Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Future Plant Designs Subcommittee
Open Session

Docket Number: N/A

Location: Rockville, Maryland

Date: February 23, 2017

Work Order No.: NRC-2902 Pages 1-144

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

DISCLAIMER

UNITED STATES NUCLEAR REGULATORY COMMISSION'S ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, as reported herein, is a record of the discussions recorded at the meeting.

This transcript has not been reviewed, corrected, and edited, and it may contain inaccuracies.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

+ + + + +

FUTURE PLANT DESIGNS SUBCOMMITTEE

+ + + + +

OPEN SESSION

+ + + + +

THURSDAY,

FEBRUARY 23, 2017

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Dennis C. Bley, Chairman, presiding.

COMMITTEE MEMBERS:

DENNIS C. BLEY, Chairman

RONALD G. BALLINGER, Member

CHARLES H. BROWN, JR., Member

WALTER L. KIRCHNER, Member

JOSE A. MARCH-LEUBA, Member

DANA A. POWERS, Member

HAROLD B. RAY, Member

JOY REMPE, Member

PETER RICCARDELLA, Member*

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

MATTHEW W. SUNSERI, Member

DESIGNATED FEDERAL OFFICIAL:

CHRISTINA ANTONESCU

ALSO PRESENT:

SARAH DITOMMASO, Westinghouse

THOMAS FREDETTE, NRO

JAMES KELLUM, NRO

LAUREN KENT, NRO

RENEE LI, NRO

JONATHAN LIZARDI BARRETO, Region II/DCO

KATHERINE MCCURRY, Region II/DCO

TIMOTHY STEADHAM, Region II/DCO

ALEXANDER TSIRIGOTIS, NRO

ANDREA D. VEIL, Executive Director, ACRS

* Present via telephone

TABLE OF CONTENTS

P R O C E E D I N G S

8:32 a.m.

CHAIRMAN BLEY: The meeting will now come to order, please. This is a meeting of the Future Plant Design Subcommittee and I am Dennis Bley, chairman of the subcommittee.

ACRS members in attendance are Ron Ballinger, Charlie Brown, Walt Kirchner, Jose March-Leuba, Dana Powers, Harold Ray, Joy Rempe, Dick Skillman, John Stetkar, Matthew Sunseri, and we have Pete Riccardella on the line.

Christina Antonescu of the ACRS staff is the designated federal official for this meeting.

The ACRS was established by statue and is governed by the Federal Advisory Committee Act, FACA. That means that the committee can only speak through its published letter reports. We hold meetings to gather information to support our deliberations.

Interested parties who wish to provide comments can contact our offices requesting time after the Federal Register Notice if published. That said,

we also set aside ten minutes for spur of the moment comments from members of the public attending or listening to our meetings. Written comments are also welcome.

The ACRS section of the U.S. NRC public website provides our charter, by-laws, letter reports, and full transcripts of all the subcommittee meetings, including the slides.

Today we will hear presentations from the NRC staff. The subcommittee will gather information, analyze relevant issues and fact, and formulate proposed positions and actions, as appropriate, for deliberation by the full committee.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register. We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting.

We have a bridge line established for interested members of the public to listen in. The bridge line will be open at the end of the meeting to allow those listening to make comments, if they desire.

A transcript of the meeting is being kept and will be made available, as stated in the Federal Register notice. Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressing the subcommittee. The participants should first identify themselves and speak with sufficient volume and clarity so that they may be readily heard.

Please silence all your electronic devices.

The purpose of this meeting is for the subcommittee to review the results related to closure of Design Acceptance Criteria, known as DAC for new reactors. In particular, the briefing will include a discussion of AP1000 DAC inspection topics: human factors engineering, piping design, and pipe rupture hazard analysis.

I want to put this in perspective for the new members. DAC was invented when early design certifications did not have immediate customers and vendor wanted to defer some design details in rapidly evolving areas and areas where vendors did not have sufficient as-built or as-procured information, those areas mentioned above. We became concerned that the

normal design review process could be circumvented because DAC were to be inspected as part of ITAAC and that is the Inspection, Tests, Analyses, and Acceptance Criteria we see in the design certs, and we felt that we were receiving mixed messages from the staff about just what that meant.

We wrote a letter to the NRC on August of 2010 expressing our concerns and later briefed the Commission in November of that year. The Commission supported our concerns by asking the staff to involve us in at least the first few DAC inspections. 2010 may seem a long time ago but delays occurred as some early COL applicants deferred construction.

The staff will discuss some of this history and for the new members, I would recommend taking a look at that letter report from August 9, 2010. It gives a real history on DAC and what our concerns at the time were.

The staff will give us some of that history and explain that they are committed to periodic ACRS briefings on the status of DAC inspections.

As you will hear, some of these inspections have required including headquarters and

other expertise beyond the regional inspectors and have delved into the associated issues at a deeper level than the phrase inspection might lead you to expect. And that was really the gist of our primary inspection back then.

We will now proceed with the meeting and I call upon Mr. Tom Fredette of the Construction Inspection Program Branch in the Division of Construction Inspection and Operational Programs in the Office of New Reactors to start the presentations.

And Tom, we appreciate you folks coming today and in the past to tell us how this process is moving forward. Please go ahead.

MR. FREDETTE: Thank you, Dennis.

As Dennis mentioned, I'm Tom Fredette from Construction Instruction Programs Branch. I have been the leader for the DAC Working Group since its inception back in November 2009. That's right, we are into our eighth year as a working group. A lot of the original members have moved on. I remain one of the only mainstays from back then.

Just to dovetail in with your opening remarks, Dennis, this is an informational briefing. We wanted to come today and give you and the committee

sort of a status and an overview of where we stand with DAC inspections, since we started this effort so many years ago. Today, our objective is to provide you all an overview of the activities with an emphasis on inspection implementation. There is a lot that has happened over the last couple of years, a lot that has happened since the last time we briefed you, which was in July of 2014.

I want to give you an overview of our approach and inspection of key areas of human factors engineering and piping design, pipe rupture hazard analysis DAC. We will provide some results, some insights, some lessons learned and enhancements that we have identified as these activities have taken place and we will give you a glimpse of what we still have to do, what we still have to accomplish going forward.

As Dennis mentioned, just a little background and history on the working group. The concept of DAC was introduced in SECY 92-053. It relied on verification of design implementation through Part 52 ITAAC in some limited areas, digital instrumentation and control, human factors engineering, piping design, and for the ABWR design,

at least, there was a radiation protection DAC at one time.

The working group was established in November 2009. We undertook to develop processes and procedures and infrastructure for the ABWR Digital I&C DAC at that time and we completed a pilot inspection in July -- I'm sorry, June of 2010.

As Dennis mentioned, later in 2010 interactions with the committee and with the working group we committed to provide the ACRS periodic briefings on where we were, what our status was, what progress we had made in the area of DAC inspection.

MEMBER SKILLMAN: Tom, where did you conduct that inspection on the ABWR, please?

MR. FREDETTE: That was a vendor inspection at Westinghouse in Cranberry.

MEMBER SKILLMAN: Thank you.

MR. FREDETTE: March of 2011, the Fukushima event happened and ABWR sort of dropped off our radar screen. We shifted all of our focus to AP1000 and that is where our focus has been ever since.

We briefed the ACRS on our AP1000 approach that we were going to undertake in November of 2011.

We, again, committed to the continuing periodic briefings as we implemented inspections.

In July 2012, we conducted a tabletop walk-through of the piping DAC inspection process with licensees and with Westinghouse. That was a public meeting. And we will talk more about our implementation of that process later on in this morning's briefing.

In January 2014, we conducted our first --

MEMBER BALLINGER: Tom?

MR. FREDETTE: Yes, sir.

MEMBER BALLINGER: Pardon me for interrupting. Could you just explain why those areas were chosen, the areas of Digital I&C, human factors, piping, and rad protection?

MR. FREDETTE: They weren't chosen by us. They were outlined in the SECY paper 92-053.

MEMBER BALLINGER: Okay.

MR. FREDETTE: And Dennis sort of alluded to this in his opening remarks but the area of Digital I&C and human factors engineering, those were rapidly evolving technologies.

In piping design, there was a lot of design detail that just wasn't available for vendors

to put into piping materials and things like that.

The radiation protection, I'm not exactly sure why that one was part of that -- was encompassed in that group. But our focus all along has been just in those three areas, the Digital I&C, the human factors, and the piping design.

We have talked about human factors and piping design in the past but mostly just in what we were going to do as far as procedure to development and infrastructure and sort of getting our process put in place. We had not done any inspections in those areas or talked about any inspection in those areas in our previous briefings because we just hadn't conducted them yet. The only inspection that we had done that we talked about in any previous briefing was the one Digital I&C inspection which was in January 2014.

So, we have been waiting all these years for opportunities to actually implement our process and procedures in the human factors and piping design area. And over the last couple of years is when a lot of that activity has taken place. So that is what we are here to brief you on today is the results of those inspections.

Richard, did I answer your question?

MEMBER BALLINGER: Yes, thank you.

CHAIRMAN BLEY: Could I say it another way, perhaps? If it were possible to do, this detail would be in the design certification.

MR. FREDETTE: That's right.

CHAIRMAN BLEY: But because that would delay the design certification indefinitely and require a lot more investment before a customer was paying the bills and so on, it became DAC.

MR. FREDETTE: That's right. Yes, and as DAC, once the COLs were issued, the DAC sort of migrated into the ITAAC. We, the construction inspection program branch in the Division of Construction Inspection and Operational Programs are sort of stuck with these specialized ITAAC and we had to figure out a way to verify that those ITAAC were complete.

CHAIRMAN BLEY: I'm going to add a little to this. We were interacting a lot, different areas of the staff at the time, even before Tom's group was set up, saying how are you going to do this. We really put off the design review. So this isn't just a simple checklist. You know you have got to dig in

more deeply on some of these. Maybe not the piping. Once the piping is specified, that is a little more straightforward. But the control room design stuff and the I&C. And they worked up a way, it is called an inspection but it really brings a lot of expertise to say -- the requirement, you will some in a minute, might just say there is a report that shows this was okay. But then they have to dig in and make sure the material in that report makes sense and was done in the right way.

Yes, Charlie?

MEMBER BROWN: Yes, on the digital I&C, just for the new members, calibration, when we initially started hearing about the new process it was we could describe the Digital I&C and the design -- the control documents with a few words and a box that showed protectors, protection systems, scram the plant. No idea what the architecture or anything else looked like.

As a result, as we went through AP1000, the ABWR, the ESBWR, et cetera, et cetera, we, the committee, insisted on having a more well-defined architecture so that you have something to review as part of our certification, using the fundamentals that

we have been emphasizing in the various meetings on Digital I&C. That doesn't mean -- at least now they have an architecture within which they can develop an inspection program to see that it actually satisfies the requirements.

When we looked at some of the initial ITAAC, it was we will test the stuff and see that it works. I mean it was so simple-minded that there was no idea of what the system was going to look like.

I see Tom shaking his head up and down. They were very, very vague.

So, the program has evolved since then and I think it can be utilized satisfactorily. But the idea that we pounced on that the I&C was a such a rapidly developing technology, there was no way that you could specify a design in advance before somebody certified the plant and a vendor designed the stuff, which is just -- I'm trying to look for some nice words to describe that concept --

CHAIRMAN BLEY: Overly drawn, perhaps.

MEMBER BROWN: It was nutty. Okay? Let me just phrase it that way.

So anyways, it worked out fairly well. We have gotten good architectures. And that is what we

focused on and that is what the staff has focused on in the other new plant, as well as backed the designs. So, just a little bit of an amplification on the Digital I&C.

MR. FREDETTE: Thank you, Mr. Brown.

Just something I want to add. And the other staff that are here today to brief the committee may talk about this also but the process that we put in place was sort of a deviation from the standard or typical or classical inspection process. Our model was regional or headquarters-based inspectors augmented by technical staff with specialized subject matter expertise in those disciplines. So, we would have an inspection team with subject matter expertise in the Digital I&C area or subject matter expertise in piping design, subject matter expertise in human factors engineering.

And today, I have done something different from what I have done in previous briefings for the committee. I used to do these briefings by myself but I have smartened up over the years and decided that this time I brought the real subject matter experts in to help with the briefing today and the core inspection group that was involved in some of these

inspections. They are also here today. So we will, hopefully, muddle through and give you a flavor for what has been happening over the last couple of years in inspections that we had previously not done but have actually completed now and sort of have moved into a new realm with regard to human factors and piping design.

MEMBER RAY: Let me make one other comment on this.

This actually has a lot of application to what we considered yesterday in the sense that we have got a lot of future plants who thought more than the AP1000 are not able to put a completed design on the table. At the time, they would like approval of the design that they are proposing.

So what we will be listening to today, think about it not just as retrospective but as prospective in terms of the limitations on certification for future plants and how you deal with those limitation.

MEMBER KIRCHNER: Just a thought that occurs to me. To what extent does this become -- I know this is a matter you brought up, Charlie, become an independent design review for the vendor applicant?

MR. FREDETTE: Well, that is a fine line we walk. You know we try to rein in our technical staff and make sure that they concentrate on inspection of attributes, the attributes that we want to look for that sort of give us confidence that the vendor or the licensee is following the methodology, as outlined in the DCD. Sometimes we get technical staff that want to have another bite at the apple and delve into a real vertical slice designer view and we sort of have to rein them in. Because first of all, we don't have time to do that. You know these inspections typically are a week-long inspection, maybe a week with a break and then another week, possibly, depending on the scope.

So, it is up to the inspection team leaders to basically rein that in and make sure that we are not doing another design review.

First of all, the licensees and the vendor wouldn't stand for it. We would get a lot of flak if we tried doing something like that. So we sort of stick to our inspectorese or inspection philosophy, which is tried and true. It has been around with NRC for 40 years. So, we try to stick with that and we have procedures that are written that we use that sort

of outline what we are going to stick with.

MEMBER KIRCHNER: Thank you.

MEMBER BROWN: The ability to rein in people is interesting because of engineers. And in the I&C world, if you have a DCD that captures either a topical report or a technical report that has those architectures defined, you can see it and the pictures are there. That is something now that your subject matter experts can come in and look at, yes, they are complying with that. It doesn't take a detailed design. The communications is laid out in those documents and you can come in and inspect to that.

Without that, the way it was previously, then I could understand why the people would want to come in and take a bit because there was no definition. There was literally no definition. The first AP1000, we were given a diagram that had four boxes on it and a couple of lines. I mean it was just -- for ESBW, I can't remember, it was abysmal.

MR. FREDETTE: Well, for the AP1000, the subject matter experts that we typically have on the inspection team are the same subject matter experts who did the design review. So they are familiar with all of the history of Westinghouse's design for AP1000

or GE's design for the ESBWR.

CHAIRMAN BLEY: I'm glad you said that because that was the thing we have really wanted to hear along the way.

MEMBER BROWN: Exactly.

MR. FREDETTE: Yes, we always try to -- we don't just take anyone from the technical staff. We take the technical staff who have knowledge and history and know all the ins and outs of what was done in the design review phase. So, they can sort of hit the ground and do the review and the inspection and it brings real value to the inspection team without a lot of learning curve.

Any other questions?

CHAIRMAN BLEY: I've got one more. I want to read something because this was a big deal for us. We were very concerned about this and I am going to read something from our letter but in our letter we quoted from the Commission in the statements of consideration for Part 52. And it goes to this you want to rein in but you want to go deep enough to really know you are doing a good job. And even at the beginning, the Commission said the Commission does not believe that it is prudent to decide now before the

Commission has even once gone through the process of judging whether a plant built under a combined license is ready to operate that every finding the Commission will have to make at that point will be a cut and dried proceeding according to highly detailed objective criteria. And they go on a little bit. You will still have to have judgment and really understand what you are doing to do this process well. And it sounds like you have the right people to do that. So, please keep going.

MR. FREDETTE: We feel confident that we do. Yes, sir.

MEMBER SKILLMAN: Tom, do you have the inspection manual chapters of well-matured and shaken down so that you are comfortable with the I&Cs as you proceed through this?

MR. FREDETTE: Well, we do for Digital I&C, Mr. Skillman. This is our -- what we have done for human factors and piping design -- well, piping design, this is our first inspection. So, we finally had a chance to sort of shake that one down.

Human factors, that procedure was written by the human factors experts. Lauren is going to talk about that in a minute but I think over the last

couple of years, all the chances that they have had to look at the integrated system validation for AP1000, I think they feel pretty confident also that the procedure works for them. I'm not saying that they are perfect and they can always be enhanced. And that is some of the things that we try to capture when we do inspections. We try to capture those lessons learned: what works really well, what doesn't work so well, what can we change in the procedure that make it more of a valuable inspector tool. So, we are constantly doing that. We are always looking for ways to make the procedures better.

And even the Digital I&C procedure which has been through -- it has been through the ringer a little bit, we still feel like we can always do some things differently in that procedure. And I was the author of that procedure so I feel like there is changes I want to make and it is on my plate to make those changes and make that a better, valuable inspector tool at some point in the future. So I still have got some work to do on that particular procedure.

MEMBER SKILLMAN: Okay, thank you.

MR. FREDETTE: We had quite a bit of

segueing there. So, I am on this slide and the last things I want to leave you with is that well, we talked about the first Digital I&C DAC inspection. It is actually the only Digital I&C DAC inspection was conducted January 2014. We briefed you all on the results of that in July of 2014, which is our last briefing for the committee. So, it has been two and a half years since we have been down here talking to you all. And in that time, the AP1000 Human Factors Engineering Inspections commenced in October 2014. They are still ongoing. Lauren will talk about that in more detail.

And then we just completed the first piping DAC Inspection in this past December. That is a typo on that slide. It should say December 2016. So, I'll take the hit for that.

CHAIRMAN BLEY: Tom?

MR. FREDETTE: Yes, sir.

CHAIRMAN BLEY: I'm not sure if this is -- I looked through your slides. I'm not sure this is in your slides. In the past and now we have gotten copies of some of the Inspection Procedures but we also got a copy of the inspection plan for piping. I don't know if that is something you can talk about but

that is really -- it goes into some detail about who is going to do what and how far they are going to go.

MR. FREDETTE: Right.

CHAIRMAN BLEY: Is that a typical process to have an inspection plan like that?

MR. FREDETTE: That is exactly right. We always develop a plan for what we are going to inspect. That is one of the ways we keep everybody sort of reined in on what they are going to do because we have a limited amount of time, a limited amount of resources sometimes. We want to make sure that we get the most value out of our inspection plan. So, those plans are developed by the team leads, always.

CHAIRMAN BLEY: And they are kind of an overlay of the Inspection Procedure against the people who are going to be doing the actual process.

MR. FREDETTE: That's right and there may be some things like risk insights included in there, things that -- or other insights that we want to bring to the inspection team that may be part in the procedure.

So, it is typically a customized tool that is developed for every inspection.

CHAIRMAN BLEY: And that is the real tool

people use on the spot as they go through this?

MR. FREDETTE: No, that is something they use when they are preparing.

CHAIRMAN BLEY: Just in preparation, okay.

MR. FREDETTE: Yes, sir.

Inspection plans are not something we typically share with the licensee or with the entity we are inspecting.

CHAIRMAN BLEY: Fair enough, yes.

MR. FREDETTE: Anyway, that sort of gives you a background and history to how we got to where we are today. As I mentioned, I have brought in the actual experts who were involved in these inspections to brief you in more detail.

And with that, I am going to turn over the human factors portion of the briefing today to Ms. Lauren Kent. Lauren is a human factors subject matter expert and she has been an integral part of all of the ISV inspections that have been conducted for AP1000.

With that, Ms. Kent.

CHAIRMAN BLEY: Tom, I know you gave us an acronym gouge but an ISV is an integrated system validation. Do you want to say anything more about that before --

MR. FREDETTE: Lauren will go into a lot of detail about that.

CHAIRMAN BLEY: Lauren, you will talk about all of that, what that means? Okay, go ahead.

MS. KENT: Good morning. My name is Lauren Kent. I am a human factors engineering technical reviewer in the Office of New Reactors. I work with Tom in the Division of Construction Inspection and Operational Programs and I specifically work in the Operator Licensing, Human Performance, and ITAAC Branch. I have been at the NRC for a little over two years now.

Prior to coming to the NRC, I worked at San Onofre Nuclear Generating Station as an operations training instructor. Specifically, I worked in implementation of the Licensed Operator Continuing Training Program and I was there for about four years.

Prior to that, I was an officer in the Navy Nuclear Power Program and I started on the USS Nimitz as a propulsion plant watch officer.

When Tom last briefed this committee on the status of the DAC inspections, it was the summer of 2014 and there was no information really to report on inspections related to the human factors

engineering design for the AP1000 and that was because those activities had not yet commenced.

Well since then, Westinghouse, which has been contracted by the two AP1000 licensees, Southern Nuclear and SCE&G, to complete the HFE design has completed a significant amount of work. So I have a lot of information to share with the committee today.

We have also completed several inspections since October of 2014. So, this morning, I would like to discuss the results of those inspections, the status of those inspections, as well as the status of the AP1000 HFE design for the main control room. I will also discuss some insights that we have gained as NRC staff and as process.

Overall, I would like to start by saying that we have observed that Westinghouse is, indeed, fulfilling its design commitments using the methods that were previously approved by the staff during the design certification process.

To begin, I am going to provide some background information about the use of DAC or Design Acceptance Criteria in the AP1000 HFE design to provide a context for the rest of our discussion today.

Next slide, please. Oh, you are already there. Okay, thank you.

The regulatory basis for the application for human factors engineering in nuclear power plants is found in Parts 52 and Part 50. Specifically, design certification applicants must satisfy the requirements in 10 CFR 52.47. One of these is 52.47(a)(8), which says: Provide the information necessary to comply with the technically relevant portions of the Three Mile Island requirements in 50.34(f).

One of these TMI requirements, or Three Mile Island requirements, is 50.34(f)(2)(iii), which says to provide Commission review a control room design that reflects state-of-the-art human factors principles.

MEMBER POWERS: How do you know what the state-of-the-art is?

MS. KENT: So, state-of-the-art is, essentially, what is accepted at the current time. So for our purposes, we maintain guidance documents for human factors engineering. One of those is NUREG-0711, which is the Human Factors Engineering Program Review Model. It contains information about an HFE

design process or a method that the staff has found acceptable to incorporate human factors engineering principles that are accepted into the control room design process.

So, we have a definition in there for what is an acceptable human factors engineering principle or standard, which is one that has been peer-reviewed, endorsed by industry, or otherwise proven to be effective.

We also have another guidance document that we maintain that is NUREG-0700, which contains design-specific standards for individual human system interface components. So, for example, it would have guidance for what would constitute a computerized procedure system that is considered state-of-the-art. So, essentially, it is what has been found to be effective at the time at which you are reviewing the design cert.

MEMBER POWERS: What defines what is acceptable and state-of-the-art, not the synonymous terms?

MS. KENT: That is true. So, again, you have to have state-of-the-art human factors engineering principles reflected that are also found

to be acceptable, which, for us, means those that, a minimum meet our acceptance criteria.

Realizing that over time -- so when the regulation was established post-Three Mile Island, so 1980's, if you look at the control rooms today of operating reactors, they look very different than the control room designs that are being brought forth in these current designs.

Now when you look at an operating reactor, you walk in and, at least for me the first time I did it, it was very difficult to make sense of where everything was because you have many different displays and controls and locations that if you are not familiar with them, haven't been trained on them, or don't know how to use them, it is very difficult to essentially get your wits about you or understand even how to operate that design.

Now, if you were to walk into the AP1000 control room design, you would see a set of computer screens and you could walk up to that and click on it and it would be a lot more intuitive, at least in my opinion I find a lot more intuitive, than trying to walk into an operating reactor control room.

MEMBER POWERS: I'm sure a person at my

age would be more comfortable with the older design than perhaps someone brought up in the digital era.

There is peculiarity that they would put state-of-the-art there and not -- and then turn around and say it is what is accepted. Because almost by definition, the state-of-the-art is going beyond what is currently operating. Peculiar.

MEMBER BALLINGER: I'm not sure, if it is the way the regulation was written.

MEMBER KIRCHNER: It might be if there was an analog school. Put that aside for the moment. How do you deal with the fact that the digital world is evolving so quickly? How do you deal with the fact that you just can create a situation where you just have information overload in the digital world?

You know it sounds nice to have three screens or however many but you push the button or you tap the screen and you get the next folder, and the next folder, and the next folder. So how does this state-of-the-art -- how do you stop the state-of-the-art and freeze a design for a reasonable period so that you have operating crews that are trained and you are not continually evolving to the state-of-the-art, which is evolving at least in the digital world, quite

rapidly?

MS. KENT: So, essentially --

MEMBER KIRCHNER: It is kind of an add-on to Dana's question. When do you stop and call it the state-of-the-art and not continue to evolve?

MS. KENT: I think I have to answer your question by saying that we -- and this is kind of getting into the next point here, which is that for the Westinghouse Design Cert Application, we approved a process.

So, instead of getting detailed design information about what the AP1000 control room was going to look like at the design cert stage, instead, we accepted and we reviewed and approved a detailed design process.

So, essentially, it is up to Westinghouse and the licensees to provide their input into how that design takes place but it is all happening within the bounds of an accepted established human factors engineering design process.

So they start -- well, they can start from whatever baseline, if you want to call it a baseline, or whatever initial design point you want to start at. And from there, using the inputs that go into the

human factors engineering design process, you arrive at a final design. But final design is then tested and validated with the integrated system validation to prove that it is effective. Essentially, what that means is that operator performance errors are minimized and the design helps to ensure safe operation of the plant by the operators.

So, your question of how are design changes controlled, well, if Westinghouse decides to make a design change, a change to its design once it started that process, you observed they have a design configuration control process that evaluates what the impact of that is going to be.

Once you get to the point where you have assembled all your inputs and come up with what is the AP1000 control room design prior to integrated system validation, it just wouldn't be prudent, I guess, from their perspective and perhaps they can speak to this, to make such changes at that point.

So at some point, it just becomes impractical to make changes because operators have been trained on what the design is going to be. They are going to be participating in the integrated system validation.

So after that point at which you have validated the design, they also have a process for evaluating design changes that are made once the design is valuated and evaluating the impact on the conclusions that were drawn from the integrated system validation.

So all along the way, there are approved processes that guide, essentially, how design changes are implemented and evaluated. Does that answer your question?

MEMBER KIRCHNER: Sort of. But again, the state-of-the-art evolves so continually and quickly in the digital world that, at some point, you have to say that is enough, we stop and --

MS. KENT: But that is up to the vendor.

MEMBER KIRCHNER: -- this is what they are going to be trained on.

MS. KENT: Right.

MEMBER KIRCHNER: And we are not going to continually evolve.

MS. KENT: Right. That's right and that is up to the designer to make that decision.

MEMBER RAY: Let me ask two questions at this point. We established earlier that this is kind

of an extension of the design certification milestone. These items were not resolved at the time of design certification. They were, instead, left to be resolved through this process that we are talking about today.

Are the COL holders involved in what you are doing?

MS. KENT: Absolutely. The COLs have contracted with Westinghouse to carry out the design work. However, they have been participating in this process in a variety of ways.

For one, I can tell you that they participated significantly in the ISV because we observed that their personnel were used during the testing process, not only as the operators performing the scenarios in the simulator but also as observers as well. And they do provide their feedback. They also review all of the products that are described in the result summary report that Westinghouse completes when they have completed the design work prior to submitting that report for ITAAC closure.

MEMBER RAY: And they are able to speak with one voice, are they?

MS. KENT: I can't speak for them. My

observation is that --

MEMBER RAY: Well, is there any difference in how different COL holders would approach the issues that you are dealing with that come to the table?

MS. KENT: We have observed some differences and that is that ultimately they are the license holders. They are ultimately responsible for completing the ITAAC. So more or less, I would say generally speaking, we have observed that they do try to work together. It is more efficient for them to do that. However, there have been instances where they have, perhaps approached some issues differently.

MEMBER RAY: Well, we should move on but I am interested in, on the one hand, the notion that the design certification then requires exemptions when anybody wants to deviate from it. We are still in the process of creating that design certification on this topic through the DAC process.

But once it is set, are we talking about then okay, a bell rings and this is it, it is frozen, unless you get an exemption?

MS. KENT: Are you talking about the --

MEMBER RAY: In other words, I am talking about human factors and displays like Walter was

asking about that, in the future, somebody might say there is a change we want to make. You froze it four years ago. Now I want to update my interface with the operators.

MS. KENT: Right.

MEMBER RAY: Each one would then, or I guess they could jointly, as they have done, seek an exemption to the design certification.

MS. KENT: Well at that point, the activities associated with the design certification would, essentially, be complete.

MEMBER RAY: Well --

MS. KENT: But then they would fall into a different process at that point.

MEMBER RAY: Let's go ahead because I'm asking you a question that maybe hasn't -- it isn't timely yet to resolve.

But my perception is that, like every other part of the design certification ultimately you are establishing a detail in the certified design that then is part of that design and can't be changed without a process of an exemption being created like we have in other cases.

MS. KENT: I will try to address that

later.

MEMBER RAY: Okay.

MS. KENT: I have an idea that they are not actually making -- an exemption would be required to make a change to the license or that part of the DC that requires an exemption to change it.

MEMBER BALLINGER: Yes.

MS. KENT: Everything that was part of the Design Control Document would include those documents that guide the process of how this design becomes established for the control room design. So, changing the process would require a license amendment.

But changing the actual design that results from that is outside of the scope of the design cert process. And it would be just like an operating reactor. When an operating reactor makes a change, they have to use the 50.59 process.

MEMBER BALLINGER: Okay. This is still a detail I am not quite resolved in in my own mind but let's go on and I will pursue it later.

MS. KENT: Okay. I think we have addressed all of the information on this slide. So, let's move on to the next slide, please.

So as a result of accepting DAC in the

AP1000 Design Control Document, Westinghouse included implementation plans as a part of the design control document for HFE activities that were not completed at the design certification stage and, thus, must be completed by the AP1000 licensee.

These implementation plans, in part, form the main basis for the staff's safety determination of the AP1000 HFE design. The implementation plans contain the methods for completing the HFE design process. Thus, they contain the DAC.

The AP1000 COL holders are responsible for executing the processes or the procedures in the implementation plans. Compliance with the DAC and satisfactory completion of the associated ITAAC provide the necessary assurance that the human system interfaces, and when I say HSI, that includes the control room displays, the procedures, the information displays and the controls. It provides assurance that the HSI have been designed and tested and implemented in accordance with the certified design.

CHAIRMAN BLEY: So at the point you did the inspection, they had already gone -- Vogtle had already gone through this process and had procedures and had their final control room display arrangement

all established.

MS. KENT: Essentially, yes. Over the next couple of slides, I am going to show the HFE activities that have associated, that are DAC activities and have ITAAC associated with them.

The point that we started the inspections was at the Integrated System Validation. And at that point, you have to have assembled all of your inputs and come up with a final control room design that includes and we refer to it as an integrated system because it includes the software, the hardware elements, the personnel elements, that includes people who have been trained on how to operate the AP1000. That includes the procedures, as well as human factors, if you will.

So when I say human factors in this sense, I mean factors associated with the personnel themselves who are performing the test, like fatigue levels, stress levels, that sort of thing.

Does that answer your question?

CHAIRMAN BLEY: Yes.

MS. KENT: Okay, thank you. Let's move on to the next slide, please.

The five ITAAC or the ITAAC related to DAC

are associated with verification and validation activities, which you can see here in the third column. This graphic here is from NUREG-0711, which is the staff's guidance that we use to review how human factors engineering has been incorporated into the control room design.

As you can see here, there are four phases of a human factors engineering design process described in NUREG-0711. Those listed under planning and analysis are inputs into the design phase. Once the design phase is completed, you validate that design. You also perform verification activities. And then, finally, you implement that design by going forward and building it in the plant. And then you continue over the life of a plant with human performance monitoring, which could include making modifications to that design if operating experience, for example, shows that a modification is necessary to minimize human performance errors.

Let's go on to the next slide, please. Thank you.

This is the ITAAC associated with task support verification. It is one of the two verification activities. The purpose of task support

verification is to verify that the control room operations have the HSI that they need to perform their tasks. This ITAAC requires the licensee to perform task support verification in accordance with the approved implementation plan. It also requires them to evaluate whether the task support verification activity was, indeed, performed in accordance with the approved plan.

And then, finally, they need to document that verification and their evaluation of the implementation in a report.

Next slide, please.

This is the ITAAC associated with design verification, which is an activity performed to verify that the design conforms to the AP1000 specific HFE design guidelines. These AP1000 specific design guidelines are found in the AP1000 style guide, which was approved as part of the design certification. It is based, in part, on NUREG-0700 HSI design review guidelines, which contains generic human factors engineering design guidance.

So an example of that would be the guidance contained in NUREG-0700, there would be a recommendation to use a method to allow operators to

identify high priority alarms. The style guide shows how that guidance has been tailored specifically to the AP1000. So, the style guide could contain information specifically how that -- how high priority alarms would be communicated or identified by the operator, using color coding and audible signals, et cetera.

Let's go on to the next slide, please.

This ITAAC is associated with the conduct of the integrated system validation or the ISV. The ISV is a performance-based test of the integrated system which, I said previously, consists of elements including the HSI, the software, the hardware, personnel elements, procedures, and training.

Test support verification and design verification provide assurance that individual HSIs support tasks and also meet HFE design guidelines. However, these verifications are limited in providing assurance that collectively the control room HSI will be effective in supporting the operators as they perform complex tasks, such as those associated with mitigating an accident such as a loss of coolant accident. Therefore, the ISV is a performance-based test that integrates all of these aspects together to

provide assurance that the HFE design would be effective.

MEMBER SKILLMAN: Lauren, for this to be successful, it seems to me that there must be a scenario, there must be a drill exercise where the operators do not know what they are going to be presented and then that activity is witnessed by people who have an understanding of what is supposed to happen and then they compare what is supposed to happen with what did happen.

MS. KENT: That is correct.

MEMBER SKILLMAN: How is that imagined at the conceptual stage? This is ITAAC. This is long before this man-machine interface is going to affect any parts in the plant. So this is obviously a simulation. How is that imagined? How is that brought together?

MS. KENT: So we have guidance in NUREG-0711, which was used to review the AP1000 certification and the implementation plan. Westinghouse submitted an implementation plan for how they would perform the integrated system validation. They also provided a list of all of the scenarios that were going to be run for the ISV. The staff looked at

the implementation plan, which again, as I said previously, contained the procedure or the method for how the ISV would be performed, compared it against the criteria in NUREG-0711, found that it was acceptable and contained a sufficient level of detail to make a safety finding. Additionally, they also reviewed the scenarios and made the same conclusion at that time.

So we do review. We review the plan at the outset, as well as the contents of those scenarios and the performance measures that are going to be selected to provide indication of the HFE design effectiveness.

MEMBER SKILLMAN: What would be a human deficiency?

MS. KENT: Human deficiency here is referring to what is called a human engineering deficiency. So what that would mean is essentially any issue that is a deviation from the performance criteria specified in the scenario for how you will know that the scenario has shown -- collectively, the scenarios have shown that the design is effective.

An example would be in one that we talk about in NUREG-0711 is -- and really, I should back up

a moment and say that you were talking about how does an observer who is grading the test essentially, know to compare performance to what is acceptable. The test personnel, the people observing the conduct of the test have scenario guides and they are essentially a script. And it says here are all the events in this scenario. Here is where we are starting from. Here are all the events that are going to happen and here is where we need to end up along the way. Here is how the plant is going to behave. Here is how the operators are going to respond. Here are the HSI they are going to be interacting with. They should be taking these actions, using these procedures. Here are the expected outcomes. And here is the acceptance criteria. There are pass/fail criteria, as well as diagnostic criteria.

An example of a pass/fail criteria which, again, we discuss in NUREG-0711, so it is generic pass/fail criteria, is if the operators are unable to perform accredited actions, so say that the transient accident analysis credits that an operator will be able to open a valve within 30 minutes of receiving an alarm that an event has occurred. So, if they are unable to do that, that would be documented as a human

engineering discrepancy.

MEMBER SKILLMAN: Good. That is the kind of example I was hoping for. So the observer has determined that panel operator 2 failed to open that valve in 30 minutes. And so now we have an employee who is on the verge of getting kicked out and the employee says wait a minute; there was no button to do that. There is nothing on the panel. There is nothing in my software. There is nothing in the procedure.

So, is that a human deficiency or is that a process deficiency and a design of the machine?

MS. KENT: So what that is is a design issue and I want to clarify.

MEMBER SKILLMAN: Okay and will the observers be able to have the level of discrimination that is thorough enough to be able to, if you will, forgive the operator when the operator really couldn't perform and point the machine design and say this is a design issue, not a personnel issue?

MS. KENT: Right. So, I am actually glad you brought this up because this was something that we observed and I plan on discussing later in the slides.

MEMBER SKILLMAN: Okay.

MS. KENT: But the observers do need to have a certain level of training because they are collecting data about the tests and that is being used as an input to determine how the design can be approved -- excused not approved -- improved. They have to know what they are looking for.

This test, the ISV is not testing operators. It is not a licensed operator exam. It is testing the HFE design effectiveness. So because operator A could not complete his or her procedure because the display didn't exist or the button wasn't there that he or she needed to operate, the design is looking to address the issue that prevented the operator from being able to complete the task. It is not looking to assign blame or to criticize their performance.

MEMBER SKILLMAN: So while it is labeled here on slide 12 as a human deficiency, it really might be a display or a machine indication or a machine capability deficiency, as opposed to human deficiency.

MS. KENT: I would agree. Yes, that is true.

MEMBER SKILLMAN: Okay, I'm fine. Thank

you.

CHAIRMAN BLEY: But they are talking about human factors engineering, which is the whole system of the instruments, the plant, and the operators all together. So, it is a deficiency of that system.

MS. KENT: That's right. And it include --

MEMBER SKILLMAN: I understand that. I was just really going after the word human in the lower right-hand corner of that slide.

MS. KENT: Yes.

MEMBER SKILLMAN: I had experience with this where we failed a biennial graded exercise because the scenario computer failed. The people were doing exactly what they were supposed to. But is very painful to fail your graded exercise. And that was exactly, exactly this issue.

CHAIRMAN BLEY: But I --

MEMBER SKILLMAN: So, I understand what you are saying.

CHAIRMAN BLEY: I guess the acceptance criteria -- this is another one like Dana said, how would we let this go? We reviewed those things a long time ago and one should observe that because I

noticed that.

MR. FREDETTE: This is one that slipped through the cracks probably with the language that is in that example.

CHAIRMAN BLEY: It is because on the left side, it is really talking about that whole system but over here, it is --

MEMBER SKILLMAN: So Lauren, that was a great explanation. Thank you. I understand what you have communicated.

CHAIRMAN BLEY: I wanted to push a little further into this, though. What did your group do to be able to look at this whole process you were talking all the scenarios laid out? Not just to see how they work if you carry them out but for the AP1000, were you able to convince yourself this was a sufficiently complete set of scenarios that they were exercising what they are going to have to do in the future very well? How did you go with that?

MS. KENT: So again, this occurred during the design certification stage. The staff had -- and I should actually clarify there was an amendment to the AP1000 design certification. So initially, it was approved with Revision 15 of the Design Control

Document, which contained significantly less detail than what we received with the design certification amendment, which included --

CHAIRMAN BLEY: True enough.

MS. KENT: -- DCD or Design Control Document Rev. 19. With Rev. 19 we received scenarios which contained the events that they were going to run for the integrated system validation. Additionally, once the DC amendment process was approved, there were some changes to some of the implementation plans, including some of the scenarios, just up until the time when Westinghouse began to conduct the test.

So we were able to review in detail what those scenarios were going to be and we were able to compare them against our acceptance criteria in NUREG-0711, which tells you, essentially, a general overview of how to select scenarios.

I should clarify that these activities, the V&V activities, test for verification, design verification in ISV are looking at a sample of all of the possible HSIs that could be available in the AP1000 control room. So we need to make sure that we select about enough sample of not only plant events that are going to occur but plant operating states

that are going to be tested in this test because you want to have confidence that you have gotten a large enough sample that is representative and you can translate those results to a conclusion about the overall, the entire AP1000 control room. So that guidance that we have basically says to sample various different plant modes, sample various different plant events. It also contains criteria such as if there are any risk important human actions, this must be tested in the ISV. If there are any deterministically identified human actions, and when I say deterministically identified I mean human actions that are credited in either Chapter 7, which is instrumentation and controls for beyond design basis failures of the Digital I&C system or events credited in Chapter 15 for the transient accident analysis, those must go into the ISV.

So what we observed with Westinghouse I can say several things, without getting into proprietary information. They developed a substantial number of scenarios. So they ran a large quantity of scenarios. They also, their scenarios also included all of the different possible modes of plant operation that are defined in the technical specifications for

the AP1000 and they also satisfied all the guidance, the sampling guidance that we had for NUREG-0711, such as what kinds of events to include in those scenarios.

MEMBER SKILLMAN: One final question. Are security events included in any of these scenarios?

MS. KENT: Meaning exercising the security, perceived security at normal operating times of procedure? I can't speak to details of what the contents of the scenarios are at this session right now. I can tell you that those scenarios are focused on tasks of licensed operators who operate in the main control room must perform.

MEMBER SKILLMAN: I'll touch on that one sometime in the future. Thank you.

MS. KENT: Okay.

MEMBER SKILLMAN: Thanks.

MEMBER MARCH-LEUBA: Changing the topic a little bit, operator training. You obviously don't have licensed operators when you were doing this testing. And going to this example, where I have this screen right here and I am looking for the button and I cannot find it because it is over there. So, how do you handle that?

MS. KENT: So we, again, in NUREG-0711 --

MEMBER MARCH-LEUBA: Yes, but let me -- that is not a deficiency of the software or the control room. It was, obviously, in the training.

MS. KENT: So issues -- so any issue that comes up during the conduct of these scenarios is analyzed to figure out what the cause is. And if it is determined that training is a cause, then you can have an issue where training is an acceptable resolution. So, that could be fed back into the training issues.

MEMBER MARCH-LEUBA: You don't have to modify the control room just because the training is insufficient.

MS. KENT: It might not be the appropriate design solution, no.

MEMBER BALLINGER: But these are all licensed operators that are doing this, right? So they should --

MS. KENT: Just to clarify, so for this process and for any process where you are developing a control room design for a new plant, you may not have operators who have been licensed on that design. So, you could have operators for this ISV that meet other criteria that are found in our guidance document,

NUREG-0711, such as previously licensed operators. Additionally, they have to have met certain training requirements. The guidance says that they need to receive training that is comparable to what the licensed operators of the AP1000 plants will receive.

So in this case, that could be folks who are in the licensed operator training program at Vogtle or somewhere.

MEMBER BALLINGER: But there is a simulator there already.

MS. KENT: There is. I'm going to discuss that process.

MEMBER MARCH-LEUBA: But the licensed operator won't be licensed until three months before the plant operates.

MEMBER BALLINGER: I understand but these are, I suppose, prospective operators, if you want to call them that. And they have, at some point, been through the training, up to some point, on the simulator, which is on-site or somewhere nearby.

MS. KENT: Yes.

MEMBER SUNSERI: So perhaps you mentioned this and I missed it but so what triggers the

inspection? In other words, how do you know when the design is far enough along to where you can actually perform your inspection and test these features that you are describing?

MS. KENT: So I am going to go into more detail in the next couple of slides on how we plan that. I can answer that question now or we can move forward.

MEMBER SUNSERI: If you are going to get to it later, I will wait.

MS. KENT: Okay, thank you. Let's do that.

Okay, let's go to the next slide, please.

This ITAAC is associated with the results of the ISV and whether or not it demonstrated that the AP1000 HFE design is effective. Next slide.

Finally, this our fifth DAC ITAAC, which is associated with issue resolution. And this ITAAC is focused on the satisfactory resolution of issues that are identified during the V&V activities, which include TSV, DV, and ISV. And each of these implementation plans contain the criteria for documenting issues. And these issues are referred to as human engineering discrepancies or HEDs, which is a

term that I will continue to use throughout the discussion today. HEDs are aspects of the design that don't conform to the acceptance criteria in the implementation plans.

For example, for design verification, an HED would result if an HSI didn't meet the HFE standards. For example, if there was a guideline that said alarms that are high priority shall be colored red and should enunciate audibly at certain level of decibels. Well, if they found that it didn't meet that criteria, that would be documented as an HE. Next slide.

Tom discussed this earlier but just, again, to provide an overview, the licensees just complete the ITAAC. In this case, as I said before, the licensees or the COL holders have contracted Westinghouse to complete this design work. The licensees are responsible for completing the ITAAC.

We use inspections to independently verify that the licensee successfully completes the ITAAC. Specifically, we do two types of inspections. We do the vendor inspections and then we also do the ITAAC inspections. We use Inspection Procedure 65001.23 to inspect the DAC ITAAC. We perform the vendor

inspections as the licensee, or in this case, Westinghouse along with the licensee, performs the activities and documents the results.

We also inspect the results summary reports to verify that the ITAAC acceptance criteria are satisfied. So where it says results summary reports, these are the reports, the word report that is mentioned in the acceptance criteria for the ITAAC. These are also called principle closure documents or PCDs when they are submitted to support ITAAC closure by the licensee.

Finally, we review the ITAAC closure notifications or ICNs as part of the verification process when the ITAAC and the associated inspections have been completed. Next slide.

As part of our inspection strategy and Tom spoke to this earlier, we assembled a multidisciplinary inspection team for the vendor inspections and included the following personnel. We had construction inspectors with I&C technical expertise from Region II. We had a simulator engineer and several AP1000 technology instructors with integrated nuclear power plant operating experience, such as prior licensed operators who work with the NRC

at the Technical Training Center.

We also have vendor inspectors with I&C technical expertise from the Office New Reactors here at headquarters. And we also had HFE technical reviewers and operator licensing examiners with prior experience working in operations or ops training at operating reactors.

Additionally, for the ITAAC inspections, HFE technical reviewers from headquarters assist the Region II construction inspectors to perform those inspectors.

Next slide.

As part of our inspection planning process and, again, we talked about this earlier, we developed detailed inspection plans based on the requirements in our inspection procedure. We conduct routine inspection planning meetings with the licensees and the vendor to determine when the inspections should be scheduled so that we can optimize our observation opportunities.

So, to answer your question, sir, we receive information from the licensees that may say we are ready to perform this activity. And we develop a plan and a schedule so that we can go to observe that

activity.

Activities --

MEMBER MARCH-LEUBA: Did they run it before you showed up or are they repeating it for you?

MS. KENT: No, they -- we observed the activity as it was conducted.

MEMBER MARCH-LEUBA: The initial one?

MS. KENT: Correct.

MEMBER MARCH-LEUBA: That's good.

MS. KENT: Activities related to the integrated system validation commenced in October 2014 and activities associated with HED resolution are not expected to be complete until May 2018 at the earliest.

And I need to clarify this bullet point here. Westinghouse has completed the ISV. The ISV was run from January 2015 to March of 2015. The ISV is over.

Now, they are in the stage of identifying issue resolution plans and implementing those plans into the design and those resolutions will need to be retested in subsequent tests in accordance with their approved implementation plans.

We use inspection reports to document our

conclusions relatively soon after the inspection. We do this because, as you can see, we started these activities and these inspections a couple of years ago. They are still not complete. And so it is important to us, as the inspection team, to document our observations and our conclusions as we go, rather than trying to do that at the end in an ITAAC inspection, which would be several years after the work was completed.

Also, we use the results from our inspection reports to provide input into our future inspection plans that we developed. Next slide, please.

This slide shows the status of our inspection activities. As I said at the beginning, based on our inspections to date, Westinghouse is conducting the activities in accordance with the approved implementation plans. So far, we have completed two vendor inspections at the Westinghouse facility in Cranberry, Pennsylvania, and one ITAAC inspection. We are also currently in progress of conducting another ITAAC inspection at this time.

Vendor Inspection 1 commenced in October 2014 and ended in February of 2016. The scope that

inspection included verification that the ISV prerequisite activities were satisfactorily completed. We assessed the results, as they were available, of design verification and test support verification. We also assessed Westinghouse's implementation of their ISV procedures and we also evaluated the ISV results.

Vendor Inspection 2 occurred in October 2016 and during this inspection, we looked at the work that had been done so far to develop issue resolution plans.

At the same time, we conducted ITAAC Inspection 1 in October of 2016, which was focused on verifying the successful completion of Task Support Verification ITAAC. And we are in the process of conducting an inspection for the Design Verification ITAAC and the ISV ITAAC that is associated with the performance of the ITAAC and the scenarios that were run.

We plan to conduct additional vendor and ITAAC inspections for the ITAAC related to the ISV demonstrating each HFE design effectiveness and also issue resolution. Next slide, please.

We started our inspections at Westinghouse in October of 2014 to confirm that Westinghouse is

ready to perform the ISV. We reviewed the results of tests that were conducted to verify that the simulator was going to be able to run the ISV scenarios such that it would adequately represent or portray the AP1000 plant systems and how they respond during operations.

We also confirmed that the ISV facility conformed to HFE design guidelines that were documented in the AP1000 style guide and also we observed a pilot ISV test scenario.

Next slide, please.

We returned to Westinghouse for several weeks of inspections, starting in January of 2015 and we observed the simulator performance during the test trials. We observed how Westinghouse implemented its test procedures. We also observed their methods for collecting and evaluating the data from the test trials.

We also reviewed Westinghouse's scenario guides. I spoke about this earlier. The scenario guides list each plant event and the expected plant response and the operator actions in each scenario that are expected.

We also observed the observer guides,

which were used by Westinghouse test app to collect data during the trial.

In April of 2015, we returned and we had discussions with Westinghouse personnel about some of the observations that we had related to simulator fidelity to the AP1000 plant systems, as well as its performance during ISV test trials.

And finally, December 2015 through January of 2016, we reviewed the results of the task support verification, design verification, and the ISV, as well as how Westinghouse had analyzed the results and documented the results.

Next slide, please.

In summary, we did not have any inspection findings. We did document several observations in the inspection report, which we would like to discuss now.

So one of the observations was that in some cases, issues identified during simulator factory acceptance testing, which was part of the testing done to demonstrate the simulator readiness for the ISV, some of these issues were mischaracterized and that could have allowed those issues to be inappropriately deferred for resolution until after the ISV. So specifically, one specific example was an issue

related to the log control system. The staff evaluated the test results and found that Westinghouse had decided to defer this issue for resolution until after ISV. The justification for the deferral was that if it occurred during the ISV, it wouldn't have an impact on running the scenarios and they would not have to freeze the simulator or take any action that would violate the implementation plan or the procedures approved in the implementation plan.

Unfortunately, that was not allowed by the implementation plan and so the inspectors addressed that with Westinghouse. Westinghouse took action to correct that, which during ISV we observed that the issue did not prevent them from running of those scenarios and they were also able to conform to all the requirements of their test procedures and their test plan. So, we found that that issue was resolved.

The second issue, during pilot testing, Westinghouse's ISV observers appeared to be more focused on operator performance, rather than on evaluating effectiveness of the integrated HSI design.

We discussed this with Westinghouse staff. Westinghouse took action to correct this. Specifically, they held additional training for their

observers prior to actually conducting the ISV to make sure that everyone understood exactly what they needed to be looking for. And during the actual ISV, we observed that the ISV test observers were much more intrusive, which is a good thing. In this case, they were able to observe effectively and to make critical comments related to HFE design effectiveness.

Finally, there were three issues in the simulator models which our inspectors observed that needed to be evaluated for potential effects on simulator fidelity. So, in summary, we observed that the operators were able to interact with the HSI as it was scripted in ISV scenarios and these issues did not impact the ability to run the scenarios as they were scripted.

CHAIRMAN BLEY: No, stay on this one a second. I have a couple of questions on this one.

I think you already some of these. I know this was at Cranberry where they did all this.

MS. KENT: Yes.

CHAIRMAN BLEY: I know up there they had operators from many potential places as they developed the simulator and revised it for American use, as opposed to Japanese use. We had pretty good

presentations on that a couple of years ago. For these tests, were these all Vogtle operators?

MS. KENT: No. During ISV, there were crews that were provided to run several trials in each scenario. The crews contained personnel from both of the licensed sites.

CHAIRMAN BLEY: Okay.

MS. KENT: So, Vogtle personnel and Southern.

CHAIRMAN BLEY: Okay.

MS. KENT: Or excuse me -- thank you. Summer personnel.

CHAIRMAN BLEY: Summer, yes.

Then I hinted at this earlier but let me be more specific. As you reviewed these, you looked at all the scenarios and decided that they were sufficient. You identified some problems, possibly, with the simulator. So you had on your team the expertise I am looking for but how did you ensure you had the expertise familiar with the AP1000, its systems in detail and its performance? What kind of people were on the team to give you that expertise? It sounds like they must have been there.

MS. KENT: There was. So at the TTC, we

have an AP1000 simulator. We also have AP1000 instructors who train NRC staff who are going to be inspectors at the AP1000 sites. So, they have been trained on the AP1000. Again, they also developed the simulator. One of them was our TTC simulator engineer. So, he was very familiar with the simulator models and how they had been applied at the TTC. So, he was essentially comparing the model at the NRC to the Westinghouse engineering development simulator model.

CHAIRMAN BLEY: Okay, so they had their own. TTC is the Tennessee facility?

MS. KENT: That's right, yes.

CHAIRMAN BLEY: I didn't realize you actually had a simulator down there. It is the real AP1000 simulator or is it a pseudo simulator?

MS. KENT: It is a simulator that simulates the staff's knowledge of the AP1000 plant systems. Westinghouse --

CHAIRMAN BLEY: But it is not the exact board setup like they have for their other simulators that are --

MS. KENT: No, it models, essentially, the AP1000 system.

CHAIRMAN BLEY: Okay.

MS. KENT: I will tell you that it was not delivered by Westinghouse.

CHAIRMAN BLEY: Okay.

MS. KENT: It was developed by staff.

MEMBER STETKAR: Let me try something. I think Dennis has been trying to allude to it and we have had a couple of other questions. Did you have on your team anyone who was familiar with the Westinghouse AP1000 PRA, yes or no?

MS. KENT: To my knowledge, I would have to say we did not have any PRA staff, correct.

MEMBER STETKAR: Then, when you essentially concluded that the breadth and depth of the scenarios that were selected for the validation were adequate, how did you have confidence that, indeed, the breadth and depth of those scenarios challenged the plant and the simulator under a spectrum of anywhere from normal operations through fairly extreme events? Because you need the knowledge of both the PRA and the plant to be able to gather confidence that those scenarios are appropriately challenging.

MS. KENT: Yes, the risk-important human

actions identified in the AP1000 PRA are required to be included in all of the scenarios. So those conditions must be simulated in the ISV.

CHAIRMAN BLEY: I want to stop there because I didn't get to it yet.

MEMBER STETKAR: I'm sorry. I didn't realize how fast you were trying to get there.

CHAIRMAN BLEY: At the time we reviewed the AP1000 design, they had a design cert PRA that had a very abbreviated human factors analysis because they didn't have the actual procedures that would be used and they didn't have trained operators, even to the extent of training that they have up at Cranberry now. So at some point in the future and before fuel load, they were to make that more real, at which point I would have hoped those scenarios that included a realistic human factors analysis built into the PRA would have -- would make their way into this process.

Do you know if -- well, it sounds like you relied on Westinghouse for brining information from the PRA. Do you know if they had revised their PRA to include the actual procedures and control room design that is in place now?

MS. KENT: I would have to go back and

look at the revision or the PRA that was the basis for the scenario development.

CHAIRMAN BLEY: So you didn't chase this at all to say is this --

MS. KENT: I personally, no, as part of the inspection team, did not go look at what version was used.

CHAIRMAN BLEY: I would be interested in that.

MEMBER STETKAR: One of the things I think when -- my recollection is as I was looking at some of my notes here is that we pressed pretty hard a few years ago on the fidelity of those scenarios that were used in this validation and I think that is a little bit the source of our questions in terms of -- now I realize you can't discuss details of the scenarios, I guess, in this open meeting so that we can have some confidence about what they were, but that was one of our concerns all along that this process, of necessity, relies an awful lot on the fidelity of those scenarios to actually challenge not so much the people but how the people interact with the machine under conditions that could not necessarily be expected from somebody who just wants to look at

displays and things like that.

So, as Dennis said, I think we would be really interested to kind of follow on on that a little bit.

MS. KENT: We can look into that and provide you that information.

MEMBER KIRCHNER: Can I ask you to elaborate on the third bullet, which I find interesting because do you know it is a problem in the simulator fidelity or is it a problem in the design of the control system that is going to be implemented in the reactor?

MS. KENT: Well, that is a possibility, which is why Westinghouse took the action we confirmed to investigate what was happening here.

I can tell you that this here, the member of our inspection team was specifically looking at simulator models. So the simulator models are, of course, based on design data supplied by -- developed by Westinghouse. So in this case, these issues would be related to the scope of the simulation.

But you do bring up a good point.

MEMBER KIRCHNER: It seems to me one of the values of the simulator is beyond training crews

and such is to, in advance of finalizing the design of the control room, look for problems that may exist or scenarios that may occur that the control room as currently thought isn't going to give you the proper signal, so to speak, or interface with the operator.

The purpose of the ISV, as we characterize it in our guidance is not to flesh out final plant design issues. Its purpose is to validate HFE design effectiveness.

However, when you have very sophisticated simulators, which we have in this case, that are integrating actual plant software with a simulated plant model, those types of issues may be revealed in the process.

CHAIRMAN BLEY: When do they get resolved if they don't get resolved at the ISV stage?

MS. KENT: The design issues?

CHAIRMAN BLEY: Yes.

MS. KENT: The design issues, well the issues, as we have seen all of the issues -- in general, Westinghouse has been very thorough at documenting and characterizing issues. Any type of design issue goes into their design configuration process. So, there are several processes that they

use to manage issues. Simulator modeling issues would go into a separate process from an actual design issue. Design process, the corrective action program --

CHAIRMAN BLEY: I asked the question wrong.

Is there anywhere in the DAC inspection of the HFE chapter where the NRC looks at simulator fidelity issues?

MS. KENT: Simulator fidelity issues?

CHAIRMAN BLEY: Yes.

MS. KENT: So simulator fidelity is inspected by the regions, essentially, as part of the operator training and licensing -- operator licensing exam process.

CHAIRMAN BLEY: So that doesn't happen until just before well maybe a year before, a fuel load kind of thing.

MS. KENT: By regulation. There are regulations that say when there are certain milestones. But in this case, that inspection has already occurred at both facilities.

CHAIRMAN BLEY: Oh, it has?

MS. KENT: Yes.

CHAIRMAN BLEY: Okay. But that is not part of DAC. That is part of ITAAC?

MS. KENT: It is not ITAAC.

MR. FREDETTE: That is the inspection program for operator licensing, Dennis.

CHAIRMAN BLEY: Oh, simulator fidelity is under the operator licensing inspection?

MS. KENT: Simulator fidelity is evaluated as part of Inspection Procedure 71111. It is also considered as part of our operational readiness program and it has to be done, it is required to be done, yes, before any license examination is given. It is evaluated by the, in this case, the Region II staff.

CHAIRMAN BLEY: And that is already done for both of these plants. Is that what you are saying?

MS. KENT: The initial one. The initial one, yes. It also occurs on a biennial basis.

CHAIRMAN BLEY: All throughout this process, even after operations?

MS. KENT: Well, into operations.

MEMBER RAY: It is an ongoing.

CHAIRMAN BLEY: It is ongoing and it is

under 71111. Okay, thank you.

MR. FREDETTE: 71111 is baseline inspection procedure for operating plants.

CHAIRMAN BLEY: So it is everything.

MS. KENT: This applies to both new and operating, yes, that is correct.

CHAIRMAN BLEY: Go ahead.

MS. KENT: And it is 71111.11. So, a lot of elevens in there.

CHAIRMAN BLEY: Is this a joke?

MS. KENT: It's not.

MEMBER RAY: I don't know if this is a question time but it is a pause, so I will ask a question.

MR. KELLUM: Excuse me. Can I address that just a second?

CHAIRMAN BLEY: Please, Jim, yes. Go ahead. Identify yourself and your organization.

MR. KELLUM: My name is Jim Kellum. I'm in the Operating Licensing Branch with Lauren. I am on the operator licensing side.

CHAIRMAN BLEY: Thank you.

MR. KELLUM: I was part of the ISV inspection team and actually I think I am probably the

first NRC AP1000 examiner, the first one that was done.

So what that -- the only reason I say that is because I was on the ISV team and someone had asked if we did the -- you know what background we had when we did that.

Now, as far as for the simulator inspection, that is done -- I was also part of that team. That is Inspection Procedure 41502 and that procedure is partially complete. We were able to do a portion of that, which we did. And as Lauren had stated, the reason we did that is before we do operator exams, they have to be done on a plant referenced simulator or a Commission-approved simulator. So Inspection Procedure 41502 verifies that that is part of that verification for a plant referenced simulator, which it was determined they did not have. So we then went the route of a Commission-approved simulator.

So, it is partially done. It is not complete. It will be completed down the road. It has to be done, obviously, before they get their 103(g) finding.

CHAIRMAN BLEY: Thank you very much. I

appreciate that.

Harold?

MEMBER RAY: We, at least I, somehow evolved into a situation where we seem to have merged DAC and ITAAC, the page titles very often do that, for example. Could you briefly just separate those for me for a second and tell me how you see DAC separately from ITAAC, if you do at all? This may be an area where they aren't separable. I don't know.

MS. KENT: The Design Acceptance Criteria are the actual procedures or the methods that we use at the design certification stage to make a safety finding, in lieu of the detailed design information.

We use ITAAC to track or to verify the completion or, essentially in this case, that the DAC have been performed as they were approved.

MEMBER RAY: So if I heard that last statement correctly, ITAAC demonstrates that DAC have been complied with or met.

MS. KENT: That's correct.

MEMBER RAY: In a sense, it is design acceptance.

CHAIRMAN BLEY: Not to be argumentative, but the definitional things we have always had in the

past are the DAC, Design Acceptance Criteria, are a special form of ITAAC.

MR. FREDETTE: Or a subset.

CHAIRMAN BLEY: A subset of ITAAC, yes.

MEMBER RAY: I guess I always thought --

CHAIRMAN BLEY: But they are, themselves, ITAAC. I'm sorry, go ahead.

MEMBER RAY: No, it's all right. I guess I always thought of them as stuff that you would include in the design certification if you could.

CHAIRMAN BLEY: If you could, yes.

MEMBER RAY: Yes, but ITAAC I always thought of as the application of what your design certification requires. So, I separated them that way, rather than have DAC as a subset of ITAAC. I don't want to dwell on it. It is just something that --

CHAIRMAN BLEY: I would only change one phrase you said. I would say if you would, rather than if you could. We have gotten into some arguments about that.

MEMBER RAY: Okay. Well, this is pretty esoteric but, again, I find it relevant going forward how we do AP1000. We will do it however we do it and

that's fine. But I'm just trying to understand our system because we need to be able to apply it at future points.

MR. FREDETTE: And a helpful tool in some of the DCDs, ESBWR comes to mind, is that they have identified which of those ITAAC are, in fact, design acceptance criteria. They will be labeled as such.

In the AP1000, they did label some of them. They did not label the ones for HFE. We have sort of discovered that they were design acceptance criteria through discussions with Westinghouse and discussions with the licensee.

CHAIRMAN BLEY: Yes, and I think some of the more recent design certs have kind of buried some of the DAC as ITAAC in other areas as well.

MR. FREDETTE: Yes, they haven't come onto our radar screen yet.

CHAIRMAN BLEY: They will be in the I&C are, I'm sure.

MR. FREDETTE: I can't wait.

CHAIRMAN BLEY: We have sort of a rule here, if nobody is saying anything, take off and try to finish.

MS. KENT: Thank you.

So essentially, Westinghouse documented these issues to assess what corrective actions needed to be taken. Overall, I will say that all of the scenarios that the simulator ran, all of the scenarios as scripted. Additionally, these particular issues that our staff observed in the simulator models were not also found by the actual licensees, who also have these simulation facilities at their sites and performed performance testing on them. And that performance testing was inspected by a Region II staff and they also didn't identify these issues.

So while we do expect to circle back on resolution of the issue, it did not impact the ability to run these test trials.

Next slide, please.

CHAIRMAN BLEY: Can I interrupt just a second? A question for Tom. I looked through the slides. It appears to me the piping DAC aren't going to take as much time as --

MR. FREDETTE: I anticipate that they would not take as much time.

CHAIRMAN BLEY: Because we are --

MR. FREDETTE: Lauren had a lot of information to share with you all this morning.

CHAIRMAN BLEY: Yes, and we appreciate it. We are running behind but I would like her to -- I would like you to go ahead and finish because I think this is important information for us and maybe a more -- I don't want say controversial but a more interesting --

MR. FREDETTE: If I had it to do all over again, I might have flipped topics and done the piping first and then gone to HFE.

MEMBER SKILLMAN: Could we go back one slide, please to 21?

Lauren in the last bullet, what documented these -- and you identified the word corrective issues. Is this work all being done under Appendix B of 10 CFR 50?

MS. KENT: The work associated with the HFE design for the control room does fall under a purview of our inspection procedures for Appendix B. It is a vendor inspection. So any quality control issues that are incorporated into the contract, Westinghouse needs to adhere to them in inspection space. And if not, then that would be a nonconformance issue.

Does that answer your question?

MEMBER SKILLMAN: For now, yes. Thank you. Thank you.

MS. KENT: During the vendor inspection, we concluded that task support verification, design verification, work performed in accordance with their implementation procedures by reviewing the result summary reports. And we also sampled some HSIs that were in the actual ISV facility to determine whether it conformed to the mandatory human factors engineering guidelines in the Style Guide.

Next slide, please.

With respect to the ISV, we concluded that the ISV activities were found to conform to requirements of the implementation plans as well. This included the prerequisite activities that Westinghouse performed prior to ISV, the scenario design and execution of the scenarios, the participant selection and training, the simulator performance during the ISV test trials, the ISV team performance, which would include the observers who were grading the ISV test personnel, as well as Westinghouse's analysis methods including their identification of HEDs.

Next slide, please.

The V&V activities did demonstrate that

there are some issues with the AP1000 control room design that need to be resolved. Westinghouse identified some human engineering discrepancies during test support and design verification which were relatively few, when compared to the large number of HSIs that were sampled for those activities. And they were also determined to be of lower priority than HEDs that were identified during the ISV.

HEDs identified during ISV ranted from a single significant problem, such as a failure to meet one of the pass/fail criteria in the scenario guide or HEDs that documented the impact of multiple individual issues that contributed to a more significant overall problem.

The HED spanned various HSI resources and plant systems. Next slide, please.

Specifically, we did observe that there were several significant HEDs related to the Alarm Presentation System. There were also several scenarios that did not meet the pass/fail criteria for passing the scenario that was contained in the improved implementation plan. Westinghouse documented these issues and identified them. We also verified that all of the HEDs are being tracked for resolution

in their formal tracking system.

Also, the resolutions that are developed to resolve these issues will need to be retested in accordance with the requirements in the ISV and issue resolution implementation plan.

MEMBER MARCH-LEUBA: Was your conclusion then what they want to do is reprogram the Alarm Presentation System or what do they want to do?

MS. KENT: So without getting into --

MEMBER MARCH-LEUBA: Proprietary.

MS. KENT: -- proprietary information, I can tell you that we were able to, at the end of last year at our second vendor inspection, look at some of the work that had already been done to resolve those issues, as well as look at plans for going forward with work that still needed to be done and we determined that it was adequate at this point.

And it will also have to pass the retest requirements.

MEMBER MARCH-LEUBA: At this point in the design, it is always preferable to improve the design instead of making the operators have another chapter on training. I hope that is what they are undertaking.

MS. KENT: We did determine that the resolutions were appropriate.

MEMBER MARCH-LEUBA: Okay.

MEMBER KIRCHNER: May I? I know this may be proprietary --

MS. KENT: At this point, at the point at which we looked at them they were appropriate. Excuse me.

MEMBER KIRCHNER: This goes back to my earlier question, though. Will this result in a change to the design of the control room?

MS. KENT: Again, I have to be careful about what kind of information --

MEMBER KIRCHNER: Sure.

MS. KENT: -- I can say at this point.

MEMBER KIRCHNER: I mean I would expect that, in going through this exercise, that you would learn and improve the system, which is clearly still developmental because it is going to be state-of-the-art.

MS. KENT: Well, the point at which they said this is our design, it is ready for validation testing, the testing showed that there need to be some improvements.

CHAIRMAN BLEY: I'll just throw two things out. We did have -- I forget when we had that meeting but we had a meeting with some of the consultants to Westinghouse, who went through the process as they brought the simulator from Japan and they first tried to transliterate and use essentially the same procedures. And that didn't work with all operators. Eventually, they had to revise a lot of the way things were displayed and the way --

MEMBER STETKAR: Read the script, remembering US-APWR.

CHAIRMAN BLEY: It is possible.

MEMBER STETKAR: Because there were a lot of issues on that on US-APWR.

MS. KENT: APWR they did have a U.S. test facility.

MEMBER STETKAR: They did but they had to translate the stuff over.

MS. KENT: Yes.

CHAIRMAN BLEY: Well, there you go.

MEMBER STETKAR: I'm not so sure --

CHAIRMAN BLEY: Anyway, these people had to do something similar because I know some of them who were involved. So, we didn't have the session on

that.

But for these things we want to dig into, we can have another time when we can talk about things that are proprietary. It is not in this meeting. We can't do it.

MS. KENT: Yes, absolutely. Okay, let's -- oh, here we are.

So, we encountered an issue during -- over the course of our -- or that occurred as we were conducting these inspections that demonstrated how deferring completion of an aspect of the design to the licensee can negatively impact operating schedules. So, facility licensees need either a physical plant, a plant-referenced simulator or a PRS, or a Commission-approved simulation facility, which is called a CAS, to administer operator licensing exams.

Licensed operators are necessary to support fuel load and they are also relied upon to participate in preoperational testing and startup testing that occurs prior to fuel load.

A plant-referenced simulator models the systems of the reference, with which the operator interfaces in the control room, including operating consoles and it also permits use of the reference

plant's procedures.

If the control room design is still being developed, then the control room of the reference plant is not complete and, thus, a simulator cannot fully or completely model the operator interfaces in the control room.

Accordingly, SCE&G and Southern Nuclear submitted requests for Commission approval of their AP1000 simulation facilities at their sites in January and September of 2015, respectively.

Next slide, please.

Requirements for Commission approval of simulation facility are contained in 55.46(b) and, ultimately, the staff must find that the simulation facility and its proposed use are suitable for a conduct of operating tests. As part of our review, we evaluated whether the HEDs that were identified during the ISV affected the suitability of the simulation facility for operating tests.

We received the results of the ISV and, of course, we had completed our observations and inspections around the same time as we were doing this simulation facility review. We interacted with the licensees significantly during this review. We used

the RAI process or the request for additional information process and also conducted an audit in order to aid in our evaluation.

Licensees worked with Westinghouse and resolved issues that prevented the simulators from being suitable for conducting operating tests. These activities contributed significantly to the review time and it also resulted in rescheduling the operator licensing exams at both sites.

Next slide, please.

Ultimately, we found that the simulation facilities were suitable for the conduct of operating tests, as well as for performing the control manipulations that are required to meet operator experience requirements for the operator licenses. Notably, we documented this. We did document this in a Safety Evaluation. There is one for the Vogtle simulation facility as well as one for the facilities at V.C. Summer.

CHAIRMAN BLEY: And when you say ultimately, that means after successful resolution of whatever you call them, HFDs, human engineering discrepancies?

MS. KENT: So after we were satisfied that

the simulators were suitable for operating tests, even with the fact that some of the HEDs were still in the HED resolution process, some of those issues we discussed with the licensee were not, could not exist or could not occur during an operator licensing exam, therefore, rendering the facility not suitable for operating tests. So, Westinghouse and licensees worked together to resolve those issues.

We also relied on -- well, let me back up here.

The licensees demonstrated fidelity of the simulation facilities to the AP1000 predicted plant system performance and we also relied on scenario-based testing methodology, as well as our exam validation process to provide additional assurance that any exams administered on these simulation facilities would meet our examiner standards in NUREG-1021.

The first operator licensing exam was administered at Vogtle in July of 2016 and at V.C. Summer in September of 2016.

Next slide, please.

So moving forward in October of 2016, we returned to Westinghouse for Vendor Inspection 2. At

this point in time, we reviewed the ISV results summary report to determine whether the issues were appropriately prioritized -- and when I say issues I mean HEDs were appropriately prioritized and that they were tracked in the formal tracking system.

We also reviewed the resolution plans that had been developed at that point in time for the issues and we also reviewed justifications for any issues that will remain as is in the final design.

In summary, we did not have any inspection findings, nor did we document any observations in the Inspection Report.

On the next slide, we will discuss our conclusions.

We found that the HEDs were appropriately prioritized in accordance with the criteria and the approved implementation plan. We determined that justifications for HEDs to remain as is were appropriate and had appropriate justification.

We also confirmed that all HEDs were being tracked and we concluded that Westinghouse had performed a thorough cumulative effects analysis as an input to the HED resolution process. And this is important because a cumulative effects analysis is

going to look at multiple issues, how they affect an HSI and determine whether the issue resolution for that needs to look at the system or the HSI in a more holistic manner, rather than addressing on a case-by-case basis.

Next slide, please. So this slide kind of talks about where we are right now in time with the process, with the inspection and where Westinghouse is. They are in the process of finalizing the resolution plans. They are going to need to develop retest plans and we also plan to inspect that those retest requirements have been implemented in accordance with the criteria that we have previously approved and that the resolutions are, indeed, appropriate.

Next slide, please.

At the same time that we did the second Vendor Inspection, we also had staff from Region II join us and perform the ITAAC inspection. That allowed our vendor inspector team to work with the construction inspector to perform her ITAAC inspection. There were no findings and, ultimately, we did verify that the information in the task support verification result summary report supported the ITAAC

closure.

Next slide, please.

In February of this year we commenced ITAAC Inspection 2 and that inspection is looking at the Design Verification ITAAC and the ISV implementation ITAAC and that is still in progress.

Next slide.

We plan to perform additional inspections once the HED resolutions have been fully developed and the retests have been scheduled. So we plan to observe some of those retests as well, as part of our inspection activities.

Finally, when Westinghouse completes the issue resolution report, then we will inspect that report to verify that the issues have been addressed adequately in the final design.

Next slide.

I would like to talk now a little bit about the takeaways or the lessons that the staff has learned over the last couple of years as we have implemented this process. As Tom said earlier, this is the first time that we have implemented our HFE ITAAC procedures.

I will say that the inspection procedure

itself, it was written by staff that had experience reviewing the AP1000 Design Control Document, including the implementation plan. So, they were familiar with what the requirements were in those plans and, overall, that inspection procedure has worked well for us.

To begin with, having a -- we have validation of something that we already knew at the outset, which was that having a multidisciplinary team is essential to evaluating all of the aspects of this complex design process.

Additionally, we have learned that we need to evaluate whether we need to develop specific criteria for simulators that are used for the engineering design development process.

Also, we have seen that the use of DAC in the HFE area can cause delays for activities as the licensee prepares to construct and operate a facility.

We have also observed that the ISV may reveal plant system design issues, as well as HFE design issues.

Next slide.

MEMBER SKILLMAN: Lauren?

MS. KENT: Yes.

MEMBER SKILLMAN: On the next to the last bullet, one takeaway is use of DAC and HFE can be a problem because it can introduce a delay. Another way to look at that is because of the thoroughness of this process, the scheduling must accommodate some time to ensure a remediation event when failures are discovered. And so I just challenge whether or not this really is an operational readiness delay or a failure in proper scheduling to accommodate what might be hits that you know are out there and you have got to make accommodate for those potential hits. If they don't come, you can shorten up but if you fail to include them in scheduling, that safety net, then shame on you.

That is a scheduling issue. It gets to work management and having, if you will, the clairvoyance to know hey this can be out there. Let's be ready for it.

MS. KENT: This process definitely presents a --

MEMBER SKILLMAN: Challenge.

MS. KENT: -- scheduling challenge.

MEMBER SKILLMAN: A real challenge. Okay, thank you.

MR. FREDETTE: That kind of things manifests itself in the development of the Digital I&C systems also. It's the same kind of thing because you have a lot of testing that has to happen there, a lot of remediation testing that may take place. That has to be built in this schedule also.

MEMBER SKILLMAN: Yes, thank you. That is exactly what I am trying to say. Thank you.

MS. KENT: Okay, moving on, let's go to the next slide, please.

The vendor inspections provided opportunities for us to develop reasonable assurance as we went through this process, based on direct observations that the HFE design activities were being performed in accordance with the previously approved implementation plans.

So the results of our vendor inspections were inputs that provide assurance when we do the ITAAC inspections. They provide the assurance that Westinghouse did, indeed, fulfill its design commitments.

We also observed that the inspection resources that we do have are inspectors' time and other resources need to focus on the ISV because it is

the activity that most demonstrates the adequacy of the plant, HFE design, since it is a performance-based test. It brings all aspects of the system together.

Additionally, as Mr. Skillman pointed out on one of the first slides, some of the terminology in the ITAAC can create problems when performing ITAAC inspections. So you might be trying to complete an ITAAC inspection looking at the acceptance criteria and wondering well what does the word addressed mean here and what is a human deficiency. And that creates delays when you are trying to complete your inspections.

One thing I can say here is that we -- since this ITAAC was developed for AP1000, the staff has developed a recommendation that two standardized ITAAC be developed for HFE. One would be related to the ISV performance and another would be related to confirming that the as-built control room conforms to or essentially is the same as the control room design that was validated through the ISV. So that is what we have recommended going forward to help eliminate those types of issues.

Next slide, please.

So while at this point I can say that we

have confidence based on our inspections to date that Westinghouse is meeting its design commitments in accordance with the DAC, we have confidence that the issues have been appropriately and thoroughly identified and are in the process of being resolved, the resolutions of those issues need to be retested successfully in order to demonstrate that the AP1000 control room design reflects the state-of-the-art human factors principles and we will conduct additional inspections to verify this.

CHAIRMAN BLEY: Now, we have inspection requirements. We also have these plans you developed and you have a bunch of lessons learned that are really important. How are we going to memorialize these lessons learned to make sure that in ten years we haven't lost track of what we have learned in this process?

MS. KENT: Well, let's go back. Could we go back to slide 25, please? Thank you.

With respect to the first bullet here, the multidisciplinary team, that guidance is written in our inspection procedure. Again, as I said, this was more of -- I struggled with how to characterize these bullets here as are they lessons learned, are they

takeaways. Some of them are, indeed, things that we need to circle back on to improve our process. Some of these are validation of things that we already knew or already had documented.

With respect to the second bullet, some of our guidance in NUREG-0711, it does provide criteria for validation test beds or simulators that are used to perform the ISV. It also contains a statement that did result in some confusion among the inspection staff that a simulator that meets the criteria in ANSI Standard 3.5 is a way to comply with this criteria.

ANSI 3.5 is a American nuclear standard for simulators that are used in operator licensing and operating training process. And it assumes that you have a reference plant, that you can compare simulators, ability to model plant system response, as well as its control room configuration, too. That is not entirely appropriate for this application, for a new reactor as it is trying to build what the AP1000 -- or trying to determine what the AP1000 control room design is going to look like.

So that was something that we identified as could be improved in our guidance document. And we periodically review our guidance documents and provide

our feedback to Office of Research, who is responsible for maintaining those documents.

With respect to the third bullet --

CHAIRMAN BLEY: I'm sorry. In many areas we track around the NRC, there is routine updating processes, sometimes sit for years and years before they happen. You have got some new knowledge here in a new process. It seems this is a time to --

MR. FREDETTE: Well, your question is how are we going to memorialize this or archive it somewhere --

CHAIRMAN BLEY: Exactly.

MR. FREDETTE: -- where it can be used for future generations.

CHAIRMAN BLEY: Because after hearing there are people who still think this ought to be much easier to do.

MR. FREDETTE: Well ultimately, the working group is responsible for making sure that that happens, Dennis.

CHAIRMAN BLEY: Have you got the schedule?

MR. FREDETTE: The natural place for it is in the inspection procedures.

CHAIRMAN BLEY: Yes.

MR. FREDETTE: I'm not saying we are always going to do that but there are some things, some lessons learned that have already been incorporated from previous work that we have done. An example is this first bullet here.

CHAIRMAN BLEY: I understand you spent a lot of time before you had these inspection procedures --

MR. FREDETTE: In the early days, we though an HFE inspection team would be a couple of inspectors and maybe one subject matter expert. Well now we have got simulator experts, operator licensing experts, operating examiners, Digital I&C personnel, and human factors subject matter experts. So, it is more than just a three-person --

CHAIRMAN BLEY: Is that kind of detail in the procedure?

MR. FREDETTE: Not yet.

CHAIRMAN BLEY: Yes, I didn't think so.

MR. FREDETTE: But it will be.

CHAIRMAN BLEY: Okay. Okay, that is something we really want to see happen. I mean we are in this to get convinced this is working well. I like what I have seen so far but until it is memorialized,

it could go away.

I think at this point, I am going to need to call our break for 15 minutes.

MEMBER SKILLMAN: Let me just add to what you have said.

CHAIRMAN BLEY: Yes.

MEMBER SKILLMAN: Lauren and Thomas, on slide 17 I thought you captured what Dr. Bley was trying to point to. You identified results from inspection reports providing input and I would say to inform subsequent plans. If you are using that as your feedback and it is catching up to what Dennis is talking to -- about and it is keeping your documentation current --

MS. KENT: Certainly, we go back and look at previous results in these inspections as input to inspection planning but that is for the scope of that inspection for that licensee. Going forward to generically apply it, we would need to look at the IP.

MEMBER SKILLMAN: Okay, thank you.

MS. KENT: And I appreciate your comments.

CHAIRMAN BLEY: Okay, we are in recess for 15 minutes. Come back at 10:45 and we will talk about pipes.

(Whereupon, the above-entitled matter went off the record at 10:31 a.m. and resumed at 10:46 a.m.)

CHAIRMAN BLEY: We are back in session and ready to shift gears here. Who is up?

MR. FREDETTE: Yes, Dennis, just by way of introduction, similar to having Lauren Kent present for HFE this morning, Tim Steadham and Katie McCurry, they are the core regional inspectors. They are augmented by Mr. Jonathan Lizardi, sitting there in the corner. He is the pipe support expert who was part of the inspection team and Mr. Alexander Tsirigotis, who is the piping design technical staff subject matter expert supporting these inspections.

CHAIRMAN BLEY: Okay.

MR. FREDETTE: So, they are all here today to help answer any questions.

CHAIRMAN BLEY: Our structures guy couldn't be here but he is on the phone. Pete Riccardella is listening in and may have some questions for you.

MR. FREDETTE: So with that, I want to turn it over to Tim. Tim was the lead inspector and he will be the lead inspector going forward, barring

resource alignment and stuff like that.

CHAIRMAN BLEY: That would never happen.

MR. FREDETTE: Tim, take it away.

MR. STEADHAM: All right, well thank you.

I guess we will move to the objectives. As Tom said, I am Tim Steadham. I'm the seam construction inspector in Region II Office.

MS. MCCURRY: I'm Katie McCurry, also Region II, the mechanical inspector.

MR. STEADHAM: We are in the Mechanical I guess slash Electrical Branch now. We have kind of consolidated and we kind of own this particular ITAAC.

So the objectives that I want to talk about are just an overview of the Piping Design and Pipe Rupture Hazards Analysis DAC; the overview of the Piping and PRHA DAC inspections, which includes the approach that we use, the plan that was briefly discussed earlier, some of the inspection results that we had. Similar to Lauren's presentation, we will have some discussion of insights and lessons learned. And just an overview of future inspections, where we have been now and where we see ourselves going in the future.

CHAIRMAN BLEY: I don't know if it is

appropriate now. You might want to put this off. Are there any significant differences in the way you approach the piping DAC and what we heard from Lauren earlier?

MR. STEADHAM: I think at high level we both certain inspection procedures that utilize the subject matter experts, augmented -- well, the inspections, in our case, led by Region II inspectors because it is an ITAAC inspection and we have the subject matter experts from headquarters on the inspection.

CHAIRMAN BLEY: Okay, so you also needed to bring expertise into the inspection team.

MR. STEADHAM: Yes, sir.

CHAIRMAN BLEY: Okay.

MR. FREDETTE: That is always our model for doing these inspections.

CHAIRMAN BLEY: For all of these. Okay.

MR. STEADHAM: So from a high level, that is pretty similar. But obviously, we diverge two totally different types of technologies.

Next slide.

Okay, so the background, of course when AP1000 Rev. 19 DCD was certified, the piping design

was not finalized. So, we have this Piping DAC ITAAC and also Pipe Rupture Hazard Analysis. And then there were several meetings between November 2009 and July -- November 2011 where various briefings were given to ACRS.

MEMBER KIRCHNER: Tim?

MR. STEADHAM: Yes.

MEMBER KIRCHNER: Pardon my interruption. Since I am new, I find you said that the piping design was not finalized when it was certified? I am reading that literally and I am dumbfounded.

MR. STEADHAM: Well, okay, we may have --

MEMBER KIRCHNER: What aspects of the piping design weren't complete?

MR. STEADHAM: The detailed calculations.

MEMBER KIRCHNER: I'm still dumbfounded.

CHAIRMAN BLEY: Some of it needs to be done after procurement and you know exactly what is going to be installed. Isn't that right?

MEMBER KIRCHNER: If you told me the layouts, the actual physical layouts and such would be field altered and such, but I am surprised that the piping design wasn't complete at certification.

I'm just surprised.

MR. FREDETTE: Probably it should be clarified to say the detailed piping design I want to say.

MEMBER KIRCHNER: And that qualification means what? That is what I am trying to understand.

MR. FREDETTE: Well again, Tim talked about calculations. Pipe runs, where components are going to be located, valve locations, piping support locations, those kinds of things. I'm just --

MEMBER RAY: Well let me, as the AP1000 Subcommittee chair just say that it is stuff that didn't need to be finalized at the time of certification and would require large investment and many commitments that you first need a customer for. In other words, you need a certified design before you have a customer.

Then you get a customer and the customer starts paying, the COL holder or applicant, starts paying for the stuff that is done the DAC winds up confirming.

So, it is a sequence that is inevitable and, like I said, it is applicable going forward because it is just detailed design that requires a lot of investment for which you first need a customer and

the customer first needs a certification.

MEMBER KIRCHNER: But I would assume things like the seismic analysis of the primary system and such was completed by the certification.

MEMBER RAY: You mean from the loading and the stress?

MEMBER KIRCHNER: Yes.

MEMBER RAY: No, the design requirement is established as part of the design certification, the response spectrum and so on. Some things may be done, some things may not be done. But as a generality, I am simply saying that design completion doesn't extend as far as you may anticipate prior to the initial certification.

Now, we are going to get an amendment here.

CHAIRMAN BLEY: We have a couple people from the staff. Who wants to go first?

MR. TSIRIGOTIS: My name is Alexander Tsirigotis. I am a mechanical engineer in NRO for the Mechanical Engineering Branch.

During the design certification of the AP1000, Westinghouse did preliminary analysis of piping, like you said, to establish the routing of the

piping, the component arrangements, and all that stuff. But they didn't have completed calculations, meaning down, checked, approved calculation in final shape.

And it was decided at that time, and NRC accepted that, that they would go with design acceptance criteria. In other words, when you say that the piping analysis will meet the criteria that we have -- now this is mainly that criteria copies the ASME Class 1, Class 2, Class 3 equations and allowables.

And so having said that, in going forward after the design certification is approved, Westinghouse continues to provide the calculations, the final calculations for the licensees that have purchased the design.

And we come into play after the last calculations, the final calculations, and we go and do the inspection. Does that answer your question?

MEMBER KIRCHNER: Yes, thank you.

MR. STEADHAM: Okay, so in December 2016, we did complete the first piping DAC inspection at the Cranberry facilities of Westinghouse. And I will just -- we had no findings during that inspection. I do

have a slide that talks about the inspection in a little bit coming up.

So the overview -- next slide -- we used the -- there is a couple of Inspection Procedures, 65001.20, which is Piping DAC and also 65001, which is Pipe Rupture Hazards Analysis. For the Piping DAC, of course, we used .20.

We also decided to augment this inspection with Inspection Procedure 65001.16, which is essentially quality assurance aspects; 65001.20 is more of the technical aspects of the inspection, whereas .16 is the QA.

So the inspection, at a high level, what we verified the adequacy of is basically the piping design conform to the DAC methodologies and the ITAAC. We also reviewed licensee records to ensure they met the required quality aspects.

We looked at the process used for piping design and the I will say PRHA here. We didn't look at PRHA at this particular time. This is more looking forward. And then, of course, we already talked about QA implementation.

Next slide.

So this slide shows you what the ITAAC

says. And if I can just paraphrase all of this, it says that the piping will meet the ASME Code Section III.

So the approach we used for piping design, of course it is incumbent upon the licensee to perform and complete the ITAAC. And we verified through inspection you know in general Westinghouse performed the design. They provide the calculations to the licensees. This is an inspection of the licensees, not of Westinghouse. So, we give the licensees the opportunity to review those calculations and specifications and all the documents associated with that, make comments back to Westinghouse and they go back and forth until they arrive at all the comments have been incorporated.

Once that is done and that particular package is ready, they notify -- the licensee would notify us that it is ready to be inspected. And once we receive a large enough sample of ones to inspect, that is when we would go out and do the inspection. And that is one of the reasons why it has taken several years to do the first inspection is just that iterative process. We need to let the licensees and Westinghouse work it out.

The inspection activities do cover all four construction units. So it is one inspection, four dockets at the Westinghouse facility. We did document the inspection report -- the inspection results in an inspection report on each licensee's docket, which should be available as of today, I believe.

MR. FREDETTE: Yes, this inspection is incorporated in the quarterly integrated report that the resident inspectors produce, Dennis. So for the fourth quarter of 2016, that report was they have 45 days, roughly, from the time they exit the inspection to get the inspection report out. That is a Region II metric. And so that is why that report is just now being issued.

CHAIRMAN BLEY: Okay, thanks.

MR. STEADHAM: So just like human factors, we did use a multidiscipline team, which was very efficient and beneficial. It consisted of several structural engineers from Region II, Jonathan; Mechanical Branch inspectors, Katie and myself; and also the piping subject matter expert, Alexander from NRO Technical Staff.

Essentially, the piping that consists of

48 piping design packages, roughly there is 13 Class 1 and 35 Class 2 and 3 packages. And what we do is we look at the verification of the methodology for the pipeline design through verification of 10 to 15 sample piping package reviews. This is straight out of the inspection plan, the number of samples.

And of course, we reviewed detailed piping design and pipe hanger reports, they are separate calculations, in accordance with the applicable procedure.

And the goal was to verify that the methodologies are sound and conform to the licensing basis.

The inspection status for the Piping DAC, of course, the first piping inspection, as we already mentioned, we did complete in December 2016 with no findings identified. One of the things I would like to also mention up front because I am sure it is going to be a question or it may be a question in your mind but essentially, the same type of review that we did during this inspection is the same sort of audit that Alexander would have done, had the piping design been fully finalized, completed, and a DAC not been required.

Again, the inspection results are available in the fourth quarter integrated reports, as Tom mentioned.

The list of the six piping packages that we did inspect during this inspection, and as you can see, we had a combination of class 1 and 2/3, including reactor coolant we did look at.

Next slide.

So some of the -- you know what did we look at? Some of the examples of the QA attributes that we verified, that the calculations were properly controlled, documentation was complete, computer software used for safety-related calculations was verified, and that design verifications were appropriate.

Some of the examples of technical attributes that we looked at, of course, viewed the stresses that they calculated, what type of the pipe size, materials, so forth and so on, inputs, assumptions, load combinations, decoupling criteria, thermal and seismic analyses, dynamic transient analyses, such as when you have a valve closure it produces a pressure transient. We looked at those. And also pipe support/hanger design and configuration.

We looked at the loads and load combinations, baseplate design, pipe deflection limits, and so forth.

I'm going to turn it over to Katie right now, who is going to talk about some of the Pipe Rupture Hazard Analysis DAC.

MS. MCCURRY: All right. Thanks, Tim.

MEMBER RICCARDELLA: Excuse me. This is Pete Riccardella. I wonder if I could ask you a question before you get on to that topic.

MR. STEADHAM: Sure.

MEMBER RICCARDELLA: You know having run a company that did this kind of work for 20 years or so, this seems very similar to me to the kind of licensee audits that we -- QA audits that we used to get that ultimately became NUPIC, they became a generic audit.

And I wonder, you know I understand the first set of bullets on this slide that you verified the QA attributes but I just wonder if there isn't a lot of duplication of those NUPIC QA audits or aren't they being done on new reactors?

MR. STEADHAM: Well, of course the NUPIC audits are done by the industry to verify QA requirements for their vendors. We perform

independent reviews of the licensees, irrespective of who NUPIC looks at. So, there may be some overlap. Where NUPIC is looking at QA, we are looking at QA.

MEMBER RICCARDELLA: Okay.

MR. STEADHAM: Did that answer your question?

MEMBER RICCARDELLA: Yes, thank you.

MR. STEADHAM: Okay, you're welcome.

MS. MCCURRY: All right, any other questions?

Okay, this is the ITAAC for the PRHA DAC and, in short, the PRHA analysis for the high and moderate energy piping shall confirm the protection of equipment, the structure systems and components that are required to perform their safety function during and following a design-basis event.

And specifically, the analysis should assess the potential effect of pipe breaks on this equipment and those are the examples such as hydrodynamic loading pipe with flooding, to name a few.

Next slide.

The inspection approach for PRHA is very similar to that of the piping DAC with the main

exception being that at this time it has not been decided whether or not our inspection team will be augmented by additional disciplines, such as electrical or civil. But at a minimum, we will have mechanical representation from Region II and the PRHA subject matter expert, Renee Li, who is also in the audience today with us.

It is also important to note that we will be conducting the PRHA inspection after the completion of the Piping DAC inspections. And we have decided to do this because the analysis is heavily dependent on the pipe stresses to determine where the pipe locations -- break locations will be.

All right, our inspection plan. The PRHA is analyzed based on areas or rooms inside the AP1000 and the entire analysis is comprised in two reports, one for the inside of containment, which that report has already been completed by Westinghouse and approved by the licensee. And the other report for the Aux Building which is not yet complete.

And similar to the Piping DAC, we will verify the methodology through a risk-informed sample of 10 to 15 rooms, as laid out in our AP guidance.

Also it is important to note that

Westinghouse has developed a 3-D plant model to identify the potential targets in those areas. And while this is not a quality record, it will be most likely a useful tool during our inspection as well.

All right, inspection status, as we have already mentioned, PRHA inspections will follow the Piping DAC inspections and this inspection is not yet planned or scheduled.

And Tim already discussed this but, ultimately, the licensee's notification schedule drives are inspection schedule and it is an iterative process between Westinghouse and the licensees. And as Lauren mentioned, the licensees are working together to approve these, complete the review of these packages.

And at this point, we are waiting for all the packages to be complete before conducting our second piping DAC inspection. The most current licensee schedule, as we received on January 27th of this year, is that the Piping DAC packages should be completed in August of this year and the PRHA reviews by May of 2017. And again, that is just the package for the Auxiliary Building is what we are waiting on.

All right, now I am going to discuss some

insights and lessons learned. Again, there were no findings identified during our first Piping DAC inspection. Schedule changes, as we have mentioned, it is just very important to maintain frequent communications with the licensee. They send us updated schedules probably a month later whenever the schedule does change.

Conducting the inspection at Westinghouse and as opposed to at Vogtle and Summer, greatly enhance the efficiency of our communications, since we were able to directly ask our questions to the piping design technical experts.

Also, being able to see demonstrations of their software, being able to see how these isometric pipe drawings are incorporated into the software they are using and the codes that they are running was very, very helpful.

Also, we wanted to mention the Westinghouse SharePoint site that we have access to. It was a great planning and inspection tool. They uploaded the specifications and the packages far in advance of our inspection and any document requests we had throughout the inspection. It was easy for them to provide electronic copies for those document

requests. And we do plan to use that for future inspections. I will leave that last bullet.

So, the nomenclature of some of the documents needed for inspection was clarified. The main thing that we wanted to talk about here was the fatigue analysis. So when we originally made our document request, we requested all of the PLRs and the PHRs for the pipe supports and the piping, and we assumed that for Class 1 packages they would include that fatigue analysis. And we found out during the inspection that we did not have the fatigue analysis for those PLRs that we had requested.

So now we know to go ahead and request those for the future inspections and we will be looking at the fatigue analysis for the Class 1 packages we have already reviewed during our next inspection, in addition to the new packages we will be sampling.

And then these next two bullets are actually observations that we gave the licensee concluding our inspection. The first one has to deal with -- deals with the license condition that requires for construction not to begin before the NRC is notified on that particular piping package. And here

we were looking at the work packages in the field and we noticed that the QA barriers were not very strong to stop that construction from happening. However, it is important to note that there was no construction that commenced on this piping. We just noticed that had there been the opportunity to start construction before the package was notified, we didn't know if the QC barrier would have stopped that from happening.

And then the second bullet for documentation quality, for calculations, again, here it was observed that when we were doing some of the calculations the assumptions were not clear for the data that had been put into the calculation and sometimes it seemed like the assumption could be incorrect. However, they were able to provide justifications on how they got to that assumption, ultimately. So, we didn't have an issue but the documentation could have been clearer for those.

And then --

MEMBER SKILLMAN: Let me ask this before we go off of that slide, please.

What is the remedy for error? Here you have got this tractor trailer truck full of calcs and you are pouring your way through one piece at a time.

Let's just presume that in the day-to-day demands, errors find their way into the final packages and they are then discovered. What is the remedy?

Is the remedy instructing Westinghouse to correct the error or is the remedy the NRC staff takes action? How do you envision the remediation of errors?

MR. STEADHAM: Well, we would follow our process that we do with any other inspection. We go out to a site, facility of some sort. We have an inspection process. We identify an issue. It may have errors in it. Certainly, we found errors in calculations at facilities in the past. We mention it to the licensee. And this is in general. This isn't just related to the Piping DAC. So, this can cover pretty much any inspection activity.

So, we identify a calculation or error. We have to make an assessment of that error. Is it a significant error? Is it a minor typographical error? Is it something that can affect the adequacy of the calculation as a whole?

The licensee, it is then incumbent upon them to take corrective actions. We would then look at the particular issue and each one has to be taken

separately. We review each particular instance and we run it through our process. Is it an issue of concern? Do we have a problem with it? Yes, they have an inadequacy in a calculation, for example.

Is there a performance deficiency? Is it minor, more than minor? And then we look at there may be enforcement, there may be a finding or violation that could be documented on the docket. But if it screens out that say it may be a minor issue, it would not make it into an inspection report.

But if it is a quality issue, the licensee is expected to enter it into their corrective action program and correct it.

So, I would say we follow a normal inspection process for that.

MEMBER SKILLMAN: So what I heard you say is even at the ITAAC level, you are using the SDP, the significance determination process.

MR. FREDETTE: Mr. Skillman, we have an SDP specific for construction inspection that mirrors the SDP that is used for operating fleet.

So what Tim has just described is a --

MEMBER SKILLMAN: Construction.

MR. FREDETTE: -- construction inspection.

MS. MCCURRY: And that is called out in our manual Chapter 2519 for construction.

And then also to add additionally, this is an inspection of the licensee. So, Westinghouse would definitely never be the remedy to go through. Any findings that we have will be addressed with the licensee.

And Westinghouse can correct me if I am wrong, but I think the piping design is expected to change as it is being installed. So once we are in that process there will like the as-built for each unit and it can differ. And that would go down a different process than the Piping DAC itself.

MEMBER SKILLMAN: Thank you. Thanks.

MEMBER REMPE: So, the certified --

MEMBER RICCARDELLA: Excuse me, this is Pete Riccardella. I would like to ask a broader question. I guess I am surprised that these PHSA calculations are even being performed. Aren't they using leak before break for new reactors?

MR. FREDETTE: There is leak before break ITAAC in the FSAR. Those are separate ITAAC. They will be addressed separately.

MEMBER RICCARDELLA: But presumably you do

a leak before break evaluation and if the location passes, then you don't have to do a pipe rupture hazards analysis, right?

MR. FREDETTE: Oh, I'm sorry. I misunderstood the question.

MEMBER RICCARDELLA: Pardon me?

MS. MCCURRY: I think this question would be better for our PRHA technical expert, Renee.

CHAIRMAN BLEY: They are going to need some help. They will be along in a moment -- she will be along.

MS. LI: I am Renee Li from the Chemical Engineering Branch. Yes, the strategy of the PRHA is first to see if the piping system can be qualified under the LBB and then those piping system will not be included within the scope of PRHA analysis. But it will qualify for the LBB. There are certain design criteria of the material and so even involved the inspection program.

MEMBER RICCARDELLA: I understand. I have done many LBB calculations.

But then presumably, you will be auditing that or inspecting for the LBB calculations as well as these, right?

MS. LI: There is a separate ITAAC for LBB and which is within the scope of different SRP and different branch review responsibility.

MEMBER RICCARDELLA: Okay, I understand.

Okay, I just hope we are not getting back into the old days of having pipe width restraints and spray shields all over the plant because in the operating reactors, we kind of got rid of most of those.

MS. LI: Agree. If the piping system can be qualified for the LBB, otherwise, it still has to be --

MEMBER RICCARDELLA: As I am sure you also know is research is pursuing an extensive research effort in the area of XLPR, Extreme Low Probability of Rupture, which hopefully will give it even more technically accurate approach to leak before break.

MS. LI: Yes.

MEMBER RICCARDELLA: Okay, thank you.

MS. LI: You're welcome.

CHAIRMAN BLEY: That's Pete Riccardella from the committee. He couldn't be with us today but he is on the phone.

MEMBER REMPE: So the certified design

changed because of some issues identified in various places, not only in the U.S. but overseas. Have all those changes been incorporated into everything you have done? Were you affected by it at all when you started this or what is the status of --

MR. STEADHAM: Well, when you are speaking of the design changes based on international --

MEMBER REMPE: And there were some from follow-on.

MR. STEADHAM: I think, to my knowledge, that is mainly related to Shield Building design. But what we look at for this inspection is Rev. 19 of the DCD. You start with that. It becomes the final safety analysis when the COL is issued and that is what we are working on because that is the facility's licensing and design basis is Rev. 19 of the DCD.

MEMBER REMPE: I'm not on my revs. Rev. 19 came before or after all those issues were identified?

MR. STEADHAM: Rev. 19 is the currently certified designed for the AP1000.

MEMBER REMPE: But it has incorporated all those changes already.

MR. STEADHAM: I'm not a -- I will let --

MR. FREDETTE: Well we have -- Sarah, do you want to speak to that? Can you speak to that whether Rev. 19 incorporated all those changes, all that experience?

Sarah DiTommaso is here. She is from Westinghouse.

MS. DITOMMASO: Hi, as Tom mentioned, Sarah DiTommaso from Westinghouse.

In terms of design changes and incorporations, there were a number of -- the original certification was at Rev. 15 of the DCD. A number of changes were made, based on Fukushima challenges like was mentioned the Shield Building and there were a number of other design changes that were incorporated into Rev. 19.

Rev. 19 was what was certified and included in the final safety analysis for both licensees for the four units. However, there have been a number of lessons learned from our international plants, the plants being built in China, as well as just completion of design activities, challenges, things, completion of equipment qualification activities that have fed additional design changes into the AP1000 design.

If they have reached a level that have needed to update the information that is captured in Rev. 19 of the DCD that is incorporated into the U.S. FARs, we have changed those, working with the licensees.

In terms of the piping packages that were reviewed as part of the DAC, we have incorporated any changes that we have had, up until the completion of those activities were done. However, during final construction activities, there could be additional challenges or changes that when we actually go in and install the equipment, there might be needs to move piping for various reasons or to change structure, supports or structural activities.

But as we have been going along, we have been taking lessons learned from the China construction, incorporating those. There are differences between the domestic plants and the China plants. So not all of them can coincide with each other.

But what the teams have right now are to the point where we were able to incorporate all of the design changes through our design change process.

MEMBER REMPE: Thank you.

MS. DITOMMASO: Sure.

MR. STEADHAM: Thank you, Sarah.

MS. MCCURRY: All right and then our last slide the path forward. We plan to conduct the second Piping DAC inspection either the third or fourth quarter of this year after all the Piping DAC packages have been notified to the NRC. And again, that will include the fatigue analysis evaluations that were not performed on the first Piping DAC inspection for the Class 1 packages. And then we will conduct the PRHA inspection after that inspection. The date is to be determined.

CHAIRMAN BLEY: Any questions from the committee? I guess I have a quick one. I&C DAC coming up anywhere soon?

MR. FREDETTE: I&C DAC?

CHAIRMAN BLEY: Yes.

MR. FREDETTE: There was just one I&C DAC, Dennis. It was the component interface module --

CHAIRMAN BLEY: Yes, okay.

MR. FREDETTE: -- planning phase life cycle activities. Okay? It was --

CHAIRMAN BLEY: Enough said. Thank you.

MR. FREDETTE: We did that inspection back

in January of 2014.

CHAIRMAN BLEY: Right, I remember that one.

MR. FREDETTE: And in fact, that ITAAC, I know that V.C. Summer just submitted their ITAAC closure notification for that ITAAC --

CHAIRMAN BLEY: Oh, is that right?

MR. FREDETTE: -- just within the past week, I believe. Vogtle submitted theirs also.

CHAIRMAN BLEY: Okay.

MR. FREDETTE: So, from an I&C standpoint, we consider our DAC inspection activities complete.

CHAIRMAN BLEY: Complete for the AP1000. Okay, thank you.

At this time, I guess I will ask, and I would like to have the public phone line opened.

Is there anyone in the room who would like to make a comment? Yes.

MR. LIZARDI BARRETO: I would like to make a comment.

CHAIRMAN BLEY: Identify yourself and use the mike. Speak directly into it, please. Directly into it. It is hard to pick you up, otherwise. Thank you.

MR. LIZARDI BARRETO: Okay, hello. Can you hear me now? So my name is Jonathan Lizardi. I am a civil construction inspector for Region II and I participated as one of the inspectors in this thing.

And I just wanted to follow-up a little bit on an initial question that I think that has to do with NUPIC overlap with our inspection when it comes to QA. And the reason that I am bringing that up again is because we also, as part of this meeting here I know that enforcement was mentioned. And I would just like to say that we are not performing at 100 review of all the calculations. So elements of QA and enforcement, they are very important so we can also focus on not only requirements but people and processes. So during this inspection, we were able to interface directly with the engineers and the lead engineers that are developing these calculations, have them to walk us through the process of getting the design inputs, how stuff would work. We looked at the design verifications, all of those things because we know that, to some degree, design may change but also knowing the players and looking at their capabilities give us some additional assurance. And because our approach is based on sampling, that helps.

Now, the aspect of enforcement having then to fix issues, even if they are minor, provide the opportunity to look at the general implication that even that minor issue could have into other areas that could turn out to be more significant.

So, I just wanted to mention that, you know, emphasize the importance of adding some elements of QA and enforcement into our inspection approach for this particular topic.

CHAIRMAN BLEY: Thank you. Anyone else in the room care to make a comment?

Is there anyone on the phone line who would like to make a comment? If so, please identify yourself and give us your comment.

OPERATOR: Bridge open.

CHAIRMAN BLEY: Thank you, sir. Going, going, gone.

At this time, I would like to go around the table and ask the members for their comments. And I will start with Professor Ballinger and come this way around the table.

MEMBER BALLINGER: I have none, other than to say that I appreciate the presentations, both of them. It was enlightening for me. Thank you.

CHAIRMAN BLEY: Matt.

MEMBER SUNSERI: I would also extend my appreciation. Both presentations were really informative. Thank you.

CHAIRMAN BLEY: Harold Ray.

MEMBER RAY: Yes, likewise, I appreciate the information we received. As I said more than once, this is fodder for thinking about the future. One can say well, I will certify a cartoon and then you guys can come and inspect it later when I am in the process of, as AP1000 is, building the plant and I have customers and so on and so forth who will answer all these questions and you can come and tell me that you agree.

I don't think that is where we want to go with the plants that lie out in the future, which whatever they are, and yet we have taken a step in that direction necessarily here. And what the limits are on what we have been looking at, as we look to the future, is the question I have in my mind -- I don't have an answer to it. I don't have any opinions about it, particularly. But it seems to me like there needs to be some limitation on how much is left to this process, as opposed to the issues that need to be

addressed prior to the certification, all of which require investment on the part of the certificate applicant, the design certification applicant.

So I understand the tensions that are involved and I appreciate this as input. I think the chairman will say, opine on this, but probably we are not done asking questions about how this goes, although I think this seems to run it pretty much to ground in this instance.

But anyway, like I say, my questions don't go to so much the effectiveness of what is being done because I think it is effective in what it is doing and it is working well. But I wonder about the future and what the limitations are.

Thank you.

MR. TSIRIGOTIS: My name is Alexander Tsirigotis.

MEMBER RAY: If you have an answer to that question --

MR. TSIRIGOTIS: Yes.

MEMBER RAY: -- I want to be sure to write it down.

MR. TSIRIGOTIS: Sure, you go right ahead.

As I said, my name is Alexander

Tsirigotis, mechanical engineer for Mechanical Engineering Branch.

You made a good point and in going forward with the new designs and starting with APR1400, we are asking for the applicants to submit completed calculations of piping analysis and design for the significant systems that they have. And so during the certification period, we will look at completed calculations. And we have already started doing that and going over those calculations.

MEMBER RAY: Well that is far easier for the APR1400 than it would be for some of the other plants I have in mind but thank you.

MR. TSIRIGOTIS: Sure.

CHAIRMAN BLEY: Dick.

MEMBER SKILLMAN: Thank you to the presenters, particularly, very thorough. Very informative. No further comments.

Thank you.

CHAIRMAN BLEY: Okay, Dana Powers.

MEMBER POWERS: I guess I am puzzled about this risk-informed sampling that was mentioned in Ms. McCurry's presentation. I'm not sure how you do it. We are looking at a system that has phenomenological

vulnerabilities and you are interested in whether those vulnerabilities have been adequately addressed in setting up the piping system.

And the connection between that vulnerability and risk is a little diffuse to me.

CHAIRMAN BLEY: Well, that is a comment. Do you want to do any more or are you seeking an answer now?

MEMBER POWERS: If you have an answer. I'm not sure how they do the risk-informed sampling.

MR. FREDETTE: Mr. Powers, are you talking about for piping design?

MEMBER POWERS: Yes.

MR. STEADHAM: Essentially, when the piping packages were -- when you have a sample, a population of 48 to choose from, we chose a particular number of them that current conforms to the inspection procedure guidance and it is just guidance. We can expand it if we would like. We could reduce it if we want but we shoot for that 10 to 15. And certainly that sample when it was derived used risk insights from PRA experts from here in the Region, as well as systems -- some of the inspectors that were familiar with the systems from the Region.

That was done how many -- I'm not quite sure when but --

MR. FREDETTE: When the sample selection that we made was done I want to say over a year ago, and as Tim mentioned, it is a sample of a sample because the 48 packages that are identified in the DCD, they were already identified and risk-informed to some extent and approved by the staff as the ones that would provide the best value in determining that the methodology was sound and conformed to the intended licensing basis.

So the sample of a sample, as Tim said, we took what was already a somewhat risk-informed sample and we looked at other PRA insights that we could get from throughout the agency to come up with the sample that we really wanted to look at when we do these inspections.

MEMBER POWERS: It is the connection between the phenomenological vulnerability of the pipeline system and that risk-informed selection process that is diffuse to me and presumes that the risk information does consider those phenomenological vulnerabilities.

MR. FREDETTE: I'm sorry, Mr. Powers, I

can't hear you.

MEMBER POWERS: It presumes that the risk analysis that was taken considers the phenomenological vulnerabilities of the piping system that you are interested in. And that is the part that I am kind of missing here.

And if it does, then how do I sample, based on what?

I mean I could see you do it by risk achievement worth or risk reduction worth or something like that but I don't know how you do it.

CHAIRMAN BLEY: We may leave this on the table. I think it is a key issue but two things come to mind. One is you mentioned a constructionist you used here. Wasn't there a subcommittee meeting that reviewed that some time ago? I was not there. I would have to look and see if we have something there.

I think one of the problems here is it is hard -- you might have some difficulty finding a PRA that looks at all these piping in the way that is implied by what we have heard.

MEMBER POWERS: I mean you understand what my challenge is here.

CHAIRMAN BLEY: Yes.

MEMBER POWERS: I just don't know how you do it.

CHAIRMAN BLEY: You look for LOCAs and primary piping but we do that in a kind of summary high level way, not in a detailed phenomenological way.

MEMBER POWERS: So why is that a good way to do sample, the piping systems for this inspection process? But that is the part I don't understand.

MS. MCCURRY: Yes, and again for PRHA, you are looking at the potential effects on the equipment that is surrounding. So that is part of what feeds into like the rooms that we are going to select where these important components and systems and structures that could be affected by a pipeline break.

CHAIRMAN BLEY: I think this is something we might want to look into at some point and I'm not sure what the right venue is for doing that. But we will try to keep it on our calendar.

I'm going to go to John Stetkar.

MEMBER STETKAR: Thanks. Somewhat related topic to Dana's comments, I would like kind of reiterate, I think that I certainly would be interested, very interested in learning how the

integrated system verification was performed for this particular design and, in particular, the selection of the scenarios that were used to guide that process.

I know we can't discuss that in open session but we can certainly have the closed session to do that.

The reason I'm concerned is both for the AP1000 design in particular, as far as understanding that process, and going forward to future designs, how those scenarios will be selected. What process does the licensee in this case, because they're -- post-COL, used to select the scenarios that challenge both the humans and the system. And how does the staff gain confidence, as I said before, the breadth and the depth of those scenarios are appropriate to exhibit those challenges so that you have confidence that, indeed, we are looking at an appropriate spectrum.

It is important in the future because, regardless of the information that anybody else is including in a design certification for a new design, we have seen a variety of those, when it finally comes down to it, the final inventory of alarms, the placement of the alarms prioritization schemes for the alarms, integration for computer-generated procedures,

if you will, of necessity will have some influence, to a greater or lesser extent by the eventual licensee.

And so, therefore, I think that any of these inspections, whether it is fore an existing plant that is in the middle or for a new design, will face those challenges.

So I think, to me it would be very interesting, sir, to have a closed subcommittee meeting to better understand how that process was done for AP1000.

CHAIRMAN BLEY: Thank you.

Jose.

MEMBER MARCH-LEUBA: I have no further comments.

CHAIRMAN BLEY: Walt.

MEMBER KIRCHNER: Thank you, Dennis. Thank you to the staff. I have just a couple of points.

I like your multidisciplinary teams that include subject matter experts in the field. And I guess this is a comment. I hope that Project AIM doesn't eliminate that capability.

Let me go on to something more substantive. So, picking up perhaps where Harold left

off, I have been pondering what the level of maturity, I guess that is the word I will use right now, of the design certification should be going forward. And then when do you implement a DAC or an ITAAC? What is the expectation before you get to that threshold?

I would expect a very high level of maturity for say the piping system, NSSS or whatever it is called, and perhaps less in the area which John just mentioned the Digital I&C and everything that goes into that part of implementing the controls for the plant.

So what is that threshold and what is the expectation for an advanced reactor certification?

And with that, I will -- and in a quote, unquote, phased licensing process? I would expect that it would be a fairly mature design but I am just concerned.

And just to clarify, yes, I know the difference between a detailed design implementation in the field of a piping system but I would submit that the AP1000 has a very mature design for the NSSS. So going forward are we going to have a like expectation for an advanced concept?

Thank you.

CHAIRMAN BLEY: Charlie.

MEMBER BROWN: No additional comments.

CHAIRMAN BLEY: Joy?

MEMBER REMPE: I would like to add my appreciation for the presentations because it provided some insights on how things are implemented. And I think my colleagues have already expressed enough of the concerns of the outstanding issues. So, I won't belabor the points.

Thanks.

CHAIRMAN BLEY: Thank you.

I really appreciate this whole process that we have gone through up to this point and keeping us informed as to how it proceeds. As Walt said, the multidisciplinary team approach goes a -- really helps us gain some confidence in these DAC inspections.

I remain a little uncomfortable that some of the things that are just ITAAC and Digital I&C probably ought to be thought of as DAC, as you discussed the HFE process as well.

Harold brings up you know somebody might call reductio ad absurdum. If you take this thing to the limit, you end up with no design and everything coming by inspection. Well, we know that doesn't

smell right.

But from the beginning, this always pretended to be as little as possible in this area and occasionally it has drifted away from that and as long as pressure -- probably the best solution there is keeping up pressure to keep the DAC as small and limited as possible.

I think Dana brought up some things we ought to think about more, John as well and Walt.

Again, thank you. It is quarter 'til 12:00. I'm going to --

MEMBER RICCARDELLA: Wait. Excuse me, Dennis.

CHAIRMAN BLEY: Thank you, Pete. I forgot you were on the line. Go ahead.

MEMBER RICCARDELLA: It's nice to be loved.

CHAIRMAN BLEY: You were so quiet. Go ahead.

MEMBER RICCARDELLA: I have some comments relative to Dana's comment. I mean I see the purpose of an audit as to confirm that the vendor is implementing a QA program and that that QA program is being followed and that the engineering is sound and

the people who are doing the analyses are confident. And I guess I really don't see the nexus of that to risk in terms of picking the systems that you audit.

I think the assumption has to be that you audit selected systems and if everything is being done properly in those systems, then it is being done in all the systems. It is not that the ones that you audit are being done properly and the other ones aren't and, therefore, you would need to pick the ones that are more important than the risk analysis. I guess I just don't see that connection.

And I get, as far as this other concept we have been discussing of well how much needs to be done as part of the design certification versus what can be left for a design, a DAC, I guess it to me it is a scheduling item. And why do you need to do all these detailed code piping analyses so early in the process? Does that really add anything to the safety? I mean basically they are saying we are going to design this system to ASME Code and we are going to follow the existing regulations. And what do you accomplish by doing that as part of the design certification versus putting it off until it is really needed? I don't understand the concern there.

Those are my comments.

CHAIRMAN BLEY: Thank you. I might respond to two of them just because I am going to because I am sitting here. But the staff brought up the fact that they have risk-informed that sampling process. So that is where that came from.

MEMBER RICCARDELLA: I understand but --

CHAIRMAN BLEY: On the other one --

MEMBER RICCARDELLA: As I said but I don't see the nexus.

CHAIRMAN BLEY: I'm not sure I --

MEMBER POWERS: Clearly, neither do I.

CHAIRMAN BLEY: Yes, I don't think anybody on the committee does at this point.

One your other one, I can understand the argument with piping but when we get to I&C and when we get to the HFE, there is a level of questioning and examining and going through the RAI process that isn't quite the same. It isn't the same at all when we get here. So on some aspects of the design, we really want that really detailed, thorough process. At least I think we do.

In any case, with 15 minutes to go, I am going to adjourn this meeting but I am going to ask

the members and staff to stick around for just a minute. And as soon as I adjourn, Theron, would you let me know when the public phone line is closed?

At this point, the meeting --

MEMBER BROWN: Can I make one observation relative to these comments?

CHAIRMAN BLEY: One last one, yes.

MEMBER BROWN: It is quick. You mentioned I&C a minute ago, in terms of how you could see something relative to piping but not necessarily I&C.

When we saw the first ESBWR DCD and the pictures of it, the references were we will comply with all the reg guides and all the IEEE inspection standards and we don't need to tell you anything else. I am paraphrasing slightly a little bit but it was very, very we will comply with all the rules and regulations you put out there and we will observe that when we finally complete the design and you can look at it then.

That was a completely unsatisfactory way of trying to address the I&C for the reactor safeguards and trip systems. So, I understand Pete's comment about why you need to do all the piping analysis early. That may well be the case. I'm just

saying there is a direct difference between pipes and digital instrumentation control and reactor trip and safeguard systems, to actuate those.

So, that is the only observation I wanted to give. Thank you.

CHAIRMAN BLEY: This meeting is adjourned.

(Whereupon, the above-entitled matter went off the record at 11:47 a.m.)

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Presentation to the ACRS

AP1000 Design Acceptance Criteria

Inspection Progress and Status

Thomas Fredette (NRO/DCIP)
Lauren Kent (NRO/DCIP)
Tim Steadham (NRC/Region II)
Katherine McCurry (NRC/Region II)

February 23, 2017

Objectives

Provide the Subcommittee:

- **Status of Design Acceptance Criteria (DAC) Working Group activities, with emphasis on DAC inspection implementation**
- **Overview of staff's approach to AP1000 DAC inspection in key areas of Human Factors Engineering (HFE), Piping Design and Pipe Rupture Hazards Analysis (PRHA)**
- **Results, insights and lessons learned from inspection activities**
- **Look ahead to future activities**

Background & History

- Concept of DAC introduced in SECY 92-053; relied on verification of design implementation through Part 52 ITAAC in limited technical areas (digital instrumentation & control (DI&C), HFE, piping design, radiation protection)
- DAC Working Group established and chartered to develop viable inspection strategy for DAC ITAAC (Nov 2009)
- Process and procedure development initiated for ABWR DI&C DAC; pilot inspection completed June 2010
- Staff committed to periodic ACRS briefings on status
- Focus shifted to AP1000 following Fukushima event; initial engagement w/ AP1000 DCWG (DI&C and Piping) and inspection procedures finalized (Sept 2011)

Background & History (cont.)

- AP1000 approach briefed to ACRS (Nov 2011); committed to continue periodic briefings as inspections implemented
- Conducted tabletop walk-through of AP1000 Piping DAC inspection process w/ licensees (July 2012)
- Conducted first AP1000 DI&C DAC inspection (Jan 2014); ACRS briefed on results (July 2014)
- AP1000 HFE (Integrated System Validation) inspections commenced Oct 2014 (on-going)
- First Piping DAC inspection completed Dec 2014

AP1000 Human Factors Engineering (HFE)

DAC Inspection Overview and Status

Lauren Kent

NRO/DCIP/HOIB

Acronyms

DV	Design Verification
EOC	Extent of Condition
HED	Human Engineering Discrepancy
HSI	Human-System Interface
ICN	ITAAC Closure Notification
ISV	Integrated System Validation
IP	Inspection Procedure
ITAAC	Inspections, Tests, Analyses, and Acceptance Criteria
PCD	Principal Closure Document
SCE&G	South Carolina Electric & Gas
SNC	Southern Nuclear Operating Company
TSV	Task Support Verification
V&V	Verification and Validation
WEC	Westinghouse Electric Company

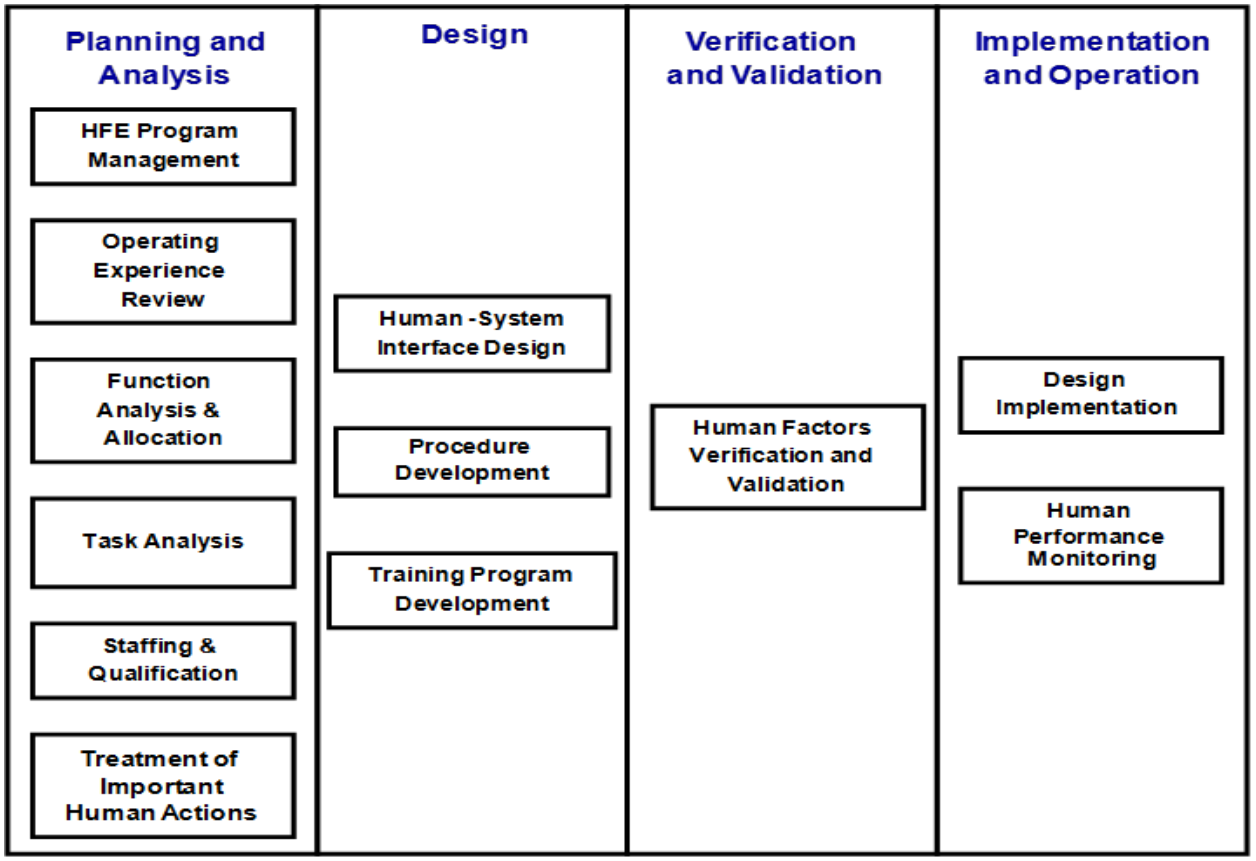
Use of DAC for the AP1000 HFE Design (1/2)

- **Design certification (DC) applications must satisfy requirements in 10 CFR 52.47**
  - **52.47(a)(8): Provide information necessary to comply with technically relevant portions of the Three Mile Island requirements in 10 CFR 50.34(f)**
  - **10 CFR 50.34(f)(2)(iii): Provide, for Commission review, a control room design that reflects state-of-the-art human factors principles**
  - **For the Westinghouse (WEC) AP1000 design certification application, staff accepted the use of DAC in lieu of detailed control room design information (i.e., staff accepted a detailed design process in lieu of the detailed design)**

Use of DAC for the AP1000 HFE Design (2/2)

- The AP1000 design control document (DCD) included implementation plans (IPs) for HFE activities
- The IPs, in part, formed the basis for the staff's safety determination on the AP1000 HFE design
- AP1000 combined operating license (COL) holders are responsible for executing the implementation plans
- Compliance with the DAC and satisfactory completion of associated ITAAC provide the necessary assurance that the human-systems interfaces (HSI) have been designed, tested and implemented in accordance with the certified design

NUREG-0711 HFE Program Elements



AP1000 HFE DAC ITAAC Task Support Verification

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
The HFE verification and validation program is performed in accordance with the HFE verification and validation implementation plan and includes the following activities: **a) HSI Task support verification**	a) An evaluation of the implementation of the HSI task support verification will be performed.	a) A report exists and concludes that: Task support verification was conducted in conformance with the implementation plan and includes verification that the information and controls provided by the HSI match the display and control requirements generated by the function-based task analyses and the operational sequence analyses.

AP1000 HFE DAC ITAAC Design Verification

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
The HFE verification and validation program is performed in accordance with the HFE verification and validation implementation plan and includes the following activities: **b) HFE design verification**	b) An evaluation of the implementation of the HFE design verification will be performed.	b) A report exists and concludes that: HFE design verification was conducted in conformance with the implementation plan and includes verification that the HSI design is consistent with the AP1000 specific design guidelines developed for each HSI resource.

AP1000 HFE DAC ITAAC Integrated System Validation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
The HFE verification and validation program is performed in accordance with the HFE verification and validation implementation plan and includes the following activities: **c) Integrated system validation**	c) (i) An evaluation of the implementation of the integrated system validation will be performed.	c) (i) A report exists and concludes that: The test scenarios listed in the implementation plan for integrated system validation were executed in conformance with the plan and noted human deficiencies were addressed.

AP1000 HFE DAC ITAAC Integrated System Validation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
The HFE verification and validation program is performed in accordance with the HFE verification and validation implementation plan and includes the following activities: **c) Integrated system validation**	(ii) Tests and analyses of the following plant evolutions and transients, using a facility that physically represents the MCR configuration and dynamically represents the MCR HSI and the operating characteristics and responses of the AP1000 design, will be performed: heatup, startup, shutdown, cooldown, reactor and turbine trip, LOCA, feed and steam line breaks, and SGTR.	(ii) A report exists and concludes that: The test and analysis results demonstrate that the MCR operators can perform the following: heat up and start up the plant to 100% power; shut down and cool down the plant to cold shutdown; bring the plant to safe shutdown following the specified transients; and bring the plant to a safe, stable state following the specified accidents.

AP1000 HFE DAC ITAAC Issue Resolution

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
The HFE verification and validation program is performed in accordance with the HFE verification and validation implementation plan and includes the following activities: **d) Issue resolution verification**	d) An evaluation of the implementation of the HFE design issue resolution verification will be performed.	d) A report exists and concludes that: HFE design issue resolution verification was conducted in conformance with the implementation plan and includes verification that human factors issues documented in the design issues tracking system have been addressed in the final design.

ITAAC Inspection and Verification Processes

- Licensees must complete the ITAAC
- Staff use inspections to independently verify that the licensee successfully completes ITAAC
  - Staff use IP 65001.23 to inspect the HFE DAC ITAAC
  - Staff perform vendor inspections as the licensee performs the activities and documents results
  - Staff also inspect the results summary reports to verify ITAAC acceptance criteria as part of the construction inspection program
- Staff also review ITAAC closure notifications (ICNs) as part of the verification process when the ITAAC and associated inspections have been completed

Inspection Strategy (1/2)

- **A multidisciplinary inspection team performed the vendor inspections and included the following:**
  - **Construction inspectors with I&C technical expertise (RII)**
  - **Simulator engineer and several AP1000 technology instructors with integrated nuclear power plant operations experience (e.g., prior licensed operators) from the TTC**
  - **Vendor inspectors with I&C technical expertise (NRO)**
  - **HFE technical reviewers and operator licensing examiners with prior experience working in either operations or operations training at operating reactors**
- **HFE technical reviewers from NRO assist construction inspectors from RII**

Inspection Strategy (2/2)

- **The staff developed detailed inspection plans based on the inspection requirements in IP 65001.23**
  - **Staff and licensees conduct routine inspection planning meetings to determine when the inspections should be scheduled to optimize observation opportunities**
- **Activities related to the integrated system validation (ISV) commenced in October 2014 and are not expected to be complete until May 2018 at the earliest**
  - **Inspection reports document staff conclusions relatively soon after the inspection**
  - **Results from inspection reports provide input to subsequent inspection plans**

Inspection Status

Type and Dates	Scope	Inspection Report
Vendor Inspection 1 October 2014 – February 2016	ISV prerequisites, DV and TSV results, implementation of ISV procedures, ISV results	ML16091A462 April 5, 2016
Vendor Inspection 2 October 2016	Initial stages of issue resolution	ML16336A244 December 9, 2016
ITAAC Inspection 1 October 2016	TSV ITAAC	ML17044A5391 February 13, 2017
ITAAC Inspection 2 February 2017	DV ITAAC and ISV ITAAC (c)(i)	TBD
Additional vendor and ITAAC inspections TBD	Activities related to ISV ITAAC (c)(ii) and issue resolution ITAAC	TBD

Results of Vendor Inspection 1 (1/7)

- **Staff performed the following activities:**
  - **Confirmed ISV prerequisites were satisfied (October 2014)**
    - **Reviewed the results of simulator factory acceptance testing (FAT), Protection and Safety Monitoring System (PMS) and Distributed Control Information System (DCIS) software integration testing, and simulator modeling deficiency reports to assess whether the simulator was an adequate platform for running the ISV test trials**
    - **Verified the ISV facility met the scope requirements of the implementation plan and the mandatory HFE guidelines in the Style Guide**
    - **Observed a pilot ISV test scenario**

Results of Vendor Inspection 1 (2/7)

- **Staff activities (continued):**
  - **Observed ISV test trials (January – March 2015)**
    - **Observations included simulator performance during test trials, WEC's implementation of its test procedures and WEC's methods for collecting and evaluating data**
    - **Reviewed WEC's ISV scenario guides and observer guides**
  - **Discussed staff's observations related to simulator fidelity and simulator performance during ISV test trials with Westinghouse staff and licensees (April 2015)**
  - **Reviewed TSV, DV and ISV results and WEC's analysis of the ISV test results as documented in the results summary reports (December 2015 – January 2016)**

Results of Vendor Inspection 1 (3/7)

- **Summary of inspection results**
  - **No findings**
  - **Observations:**
    - **In some cases, issues identified during simulator factory acceptance testing were mischaracterized, which could have allowed issues to be inappropriately deferred for resolution until after ISV**
    - **During pilot testing, WEC's ISV observers were more focused on operator performance rather than human-system interface (HSI) effectiveness**
    - **There were three issues in the simulator models that needed to be evaluated for potential effects on simulator fidelity**
    - **WEC documented these issues to assess what corrective actions needed to be taken**

Results of Vendor Inspection 1 (4/7)

- **TSV conclusions**
  - **The staff reviewed the results summary report for TSV and determined that WEC performed TSV in conformance with the implementation plan and any human engineering discrepancies (HEDs) had been entered into the formal HFE issue tracking system for resolution**
- **DV conclusions**
  - **The staff reviewed the results summary report for DV and determined that WEC performed DV in conformance with the implementation plan and any HEDs had been entered into the formal HFE issue tracking system for resolution**
  - **Additionally, the staff determined through inspection of the ISV facility that it conformed to the mandatory HFE guidelines in the Style Guide**

Results of Vendor Inspection 1 (5/7)

- **ISV conclusions**
  - **The following activities were found to conform to administrative controls and the requirements of the implementation plans:**
    - **Prerequisite activities**
    - **ISV test procedures, scenario design and execution of the scenarios**
    - **ISV participant selection and training**
    - **Simulator performance during ISV test trials**
    - **ISV team performance**
    - **ISV analysis methods and data analyses, including identification of HEDs**

Results of Vendor Inspection 1 (6/7)

- **HFE V&V activities demonstrated that there are some issues with the control room design that need to be resolved**
  - **TSV and DV**
    - **WEC identified some HEDs during these activities, which were relatively few when compared to the large number of HSIs that were evaluated against task requirements**
  - **ISV**
    - **HEDs ranged from a single significant problem, such as failure of to meet a pass/fail criteria, to HEDs that documented the impact of multiple individual issues contributing to the more significant problem identified in the HED**
    - **The HEDs spanned subjects relating to human system interfaces, plant systems and functions**

Results of Vendor Inspection 1 (7/7)

- The HFE V&V activities (continued)
  - ISV (continued)
    - Several significant HEDs are related to the Alarm Presentation System (APS)
    - Five scenarios, including a plant and reactor startup scenario, did not meet pass/fail criteria
- All HEDs are being tracked for resolution in the HFE tracking system
- Resolutions need to be tested in accordance with the requirements in the issue resolution implementation plan

Impact of ISV Results on Operator Licensing Exams (1/3)

- **Licensees need either a physical plant, a plant-referenced simulator (PRS), or a Commission-approved simulation facility (CAS) to administer operator licensing exams**
  - **A PRS models the systems of the reference plant with which the operator interfaces in the control room, including operating consoles, and permits use of the reference plant's procedures**
  - **If the control room design is still being developed, then the control room of the reference plant is not complete; thus, a simulator cannot model the operator interfaces in the control room**
  - **SCE&G and SNC submitted requests for a CAS in January and September 2015, respectively**

Impact of ISV Results on Operator Licensing Exams (2/3)

- 10 CFR 55.46(b) identifies requirements for a CAS
  - The staff must find the simulation facility and its proposed use are suitable for the conduct of operating tests
- As part of its review, the staff evaluated whether the HEDs affected the suitability of the simulation facility for operating tests
  - Staff received ISV results during the CAS review
  - Staff conducted an audit to aid in the evaluation
  - Licensees worked with WEC and resolved issues that prevented the simulators from being suitable for operating tests
  - These activities contributed significantly to the review time and resulted in rescheduling of operator licensing examinations at both sites

Impact of ISV Results on Operator Licensing Exams (3/3)

- **Ultimately, the staff found the simulation facilities were suitable for the conduct of operating tests as well as for performing significant control manipulations to meet operator experience requirements**
  - **The licensees demonstrated fidelity of the simulation facilities to AP1000 predicted plant system performance**
  - **Scenario-based testing and NRC's exam validation processes provide additional assurance that operating tests meet the exam standards in NUREG-1021**
- **The first operator licensing exam was administered at Vogtle in July 2016 and at VC Summer in September 2016**

Results of Vendor Inspection 2 (1/3)

- **Staff performed the following (October 2016):**
  - **Reviewed ISV results summary report to determine whether issues were appropriately prioritized and tracked in accordance with the implementation plan**
  - **Reviewed available resolution plans for V&V issues and justifications for any issues that will remain "as is"**
- **Summary of inspection results**
  - **No findings or observations**

Results of Vendor Inspection 2 (2/3)

- **Conclusions**
  - **The staff reviewed a revision to the results summary report for TSV and determined changes did not affect the staff's conclusions from Vendor Inspection 1**
  - **TSV, DV and ISV HEDs were appropriately prioritized in accordance with the criteria in the implementation plan (high degree of conservatism from WEC)**
  - **Justifications for HEDs to remain "as is" were appropriate**
  - **All HEDs were tracked in the Human Factors Tracking System**
  - **WEC performed thorough cumulative effects analysis as an input to the HED resolution process**

Results of Vendor Inspection 2 (3/3)

- **ISV conclusions**
  - **Issue resolution plan development and issue resolution tracking are being conducted consistent with their administrative control and the implementation plan**
  - **The process for resolving HEDs and the retesting of the corrective actions that derive from these resolutions is in progress**
  - **Corrective actions need to be implemented and retested to conclude that the test and analysis results demonstrate that the operators can perform the plant operations listed in the ITAAC**

Results of ITAAC Inspection 1

- **During Vendor Inspection 2, the staff also performed ITAAC Inspection 1**
  - **Staff reviewed the licensees' principal closure document (PCD) for the TSV ITAAC, which was the TSV results summary report**
- **Summary of inspection results**
  - **No findings or observations**
  - **The staff verified that the information in the PCD appropriately supported the TSV ITAAC closure**

Results of ITAAC Inspection 2

- **In February 2017, the staff commenced ITAAC Inspection 2**
  - **Staff reviewed the licensees' principal closure documents (PCDs) for the DV ITAAC and the ISV implementation ITAAC (essentially, the DV and ISV summary reports)**
  - **Inspection still in progress**

Upcoming Vendor and ITAAC Inspections

- **The staff plans to perform additional inspection of testing performed to verify HED resolutions are adequate (no sooner than May 2018)**
- **When WEC completes the issue resolution results summary report, the staff will inspect the following items to verify issues have been adequately addressed in the final design:**
  - **Retesting requirements have been appropriately applied**
  - **Results of retesting demonstrate operators can perform the plant operations listed in the ITAAC**

Lessons Learned (1/2)

- A multidisciplinary team is essential to evaluate all of the aspects of this complex design process
- Staff should evaluate simulator fidelity criteria specifically for engineering development simulators
- The use of DAC in the HFE area can cause operational readiness delays
- The ISV may reveal plant system design issues as well as HFE design issues

Lessons Learned (2/2)

- **Vendor inspections provided opportunities for the staff to develop reasonable assurance, based on direct observation, that the HFE design activities were being performed in accordance with the implementation plans**
- **Inspection resources should focus on the ISV because it is the activity that most demonstrates the adequacy of the plant HFE design**
- **Vague terminology in the ITAAC can create problems when performing ITAAC inspections**

Concluding Remarks

- **The Staff has confidence based on inspections to date that WEC is meeting its design commitments in accordance with the DAC**
- **Issues in the AP1000 HFE plant design have been appropriately identified and are in the process of being resolved**
- **Resolutions will need to be retested successfully to demonstrate the AP1000 control room design reflects state-of-the-art HFE principles**

Discussion / Subcommittee Questions

AP1000 Piping Design
&
Pipe Rupture Hazards Analysis

DAC Inspection Overview and Status

Timothy Steadham & Katherine McCurry
NRC Region II

Acronyms

ASME	American Society of Mechanical Engineers
CMT	Core Makeup Tank
CVS	Chemical and Volume Control System
IP	Inspection Procedure
ITAAC	Inspections, Tests, Analyses, and Acceptance Criteria
PLR	Piping Line Report
PRHA	Pipe Rupture Hazards Analysis
PXS	Passive Core Cooling System
QA	Quality Assurance
QC	Quality Control
RCS	Reactor Coolant System

Objectives

- Overview of Piping Design and Pipe Rupture Hazards Analysis (PRHA) DAC
- Overview of Piping & PRHA DAC inspections
  - Inspection approach
  - Inspection plan
  - Inspection results
- Insights and Lessons Learned to date
- Overview of future inspections

Background

- Piping design not finalized when AP1000 was certified
- November 2009 – Working Group established to develop viable inspection strategy for DAC
- September 2011 – Inspection procedures finalized
- November 2011 – Briefed ACRS on AP1000 approach
- July 2012 – Tabletop public meeting for piping DAC inspection process
- July 2014 – Last ACRS brief on piping DAC
- December 2016 – Completed first piping DAC inspection

Inspection Overview

- Inspection procedures that address piping DAC and PRHA
  - IP 65001.20 (Piping DAC)
  - IP 65001.21 (PRHA)
- IP 65001.16 (Inspection of ITAAC-Related Engineering) also utilized
- Inspection verifies adequacy of:
  - Piping design conformance to the DAC methodology/ITAAC
  - Licensee records
  - Process used for pipe design & PRHA
  - QA implementation

AP1000 Piping Design DAC ITAAC

Design Commitment	Inspections, Tests and Analyses	Acceptance Criteria
The American Society of Mechanical Engineers (ASME) Code, Section III piping is designed in accordance with ASME Code, Section III requirements.	Inspection of the ASME Code Design Reports (NCA-3550) and required documents will be conducted for the set of lines chosen to demonstrate compliance.	The ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the piping for lines chosen to demonstrate all aspects of the piping design complies with the requirements of the ASME Code section.

Inspection Approach – Piping Design

- Incumbent on licensee to perform and complete ITAAC – Staff verifies through inspection
- DAC inspection is an ITAAC inspection
  - Inspection activities cover all four construction units
  - Documented in an inspection report on each licensee's docket
  - Conducted at Westinghouse HQ
- Multidiscipline team
  - Civil/structural inspector (RII)
  - Mechanical branch inspectors (RII)
  - Piping design subject matter expert (NRO technical staff)

Inspection Plan – Piping DAC

- 48 piping design packages (13 Class 1, 35 Class 2/3)
- Verification of the methodology for piping design through verification of 10-15 sampled piping package reviews
- Review detailed piping design and pipe hanger reports in accordance with IP 65001.20
- Goal is verification that the methodologies are sound and conform to licensing basis

Inspection Status – Piping DAC

- **First piping inspection completed December 2016**
- **No findings identified**
- **Inspection results available in fourth quarter integrated reports for both Vogtle 3&4 and V.C. Summer 2&3**
- **6 piping packages inspected**
  - (Class 2/3) **APP-CVS-PLR-100**, CVS Letdown from Penetration 002 IRC 2
  - (Class 2/3) **APP-CVS-PLR-530**, CVS Makeup from Penetration C03 ORC
  - (Class 1) **APP-PXS-PLR-010**, Direct Vessel Injection Line A
  - (Class 1) **APP-PXS-PLR-050**, CMT 2A Supply Line
  - (Class 1) **APP-RCS-PLR-020**, Pressurizer Spray, Auxiliary Spray, and CVS Supply and Return
  - (Class 1) **APP-RCS-PLR-050**, Reactor Coolant Loop
- **Inspection verified both technical and QA attributes**

Inspection Status – Piping DAC

- **Examples of QA attributes verified**
  - **Calculations properly controlled**
  - **Documentation was complete**
  - **Computer software used for safety-related calculations was verified**
  - **Design verifications were appropriate**
- **Examples of technical attributes verified**
  - **Calculated stress**
  - **Pipe size, materials, thickness, etc.**
  - **Inputs and assumptions**
  - **Load combinations**
  - **Decoupling criteria**
  - **Thermal and seismic analyses**
  - **Dynamic transient analyses (such as valve closure)**
  - **Pipe support/hanger design and configuration – loads and load combinations, baseplate design, pipe deflection limits, etc.**

AP1000 PRHA DAC ITAAC

Design Commitment	Inspections, Tests and Analyses	Acceptance Criteria
Systems, structures, and components (SSCs), that are required to be functional during and following a design basis event shall be protected against or qualified to withstand the dynamic and environmental effects associated with analyses of postulated failures in high and moderate energy piping.	Inspection of the as-designed pipe rupture hazard analysis report will be conducted. The report documents the analyses to determine where protection features are necessary to mitigate the consequence of a pipe break. Pipe break events involving high-energy fluid systems are analyzed for the effects of pipe whip, jet impingement, flooding, room pressurization, and temperature effects. Pipe break events involving moderate-energy fluid systems are analyzed for wetting from spray, flooding, and other environmental effects, as appropriate.	An as-designed pipe rupture hazard analysis report exists and concludes that the analysis performed for high and moderate energy piping confirms the protection of systems, structures, and components required to be functional during and following a design basis event.

Inspection Approach - PRHA

- Incumbent on licensee to perform and complete ITAAC – Staff verifies through inspection
- DAC inspection is an ITAAC inspection
  - Inspection activities cover all four AP1000 construction units
  - Documented in an inspection report on each licensee's docket
  - Conducted at Westinghouse HQ
- Multidiscipline team from RII and NRO
  - Two mechanical branch inspectors (RII)
  - PRHA subject matter expert (NRO)
- Analysis is heavily dependent on pipe stresses to determine pipe break locations; as a result, PRHA inspection will be performed <u>after</u> piping design inspection

Inspection Plan – PRHA

- **Confirms the protection of equipment required to be functional during and after an accident**
  - Assessed for the potential effects of pipe breaks (hydrodynamic loading, pipe whip, flooding, compartment pressurization, temperature, etc.)
  - 3-D plant model is used to identify potential targets in the zone of influence
- **PRHA analyzed based on AP1000 containment building and auxiliary building layout (areas/rooms/compartments)**
- **Verification of the methodology through a sample of rooms / compartments**

Inspection Status - PRHA

- **PRHA inspections will follow piping DAC inspections**
- **Inspection(s) not yet planned**

Issues Affecting Inspection

- Licensee schedule for package review
- Most current licensee schedule/status:
  - 15 piping DAC packages remain under licensee review
  - Piping DAC package reviews complete by August 2017
  - PRHA reviews complete by May 2017

Insights / Lessons Learned

- **No findings identified. Piping for the samples chosen were designed per the applicable Codes, standards, and regulations**
- **Schedules change – maintain frequent communication with licensees for updated schedule**
- **Inspection at Westinghouse instead of plant site enhanced the efficiency of the inspection (access to piping design technical experts)**
- **Review of piping design via the DAC inspection process was effective – free flow of information and questions between the inspectors and the subject matter experts**

Insights / Lessons Learned (Continued)

- **Nomenclature of some of the documents needed for inspection was clarified – document request for future inspections will be more efficient**
- **Improving licensee QC barriers to ensure construction does not begin before NRC notification (license condition)**
- **Documentation quality for calculations – assumptions and background information not always fully documented**

Path Forward

- **Conduct second piping DAC inspection – date TBD but anticipate 3Q/4Q 2017**
  - **Include fatigue analysis evaluations that were not completed in the first piping DAC inspection**
- **Conduct PRHA inspection – date TBD**

Discussion / Subcommittee Questions