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UNITED STATES NUCLEAR REGULATORY COMMISSION
BRIEFING ON DIGITAL INSTRUMENTATION AND CONTROL

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WEDNESDAY

November 8, 2006

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The Commission convened at 9:30 a.m., Dale E. Klein, Chairman,
Presiding.

NUCLEAR REGULATORY COMMISSION:

DALE KLEIN, CHAIRMAN

EDWARD MCGAFFIGAN, JR., COMMISSIONER

JEFFREY S. MERRIFIELD, COMMISSIONER

GREGORY B. JACZKO, COMMISSIONER

PETER B. LYONS, COMMISSIONER

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PANEL 1:

JAY K. THAYER, VP, Nuclear Operations, NEI

AMIR SHAHKARAMI, SR., VP, EXELON

JACK A. BAILEY, VP, TVA

PANEL 2:

LUIS A. REYES, EDO

BRIAN SHERON, DIRECTOR, RES

WILLIAM KEMPER, CHIEF, IEE, RES

JIM DYER, DIRECTOR, NRR

ALLEN HOWE, CHIEF, ICB, NRR

P-R-O-C-E-E-D-I-N-G-S

9:30 a.m.

CHAIRMAN KLEIN: Well, good morning.

Well, we're here this morning to hear about digital instrumentation and control. And we'll first hear from an industry panel. And then we'll hear from our staff panel. Obviously, digital technologies are something that's changing in our daily lives and certainly it impacts nuclear reactors as well. So we look forward. Any comments before we start? Jay, would you like to start?

MR. THAYER: Thank you, Mr. Chairman. Commissioners, we really appreciate the opportunity to speak with you this morning about digital I&C and progress and future trajectory in our industry. We look at this as a very important technology application issue. And because it cuts across both our existing fleet of nuclear plants and influences our proposed expansion to the U.S. fleet, we've brought two industry leaders here this morning. Mr. Jack Bailey who is the Vice President of Nuclear Generation Development at TVA. Jack is here representing the new plant working group. And Mr. Amir Shahkarami, Senior Vice President, Engineering and Technical Services at Exelon. Amir also is the Chairman of the NEI Digital I&C Human Factors Working Group.

And I would like to mention that a significant number of that working group is behind us here this morning because of the interest in this issue as well as many of the utilities that are watching this issue, both from a new plant and existing plant standpoint, as well as many of the vendors who were also interested in this issue. So we appreciate your time this morning. I will turn it over to Amir.

MR. SHAHKARAMI: Mr. Chairman, Commissioners, good morning. Before I start, I want to echo and thank you for the opportunity you have given us

1 to be here to talk about this very important topic. As you know, and you
2 mentioned, we're going to walk through some of the issues.

3 Before I start, I want to refer to page twenty-three. That's a list of
4 acronyms that we put in there. So I'll try very hard not to use them. But in case I
5 do, page twenty-three reflect them.

6 In respect to the topic, we will discuss our thoughts today on the
7 regulatory involvement regarding the use of application of digital technology and
8 offer perspective on the need for a shared vision, ongoing activities and the
9 problem statement. We will look to define success criteria in terms of our mission
10 needs. We want to then go over some of the action we would like the
11 Commissioners to take on. And then finally, we're going to wrap it up with our
12 conclusion.

13 Next page. Clearly, the new plants being built will look distinctly
14 different than anything that we've seen before. Here are examples of four vintage
15 plants. As you can see here is much less equipment and digitized system, much
16 smaller screen. And ESBW is not here. But basically is similar to ABWR with
17 improved human factors.

18 Next slide reflects our existing plant. And you can definitely put
19 those two next to each other and see the differences between those. Then we go
20 to page five to talk about digital technology. We believe the use of digital
21 technology is absolutely necessary for the future of our nuclear industry. It will
22 enhance safety. It reduces obsolescence, not only from equipment standpoint,
23 but from a knowledge standpoint.

24 Today's colleges, technical and trade schools, no longer educate
25 analog. And most of our young people that are coming from these institutions are

1 pretty much in a digital arena. With respect to the hardware, there is significance
2 obsolescence issue. You can go on E-Bay and actually search and you would find
3 an organization like NASA or search and replacement for the obsolete analog.

4 Clearly, the observation of surveillance and function will reduce the
5 burden on operators. Again, as has been demonstrated in other industries,
6 there's a clear nexus to improving safety.

7 As noted in a recent Wall Street Journal article on the adoption of fly
8 by wire concept in airline industry, I'll quote, "safety provisional ID that is steady
9 progress in onboard computing is a major reason accident rates for jetliners have
10 declined significantly in the USA and much of Europe over the last two decades.
11 This trend means the chance of a plane now taking off will crash in less than one
12 in two million."

13 Digital control and protection systems are inherent part of the design
14 construction of new plants. There is no other option.

15 MR. BAILEY: I'll try to add a perspective on new plants as we go
16 through this various places. Of course, because these issues do apply to both
17 new plants and existing plants. But the way they apply are not necessarily the
18 same, partly because remember we have four different plants being prepared for
19 deployment in the U.S. right now. And all of them are at different stages of the
20 licensing process.

21 So I'll try to add a perspective that characterizes it in general where I
22 can. To eliminate the confusion, we'll keep it at a pretty high level for most of that.
23 But it's clear that all of those new plant designs take advantage of digital
24 technology in those designs. And the big concern I have is we'll go over several of
25 those is changes in the requirements going forward based on where they are right

1 now.

2 But they do rely on the digital technologies. And we won't build
3 those new plants without digital technologies eventually being approved and used.

4 Next slide.

5 MR. SHAHKARAMI: Page six. This absolutely is not new
6 technology. And in fact, I would say the U.S. nuclear industry is well behind in
7 terms of adopting digital technology. Again, I want to go back to the Wall Street
8 Article. "In theory, most advanced jetliners can take off, climb, navigate along the
9 prescribed route, descending to their destination and roll to a halt at the end of the
10 runway, all without human intervention."

11 Auto pilot program was first created to make planes fly more
12 smoothly and reduce pilot distraction by taking over routine tasks. Today's
13 software also handles many other wider areas of flight such adjusting cabin air
14 pressure, maximizing fuel efficiency and warning of impending mechanical
15 breakdowns or collision threats.

16 Advance plans for the Air Force Alpha 380 Super Jumper Jet due to
17 start passenger service late this year and Boeing Long Range 787 during 2008 will
18 take automation to new heights. Instead of independent hardware and software
19 system for each task, the new jet will save weight by relying on redundant central
20 computer to run the whole thing. The system will have safeguards to prevent
21 programs from interfering and confusing each other.

22 For example, if a speed reading from sensors differs widely, the
23 computers are designed to disregard the most extreme measurement and to
24 figure out which reading is correct. This type of concept of redundant computer
25 based program, if it is good enough for airline, it definitely should be advantage to

1 us to apply.

2 We need to define what the diversity's all about. Yes, we do
3 understand there maybe some problems. But we must acknowledge the
4 consequences of them and then address those issues, as staying put will be much
5 worse.

6 Now, I'm going to talk about the need for a shared focus. We should
7 be moving forward with digital applications. But we are not getting there. And
8 that's just based on history and the results that we've seen the last ten, fifteen
9 years.

10 Given all that is going on, we believe we must have a shared vision.
11 A shared vision that we all can agree on. While this may not be the exact wording,
12 it does provide some key points, some common ground. Digital I&C enhances
13 safety and reliability, is necessary for new plants, requires industry and regulators
14 to work together for a timely ... again, I say timely ... employment of safe
15 implementation. Need agreement on how to implement digital I&C.

16 In order to make effective use of technology and reality, you almost
17 understand the impact about behavior and actions, whether it is in terms of design
18 errors, of statement regarding infallibility.

19 MR. BAILEY: A note here for new plants again. We agree I think
20 overall with this vision because it's needed for us too. I don't want to downplay the
21 fact that a lot of progress has been made on digital with new plants though across
22 the board with interaction by the vendors, individual vendors and the staff, over
23 years.

24 However, the thing to keep in mind now is that these are real designs
25 for real plants that have real schedules that we're trying to meet going forward. So

1 for the issues that have not been completely resolved yet, this timely
2 implementation as part of the vision is very important for the new plant. Next slide.

3 MR. SHAHKARAMI: Thank you. Why is a common vision
4 important? Just look at all the things that are going on. Plus, in public meetings,
5 the staff is stating that they are still forming an opinion on some key, very key
6 issues. We are right now setting the stage for the future use of digital technology.

7 Between the guidance development and changes and the staff
8 development criteria for several key pieces ... next page ... if you look at NRC
9 research plan, you see a lot of things that likely will result in changes to the current
10 guidance. From a new plant perspective, the timing is not good. Design
11 certification are either done, nearly done or well along. We must stay fully
12 engaged in this area to ensure that we are doing the right research for the right
13 reason with the right time frame for completion.

14 MR. BAILEY: Let me emphasize here too a number of the vendors
15 for new plants don't believe new research is required for them to get to the other
16 end of the tunnel from where they're at right now. And they do believe it would be
17 necessary to take full advantage of digital technology longer term in the next
18 maybe generation or evolution of what they're doing with their plants.

19 So we don't want to get bogged down if the research is not
20 necessary for some of the activities. And that gets back into the characterization
21 of there's the new plant first wave which is already substantially done much of the
22 work necessary to get the plants designed and get agreement among the staff of
23 those designs going forward.

24 And they're doing final design engineering right now to get it out the
25 other end. Versus what we're going to need longer term for both the industry to

1 apply new technologies in different ways and to do it efficiently with plants that
2 have to do changes to existing designs and then to do the next design changes for
3 the next change of new plants. Next slide.

4 MR. SHAHKARAMI: On page ten and eleven, I have put three
5 topics. One is a regulatory guidance issue. One represents technical issues that
6 need to be addressed. And the last one is the process itself. As we noted,
7 changes to existing guidance will have substantive impact. New plant design
8 certification in some cases are completed as I said earlier or in other cases well
9 along. All of these are based on existing guidance.

10 COMMISSIONER MCGAFFIGAN: Mr. Chairman, could I ask a
11 clarifying question? It is my understanding that a lot of this stuff, particularly
12 control room design, was intentionally not dealt with on design certifications for the
13 various plants because design certifications were a long time ago for some of the
14 plants, the ABWR. And they intentionally didn't want to be tied into a certain
15 generation of digital technology.

16 My understanding is that the design centered approach is going to
17 result in locking at least a cohort of plants of similar age profile into a design,
18 digital I&C design, for control rooms and other things. And we'll deal with that at
19 the COL stage. Or we'll deal with it in parallel in updating the design cert. But a
20 lot of these issues haven't been dealt with yet, right? In the design certs that have
21 been completed, these issues haven't been dealt with.

22 MR. BAILEY: You're correct. There are issues that have not been
23 dealt with on new plant designs. Some of them were left open until later in the
24 review process. I think the concern would be for the things that were dealt with
25 and agreed to that somehow that might change when the additional reviews that

1 were necessary need to take place.

2 Clearly, human factors in control rooms is one of those open items
3 still. And we do believe that there's a good interaction with the new plants that I'm
4 aware of and the staff to try to resolve those issues. But getting back to the vision,
5 we can't get bogged down into delaying those issues. We need to move that
6 forward. And if there are issues that need to be addressed, you know, get them
7 addressed and get them resolved.

8 COMMISSIONER MCGAFFIGAN: I was just trying to clarify. I
9 appreciate the clarification. We're going to deal with some of these issues in the
10 future.

11 MR. BAILEY: Yes.

12 COMMISSIONER MCGAFFIGAN: They are not resolved.

13 MR. BAILEY: That's correct.

14 COMMISSIONER MCGAFFIGAN : Okay.

15 MR. SHAHKARAMI: As far as technical issues go, much has been
16 said and discussed about the application from Duke Energy that I'm sure you're
17 well aware of. And we are not here to debate who was wrong. But we can tell you
18 the impact it's having on plants considering changes. Rightly or wrongly, you are
19 seeing more issues arise.

20 Branch Technical Position-19 is one example of change to current
21 guidance that could have a significant impact. I can give you a couple of
22 examples on a Branch Technical Position.

23 One is coping with software common failure in conjunction with the
24 large break that took place during the Oconee discussion. And it looks like we
25 have to have the endorsement of certification as the guidance support that.

1 We also have significant advantage of using PRA systems to give us
2 insight on a digital system and I don't think we have made significant improvement
3 in that area. I think a good coordination between the PRA group and I&C group is
4 a must to understand how can you take advantage of a PRA in the application of
5 digital systems.

6 There are also other actions in defensible manual operator action
7 with coping with common mode failure of the digital system. And the list goes on.
8 But all these technical issues need to be dealt with.

9 In respect to the process on page eleven, clearly with the
10 development of new plant office, there is a need for an unprecedented level of
11 coordination and cooperation between the parties to ensure consistency in a
12 regulatory process associated with the technology. It must have a way of
13 identifying issues and moving them to resolution in a prompt manner.

14 And from the process perspective, the amendment process that is
15 being used today is not working. We understand the staff's need for up-front
16 discussion, but we also need to work on a concept that will allow us to clearly
17 understand what information is needed. At what point in the design process
18 without resolution of key technical issues having a completed design on shelf
19 before we get concept agreed upon, will cause unnecessary delay and cost.

20 Now, let me talk about the problem statement. So what is the
21 bottom line? The existing regulatory process lacks stability. And to get there, we
22 must have clear path for success in terms of resolving a number of long standing
23 technical and process issues that I've just discussed.

24 A number of plants have changed or deferred their I&C upgrade plan
25 due to unstable regulatory involvement. In my company, we have a long-term

1 strategy for the I&C upgrade. But if you look today, most of those are being
2 pushed to the right. Because that stability is not there. And that goes for
3 Comanche Peak, Diablo Canyon and so on.

4 MR. BAILEY: And I can put my other hat on for TVA and give you
5 an example where it impacted us somewhat too. As we were scoping the Browns
6 Ferry restart work that we wanted to do, we had to technically decide whether we
7 wanted to upgrade the reactor protection system or the emergency core cooling
8 system to digital technology.

9 The engineering staffs of TVA determined that based on the
10 regulatory uncertainty and the concern about being able to meet the schedule if
11 we went that way, we chose not to do that and to stick with the existing analogue
12 designs that we had.

13 MR. SHAHKARAMI: And we have represented it from this utility in
14 our working group. And I ask them why that's the case. Because I know from my
15 perspective what it is. They all basically said it's all due to the changes based on
16 this instability, the fear of protracted view with possible redesign that's causing
17 progress paralysis.

18 MR. BAILEY: And one point just to make sure the Commission is
19 aware of it, for new plants, the current critical path for several designs in order to
20 get the plants' final design engineering done and the deployment of those plants
21 done by 2015 even is the control room design and the simulator being built and
22 operators trained.

23 So it's through that path that we are on a critical path potentially with
24 some of the designs already. And it's not the fault of the staff. I'll make that clear.
25 I mean, the industry could have started two or three years earlier in this process

1 because we knew it was a long process to begin with. Plants weren't being
2 ordered. There wasn't a lot of interest.

3 But once there was and everybody now is aggressively trying to work
4 through that, it's finding itself beginning to stack up on that type of schedule. So
5 we think the issues are resolvable. And those schedules can still be met. But it
6 has to be done with urgency and earnest on both sides.

7 MR. SHAHKARAMI: Page thirteen. In terms of success, we can
8 discuss success in terms of our mutual needs. We need a stable, predictable and
9 timely process. To be timely, for example, we must design a way that we can get
10 started on technical issues. We need to have that mechanism. How do we put
11 issues on the table with a time line and resolve them?

12 Traditional thinking of physical separation, redundancy, those
13 concepts do not work as well for digital applications. We must clearly define the
14 ways you can achieve adequate diversity in digital design and work together to get
15 there.

16 Page fourteen. There are multiple organizations and areas that have
17 a stake in this. And we must get ourselves organized in a manner that ensures
18 such coordination. As we have stated, we certainly believe that risk insight can be
19 helpful and meaningful today. But we need to find a way of working out issues
20 with the staff.

21 And with this factor research. Early understanding of research
22 activities is the key. We should not wait until an effort has resulted in a draft
23 report. Rather, up front understanding is key. There are existing collaboration
24 agreements that can be leveraged with this up front engagement. Having an
25 agreement on the need for research and what the end result will do to us, for us, is

1 just as important as the product itself.

2 MR. BAILEY: Let me make sure the point is made, I've been trying
3 to make it earlier though. For the first wave of new plants, in general, a lot of
4 change in this area is not good. Because unless it lessens requirements reliably
5 and safely.

6 And the reason is they're well down the path of trying to finalize their
7 engineering work now. And they've taken a conservative approach on digital in
8 most cases to try to comply with the existing requirements.

9 So there are additional gains that can be made for new plants also.
10 But it will probably come in the second or third wave. That doesn't diminish the
11 need to make all these changes.

12 We've just got to keep in mind that you don't want to do things that
13 will have long-term benefits, but then it hurts us short-term on the first units we're
14 trying to deploy.

15 MR. SHAHKARAMI: Page fifteen. I'm going to shift gears now. I
16 want to talk about what the industry has done to get itself more organized to work
17 through these issues that I just described. We developed, through NEI, a working
18 group that includes several industry executives. The Digital I&C and Human
19 Factors Working Group, coordinates industry relative to resolution of regulatory
20 issue associated with application of digital technology, both existing and new
21 plants.

22 It provides infrastructure to prioritize and address technical and
23 process issues in a timely manner. Coordinates efforts of various industry groups
24 and initiatives. Supports guidance document update, such as DG-1145 and a
25 Standard Review Plan. What we learned on DG-1145 was we were making

1 comments, sending them over to NRC. NRC was implementing some of those,
2 sending it back and forth.

3 And the best way we could resolve that was to get the right skill set
4 and talent in a room, face-to-face. And then it was very easy to resolve the
5 issues. I think we need to do more of that, when we get a specific technical issue,
6 rather than letting inefficiency get in our way to resolve those.

7 On the next page sixteen, I'm not going to go through the description
8 of every one of these task forces and the focus group. But basically due to
9 diversity of issue, we felt that these were the appropriate distribution of the issue.

10 But again, several require cross-functional pollination of resources.
11 We put a lot of thought into this organization. It would be good to have a similar
12 arrangement at NRC that helps us coordinate better. The rationale behind that is
13 if we have a mirror organization and we can get on a specific area, the technical
14 expertise at that level to work together to resolve the challenges and issues. And
15 we have seen actually that work on the digital I&C on a couple of the areas that
16 we have.

17 Page seventeen, moving forward. It would take a dedication of
18 resources and oversight at the highest levels on both our parts to move this
19 technology forward. So we need your help. And we would like to offer some
20 specific suggestions on how we make this work.

21 On the next viewer slide, it will discuss the specific action we would
22 like to have the Commission take related to problems we have identified earlier,
23 actions we believe are necessary to meet the needs of both parties.

24 On page eighteen, we talk about some actions. Develop an
25 interaction protocol that will capitalize on previous success initiatives. License

1 renewal organization as we saw it has been very effective. Now, we're not saying
2 exact same structure.

3 Could you click on license renewal model line? Here is where we
4 actually have set up an organization that will mirror license renewal. And you have
5 a variety of organization involved, cross functional areas involved. There is a
6 quarterly meeting with the industry working group that takes place. We have a
7 frequent meeting with NRC technical staff and industry task forces. And we do
8 provide routine updates to the Commission. So I think this is a good model. And
9 we're not saying this is it. But I think it needs the same focus to be brought into
10 the digital I&C application and implementation.

11 I'd like to go ahead and move to page twenty. I want to talk about
12 risk insight. The following is from the first paragraph of PRA policy statement.

13 COMMISSIONER MERRIFIELD: If I can, Amir, I'm not certain that
14 the version I have is quite the same as yours. You're on currently your slide
15 twenty, is that right?

16 COMMISSIONER MCGAFFIGAN: I think he's on nineteen actually.

17 COMMISSIONER MERRIFIELD: Well, maybe nineteen on ours.
18 There maybe some re-numbering.

19 MR. SHAHKARAMI: Yes, nineteen was the one that I displayed on
20 the screen.

21 COMMISSIONER MCGAFFIGAN: Risk insights is our nineteen.

22 CHAIRMAN KLEIN: Yeah, we have 18A. And then nineteen is
23 requested actions is what we have.

24 COMMISSIONER MERRIFIELD: So what's the title at the top of the
25 slide that you want to be on?

1 MR. SHAHKARAMI: Requested Actions.

2 COMMISSIONER MCGAFFIGAN: That one right there.

3 COMMISSIONER MERRIFIELD: That's our slide number nineteen.
4 That's the one you're talking about right there?

5 MR. SHAHKARAMI: That is correct.

6 COMMISSIONER MERRIFIELD: Okay, great. Thank you.

7 MR. SHAHKARAMI: So I was trying to provide a quotation of a PRA
8 policy statement. The Commission believes that an overall policy on the use of
9 PRA method in nuclear regulatory activities should be established so that many
10 applications of PRA can be implemented in a consistent and predictable manner
11 that would promote regulatory stability and efficiency.

12 The Commission believes the effective use of PRA promotes
13 regulatory stability. Why would we continue to delay on this issue? We believe
14 there are ways to take advantage of this today and improve safety.

15 Let me talk about the second bullet. The staff is working and has
16 been working since June, 2006 on revising the guidance associated with diversity
17 and defense in-depth without any input from industry. This type of hidden
18 challenges are leading to industry paralysis in moving forward with the changes.
19 We must bring these issues out into the open and debate them in an appropriate
20 manner.

21 We ask that you don't endorse the staff recommendation without the
22 staff having first openly engaged in stakeholder discussions. We believe that we
23 all need to clearly understand the research needs of the staff and especially for
24 new plants what that might mean.

25 Continue on page twenty-one. Finally, we ask that the staff revisit its

1 1993 policy statement in this area to clearly articulate the need for all parties to
2 move forward in a timely manner to improve the regulatory involvement associated
3 with implementing digital technology in our current and new plants.

4 And I'll move to the last page, page twenty-two, as means of
5 conclusion. I think you can see by the number of people here today the industry
6 has significant interest in this area. But this meeting is not the exception. In
7 nearly every NRC public meeting over the last six months, the room has been
8 packed. And not just with those directly associated with the meeting. We need to
9 act now and provide more focus for this matter. Our current efforts are not getting
10 the results we need. The needs we have listed on this slide are pretty basic needs
11 of an important project. All necessary for both NRC and industry to be successful.

12 We had a meeting on October 19th and we are very, very pleased
13 with the information that has started turning corners on this technology with the
14 staff. And I think we need to have more healthy meetings like that going forward.

15 What I would like to recommend at this time, based on everything
16 that I covered here, is that we work with the staff and we can take the ownership
17 to develop a project plan. I really think the only way we can be successful to get
18 this side of the technology into a real defined project plan that has all the items
19 identified, due dates, owners, what we can bring to the table, what is the alignment
20 on the research program, is have that in place I would say within the next two or
21 three months or so, and then ask you to allow us to come back in six months and
22 show you what progress has been made. I think that becomes crucial from
23 providing that oversight on this very important issue. And that's the end of my
24 presentation.

25 CHAIRMAN KLEIN: Any more comments?

1 MR. THAYER: That concludes the industry presentation, Mr.
2 Chairman.

3 CHAIRMAN KLEIN: Okay. Thank you. Obviously, we will hear from
4 the staff following this. So we'll go through one round of questioning now. But I'm
5 sure that you'll stay around that we can grab you for more questions if they come
6 up. We'll start with Commissioner Lyons.

7 COMMISSIONER LYONS: Thank you, Mr. Chairman. And let me
8 thank each of the industry presenters, very much appreciated, Jay, Amir and Jack.
9 Thank you. Amir, you started out with the point that you believe the transition to
10 digital I&C is necessary. And I very, very much agree with you that it is necessary
11 and we need to be moving ahead effectively to do that.

12 I also agree that the opportunity to move towards digital I&C does
13 present certainly the opportunity for enhanced safety along with presenting a
14 number of challenges along the way. And some of those challenges are going to
15 be trying to understand the different failure modes which I'm sure ends up with in
16 some of the areas of concern that you described.

17 But, as you noted, and as I think we're all well aware, there are many
18 examples where digital I&C has been used in many industries and in the nuclear
19 industry with considerable success, albeit with some hiccups, but considerable
20 success around the world.

21 As I was going through the slides in preparation for this meeting that
22 industry was going to present and the slides that staff was going to present, I
23 found myself honestly wondering if we were talking about the same subject. And
24 I'm sure this will come up more in the discussions with staff also.

25 Because on the staff slides, I got the impression that the general

1 feeling is that we are on a track toward success, that we do have a path defined
2 towards success. But certainly in your view graphs and certainly in the remarks
3 you've made, I don't get that impression anywhere near as strongly. And, in fact, I
4 get an impression of a very, very strong concern.

5 At one point in your presentation, just to show some of my confusion,
6 Amir, you mentioned the lack of involvement with staff. And that rang in my mind
7 the fact that there had been that October 19th meeting which certainly from
8 anything I'd heard had gone very well. And then you mentioned later in your
9 remarks that that was a very positive step forward. So maybe that can be the kind
10 of model that we look towards to emulate.

11 On one of your slides, you suggested, I think it was my 18A, but we
12 have different numbering. You talked about the possibility of a high level digital
13 I&C human factors steering committee established between industry and staff.
14 That strikes me as a very, very good idea.

15 I may have asked the wrong question. But in preparing for this
16 meeting, I'd asked staff whether that was discussed on October 19th. And I don't
17 think it was. Or maybe I asked the wrong question. But at least I got the
18 impression from a few staff with whom I talked that the idea of such a committee
19 was viewed very positively by staff. But there seemed to be some question as to
20 whether it had been discussed in that October 19th meeting.

21 Let's turn to a few specific questions though. It's my slide thirteen.
22 I'm not quite sure what your number is. It's the slide that starts "we all need" at the
23 top. You have a bullet on there, the last bullet. You talk about ... let's read your
24 bullet. Understanding that the application of mechanical system or analogue
25 design concepts to digital technology may not be the appropriate model.

1 Now, to me, design system or analog design concept mean things
2 like redundancy, independence and diversity. And I wasn't aware that we were
3 really asking for anything different as we look towards digital systems.

4 So I guess the question would be am I misinterpreting that you mean
5 here? Or are you suggesting that redundancy, independence and diversity need
6 not be part of a system involving digital I&C.

7 MR. SHAHKARAMI: I think we promote and I think technology offers
8 the redundancy defense-in-depth and all that in a digital system. But we cannot
9 keep thinking deterministically on the issue.

10 And I start getting into the more risk informed aspect of it. We can
11 break down the technology to a smaller box and start evaluating every box and
12 see which one of these boxes have a common software and start addressing that
13 issue. What we're talking about here is let's get into the more risk inside of the
14 application and try to bring all those together with no means we say you don't have
15 to have separation. That was not the intent at all.

16 COMMISSIONER LYONS: When you talk about risk insights ... I'm
17 sorry, Jay. Did you want to say something?

18 MR. THAYER: I think you make a good point. Diversity, redundancy
19 and independence, those are cornerstones for design. They really are. And we're
20 not challenging that one bit. What we are saying and what we're trying to say is
21 that the analogs for evaluating those cornerstones in the past have gone back to
22 primarily mechanical analogs.

23 And when you get in with digital universe, you have different ...
24 there's a different analog for reviewing the concept of diversity, reviewing the
25 concept of redundancy. And it takes thinking outside of that mechanical box that

1 we've been in for the last thirty-five, forty years. It's a different review concept.

2 COMMISSIONER LYONS: When you talk about risk informed as
3 applied to a digital system, at least in my mind, you get to a very difficult question of
4 how do you quantify risk for a digital system? And to me in order to actually move
5 ahead with let's say a traditional risk informed system, we'd have to be able to or
6 you'd have to be able to literally list all the failure modes of a digital system which
7 would get into one of the Chairman's favorite comments of unknown unknowns. And
8 at least in my mind, the approach that I know has been discussed between staff and
9 industry of maintaining diversity of systems, so that you avoid the potential for
10 common mode failures even if you don't necessarily have the ability to catalogue
11 every failure mode maybe a better path forward.

12 So I guess the question out of this is do you see that it's possible to
13 truly do a risk informed approach with a digital system in the sense that you can
14 catalogue all its failure modes?

15 MR. SHAHKARAMI: There is an EPRI report that was submitted in
16 2004 to NRC that is still sitting there, it hasn't been really endorsed and has a
17 pretty good section on the use of risk informed and the whole model of what you
18 do to go through it.

19 There are going to be some failures. Important in PRAs, which one
20 of those need to be of concern of us so we can go at this. We're trying to use that
21 intelligence in a compartment that we select and go through it step-by-step and
22 understand what is it that would concern us and try to address those? If you want
23 to go through the entire box, every piece, I don't think you're ever going to get
24 there because there is a test requirement that gives you that validation. And then
25 there is a design aspect that goes through. But the PRA provides you that

1 intelligence of those that you need to be focused on and not every single failure
2 that doesn't have anything to do with the function of the system.

3 COMMISSIONER LYONS: And maintaining a diverse approach.

4 MR. SHAHKARAMI: That's correct.

5 COMMISSIONER LYONS: Whether it be diverse in software or
6 diverse in a hardware/software mixture. Which as far as I know, we've never
7 specified. We've left that up to you.

8 MR. SHAHKARAMI: That's correct.

9 COMMISSIONER LYONS: Maintaining that diversity of approach to
10 me is very important in avoiding any soft of a common mode failure.

11 MR. TOROK: My name's Ray Torok. I'm from EPRI. And I was
12 involved in a project that Amir mentioned there. And I wanted to add a few
13 clarifications here. There are some things you can do with the risk informed
14 approach that go beyond a simple deterministic approach where you say, make it
15 diverse. Make everything diverse which is not a bad strategy. I shouldn't say it
16 that way.

17 But if you look at it risk informed, you can put the digital I&C and the
18 software on the same playing field with the other components in the system and
19 look at for example whether the I&C is a significant contributor to the probability of
20 failure of a system or a safety function which is what you really care about. And
21 that gives you a handle on where it's most important to have diverse backups and
22 where it doesn't make any difference because the failure of probabilities are
23 dominated by other things. And that's really what the risk insight approach is
24 about. Does that help answer your question?

25 COMMISSIONER LYONS: Yes, that does help.

1 MR. SHAHKARAMI: Yes, I think we see that adding more backup or
2 redundancy from a safety perspective may not add any leverage. But if you
3 understand what needs to be added, then you can make that decision.

4 COMMISSIONER LYONS: Thank you. And I'm over my time.

5 CHAIRMAN KLEIN: I just have a few quick questions. I guess I
6 think all of us at the table and probably the staff, from my discussions, believe we
7 need to head towards digital controls because that's where everyone's headed.
8 And I guess I'm surprised that we seem to have the differences that we're having.
9 And getting back to Commissioner Lyons' comment on slide 18A, have you talked
10 to the staff about that plan?

11 MR. SHAHKARAMI: The October 19 meeting was the first time we
12 really started seeing a change in our behavior and establishment of a plan. I think
13 if you look at the results up to this point, a lot of activity has taken place. But if you
14 look at the results up to this point, it's not supporting our expectation about
15 building a new plan with a time line we established to get there. We're looking at
16 research to go past 2009.

17 So I think what we're asking here is establish a plan, a project plan,
18 very detailed that puts all this issue on the table and it starts seeing our progress
19 as we're walking through because we can walk away from here and be here
20 exactly a year from now. And history has shown that to us.

21 So what we're trying to do is establish a vehicle that will provide
22 oversight from your perspective and our perspective and make sure we get those
23 line items in a project.

24 CHAIRMAN KLEIN: I guess what I'm looking at is, have you laid out
25 a plan to the staff, a path forward? In other words, a solution, a get well plan?

1 And have the not agreed to it?

2 MR. THAYER: Mr. Chairman, if I could, the October 19th provided
3 really a kickoff point that illustrated to us that we were mired in the technical
4 issues. We initiated discussions with senior management. Actually, senior
5 management initiated discussions with us.

6 And the discussions, as you might expect, focused on a lot of things
7 which Amir talked about this morning, putting this into a project management box
8 where we had mutual expectations, defining the technical issues, defining the
9 ownership of those issues and the various branches because of the diversity of
10 the issues and the cross connectiveness of the issues that Amir talked about.

11 So it's been just in the last few weeks that we've had those kind of
12 discussions that would led. But I can't tell you that we have a finished product for
13 the vision that Amir discussed.

14 I will tell you that a lot of the things that we talked about with senior
15 management just over the last few days in preparation for this presentation are
16 encouraging from the standpoint of providing this layer of oversight so that we can
17 manage these complex technical issues with some more predictable expectations.

18 MR. SHAHKARAMI: We have discussed internally to develop a
19 project plan that I talked about. As we take the ownership to develop and then
20 provide it to the staff to get input and check and adjust that. And that's what I was
21 talking about. I'd like to see that coming together within the next three months or
22 so.

23 So then we can come and see you three months after that just to
24 show how it's laid out and what kind of progress we've been making on that.

25 CHAIRMAN KLEIN: I know the question will surprise you because

1 industry always speaks with one voice. But is the industry organized? I guess this
2 is a question for Jay. Do you all have an agreement on a path forward on what
3 industry, one voice, says that they want to see on digital reliance?

4 MR. THAYER: Yes, Mr. Chairman, I think we do. I think we're close.
5 The experience ...

6 CHAIRMAN KLEIN: Close? Close? And what percentage, 99.9?

7 MR. THAYER: Ninety-nine and some change. We have the
8 structure that Amir talked about with the working groups so that we know we're
9 covering the technical issues. The technical issues as they roll up, we have the
10 management oversight.

11 Because we've got some senior leadership from the industry
12 representing various companies as I said in my opening with the new plant
13 deployment as well as the existing plant deployment of digital I&C. So we think
14 we've got the oversight of both the technical issues and the management issues
15 for a clear path forward.

16 What we don't have is the corresponding understanding of the
17 agreement on the NRC staff side and turning that vision into a concrete plan of
18 action forward, based on the urgency that we see associated with this issue that
19 Jack talked about.

20 MR. BAILEY: The other thing though to keep in mind, the industry I
21 think knows where they want to go and they've got a plan, 99 percent. But you're
22 also interacting with four individual vendors which are also participating with the
23 industry. And that gets back to the long-term direction they think we need to go in
24 digital they are probably in agreement with that.

25 But in terms of the short-term impact on their designs and what's

1 happening now, they're all at different places. And they have their own
2 interactions with the staff. Some very good.

3 I mean, when I reached out and tried to say where are you right now
4 on trying to resolve issues for your design, some of them said we're doing fine
5 right now with the staff. So don't mess up the cart.

6 They were really concerned about imposing new things or
7 requirements that would make it worse than where they are right now. But long-
8 term vision of where they think we need to go is consistent with where the
9 industry's trying to go.

10 CHAIRMAN KLEIN: That was relating to one of my questions on
11 your slide three where you had pictures of various systems. I assume that the
12 ABWR is real, that it exists.

13 MR. SHAHKARAMI: That's correct.

14 CHAIRMAN KLEIN: On your AP1000, is that real or is that a
15 schematic?

16 MR. BAILEY: That is a real simulator. But it's not ... they don't have
17 the control room design on site.

18 CHAIRMAN KLEIN: Thank you. Commissioner McGaffigan.

19 COMMISSIONER MCGAFFIGAN: Thank you, Mr. Chairman. I'll
20 make a few comments at the outset. I'm an old hand here. And I've been through
21 this a few times in other areas. It is standard staff procedure when the
22 Commission schedules a meeting on something to schedule a staff meeting a few
23 weeks earlier so they can report progress. And I'm glad there was progress on
24 October 19th.

25 But I get the sense as I have, you know, the sort of plea that they're

1 making today, the industry's making today, is not dissimilar to previous pleas in
2 other areas. And they're asking us to be involved. They're asking the senior staff
3 to be involved. And I sympathize and support that.

4 I think the sort of project plan approach, the sort of license renewal
5 steering committee approach, the sort of getting the Commission involved every
6 six months, I think those are necessary actions. I'm not sure they'll be sufficient.
7 But they're necessary actions in order to try to get a path forward in this area.

8 And this is not the first time that I would say that there's a mismatch
9 in ... staff/industry mismatch about what happened in a meeting. And the staff
10 oftentimes can go to meetings wildly optimistic that vast progress has been made
11 and the industry is a little bit more of the doubting Thomas school, especially when
12 it's the first meeting they've had in a long time.

13 The other comment I'd make is that there is ... perhaps you'll hear
14 about it tomorrow ... a bigger issue here. You talked about the staff going dark on
15 this guidance with regard to diversity and defense in-depth. And that's what the
16 staff does when it's up against deadlines. And they feel like they're up against
17 deadlines for next March.

18 Again, I think we need to break through that. We can't break
19 through it everywhere. But the staff oftentimes goes dark in order to meet
20 deadlines. Because they have enough problems hurting themselves rather than
21 getting any external abuse.

22 That all said, I believe that we have to approach this carefully. I
23 mean, we have to transition to digital systems because I don't plan for plants that
24 we might be operating to 2075 to be searching on whatever E-Bay is 2074 for
25 analogue devices to plug into their control rooms.

1 So we've got to go digital. And the issues are going to have to do
2 with common mode failures and how much diversity is enough and how much
3 defense-in-depth is enough? Our Finnish counterpart has decided that they need
4 an analogue backup for some digital functions in their review of the EPR.

5 I don't go there necessarily. But I do think the heart of the issue is
6 this diversity and defense-in-depth issue. And we've got to resolve it. Because
7 you guys are up against deadlines. And we may not resolve it. I think Mr. Bailey
8 suggested that the first designs are likely to be more conservative than what
9 follows. Simply because we may not be ready to approve everything at the
10 moment. So you'll build greater diversity and greater defense-in-depth in than
11 perhaps EPRI's risk informed models would indicate is necessary. Because you
12 just don't want to get delayed.

13 But we've got to have a process to get DS and I endorse that. Could
14 I ask Mr. Bailey a couple of questions? Presumably the COL applicants are going
15 to have to have ITAACs for digital I&C. You describe this fairly unstable
16 environment in which you are today. But are you developing, are each of the four
17 vendors developing ITAACs for digital I&C?

18 MR. BAILEY: Yes. I mean, they are ... well, I'm most familiar with
19 one or two of them. So I have difficulty painting a broad brush. But the intent all
20 along was to complete the designs once they had the certainty of building a plant
21 with the latest technology to take advantage of it but to do it in accordance with the
22 safety evaluation report constraints, which were the designs. And then to come up
23 with the ITAACs to actually verify that it met all of the requirements. So those
24 things are all part of the process.

25 The question will be as you develop those things now and

1 reintroduce the topics to the NRC, how certain was what they approved before in
2 the SERs or topical reports or other things that have already been reviewed and
3 approved versus what is really new and has to be decided now as part of the
4 problem?

5 COMMISSIONER MCGAFFIGAN: Well, it just strikes me that an
6 applicant who may be coming in here September or October of next year sort of
7 has to have some degree of certainty there.

8 The second question, and maybe this goes to anybody on the panel,
9 maybe Mr. Thayer. We are under a continuing resolution at the 2006 level which
10 is about \$100 million less than both houses would like to fund us at this year.

11 And there is some chance, reading the Congressional Trade Press,
12 that in light of the election result yesterday evening that we could be under
13 continuing resolution well into next year. So we could be facing some at the 2006
14 level, \$100 million less than both houses want to give us. And that's far more than
15 ten percent.

16 So if we decide to make this a priority, and I'm open to that and I
17 think it's necessary for both existing and particularly new plants, are you prepared
18 to see other licensing actions in the licensing inventory and other preparations for
19 new plants to be delayed? Because we're not in a zero sum game. We're in a
20 negative sum gain.

21 If we make this a priority and consume resources that perhaps the
22 staff hasn't planned for, even under our expansive \$100 million above 2006 level,
23 when we're at 2006 level for six months, and it's in a critical six months, do you all
24 mind ... the right answer is no ... but do you all mind us de-prioritizing a whole
25 bunch of other things?

1 MR. THAYER: No. Having said that, let me give you a little backup
2 to my answer.

3 COMMISSIONER MCGAFFIGAN: And they'll give you a list of what
4 they think those things that should be funded.

5 MR. THAYER: Speaking for NEI, we have multiple forums, both at
6 the executive committee level which involves the CEOs of all the companies
7 involved in nuclear, as well as the Chief Nuclear Officer level where we routinely
8 put issues on the table that need prioritization because the industry is in the same
9 position. We can't work every issue everyday. So the prioritization of issues that
10 you talk about is a concept that's very familiar with us. We have the forums to do
11 it. And we have the forums to reach consensus as an industry on an issue that we
12 consider important.

13 COMMISSIONER MCGAFFIGAN: Okay. Well, there will be
14 consequences if we put this to the front of the cue. Thank you, Mr. Chairman.

15 CHAIRMAN KLEIN: COMMISSIONER MERRIFIELD.

16 COMMISSIONER MERRIFIELD: Mr. Chairman, thank you very
17 much. It's going to seem like a broken record but I too noticed, and perhaps
18 because I too am an old hand, the difference between the slides that we had from
19 your panel and the slides that we had ... we are going to have from our staff which
20 do appear to be much more optimistic in its approach.

21 I think one of the problems that we have is that we have gone ... a lot
22 has changed in the last year. I think if we all asked how do we think the new build
23 efforts going to go, I think we probably would have made more of an analogy to a
24 World War I biplane and its speed and trajectory whereas today we appear to be
25 much more like a rocket.

1 And so the time line that we set for ourselves a few years ago in
2 addressing some of these digital I&C problems, issues, challenges, made sense
3 given the movement that the industry was going to take to order new plants. And
4 now that you guys have changed your mind, in part because of the Energy Policy
5 Act that got adopted last year, everything's going to get hurried up.

6 It seems to me that one of the issues we've got to grapple with very
7 much goes to Commissioner McGaffigan's notion, prioritization. We did have ...
8 looking back at things, we did have some challenges. And we don't need to get
9 into who shot Paul ... who shot John I should say.

10 But there were issues relative to the application and what we saw
11 coming out of the box with some I&C issues. Some of those issues fall on our
12 side of the table. Some of them fall on your side of the table.

13 But I think the issue of prioritization really does get to the issue of
14 some of the new plant concerns. If you've got a time line that you need to move
15 on to make all this work, yet there are also folks out there who would like to take
16 advantage of this with the currently existing fleet, I think there does become some
17 push and pull.

18 And I know it's very difficult for NEI, given this membership, to say,
19 okay, here's one and here's two. Given the fact you've got some folks who want
20 to build new plants and others who don't.

21 And I think that's going to have to be a choice of perhaps that we're
22 going to have to make. If it's important enough that these decisions get made in a
23 timely way relative to new plants, it would seem to me maybe that gets put first.

24 And resolving some of the more thorny questions as to how do we
25 back fit that relative to our existing fleet may get put second, or put in an

1 appropriate, logical order. I'm going to go to our staff on the next panel on the
2 issue of research. I take with a lot of seriousness some of the comments you
3 made about gee, it seems to us, NEI, a lot of these research issues should have
4 been resolved. I remember when I visited the Holden facility in Norway back in the
5 year 2000, I think it was July of 2000, they were talking to me about how they had
6 already deployed a lot of these systems of aboard oil platforms and other facilities,
7 and I do have to scratch my head as to how so many other elements of our
8 infrastructure seem to have been able to deploy digital instrumentation and control
9 and we're still doing a lot of research efforts that are going to play themselves out
10 through 2009. So that's certainly one I'll telegraph to the staff, I want to have a
11 better understanding. In terms of a question to this panel our counterparts over at
12 the FAA seem to have made the leap to say we can go with digital instrumentation
13 and control in the cockpits of our nation's airplanes and we've done that in a way
14 in which I won't quibble with the assertion that you've made that they are a whole
15 lot safer having done so. Can anyone here on the panel or perhaps our person
16 from EPRI sort of walk me through how FAA was able to make that kind of a
17 change and get there, whereas we seem to be struggling to a much greater
18 degree.

19 COMMISSIONER MCGAFFIGAN: Walking time doesn't count.

20 (Laughter)

21 RAY TOROK: This is Ray Torok, from EPRI again. Yeah, I know a
22 little about what they did. And the problem that you pointed out earlier, somebody
23 pointed out earlier has to do with failure probabilities for digital systems. There's
24 no consensus on the best way to do that or how you determine that accurately.
25 Although we know a lot about how to hedge our bets in terms of design features

1 that you would use, in terms of processes for software development and that sort
2 of thing, in the case of the FAA, they have, I guess a very extensive process for
3 software development. And I'm not sure if it includes or dictates design features,
4 but sort of the negotiated agreement where if it's been agreed upon that if you
5 develop your software under this standard then they will accept your claim that the
6 failure of probability is less than some number. And I think their number is ten to
7 the minus ninth failures per hour of operation. And they consider that acceptable.
8 So it came down to a judgment call based on good software development process
9 and design in their systems.

10 COMMISSIONER MERRIFIELD: Well, let me just get a little bit more
11 information. Like I said I think we've got other counterparts in various industries
12 who have been able to have a sufficient level of trust that the systems in the digital
13 systems can be relied on along the ways that they need to for their purposes. And
14 I think that an analog with the FAA is a pretty good one from that regard.

15 MR. SHAHKARAMI: Commissioner if you just take a look at, you
16 know, not that much on a safety application but on a feed water system. We have
17 digitized that in our fleet and a lot of other utilities have done it. You just go look at
18 failure over years and you see the performance of a digital system that has
19 created more stable conditions during transient. I mean, it's a lot of benefit and
20 the operator cannot be happier than when they see a digital system taking control
21 and doing the things that was very difficult in the past. So I think even to dialogue,
22 as I said we all feel pretty safely that the enhancement that digital brings to safety I
23 think is a key issue here. And we've seen it in a platform that we have already put
24 in turbine system, digital on a feed water system, some safety application that we
25 don't, so I don't think that we need to go out to see the advantage, I think

1 internally, within our industry we have seen a lot of benefit from digitizing.

2 COMMISSIONER MERRIFIELD: Well, I appreciate that comment.
3 Having sat in the NRC Operation Center when it turned to the year 2000 I think
4 there was a lot of comfort and I think there is a psychological issue that we all
5 have to grapple with, going from analog to digital. And I think that it's that very
6 same issue that many of our counterparts internationally, as we see in Finland,
7 have really grappled with. Some of them simply said we want to have a complete
8 analog backup because it gives us that psychological comfort level. What you're
9 asking for is this agency and our staff to go beyond that and to go solely with a
10 digital system. And that's a psychological, I think that's a psychological challenge
11 in part that we're going to have to grapple with. I think it's one that other of our
12 counterparts have and certainly from my perspective, agreeing with Commissioner
13 McGaffigan, I think we need to as well. The final thing I would say and I've got to
14 cut my time is I agree with my fellow Commissioners I think the suggestion to put a
15 high hat on this, to have an NRC team that can interact across the offices to help
16 direct some of this would seem to make a whole lot of sense. Thank you Mr.
17 Chairman.

18 CHAIRMAN KLEIN: Commissioner Jaczko.

19 COMMISSIONER JACZKO: I think perhaps my first question is a
20 little bit of a follow up of some of the things that you said Mr. Shahkarami, I hope I
21 said that right, you've made several claims about the safety advantages of digital
22 systems over the analog systems and the enhanced safety. You've talked just
23 now about some very specific advantages. Maybe you could just elaborate on
24 some more about what some of those safety benefits really are. I mean, I don't
25 think that's something that has come out of this. I mean, ultimately I think we

1 should be doing this, because there's a safety enhancement that we can get out of
2 it. So maybe you can briefly just go into a little bit more detail about what some of
3 those enhancements would be. Or anyone here on this...

4 MR. SHAHKARAMI: Well, I can probably talk about a few, but we've
5 got people here that can easily get all the safety improvement and margin that we
6 have seen on a digital system. Definitely the area that we've seen is the stable
7 behavior of a digital system during transient, the redundancy that we can build
8 within a system, the interaction. I mean, there's a lot of concern between non-
9 safety related and safety related interaction. Well, if the turbine trips, the reactor
10 has to trip, so there is no way you can get around that and put that totally
11 separate. So I think that if it enhances that communication significantly and I'll let
12 you talk about more.

13 COMMISSIONER JACZKO: Very briefly, please.

14 MR. HESS: Yes, this is Steve Hess from EPRI. If you look from a
15 safety side where we've put digital systems into the non-safety functions, like
16 digital feed water control, digital turbine control, you see a decreasing trend; it's
17 rather stark in terms of initiators, in terms that can challenge safety. So we see
18 much fewer failures that lead to reactor trips and can be the initiators in any
19 sequence. And we've seen that on the non-safety side. And there is a
20 corresponding expectation that as we go to digital on the safety side we would see
21 improvements in terms of performance and operator interaction and that type of
22 thing that's commensurate with that.

23 COMMISSIONER JACZKO: Thank you. The next question I wanted
24 to ask, and this gets I think a little bit to the some of the comments that
25 Commissioner Merrifield made about kind of a change in our thinking a little bit on

1 some of these issues. Right now we have operators, we have operator training
2 requirements and standards for operators that are largely based and built around
3 control rooms that have analog systems that have alarms and visual alarms and
4 audible alarms that are readily accessible. If you just look, I think as you showed
5 in your slides, a comparison of an old control room to a new control room, there's
6 a much fewer number of pieces of information I think that are readily available. So
7 it seems that procedures and processes would change in accident situations;
8 instead of listening and hearing and seeing alarms, you may have operators that
9 are looking through various screens and panels bringing up different windows to
10 deal with the information that they're processing. So it would be a very different
11 way of dealing or responding in that kind of situation. So I'm wondering if you can
12 talk a little bit about what's going on on that side of this effort in terms of training,
13 in terms of looking at how does operator training need to change in order to have
14 operators perform and function in a new digital control room.

15 MR. BAILEY: I can take a stab at it. Within the design center
16 working groups each of the designs are taking existing operators and depending
17 on the level of maturity of where they are in the process right now they are starting
18 to go through emergency operating procedures, for example, they've already
19 simulated the events for their plant designs. Recall these procedures a lot of
20 times in the future world are electronic and where you used to have to look at
21 various indicators across your board and determine whether you met a certain
22 requirement at a certain stage in the event, that information is filled in
23 automatically for you through all these inputs that now are part of the process. So
24 it is a difference in how they have to do it. But from a process point of view, we are
25 using real operators today to try to do the human factors part of the new changes

1 that are taking place with these procedures. The entire training program and how
2 it's going to be impacted is still not fully defined, and it is something that also is on
3 a critical path for the first plants that are going to be built because again they have
4 to do their simulator training and get their operators qualified now within, you
5 know, possibly three to four years from now, starting, some of them are talking
6 starting operator hiring and stuff within two years.

7 MR. THAYER: Commissioner, I would challenge your statement that
8 operators would not have as much information in the new control rooms. I think in
9 fact the challenge will be that they will have an incredible amount of information.

10 COMMISSIONER JACZKO: Yeah. Information will be presented in a
11 different way that was it.

12 MR. THAYER: In a different way, but I think the challenge, which is
13 pretty exciting, is to present more information in a more meaningful way that would
14 actually influence the way the operators managed a transient or managed an
15 upset condition. And I think this opportunity to provide them even more
16 information has a challenge of sorting that information into bins where it would
17 actually produce a better management of the situation for the operators. That's a
18 little different philosophy from kind of dealing what you're given in the current
19 control rooms to be able to say given upset conditions, what is the optimum that
20 you would need to better manage that situation. And I think that's a pretty exciting
21 opportunity that we have both in the digital equipment as well as the training that
22 we do for tomorrow's operators.

23 COMMISSIONER JACZKO: If I can just briefly ask one more
24 question, and again it gets to this human reliability issue. We had a meeting with
25 the ACRS a couple of weeks ago, and one of the issues that they brought up there

1 is that in PRA space we have a lot of human reliability models. I guess there are
2 three NRC models right now, there's one industry model. With the current analog
3 systems and the current operator and human interaction and human behavior
4 modeling that we have, we don't have consensus among those models as it is
5 right now. And I'm wondering what, if anything, is going on to begin to incorporate
6 the kinds of changes that we would see in human, in operator action with the
7 result of a digital system, and is that being incorporated into some of these
8 disparate models that we have already on human reliability?

9 MR. SHAHKARAMI: Human factors, if you look at the organization
10 that we established we specifically identified that as one of the critical areas and
11 there is an entire task force just focused in that element. I'm sure the chairman or
12 somebody from a task force may be here. Do we have the human factor?

13 COMMISSIONER MCGAFFIGAN: They may be trying to leave.

14 COMMISSIONER JACZKO: That's fine.

15 MR. SHAHKARAMI: But there is a lot of focus going on training, the
16 whole culture, what's going to happen in our control room. That's all the elements
17 that they're looking at.

18 COMMISSIONER JACZKO: I appreciate that and I think in the
19 future if we do another meeting I think it would be helpful to have, certainly have
20 EPRI or some of the other people who are doing a lot of this work at the table.

21 COMMISSIONER MERRIFIELD: I agree.

22 COMMISSIONER JACZKO: We certainly appreciate your being
23 here, but I think it would have been helpful to have some of these additional
24 people as well.

25 COMMISSIONER MCGAFFIGAN: Mr. Chairman I know that we were

1 going to just do one round, but there's one question I want to ask, they might know
2 the answer to. You are making this analogy to the aircraft industry, for better or for
3 worse the aircraft industry does tolerate aircraft crashing, probably to a greater
4 degree than we do. Can a pilot on one of these fully digitized Boeing or Airbus
5 380, if the digital systems fail can the pilot land the plane? Can he take over? Or
6 is there some sort of backup where he can take over and still land the plane.

7 MR. SHAHKARAMI: Definitely, definitely. There is that vehicle
8 available. They can take manual control of the system.

9 COMMISSIONER MCGAFFIGAN: Well, that sort of goes to this what
10 sort of backup do we need for the digital systems here? We want to be able to
11 safely shut down these plants, even if we have a massive digital failure. And I
12 don't know what that means. It may mean multiple digital systems. But we ...

13 MR. BAILEY: Keep in mind it could also mean something different
14 for active versus passive designs, because the passive design features there
15 wasn't a whole paradigm shift for people.

16 COMMISSIONER MCGAFFIGAN: Sure I understand that. Okay.

17 CHAIRMAN KLEIN : Well, thank you for the input and we'll now hear
18 from the staff. Obviously this is a subject that is of high interest to all of us. And
19 one thing that our Commissioners are aware of is that there are other mobile
20 nuclear platforms that move around that another department has that has gone
21 digital. And so I think we're not going from ground zero on this transition from
22 analog to digital. Thank you very much.

23 COMMISSIONER MCGAFFIGAN: During the transition Mr.
24 Chairman, I'll just note that I've been watching with interest the latest Lexus
25 commercials with their eight speed automatic transmission and their parallel

1 parking without human intervention modes. I'm never going to be able to afford a
2 Lexus, but I guess once it's in a Lexus maybe ten years later it will be in a Ford
3 and all of us will have it. I don't think I would trust it to parallel park for me though,
4 I'd do it myself.

5 CHAIRMAN KLEIN: Somehow those collisions come to mind.

6 COMMISSIONER MCGAFFIGAN: Yeah, well, I mean, in the
7 commercial they neatly park between two crystal displays, and I'm sure they've got
8 all sorts of technology at the front and back saying there's something there,
9 there's something there, there's something there, but the notion of just saying
10 push your button and parallel park and then it does it for you is a little alien for me.

11 CHAIRMAN KLEIN: I think now we'll hear from the staff perspective
12 on how we're moving towards the digital I&C. Luis it's all yours.

13 MR. REYES: Good morning Chairman and Commissioner, staff
14 would like to brief you on where we stand on digital instrumentation and control. I
15 have representatives here from the Office of Nuclear Reactor Regulation and the
16 Office of Research, and I believe we're going to touch on the points of the earlier
17 discussion, and with that, Jim.

18 MR. DYER: Thank you, Luis. Good morning Chairman,
19 Commissioners. Before I start my presentation I guess just to put it in perspective
20 some comments on the industry's earlier presentation and that certainly we agree
21 that digital instrumentation control is something that's in an area that's rapidly
22 evolving and is of critical importance to both new reactors and the current fleet of
23 operating reactors, and could benefit from an integrated plan and enhanced
24 oversight. Where we tend to disagree is that the staff would need Commission
25 direction to work with the industry or that we would need a policy statement to

1 capture the urgency on this effort. Just so you know neither the EDO or the office
2 director level has been approached or engaged by the industry to undertake these
3 kinds of initiatives and in our dialogue between the EDO and the other office
4 directors we will firmly support that effort. The staff and the industry have been
5 meeting informally and as you heard up to the most recently on October 19th to
6 discuss digital instrumentation and controls issues. And I think if, we included
7 those meeting minutes in your background books and if you look at the summary
8 of that meeting it identified some key issues for follow up. In fact, those issues
9 really formed a key input to our presentation today as Commissioner McGaffigan
10 alluded to earlier in his comments. And we believe that it forms a good start on
11 the issues to develop that integrated plan, as we go forward. So I think that's just
12 sort of as a transition. And with that I'll proceed. Slides two and three are the
13 acronyms that the staff will try not to use. But again we fail often. I do mostly.
14 The agenda for today's presentation by the staff is an integrated Research and
15 NRR effort. I'll take the background and discuss briefly the licensing activities that
16 we have on our plate. Then Allen Howe, to my left, the Branch Chief for the
17 Instrumentation Control within NRR will talk about the technical issues and then
18 Bill Kemper, the I&C Branch Chief within Research will talk about our research
19 activities. And then Brian Sheron will get to summarize and close the
20 presentation. Slide five, please. Similar to the industry presentation this is a
21 picture of the four-loop Westinghouse pressurized water reactor control room and
22 its design is dominated by the analog equipment such as switches, enunciators,
23 chart recorders and panel mounted meters for indication and display. And these
24 control rooms are slowly being converted to digital instrumentation and controls,
25 under either 10 CFR 50.59 or in many cases license amendments when they

1 involve the reactor protection system or the mitigation systems. And that's due to
2 analog system obsolescence. Slide six, please. This is similar to the industry
3 picture. It's a picture of the prototype of the AP1000 control room. As you heard
4 earlier it's also similar to the other designs of the new reactors that is under review
5 with staff, captured by flat screen displays and keyboards for operator interface
6 and control. And as also was noted earlier at this time none of these full control
7 rooms and digital instrumentation controls are approved by the staff; they're
8 currently under review, and, in fact, submittals on all the new designs are
9 continuing to be made in this area. The design certifications that have been made
10 have been utilized, the design acceptance criteria or DAC concept, which allows
11 the identification, the performance characteristics, and in lieu of the detailed
12 design reviews, and that's what a lot of these topical reports are now being
13 submitted to close out those open items from the certified designs. The current
14 licensing criteria that we're working to are really identified as far as the content in
15 the draft guide, 1145, talks in their chapter 7 for the content of the COL
16 applications as well as our Standard Review Plan, chapter 7, which is under
17 review, under revision as a part of our program of updating our guidance for the
18 new reactors. And that current criteria is based on some guidance that for many
19 aspects was approved in the 1990s by the Commission in preparation for some of
20 the earlier design certification work in the past. And it's really based on
21 maintaining the integrity of the four echelons of systems for reactor safety. And
22 those being control systems that regulate the plant; protection systems that place
23 the reactor in a safe condition during upset conditions; mitigation systems that
24 protect the fission product barriers or reduce the consequences of a fission
25 product barrier failure; and then monitoring systems that provide information to

1 plant operators in order for them to take affective manual action should they need
2 to in the plant. And where these systems do offer – shifting to digital equipment
3 for these systems do offer a very significant increase in safety and diagnostic
4 capability for the plants. The staff would agree that our concern is more they also
5 offer the potential for common cause failures. And that is the challenge that we are
6 working on with the industry and among ourselves to ensure that through design
7 diversity, defense-in-depth and redundancy and the software quality assurance
8 that we don't create any unintended consequences while shifting to these designs.

9 Slide seven, please. The future or the workload that we're
10 anticipating in this area, right now we have approved some digital reactor
11 protection systems in the past and the plants continue to upgrade them, of what
12 we know is that three sites are intending to, planning to submit applications to
13 replace their analog or first generation digital protection and mitigation systems
14 with newer digital designs. Some of these designs are going to propose different
15 approaches to satisfying maintaining the integrity of those four echelons that I
16 spoke of earlier. And in that in that looking at common platforms or merging the
17 echelons under the same processor. We are also in pre application discussions
18 with AREVA for the EPR and Mitsubishi for the advanced pressurized water
19 reactor and in lining up design certification reviews of topical reports in anticipation
20 of their submittals in the pre application. And as you know we're currently
21 reviewing the economic and simplified boiling water reactor design certification
22 where recently GE announced an intention to change the direction or some of the
23 initial design submittals for the digital safety systems for that design, and the staff
24 anticipates getting some additional topical reports later this year for that review. In
25 preparation for the combined license applications that are scheduled for later this

1 fiscal year, in the beginning of fiscal year 2008, Westinghouse has submitted
2 several topical reports providing the design details of their instrumentation controls
3 proposed for the AP1000 safety systems and the General Electric advanced
4 boiling water reactor submittals are anticipated later this year and at the beginning
5 of next year in a pre application stage to get ready for the ABWR combined
6 license submittals later next year. And the point that I was trying to make is that
7 we have a very, a significantly growing work load in this area and the staff is
8 working, now working with the industry in order to prepare to effectively manage
9 that work load and accomplish the needs on the schedules that we established to
10 support those areas.

11 COMMISSIONER MERRIFIELD: Mr. Chairman, can I ask a brief
12 clarifying question that I would hope would have a brief clarifying response? You
13 have a list of three bullets here. Are those in priority order? And do those
14 compete against each other for resources or can they be done by our staff in
15 parallel?

16 MR. DYER: Right now we believe they can be done in parallel. We
17 have the resources identified within the staff for what we have coming in. And we
18 have a, I'll call it a surge capacity and arrangement with DOE Laboratories. But
19 it's, the goals ...

20 COMMISSIONER MCGAFFIGAN: You have that under a CR?
21 You're a miracle man.

22 (Laughter)

23 MR. REYES: The answer is if we get our approved budget, yes, if
24 we're not, we have to prioritize. Short answer to your question.

25 CHAIRMAN KLEIN: And on the other question, are those in priority

1 order?

2 MR. DYER: No, I think we would do them in parallel.

3 COMMISSIONER MCGAFFIGAN: Which means you would have to
4 prioritize based on the resources available.

5 MR. DYER: Yes, sir. It would be negotiated plant specific
6 application. With that let me turn the presentation over to Allen Howe to discuss
7 the technical issues. AI?

8 COMMISSIONER MERRIFIELD: Mr. Chairman, before Allen gets
9 started, I just want to say I appreciate Jim Dyer's comment about acronyms. I do
10 have to say I believe our staff is somewhat acronym intensive and I think creating
11 a D3 acronym is a prime example of going overboard.

12 (Laughter)

13 CHAIRMAN KLEIN: As I have stated numerous times I used to think
14 that DOD was acronym heavy, but I've learned that NRC ranks right up there.

15 COMMISSIONER MCGAFFIGAN: I look forward to D4, D5, and D6
16 personally.

17 (Laughter)

18 COMMISSIONER MERRIFIELD: I don't. I hope not to see D3 again.

19 (Laughter)

20 MR. HOWE: Thank you and good morning. I'm pleased to be able to
21 update you on licensing issues related to digital I&C. Slide eight, please. The
22 NRC has applied a diversity and defense-in-depth or D3 approach to resolve
23 concerns with potential digital system common cause failures. Current methods
24 do not allow detection of all potential software errors. Because the same software
25 is running in all redundant channels a software error could disable the safety

1 system and keep it from performing its safety function. The current approach for
2 D3 is consistent with Commission direction provided in the Staff Requirements'
3 Memorandum related to SECY-93-087. The D3 elements are first, an application
4 must demonstrate that vulnerabilities to common cause failures have been
5 addressed. Second, the applicant must evaluate common cause failures for the
6 events analyzed in their safety analysis report. Third, adequate diversity shall be
7 demonstrated, and if a postulated common cause failure could disable a safety
8 function then a diverse means shall be put in place. And finally independent and
9 diverse controls and displays shall be provided for operator actions. D3 is widely
10 used. For example, the EPR in Finland will include a hardwired backup for safety
11 systems as was mentioned earlier. The EPR in France will have a diverse digital
12 system. We've also discussed D3 with naval reactors to gain their insight in this
13 area. The staff identified concerns in a recent application for a digital system
14 where potential common cause failures could disable multiple protective functions.
15 The D3 approach for this design was heavily reliant on short time frame operator
16 actions. The staff is preparing a Commission paper that presents options and a
17 recommendation to update the NRC policy to assure adequate levels of D3.
18 Finally, NRC staff believes that an all digital control room can be licensed. The
19 staff considered this issue several years ago as part of the original policy for D3.
20 This design would need to satisfy the applicable safety criteria and have displays
21 and controls for the operators that are both independent of and diverse from the
22 main digital system.

23 COMMISSIONER MERRIFIELD: Mr. Chairman, before we go on to
24 the next slide, one of the things that Allen just referenced, the discussions that we
25 have had regarding diversity and defense in-depth with naval reactors. Obviously

1 the details of that discussion is not something that we could or should do in a
2 public forum, but I do think we may need to think about asking staff to provide a
3 separate briefing whether it's to our TAs or ... I'd like to personally get a briefing
4 on that, from our staff to better understand the insights the naval reactors have
5 had because I think that that will help inform the Commission about the approach
6 that we ought to be overseeing of our staff.

7 COMMISSIONER MCGAFFIGAN: And Mr. Chairman could I just ask
8 a clarifying question as well? This paper that you're working on, first has there
9 been any discussion with industry about it? And second what's the time line for
10 getting it to us, because if we're taking a project approach to this thing, receiving
11 that paper yesterday presumably would have been a good thing.

12 MR. DYER: Commissioner let me answer that question. One is in
13 preparation for this Commission meeting I got an advanced copy of the paper, so
14 it hasn't percolated up even to the office director level. And, yes, we do need to
15 talk to the industry and ...

16 COMMISSIONER MCGAFFIGAN: We haven't?

17 MR. DYER: We have not. And it's a direct result of work with the
18 industry on, it was the Oconee application and a recognition that some of the
19 earlier guidance that was provided in the SRM from 93-087, the staff's view was
20 that the direction that we were willing to accept for Oconee was outside the
21 bounds of the earlier approved Commission direction in this area. My question to
22 staff is, is there any other areas that we need to address in the same time? And
23 we need to get out and...

24 CHAIRMAN KLEIN: I think I have a similar comment to
25 Commissioner McGaffigan's, don't get so hung up on process that you forget

1 progress. And that means communication.

2 MR. DYER: Yes, sir?

3 COMMISSIONER MCGAFFIGAN: I suspect there are people who
4 are hearing some of this for the first time in the background, maybe not. But we
5 just got to make, we got to get going. And I know the process, if the office director
6 had asked to see it, we're probably about 85 concurrences from actually
7 presenting it to the Commission in some distant month, based on our usual staff
8 process, which is very efficient and effective. Well, it was targeted ...

9 COMMISSIONER MERRIFIELD: Slight tone of sarcasm.

10 COMMISSIONER MERRIFIELD: You forgot to mention timely.

11 MR. CHAIRMAN: Continue.

12 MR. HOWE: Thank you. Slide nine, please. Second evolving area in
13 our regulatory approach is risk informing digital I&C. Industry recently presented
14 an approach to risk informed D3 analysis. However, that approach did not specify
15 how to develop a reliability model of digital systems and acknowledge weaknesses
16 in the state-of-the-art for modeling digital systems. We provided feedback on our
17 concerns to the industry about a year ago. More broadly than D3 the NRC had
18 earlier initiated work to improve methods for modeling digital system reliability and
19 risk informing digital I&C. Bill Kemper will describe NRC activities on risk
20 informing digital I&C systems. Industry acknowledged that digital system methods
21 continue to evolve and requested further dialogue with the NRC in this area. Staff
22 and industry agreed to further interactions next year on planned development of
23 regulatory standards for risk informing digital I&C.

24 Slide ten, please. The advanced control room includes highly
25 integrated digital systems and flexible displays for operator interface. Designers

1 are proposing digital systems with extensive bidirectional communications among
2 safety channels and between safety and non safety systems. Extensive
3 bidirectional communications pose challenges for staff to confirm that the safety
4 requirements for communication independence are met. NRC requirements
5 provide for separation of protection and control systems and for independence
6 between safety and non-safety systems. The key safety principle is to assure that
7 the non-safety system does not prevent a safety system function during normal
8 operations and during anticipated events and accidents. The staff is evaluating
9 the issue of bidirectional communications and developing safety review criteria to
10 support NRC licensing. The NRC and industry will meet in December to continue
11 interaction on this topic. The industry also plans to provide a technical paper for
12 meeting the safety to non-safety communication independence requirements for
13 NRC review.

14 We have also interacted with the industry on the human factor
15 aspects of control room designs. Industry plans to submit a technical paper for
16 NRC review on the minimum required inventory of instrumentation and controls.
17 Industry also plans to submit technical reports on the role of the operator and on
18 computer based procedures for NRC review.

19 Slide 11, please. The NRC updated the regulatory guide on use of
20 computers and safety systems. This guide is focused on digital safety systems
21 and provides detailed digital system security guidance for the system life cycle
22 from development to retirement. The NRC also completed its review and
23 acceptance of industry guidance on cyber security. This guidance addresses a
24 broad scope of digital systems that are in use at operating reactors. Industry
25 recently expressed concern that there are overlaps in this guidance. They plan to

1 submit a report for staff review to show how the industry guidance addresses the
2 regulatory guide.

3 Slide 12, please. We are working on our infrastructure by updating
4 the Standard Review Plan and Regulatory Guides. The Standard Review Plan
5 update will capture insights from digital review experience since the last update in
6 1997. Most updates are scheduled to be complete in January. Staff has recently
7 issued updates to regulatory guidance for computers and safety systems and also
8 for accident monitoring. Staff is also preparing regulatory guides for qualification
9 of digital systems and for content of COL applications. All are targeted for
10 completion in early 2007. We are continuing to recruit and hire highly qualified
11 experienced and entry level I&C engineers to support current and projected work
12 loads in NRR, NRO and Research.

13 COMMISSIONER MCGAFFIGAN: Mr. Chairman, could I ask a
14 clarifying question about the regulatory guides? Are those going to be issued for
15 comment? Or are they just going to be finalized? You said that all are targeted
16 for completion in early 2007.

17 MR. KEMPER: I'm sorry, this is Bill Kemper. The plan is to issue
18 those for comment. In fact, many of those are out already, as we speak.

19 COMMISSIONER MCGAFFIGAN: Digital ones?

20 MR. KEMPER: Yeah, well, all the Reg Guides in general, including
21 electrical and digital ones.

22 COMMISSIONER MCGAFFIGAN: Okay.

23 MR. HOWE: In the interim we're using I&C engineering resources at
24 National laboratories and commercial firms to accomplish the I&C staff workload.
25 The NRC Technical Training Center is developing digital technology training for

1 both technical reviewers and inspectors. The course is projected to be available
2 early next year. NRR has also recently issued training guidance for technical
3 reviewers. The staff is interacting extensively with external counterparts and
4 stakeholders. We have met with regulators in Finland and France to discuss the
5 EPR. In addition, we developed insights from the Lungmen ABWR project in
6 Taiwan that we are incorporating into our Standard Review Plan update. Staff has
7 also met with naval reactor counterparts on several occasions to explore possible
8 insight from their experience that can be applied to NRC regulation.

9 COMMISSIONER MERRIFIELD: Mr. Chairman just to understand
10 this and clarify, you haven't mentioned Japan here. There are four operating, I
11 believe four operating ABWRs in Japan. What have we done with them and what
12 approach have they taken to ... We talked about an analog backup, France has
13 got a defense-in-depth through a duplicate or redundant digital system. What are
14 the Japanese doing relative to the ABWRs and how have we interacted with
15 them?

16 MR. HOWE: I'll take that. Sometime back we had had some
17 interactions with the Japanese. Their ABWR systems, for example, do have some
18 diverse backup systems. For example, some manual controls and things like that
19 that are in the control room. I believe they also are crediting some of their non-
20 safety systems as part of their diversity for the digital systems.

21 In closing there is more work to do in the digital I&C area as we
22 move forward. This area affects multiple NRC organizations and we will continue
23 the extensive internal coordination among NRR, NSIR, RES, and NRO staff. We
24 also plan to continue interaction with the industry, other government agencies and
25 international regulators. We have several research activities under way or

1 planned and Bill Kemper will provide an overview. Thank you.

2 MR. KEMPER: Thank you, Allen, and good morning. The broad
3 scope of our digital I&C research program supports the near term regulatory
4 needs of the agency and also addresses long term evolving technology areas that
5 require establishment of regulatory infrastructure. The results of these research
6 projects are designed to augment and supplement existing agency licensing
7 criteria and guidance for new reactors and operating reactors.

8 Slide 13, please. The Office of Nuclear Regulatory Research has
9 developed a comprehensive digital system research program plan which defines
10 the I&C research programs to support the regulatory needs of the agency. The
11 research plan has been developed with input from several sources, including the
12 National Research Council report on Digital I&C Systems at Nuclear Power Plants,
13 the Advisory Committee on Reactor Safeguards, external stakeholders, and, of
14 course the staff itself. The research plan has been approved by the user offices
15 and currently consists of 27 projects. The products of these research programs
16 include technical review guidance, information to support regulatory based
17 acceptance criteria, assessment tools and methods and review and inspection
18 procedures. Within these research programs there are a number of ongoing
19 research projects that address key technical issues that affect licensing of
20 operating and new reactors.

21 Slide 14, please. The NRC's diversity and defense-in-depth policy
22 has been applied as a means to address common cause failures in digital safety
23 systems. However our knowledge of digital technology has increased significantly
24 and the technology has evolved considerably since the agency's diversity and
25 defense-in-depth policy was established in 1993. The current NRC diversity and

1 defense-in-depth guidance considers six categories of diversity attributes that can
2 be used in a design of digital systems, including hardware, software, and operator
3 actions. The complexity of determining digital system failure modes and
4 assessing the adequacy of diversity and defense-in-depth to the system can make
5 it difficult to use this guidance. This research project will develop combinations of
6 diversity attributes and associated criteria that provide acceptable diversity and
7 defense-in-depth strategies for addressing common cause failure vulnerabilities.
8 These improved methods for diversity and defense-in-depth analysis will be used
9 to enhance and further refine regulatory guidance and acceptance criteria for
10 licensing activities. The project is currently underway and scheduled for
11 completion by August of 2007.

12 Slide 15, please. The current digital I&C system licensing process is
13 deterministic. The NRC and the industry are interested in risk informing digital
14 safety system licensing reviews. The staff has been working over the past two
15 years to develop risk and reliability methods needed to risk inform digital system
16 reviews. One of the major challenges to risk informing digital system reviews is
17 developing a common method for modeling digital system reliability. The staff
18 examined a number of reliability and risk methods that have been developed in
19 other industries, such as aerospace, defense, and telecommunications. We
20 believe that some of the digital system risk modeling methods used in these
21 industries can be adapted for use in the nuclear industry. Based on our review of
22 these techniques together with available failure data we are evaluating several
23 digital system modeling methods with the intent of establishing the best practice
24 for modeling digital systems in nuclear power plants. We are working with the
25 nuclear industry, DOE Labs, commercial firms and the academic community to

1 review NRC modeling methods and develop techniques for probabilistic risk
2 assessment that may be used to augment and enhance current risk informed
3 licensing guidance for use in this area. Draft regulatory guidance is scheduled for
4 completion in late 2007 and a final regulatory guidance for mid 2008.

5 Slide 16, please. New reactor control room designs will use highly
6 integrated, glass or cockpit style controls and displays as they're called, and
7 advanced control strategies such as touch screen video display devices and semi
8 autonomous controls. For example, changing power levels may be a one touch
9 preprogrammed action by the licensed operator in the control room. The NRC
10 must enhance its understanding of these control room designs and develop
11 guidance to assure compliance with regulatory requirements. In 2004 the staff
12 published the results of a study to review international experience with digital
13 control rooms. This report identified potential issues associated with digital
14 system architecture and communication, information and data management and
15 system performance. These items are being evaluated further under our current
16 research plan and we will develop regulatory guidelines for these design concerns
17 including separation and independence within safety systems and from non-safety
18 systems. As part of this research effort the staff will continue to collaborate with
19 other industries, foreign regulators and government agencies, including naval
20 reactors to leverage their experiences in licensing highly integrated control room
21 designs. For example, the staff intends to collaborate extensively with regulatory
22 research organizations in France and Finland to gain insights on their experience
23 with the EPR I&C design. This research project will develop licensing review and
24 acceptance criteria for issues such as electrical and communication separation
25 and independence between safety related and non-safety related displays and

1 controls and redundant safety channels. The project will augment and supplement
2 NRC guidance for confirming that highly integrated control room designs are in
3 conformance with NRC regulatory requirements. Based on availability of
4 information from the reactor vendors initial results should be available by August
5 2007.

6 Slide 17, please. The staff is also actively engaged in ongoing cyber
7 research to explore cyber vulnerabilities and digital systems expected to be
8 deployed in nuclear power plants. This project will ultimately provide regulatory
9 guidance and tools for evaluating digital systems, for cyber vulnerabilities,
10 including potential vulnerabilities arising from safety and non-safety system
11 interconnections. The staff has already initiated cooperative agreements with a
12 licensee and a micro processor vendor to perform cyber assessments on their
13 digital platforms. Also the staff is currently working with the Department of
14 Homeland Security and initiating interactions with a foreign regulator to leverage
15 their capabilities and experience in cyber security. Based on availability of
16 licensee and vendor hardware and software initial results should be available in
17 July of 2007.

18 Slide 18, please. Looking to the future and through interactions with
19 the industry, we have other research programs in progress that will support
20 licensing of new technologies in nuclear power plants. The staff has recently
21 initiated a research project to assess alternative technologies to traditional
22 software driven microprocessors. These devices are referred to as Field
23 Programmable Gate Arrays or FPGAs, which can be programmed one time to
24 perform the basic function of logic gates. Due to the simplicity of these devices
25 they may be less susceptible than micro processors to software common mode

1 failures. New reactor vendors and current licensees have announced their
2 intention to implement safety functions using FPGAs. This research project will
3 build upon regulatory approaches used in other countries and other agencies and
4 experts in the FPGA development field to develop NRC staff guidance for
5 licensing FPGA based safety systems.

6 COMMISSIONER MCGAFFIGAN: Just to clarify this technology is
7 used in other industries besides nuclear, this FPGA..

8 MR. KEMPER: Yes, that's my belief, yes, it is. This project is
9 scheduled for completion in August 2007. Also on-line monitoring technology is
10 expected to be used in new and current generation plants to expand and improve
11 the reliability of system monitoring capabilities and reduce calibration requirements
12 for safety related instruments. This program will develop guidance on analytical
13 methods and uncertainly analysis for on-line monitoring systems that can be used
14 to review and approve these applications. This project is scheduled for completion
15 in May 2007. Thank you and I'll now turn the presentation over to Brian Sheron.

16 MR. SHERON: Thank you. In closing, staff is working closely with
17 our internal and external stakeholders to gain their insights and participation in
18 updating our regulatory requirements and guidelines for licensing digital
19 applications. Staff will also continue to engage in collaborative research initiatives
20 so that we can leverage available knowledge and resources. Finally, we are
21 working to recruit, train and retain highly qualified, experienced I&C engineers to
22 support our current and future NRR, NRO and RES work load. This completes the
23 staff's presentation and we are prepared to answer any questions at this time.

24 MR. REYES: Chairman, that completes our presentation, we're
25 looking forward to your questions.

1 CHAIRMAN KLEIN : Thank you. Commissioner Lyons.

2 MR. LYONS: I do appreciate the staff's presentation. And I think
3 we've all indicated already in the previous line of questions the importance that all
4 of us attach, all of us on the Commission attach to this area. I started my
5 comments with industry with my note that I was stuck by the difference in tone
6 between the staff and the industry presentations. And I guess maybe a question
7 for Luis or Jim, but I am curious if you folks were somewhat caught by surprise by
8 the difference in tone of the two presentations.

9 MR. REYES: Yes, let me answer that. I was, but after looking at the
10 two presentations, something that my grandfather used to tell me came to mind
11 and it goes something like this. We judge ourselves by our intentions; others
12 judge us by our actions. And I think perhaps outcomes is a better word. So I think
13 the intention of the staff is to improve safety in use in digital instrumentation and
14 controls. But what I think you heard from the industry this morning that this issue is
15 now a critical path for the deployment of the new fleet. And I think we need to
16 take a hard look at how we're moving forward in terms of the project schedules
17 and reflect on that. And we're eager to do that. We're not opposing that.

18 MR. DYER: From my perspective, it was a cup's half full, cup's half
19 empty approach. The cup's half empty is looking at getting to the end point, which
20 if you read our October 19th meeting minutes in that we're just right now identifying
21 the issues. What we need to is get to that end point.

22 COMMISSIONER LYONS: Certainly, I appreciate those
23 perspectives. And I think that you heard from a number of the Commissioners
24 and certainly including me that to the extent there are high level interactions that
25 can be undertaken to advance bringing this to closure, closure maybe the wrong

1 word, but at least bringing it to a near term successful completion, certainly are
2 highly endorsed.

3 Maybe a question for Bill in your presentation. And this is certainly
4 coming from an amateur in this, but to the extent I understand some of the
5 technical controversies, a lot of it seems to revolve around what it means to risk
6 inform a digital system. And you referred to a number of research activities that
7 are ongoing, as I think Brian referenced also, that are trying to better understand
8 what it means to risk inform a digital system. I'm wondering if we're far enough
9 into this work that we can start to quantify the uncertainties in such risk informing
10 of a digital system and start to understand how those uncertainties correlate or
11 correspond to other uncertainties that we already have in our PRA models. I'm
12 just trying to get a feeling for how the uncertainty in the performance at the digital
13 system falls relative to other uncertainties that we also have in a PRA model.
14 That's not a well-stated question, but I'd appreciate a few comments.

15 MR. KEMPER: I think I understand your question. As I say we've
16 been working on this project for a couple of years and really asked to identify a
17 common modeling methodology. And we've engaged many different
18 organizations to see how they model digital safety systems. And some of the
19 results of that have been very good. However, I think at the current time we're not
20 far enough along to really provide an opinion on that. We just haven't got that far
21 along into the research project. That is one of the things though that we will
22 attempt to quantify. I mean, it's just part and parcel to risk informing these
23 systems. We have to come to grips with that in some fashion. So I'm sorry I can't
24 give you a definitive answer right now other than just that it's yet to come. But the
25 results of this should be available in the next year or two, based on the current

1 status.

2 COMMISSIONER LYONS : At least in my mind, in the absence of
3 having these uncertainties tied down quite well and having solid models for risk
4 informing that one can equally address safety issues from a diversity perspective.
5 So am I wrong in thinking that we can make up for incomplete understanding of
6 the PRA aspects of a digital system by continuing to stay with our focus, as we've
7 always had, on diverse approaches in safety systems.

8 MR. KEMPER: No, I think you're absolutely correct. You're right on
9 target, because it would be nice to have all of the potential possible failure modes
10 for digital systems at our disposal. However, in practicality a well designed digital
11 I&C system that has proper redundancy and diversity will accommodate all digital
12 system failures.

13 COMMISSIONER LYONS: I guess that gets to the last question I'll
14 ask since I know we're short on time. Industry made the comment that we need to
15 do the right research at the right time, they used the phrase don't get bogged
16 down in research. In general I have been very supportive of the research
17 programs going on this area and I believe that ACRS was very supportive of the
18 research programs. I do notice though, Bill, as you went through completion
19 dates, many of those are in the May, August 2007 time frame, which is certainly
20 the time frame, probably somewhat past the time frame when industry has to be
21 finalizing their inputs to us. I'd just be curious from maybe Brian or Bill or Luis, if
22 you want to comment, on how you respond to the industry concern of this right
23 research, right time, and not getting bogged down. I mean, in your view, are we
24 bogged down or are we looking at research products that will be required as we
25 continue to see future evolution in digital systems?

1 MR. SHERON: I think we're trying to accomplish both. One is
2 obviously we would like to provide guidance, both in a form of Reg Guides as well
3 as perhaps review guidance to NRR on the schedule that they need it for. Just
4 like with our other Reg Guides we've been shooting for the early 2007 time frame
5 to get that guidance out in the street. I also think that some of the actual digital
6 I&C or digital protection system designs actually won't be finalized until later on in
7 the COL review stage. So I think that the documents we're trying to get out will be
8 available and will be timely for the industry. In the same sense I think you've
9 heard that this is an evolving field and we have to keep up with it and I think as
10 progress is made in this area we will be updating all of our documents periodically
11 trying to keep ahead of the, you know at least up to speed with the technology.
12 The other piece of this is that our guidance documents, our Reg Guides and stuff,
13 these are just one acceptable way to implement our regulations. And this certainly
14 doesn't stop the industry from coming forward with designs that they believe
15 address the principle areas, in other words, in terms of defense-in-depth and
16 diversity. The staff can review and approve these and like right now if the industry
17 comes forward with designs that address these issues in an acceptable way.
18 We're providing guidance which hopefully will be helpful down the road, but it
19 doesn't prevent the industry at this point from coming forward with the designs.

20 COMMISSIONER MERRIFIELD: This is a follow up, just a logical
21 train of thought here, but doesn't that put them at risk if you've got a whole series
22 of research projects that don't manifest themselves for six months to a year down
23 the road and they may have to go back and change those if they don't have
24 sufficient guidance right now?

25 MR. SHERON: There's always some ... I mean, whenever you do

1 research you never know what the answer is going to be, but the intent right now
2 is not that we're off discovering new and unknown things that are going to require
3 them to go back and redesign these systems. The research that we're doing now
4 is to help really kind of just codify the staff's thoughts on what we believe are
5 acceptable ways to address the issues that you've heard of. I don't know, Bill do
6 you want to add on anything on that.

7 MR. DYER: Commissioner, if I can just break in there. I think a point
8 to be made is the research that we're talking about is to look to the future, and
9 possible, I won't use the word relaxations or alternatives to what our current
10 deterministic criteria are. It's highly unlikely that with our current deterministic
11 criteria that we're trying to apply that we would go back and say that's non-
12 conservative. So this look is the risk informing, the cyber security is to look at
13 alternatives to the existing not necessarily, we don't anticipate that or believe that
14 our existing criteria are going to be challenged by the research that's being done.
15 But as Brian said it could always happen. And if it does then we'll deal with it. But
16 it's not our intent or our thought that that's going to happen.

17 COMMISSIONER LYONS: I'm certainly out of time and I need to
18 stop. Let me just mention that I would support what several of my colleagues said
19 earlier that this is a sufficiently active and important subject that subsequent
20 Commission meetings I think, perhaps on a six-month basis would be very well
21 served.

22 CHAIRMAN KLEIN: Luis, when you commented about your
23 grandfather's statement it reminded me one that I've heard, and that's there's a
24 road to a certain location that's paved with good intentions.

25 (Laughter)

1 MR. REYES: You told me that before.

2 (Laughter)

3 CHAIRMAN KLEIN: And I guess listening to Allen and Bill and their
4 description it seems like there's really, it's a bureaucratic system that's in place
5 and I guess my question to you is, do you have a fairly simple milestones and
6 deliverable schedule that tells you how to bring this to timely closure?

7 MR. REYES: No.

8 CHAIRMAN KLEIN: When will you have one?

9 MR. REYES: As soon as we have the meeting with industry of the
10 steering committee. It just became clear to us the critical time frame involved
11 here. I mean, things are moving rather quickly. We were working a different time
12 frame. There's no secret there. And now this has become the critical path for the
13 deployment and we need to react to it. So we were working in a different
14 approach. So what we need to do is we need to regroup and make sure that
15 we're responsive to that. Still improving safety, still making sure we're satisfied as
16 regulators, but perhaps in a different approach, which is what the industry
17 proposed this morning.

18 CHAIRMAN KLEIN: Clearly you know it seemed like there are two
19 ships passing in the night and we need to bring them together for the benefit of the
20 America people, so that we can do this safe and do it timely and do it with
21 advancing technologies. If you look around, Commissioner Merrifield sort of
22 brought up the question -- if you look around, who's your metric on digital state-of-
23 the-art? In other words, if you looked at who has the state digital I&C is it the
24 chemical industry, is it Japan, is it the airline industry? In other words, who do you
25 look to that in your mind is a leader in this field?

1 MR. HOWE: Clearly the other process controls industries you've just
2 mentioned like Petro Chemical Pharmaceuticals, they are ahead of us are
3 employing more advanced digital systems because they continued their
4 construction program for the past 20 years.

5 CHAIRMAN KLEIN: I think that it would be an advantage for us not
6 to re-invent the wheel, to take lessons learned and put those into practice. So that
7 would be ... I look forward to seeing the milestones and deliverables for timely
8 conclusion after you meet with the industry. Commissioner McGaffigan?

9 COMMISSIONER MCGAFFIGAN: Thank you Mr. Chairman. Mr.
10 Dyer you pointed out that you didn't think that the staff doesn't need Commission
11 direction to do steering groups and whatever. Don't be surprised if you get
12 Commission direction, because I mean the way for us to make sure that the ships
13 aren't passing in the night and maybe this is something you in the last several
14 days have tumbled to as well, but I think the way to clarify it is there shall be a
15 steering committee, you shall use the license renewal like process, you will
16 develop a project plan, looking at various options with regard to availability of
17 resources, long term CR versus getting our budget sometime within finite time and
18 all that and lay it out for us, and not have a disagreement six months from now
19 when you all come in here as to whether we've got the right priorities. So I know
20 it's staff, again speaking as a ten year Commissioner, staff hates getting direction
21 from the Commission on almost anything.

22 MR. REYES: I wouldn't say that.

23 (Laughter)

24 COMMISSIONER MCGAFFIGAN: The other Thing that I'd say is
25 that I look back at the 93 SRM, and I can understand Mr. Howe's dilemma, I don't

1 recommend to my fellow Commissioners ten page SRMs, which is what was
2 emitted from the Commission in 1993. I think if you believe every word of that as
3 writ, you know, gospel, then it's not hard over a 13 year period to start to find
4 problems with it and I look forward to getting that paper promptly. But maybe this
5 time around you should try to get us to endorse broad principles as opposed to
6 giving you a ten page SRM as to how to do every jot and tiddle of the thing. I
7 noticed that there was a 1991 paper that is still, I assume the 93 paper is on our
8 web page somewhere, and the SRM and the voting record, perhaps not easily
9 accessible, but accessible somewhere. Is the '91 paper ... the '91 paper says the
10 reason it is sensitive, internal only, is that one of the enclosures includes sensitive
11 foreign information. I don't know whether 15 years later it's still sensitive, but if the
12 rest of that paper might, it might useful for background information for the public to
13 have it. And that leads to a sort of if this is going to be given a high hat, ala
14 license renewal and some of the other things we've done, power uprates,
15 whatever, you may want to think about how to organize things on the web page,
16 because it does strike me there's a whole bunch of stuff coming. And it may be
17 redundant to put it in, but you may want a digital I&C web page place where
18 there's sort of one shop stopping for what we're up to at the current time, both for
19 existing reactors and advanced reactors. And the advanced reactors as we've
20 said, may well deserve higher priority, given the budget situation. So that's a
21 suggestion.

22 At the October 16th meeting, here's a question, we heard from I think
23 the EPR vendor, that he needed to be ordering control rooms -- or simulators by
24 2008, sometime. Is that possible? Are we going to resolve enough of the EPR
25 issues? I mean, they are probably going to apply for their design cert about late

1 2007 or 2008. So we'll barely have a design cert in front of us. But through
2 topical and early interactions is it within the conceivable that they could order this
3 long lead simulator in mid 2008?

4 MR. DYER: Based on what we've, the experience we've had in
5 dealing with Oconee, which used the AREVA design, staff believes that if we get
6 the proposal in 2007 we can turn it around.

7 COMMISSIONER MCGAFFIGAN: Okay.

8 MR. DYER: In time to make the order. But we don't have the
9 application and we're just having dialogue and starting to get the beginnings of the
10 topical in now.

11 COMMISSIONER MCGAFFIGAN: And I guess a final question, one
12 of the ... I'm always worried where we ... in one of the slides in talking about one
13 of the slides, slide nine, Mr. Howe, you used, and I think later Mr. Kemper used
14 this notion that we have to be able to detect all potential software errors. And
15 whenever I see the staff using the words all or any, you know the old 50.59, I
16 worry whether we're outside a reasonable assurance of adequate protection
17 regime and whether we're into sort of an absolutist regime. So we have to make
18 decisions with incomplete information, hopefully as complete as possible. They
19 need to be somewhat more conservative. But has the staff been unduly
20 conservative in its approach to this, maybe influenced by the 93 SRM in the last
21 several years? And I don't want to delay ...

22 MR. KEMPER: Let me start in with this. The point of my statement
23 about the current methods not allowing detection of all potential software errors
24 was part of the reasoning why we have the diversity and the defense-in-depth
25 philosophy right now.

1 COMMISSIONER MCGAFFIGAN: But the question is how much
2 diversity and how much defense-in-depth. In all, we may never be able ... I
3 suspect we will never be able to detect all essential software errors. I mean,
4 Microsoft doesn't seem to do a very good job of it and their entire purpose in life is
5 to develop software. And I think that's true for every other software company. So
6 to detect all is maybe not good enough and I mean, it may be too high and we just
7 have to ... the question is which software errors are more important and where do
8 you need diversity and where do you not and all that?

9 MR. KEMPER: But the objective is not to be able to detect all
10 software errors, it may be exceedingly difficult to be able to do that. But the idea
11 was when we looked at this many years ago and it's still the current thinking, that if
12 we can't demonstrate that we have software that doesn't have potential significant
13 errors in it, then the alternative is to use the diversity and defense-in-depth
14 approach to compensate for that, to mitigate that kind of uncertainty. Again it's
15 one of these things where we can't even measure what the likelihood is of a
16 software error right now.

17 COMMISSIONER MCGAFFIGAN: I just suspect that those other
18 process control industries that are already using this technology do not, or have
19 some tolerance for software errors because I suspect they're there. But I'll close it
20 up there because I know we're running out of time.

21 CHAIRMAN KLEIN: Commissioner Merrifield.

22 COMMISSIONER MERRIFIELD: You reminded me of an analogy
23 one being that as a Microsoft user I would certainly hope that we would not
24 benchmark our success by the number of patches that Microsoft makes us all deal
25 with their products. That having been said, diversity for us in that program means

1 you get Symantec to be your security system on top of your Microsoft product. I
2 want to go to the issue of the interface between making regulatory decisions and
3 continuing to conduct ongoing research, because I go back to conversations I had
4 with Carl Paperiello who was our former Director of Research, and Carl's
5 philosophy of which I agreed was that the principle focus, a lot of different things
6 that research does, but the principle focus is to provide sufficient information to
7 make a regulatory decision. And what I'm trying to grasp is given all the different
8 things you've got in play and the fact that those are going to continue to lay
9 themselves out during the course of 2007 and beyond, do we have sufficient
10 information at this time, to make regulatory decisions on the applications that are
11 going to come to us on digital instrumentation and control? And how much ... and
12 I guess associated with that how much risk do the utilities really have to be
13 concerned about relative to those products coming in down the line?

14 MR. DYER: Commissioner, I think we have enough, we have the
15 tools in place to make the decisions. Right now those tools are deterministic, as
16 we just said. The industry's proposals are coming in with a slight risk or
17 challenging those deterministic criteria that we have currently established. To that
18 extent that they can justify them we're willing to accept it. The research I think is
19 aimed at coming out with new criteria. You're altering our deterministic criteria or
20 going to a risk, more risk informed approach. And so as Brian said once we get
21 the tools we can still use them and make regulatory decisions outside of the
22 current criteria.

23 COMMISSIONER MERRIFIELD: Well, I mean, I think that's fine.
24 There is an issue of timing. And I don't think it's anybody fault. I think the staff
25 made a plan under a specific set of time lines and expectations, obviously times

1 have changed. Given the work that we've been undertaking for a long period of
2 time, in retrospect and this is one that clearly hasn't been on my radar screen as
3 well, so I share whatever blame the Commission has in this regard. Knowing the
4 desire of licensees to deploy digital instrumentation and control at existing units in
5 retrospect, and this is Monday morning quarter backing admittedly, it's too bad we
6 didn't align these things so that we got results earlier than the time that we have
7 today. But it is what it is, you know we can't ... we don't have a time machine, we
8 can't go back and change things, we have to deal with the cards we have today.
9 And I think the discussions about aligning our staff in a dialogue with industry and
10 having continuing oversight, Commissioner oversight of that process hopefully will
11 put us in decisions so we can have sound regulatory decisions backed by good
12 research and done in a way which is consistent with our Strategic Plan that calls
13 for efficiency, effectiveness and timeliness.

14 I do want to get to slide 19 though, in terms of some comments
15 about the right people and procedures for licensing digital systems. What do you
16 see right now in terms of staffing and resource challenges of getting the right
17 people and the right dollars, presumably the right contractors in place to help us
18 make these changes and come to these solutions? And what are you doing given
19 the challenges that Commissioner McGaffigan has spoke about and the potential
20 continuing resolution? How we're aligning that in such a way as to deal with the
21 scope of work that we're going to get both as it relates to new reactors as well as
22 the ongoing work that licensees want to have in retrofitting digital instrumentation
23 control systems for operating units.

24 MR. DYER: Commissioner, let me talk first about what our strategy is
25 absent the continuing resolution. And that is roughly to double the size of our

1 instrumentation control staff qualified to do digital instrumentation and control
2 work. Between the New Reactor Office and the Office of Nuclear Reactor
3 Regulation, NRR and NRO, right now it's all the technical staff is located in NRR.
4 And roughly we have 13 technical reviewers who are qualified in the digital I&C
5 area. What we anticipate is we're going to need about twice that many by the end
6 of calendar year 2008. We have as you heard we have a training program and a
7 hiring program that could get us there but we don't, you know, doubling our size
8 and having it is not, it may not happen. In that case we have identified both
9 commercial contractors and we have a consortium with DOE Laboratories as Allen
10 spoke about that we are using and exploring now for some of our digital I&C
11 review work in order to understand the staff and make sure they can provide
12 quality technical input to our decision making criteria. So that's sort of our
13 defense-in-depth in working to get the right size of an organization. But again this
14 is based on a lot of long range projections that we did and we undertook as part of
15 the anticipated new reactor work and when we thought that work was coming in
16 and the schedules and things moving up. It's going to be very much a challenge.

17 COMMISSIONER MERRIFIELD: Well, it strikes me Mr. Chairman,
18 that this may be an area, you know, I know what our traditional hiring practices
19 are. We get folks from universities. We get them in from mid careers from utilities
20 and elsewhere. This may be an area where we need to think a little bit more
21 broadly than others about reaching out to the petro chemical industry, the airline
22 industry, folks who have experience with these systems who are well up to speed
23 and can bring that quality level into the agency and have a knowledge of the
24 deployment of these systems in applications which have the degree of
25 seriousness which we treat this one. We may also want to think, you know, I know

1 we help our friends over in the naval reactor on various things, maybe they can
2 lend us a couple of folks as well in response to help us get through some of these
3 issues in a more timely way. Thank you.

4 CHAIRMAN KLEIN: Commissioner Jaczko.

5 COMMISSIONER JACZKO: I had a more general question. This
6 goes to perhaps to some of the issues that we talked about. It seems that there
7 are, that a lot of the impetus right now to get a lot of these issues resolved has to
8 do with resolving these issues for new reactors and potential new reactor outputs.
9 I wonder if the staff sees two different resolutions to a lot of these issues for new
10 plants versus existing plants. And I ask that perhaps in the context that existing
11 plants have control rooms,, they have reactor protection systems, they have all of
12 these systems built in an analog way. Do you see there being two different
13 answers so that in the case of existing plants perhaps we're overlaying a digital
14 system on top of some of that and that may be a simpler thing to get resolved than
15 moving to perhaps a new control room that is purely digital and perhaps doesn't
16 have analog backup systems or other kinds of systems?

17 MR. DYER: I think the criteria and the licensing criteria are still the
18 same. The process, the challenge would come in to the system interfaces and that
19 and as Mr. Bailey said I think there may be some, you know, because of the new
20 reactors, the passive designs, the more inherent, there are fewer actions that have
21 to occur in order for safety systems to initiate. I think that there maybe some
22 savings. But I think the principles would be the same it's just that the application is
23 going to be slightly different.

24 COMMISSIONER JACZKO: I'm reminded when I was an
25 undergraduate I actually had an opportunity to design a digital control system. As

1 we were having this ...

2 COMMISSIONER MCGAFFIGAN: God help us.

3 (Laughter)

4 COMMISSIONER MCGAFFIGAN: This is a future particle theorist.

5 COMMISSIONER JACZKO: Not to I guess date myself but this was
6 in 1994. And what I was entrusted to do was design a system, a control system
7 for, this was a particle accelerator to run an experiment that involved turning on
8 and off a series of magnets in order to essentially be able to calibrate the position
9 of the beam in this accelerator. And at that time, and this was a fairly large
10 particle accelerator in Germany ... so I worked for a long time in developing this
11 control system that would do this process of energizing these magnets, de-
12 energizing them. And as a result we would be able to get some experimental data
13 that would allow us to calibrate the monitors that we used to tell you where the
14 beam was. So I worked for a long time developing this program, software and I
15 thought it was pretty good. So I went, they finally then for those of you who aren't
16 familiar with particular accelerators getting access to a beam for something other
17 than actual particle experiments is almost unheard of. But one morning about 6:00
18 in the morning I got a call that said that you got an hour of beam time if you want
19 to try to run your program. So I got over there, mind you I had never operated a
20 particle accelerator. In the control room although smaller is very similar to some of
21 the control rooms you see in some of these facilities. These particle accelerators
22 are similar in a lot of ways to nuclear power plants in that it's kind of a more of an
23 art than a science to operate them. And so I had my program which was a digital
24 interface that actually, this was an old system and it used, the staff there
25 developed a card that they used to interface to the old control system and it would,

1 the digital system would then actually send all the assembly language controls to
2 the actual control system that energized the magnates. It was a digital front end to
3 all of this process. So I sat down and began to do my program and got through
4 and we actually got good information. And then at about five or ten minutes into
5 this the program froze. And I froze. I think appropriately so, because all the
6 operators had left, they had gone to get coffee.

7 (Laughter)

8 And I said, well what do I do? Luckily before they left to get coffee I
9 said well what do I do? They said well, you probably got lots of redundancies built
10 into your program so that if something happens you're going to be fine. Well, it
11 turned out that I had guessed pretty well and realized that I was probably going to
12 make some mistakes and somehow things worked quite well, so that the program
13 left the machine in a stable state and you know waited for the operators to come
14 back and they could then basically shut down the machine, the beam was
15 decaying and deteriorating anyway. So I just bring that up as an example. Now,
16 of course, they used this later when I was gone. And again these are the kinds of
17 things that I think happen. We actually got some good data and it turned out to be
18 a very successful way to measure these beam positions. But they went through
19 and as part of this I had to hardwire in a lot of, because we had to hardwire all this
20 stuff to an existing analog system. And an existing archaic system which was a
21 Norwegian control system for this thing. And I had input the magnates in the
22 reverse order. In one picture there's four quadrants and we did this in basically
23 four quadrants. And I input the magnates in reverse order in one. I still don't think
24 I did, but as they went through...

25 (Laughter)

1 They did this and they called me and told me that they used it and it
2 worked perfectly fine except in one quadrant, the magnetes went in backwards,
3 you know which again it just brings up some of the kinds of things that you know
4 can happen and I think, you know, as Mr. Howe mentioned that we can't always,
5 we can't anticipate all the problems that are going to happen. Of course, we all
6 know which of the Mars probes that didn't quite make it because somebody had
7 used the wrong units and I think we are all familiar with that story. So we can't
8 know all the software problems that are going to happen. But what we can do is
9 make sure that we do have the diversity and the D3 I guess it is and the defense-
10 in-depth to make sure that in the event of an unforeseen software problem the
11 system is able to recover and we're able to operate or do some kind of a scenario
12 to allow things to proceed. So I don't really have a question in there other than to
13 say that I have some familiarity with these digital systems and I hadn't really
14 realized it until listening to some of the discussion. And again that was some
15 almost 12 years ago now I think that I worked on that. So I do think this is
16 certainly something that we need to move forward on as an agency. But again
17 keeping in mind that we have to make this a safety improvement and I think it can
18 be done in the right way.

19 CHAIRMAN KLEIN: Well, I think Commissioner Jaczko, this is
20 probably why number one we are very cautious about theoretical physicists going
21 into control rooms.

22 (Laughter)

23 And number two the nuclear reactor operators don't leave the
24 controls.

25 COMMISSIONER MCGAFFIGAN: Mr. Chairman, I do want to report

1 that I have figured out what D4 and D5 might be, diversity and defense in-depth,
2 dogma, would be D4, and then somewhat redundantly, definitive diversity and
3 defense in-depth dogma would be D5. I haven't gotten to D6 yet, but I'm sure
4 there's a D6 out there somewhere that would totally appall my long term
5 colleague.

6 CHAIRMAN KLEIN: On that note I would like to compliment Madam
7 Secretary for getting the clocks up on the columns, because we can now see that
8 we're over the time that we had initially planned. I think a couple of comments.
9 One I'd like to thank both panels, industry and the staff. I think that this was good
10 background and it is clearly not the last session that we will have on this. I'd like to
11 suggest that we look at our next planning session about scheduling a joint industry
12 staff presentation in about six months to see where we are. We've now had a
13 good background, and what I'd like to see is where are we going.

14 COMMISSIONER JACZKO: I would certainly that we have EPRI or
15 other relevant folks here as well.

16 CHAIRMAN KLEIN: So at our next agenda planning session let's
17 take a look at that schedule and see when we can get that done. Well, thank you
18 very much.

19 COMMISSIONER MERRIFIELD: Before you conclude I completely
20 agree that I think they were excellent presentations. You know what industry
21 made a suggestion of having this task force and I think the staff understandably
22 our senior managers are understandably a little concerned that this is the first time
23 they'd heard about it. And I do think that it is In industry's best interest if they're
24 going to raise issues like this that they should give our senior managers a
25 sufficient heads up of where they're going. obviously they can choose to say

1 whatever they want in our meetings but in fairness they should give a heads up. I
2 would also say finally Mr. Chairman if we're going to have other issues that are
3 going to challenge us in the new reactor program and the sooner we can raise
4 those in a format like this the sooner we can get them resolved. And it pains me
5 that we didn't have this meeting a year ago where we could have perhaps set
6 things in a slightly different trajectory but like I said we are where we are. Hopefully
7 if there are issues that our staff or the industry sees that may be a challenge for us
8 going forward, raising those now when we can effectuate change rather than later
9 when it gets more difficult makes a whole lot more sense. Thank you.

10 CHAIRMAN KLEIN: Well, I think communication between industry
11 and staff is good and so we'll continue that and we'll look at our schedules to see
12 when we can have the next meeting. Meeting's adjourned. Thank you.

13 (Meeting adjourned)

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