
7 moving into a more regular -- regulatory approach for this in sun-setting the  
8 Steering Group and moving into a more traditional review type process. So I  
9 think it's certainly a testament to where we've come, the completion of the Interim  
10 Staff Guidance I don't think when we started would have seemed really possible,  
11 I think in a lot of ways. But we've come a long way and updated a lot of guidance  
12 and I think now the challenges as I hear them are actually now taking that and  
13 implementing it and I suspect as we go along there'll be improvements and  
14 enhancements and I think we got some good information this morning from some  
15 of the people involved in the process about ways to continue to refine that and  
16 make it better, but in the end, obviously safety's got to be the number one  
17 concern, and we'll continue to make sure that's the case.

18           We have a few minutes if there are items any Commissioners  
19 wanted to talk about. Well good, I want to thank everybody and we're adjourned.

20           [Whereupon, the proceedings were concluded]

21