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NUCLEAR REGULATORY COMMISSION

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591st MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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FRIDAY

FEBRUARY 10, 2012

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., J. Sam Armijo, Chairman, presiding.

COMMITTEE MEMBERS:

J. SAM ARMIJO, Chairman

JOHN W. STETKAR, Vice Chairman

HAROLD B. RAY, Member-at-Large

SAID ABDEL-KHALIK, Member

SANJOY BANERJEE, Member

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR. Member

DANA A. POWERS, Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

STEPHEN P. SCHULTZ, Member

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

GORDON R. SKILLMAN, Member

NRC STAFF PRESENT:

CHRISTINA ANTONESCU, Designated Federal Official

TOM BERGMAN, NRO/DE

SUSHIL BIRLA, RES/DE

IAN JUNG, NRO/DE/ICE2

STU MAGRUDER, NRO/DARR/APRB

DAN SANTOS, NRO/DE

A G E N D A

P R O C E E D I N G S

(8:31 a.m.)

CHAIR ARMIJO: Good morning. The meeting will now come to order. This is the second day of the 591st meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting the Committee will consider the following; Licensing Approach for Reviewing Instrumentation and Control (I&C) for the mPower and other Advanced Reactors; Future ACRS Activities/Reports of the Planning and Procedures Subcommittee; Reconciliation of ACRS Comments and Recommendations, and Preparation of ACRS Reports.

The meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Ms. Christina Antonescu is the Designated Federal Official for the initial portion of the meeting.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's session.

There will be a phone bridge line. To preclude interruption of the meeting, the phone will be placed in a listen-in mode during the presentations and Committee discussions.

A transcript of portions of the meeting is being kept, and it is requested that the speakers use one of the microphones, identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

And at this point, I think we'll turn it over to Charles Brown to lead us through this presentation.

MEMBER BROWN: Okay. First of all, I want to make just a couple of comments to give you a perspective on what the Staff is doing. They are using the small modular reactor designs as an opportunity to look at the process by which they do their overall reviews. It's kind of a look at the old Standard Review Plan, here's a way maybe we ought to do this and take the lessons learned from AP1000 ESBWR, all the rest, and then try to shift the focus; and I think you'll see it reflected in a couple of the slides in here to emphasize fundamental principles of redundancy, independence, determinism, diversity and defense-in-depth as fundamental -- an umbrella under which their reviews are done, as opposed to the what I call the potpourri of guidance piecemeal, trying to stitch all -- in other words, here we're going to review the cam shaft, and we're going to look at the

carburetor, and then we're going to try to say oh, yes, we put that together and we get an engine out of it.

So, I think they -- and this is their initiative to try to do this. They've been very forthcoming, and I appreciate their diligence at looking at how we've been doing things for the last three years and trying to get the focus so that everybody has a better understanding of these. And this was their approach at trying to say okay, how do we take what we've done the last three or four years and coalesce it into something that gives us a better overall view and confidence that we're getting what we want.

There are some details. This is a big picture look at where they're going. They don't want a letter right now. What they're looking for is just to inform us -- it's information to inform us of where they're going. And if anybody's got any particular comments or thoughts, so they can integrate that in with their follow-up work. I think there's a schedule in here also, so I'm not going to go into that.

So, with that should I -- am I going to ——- should I turn it over to you first, Tom, and let you make some introductory remarks?

MR. BERGMAN: Yes, thank you very much.

MEMBER BROWN: Okay.

MR. BERGMAN: And to be clear, I have absolutely no I&C background.

(Laughter.)

MR. BERGMAN: All I know about I&C has been pretty much taught to me by the people at the head of the table and some around it. But when I came to the Division of Engineering -- and by the way, I'm sorry, my name is Tom Bergman. I'm the Director of the Division of Engineering in the Office of New Reactors; is how different the licensing reviews for Digital I&C were compared to how we reviewed the rest of the facility. And a challenge to Staff really since I got there is why are we doing it this way.

It wasn't that it wasn't reaching good safety finding, it was, but the level of detail of the review and the things they looked at, it wasn't always clear that you were getting the return on safety given the investment and time.

As we went through those reviews we gained -- learned a lot, and we think we see some improvements, so we looked for an initiative to take the lessons learned and apply it to one of the small IPWRs, mPower in this case, as a way to potentially

come through with a breakthrough on how we review, and make it more like the rest of the facility.

And as Member Brown mentioned, by focusing on the higher order issues that affect safety like redundancy, independence, defense-in-depth and diversity, deterministic behavior, and I do like to throw in simplicity, although it isn't a regulatory requirement. It does make the reviews more effective if the design is not unnecessarily complex.

We do believe that this initiative has the potential to substantially contribute not only to effectiveness by which I mean a safety finding that's at least as good as the one we make today, but at substantially reduced resources in terms of our review and the effort on the part of the Applicant.

So, we've been working hard with all the stakeholders. The Applicant has to date been very receptive and supportive, which is important because this is -- we're trying something new. And I want to say NRO management up through Mike and Gary have been completely supportive of the initiative, and we expect to continue to interact with you heavily on this aspect of the mPower reviews moving forward.

So, with that I'd like to turn it over to the Staff.

MR. JUNG: Good morning, Committee members, and thanks for allowing us to be here and make our presentation on this topic.

Having gone through about five years as a Branch Chief in I&C in Office of New Reactors, and I'm very excited actually being able to try something new that could really provide the opportunity to establish safety more clearly, and then all the heartburns that we had on controversies, and schedules, and critical path, number of hours we spent, some reviews went to 15,000 hours on Chapter 7.

So, I think it's -- we are given an opportunity to really -- I'm very excited but at the same time it's a very challenging schedule and resources we have to put on to this initiative. So, I think there are a lot of low-hanging fruits in some of the lessons learned. Some of the lessons learned are still very hard, and some of the issues are still having interactions with even the Committee in some cases. But this project is not to solve all the problems, but at least the ones that we could clearly apply and make it -- make the whole licensing review process better.

We'd like to achieve as much and along the way we'd like to get all the stakeholders to be

familiar with this, and provide any suggestions and comments, and opinions. We're look for that, including the ACRS down the road. I think we'll probably come back next round with a draft -- early draft of the particular guidance we are developing. My staff is working hard.

And with that, along with me is Sushil Birla, is a distinguished Senior Technical Advisor from Office of Research for Digital I&C, and Dan Santos is also Senior Technical Advisor for Division of Engineering in the Office of New Reactors.

With that, simply --

MEMBER BROWN: I just want to make -- based on --

MR. JUNG: Yes.

MEMBER BROWN: I just want to make one other observation. There's a whole potpourri of, like I said, Reg Guides and specific requirements from GDCs to IEEE-603. This is not meant to throw those out. I mean, obviously, technical requirements are technical requirements. The idea is how do you use those from a top down use as opposed from a bottom up use, and try to establish that you've got a safe design.

And that's part of our discussion that we had in the informal meeting. I just wanted to make

sure you understood that they're not down here to take all the stuff and throw it out and say we're not going to -- that's not the point. The point is --

CHAIR ARMIJO: The structure of the Standard Review Plan going to change.

MEMBER BROWN: Yes.

CHAIR ARMIJO: Okay, to make it more efficient and get these --

MEMBER BROWN: Well, hopefully, it will be more efficient.

CHAIR ARMIJO: Well, I heard that. Efficiency was an important thing.

MR. JUNG: And my presentation will show a couple of examples where -- how wide the structure the way it's written is causing a lot of distractions and inefficiencies. You will probably see that fairly quickly.

Objective is information briefing for the Committee. Any suggestions and comments during the meetings that we appreciate, we'll capture those and we'll consider those. And we are focusing on right now small modular reactor design called mPower.

We are still learning about the design. It's a pre-application stage and that's the -- timing-wise, we are given an opportunity. That's why we are

putting some urgency to it. By requirement Staff has to have a guidance in place prior to the submittal of the application so the Applicant would be able to use the guidance to prepare the application.

MEMBER BROWN: Can you use an ISG-6, the stuff we did out of that, and you're following kind of a little bit of that --

MR. JUNG: They're not generally conceptually the same process.

MEMBER BROWN: Okay. All right.

MEMBER BLEY: Just for the Committee, you'll remember this is the first of the design-specific SRPs for all of these SMRs. I guess we're going to see other ones in other areas soon. We're going to see quite a few of these over the next year.

MR. JUNG: The answer is yes, and Stu can leverage it, but we'll just leave it at that. Chapter 7 is going way beyond what originally envisioned by the Division of Advanced Reactors in rulemaking for ORO TSRS development. Chapter 7 is going beyond it to incorporate significant lessons learned.

MEMBER SIEBER: Why did you choose mPower as the model upon which you would make this development --

MR. JUNG: It's a timing issue. That's the

first one that we'll see coming in --

MEMBER SIEBER: Okay.

MR. JUNG: -- from a schedule perspective.

CHAIR ARMIJO: But this framework isn't limited to modular reactors. Right? It's a general framework that could be applied to an AP1000 if it was -- or not?

MEMBER SIEBER: Starting over again.

CHAIR ARMIJO: If it was starting over again would you use this --

MR. JUNG: You will see -- the members will see some of the lessons when you look at it, you're going to realize yes, these can be applied for all. And there are some elements that might be structurally maybe a little different in the sense that the operating reactors, if their licensing basis is based on old regulation, like IEEE-279, and Advanced Reactors would have -- you know, they have no nexus to it. And we are still working with NRR along the way how this could really provide efficiency moving forward.

MEMBER STETKAR: I was going to say going forward, we're sort stuck with the in-process design certifications right now, but for the future digital upgrades for operating plants, are you at all

encouraged that you could weave this approach in for the reviews of those? Or are you too constrained about older licensing basis?

MR. JUNG: I don't think so. Some of the fundamental principles that -- design principles Charlie has been preaching us about last three years, and those are common engineering practices. Those are something that we believe it could be easily applied to operating reactors and new reactors. But in terms of specific regulations or licensing basis, 1960s design versus 2000 -- 21st century design, obviously, there's going to be some applicability, as well as the approach that are different to think through. Some -- I don't think overall the core safety or technical elements we believe is going to be generally applicable. So, I think we're going to have to work through it.

This mPower practical initiative, we are doing it as a sort of -- what we call sort of trial. We want to actually use it and demonstrate what works, what needs to be improved.

MR. BERGMAN: I think in the interim period before this was incorporated into say SRP, this would be looked at more as an alternative way. It would be available. My impression is for the operating units

they're tending to do a few systems, so there may be advantages to sticking with what's currently in the SRP. And, in addition, their schedule frequently is tighter because the upgrade is linked to an upcoming outage, so having a pathway that's already been established, the ISG-6 may be their preferred simply because it's more predictable at this time.

MEMBER STETKAR: I was thinking more of a larger scope, like the Duke Power conversion where you're not system specific, you're really replacing the whole protection system.

(Simultaneous speaking.)

MEMBER BROWN: This would have been -- after the Oconee experience when I first got here, I was looking forward to an approach like this which will get us -- I don't see how this would not apply to the --

MEMBER STETKAR: I was just curious, you know, whether --

MEMBER BROWN: -- even though the licensing basis will -- this is more fundamentals and principles based, and I don't think it -- what comes underneath can be former licensing basis. It can be a more current licensing basis, so that's the point, is get those fundamentals up at the top level and focus

on those. Make sure you get enough detail that you understand what you've got in those five areas, and you go from there. So, that's --

MEMBER STETKAR: I was trying to think in terms of applicability. I mean, in the license renewal scope if we're looking at several more years of operation for the current fleet, I would not necessarily be surprised if a number of plants were going to go the approach of large-scale digital upgrades.

MR. BERGMAN: And in the long term we think -- again, we'd like to actually try it first, but we believe this approach yields benefits, but those plants between now and then, again, ISG-6 predictable. I would expect they may stick with it, but that's between NRR and individual licensees.

MEMBER STETKAR: Okay, thanks.

MR. JUNG: Okay, looking those, I'd like to go over some of the high-level background, and then I'm going to share with you some of the key lessons, not all the lessons. We are still compiling, some of the reviews are still ongoing. And the eventual goal, what we are trying to achieve and some of the challenges we have. Any time you have a brand new initiative, there are some certain challenges. A

little bit about status and schedule, and at the end I'll summarize that. Next slide.

As I stated earlier at the beginning, licensing reviews of I&C has been a significant challenge from the perspective of safety demonstration, as well as the schedule and resources for new reactors. Starting with ESBWR, I've been on this table several times, along with Harry Jackson's group on EPR and ABWR South Texas. It was all challenging, but Staff worked hard, and I think we eventually made a safety finding. I think lessons learned back -- you know, looking back some of the areas now, I don't know why it took that long. I wish Applicant was forthcoming on safety, clear design information up front without going through three, four rounds of RAI, hundreds and hundreds of RAIs trying to get the information that we need.

There are some structural issue that Staff -- structure of the SRP that really introduced a lot of time for the Staff, because the way SRP is written and structured, and it was a challenge for us. So, we learned a lot of lessons from that. That's the background of why we are here.

In terms of the opportunity, the Office of New Reactors Division of Advanced Reactors and

Rulemaking will be called DARR in the organization after this reorganization we had. Has decided to develop a design-specific review standard for small modular reactors starting with mPower, new scale design will have its own, their logic, and specification beyond that. I'm sure the Staff is still questioning sometimes, but I think when I talk to Stu and folks it makes sense. It's a new way of doing it. Once -- design certification, once you use those tools that design is standard design and it moves on from that perspective.

Stu is here if you have any questions on why are we developing that. Stu can answer that. Next background.

(Laughter.)

MR. JUNG: The purpose of this presentation is not to really discuss why DSRS. We are given -- the Staff is given a tool an opportunity that we're going to work with that.

So, timing-wise right now the schedule what the Staff heard was that the B&W is planning on an application, design certification application for mPower sometime late fiscal year '13, late 13.

MR. MAGRUDER: It looks like late calendar year '13.

MR. JUNG: Late calendar year '13, so--

mR. MAGRUDER: Towards the end of '13.

MR. JUNG: So, just about two years to go. So, I think the goal for the Staff is at least six months prior to their application we'll finalize the SRS for the Applicant to use. But before that, the Staff is trying to publish this draft, the SRS work for public comment, so the Applicant would know much earlier than that.

Of course, for B&W and Northrop Grumman, who is the vendor for supporting this, they already know what Staff is thinking about. They are already supportive of -- they already have certain areas they already started working on. So, they'll have a lot of time working with us.

MEMBER SIEBER: Will your development effort in this area impede in any way your review of the mPower application?

MR. JUNG: I don't think so. Right now, those areas that are critical based on lessons learned, of course, B&W knows what areas is going to be important, for example, Staff on methodology, they already submitted the topic report we are looking at. They are working on some other areas already. So, I don't think it's an issue, but they know it's coming.

They understand it's a lot of challenge.

MEMBER SIEBER: And they have agreed to it already.

MR. JUNG: Yes.

MEMBER SIEBER: Okay. I think that's important because it does require additional effort to do what -- to take the path that you're taking.

MR. JUNG: Yes, B&W already has expressed that potential concern with us, because we are fully aware of it.

MEMBER SIEBER: Okay.

MR. JUNG: It is -- at the end, there's current SRPs always available, so if they're willing to go with that current -- I think Staff is more efficient now than before, but we are trying to take extra step. I think you'll see there are a lot of low-hanging fruits that is going to help both sides very quickly.

MEMBER SIEBER: Okay, thank you very much.

CHAIR ARMIJO: Are there unique challenges in this that are simply because to apply this methodology when you have -- you're going to be operating a number of modules from perhaps a single control room. Is the I&C structure going to be different, or you see this as --

MR. JUNG: I don't think from an I&C fundamental design principles and fundamental regulations, IEEE-603 Standard I don't think is going to be applying, is going to cause any significant challenges. I think it's more of a staffing issue, and the control room design itself. I think it's more of the other disciplines.

I know there are some policies just being discussed and addressed from that perspective, EP staffing, control room design. But those are beyond the fundamental design principles with I&C design.

CHAIR ARMIJO: Okay.

MR. JUNG: I don't think it's going to be significant challenge, but we are closely tied to those policy issues.

CHAIR ARMIJO: Okay.

MEMBER SCHULTZ: Is the major focus here only to develop this for the I&C technical field, or are there other technical fields that could benefit from this in other areas of engineering?

MR. JUNG: I think there are -- do you want to --

mR. MAGRUDER: This is Stu Magruder from Division of Advanced Reactor Rulemaking. I want to make sure I understand your question. Are you asking

will there by other areas of the SRP that are updated?

MEMBER SCHULTZ: That's correct, that's my question.

MR. MAGRUDER: Yes. And the answer is yes, we're planning to go through all the chapters of the SRP, actually. As Ian alluded to earlier, and as Member Bley mentioned, the direction the Staff got from the Commission was to look at the SRP and see if we could do a more risk-informed and integrated review of these small modular reactor designs. So, we're going to go through all of the chapters. Some of them need more revision than others because of the specific design aspects, and we'll be coming to the Committee with most of the sections individually in any case. The plan is by November of this year to publish a draft revision of the entire SRP. We'll have a draft mPower design-specific review standard for the Committee to look at.

MEMBER BLEY: By November?

MR. MAGRUDER: By November. That's the goal. And that's predicated on having something out, a draft about a year before their application is expected.

MEMBER SCHULTZ: Thank you.

MR. JUNG: Next slide are the goals. I

think overall goals in a high level from the Staff's perspective, always safety focus. We would like to reach a safety finding in a more efficient and effective manner. And because of the structure issues that I talked about, and some of the distractions that came along with the other quality of submittals, details, I think reaching a safety finding in some areas took unnecessary longer time. Where at the end it was a simple Applicant design change or additional details with the diagrams that really solved the problem, where people are still trying to -- last steps trying to figure out.

So, let me say I think all the reviews we've done, at the end we reached the reasonable assurance finding. But looking back we are trying to see how we could really reach a safety finding -- the safety finding should be actually made by the Applicant themselves. It's a demonstration of that to the Staff in a clear and concise manner that we can understand and we can write the safety evaluation.

So, we see an opportunity. We make it clear what steps looking for, what the regulation says the Applicant has to do so that by the time we look at the application up front when we do an acceptance review, we can make a determination, yes, this is

going to be routine safety review. Some of the applications actually came along, starting with the ESBWR, for example, acceptance review, Staff rejected it for Chapter 7. It's not even sufficient review. And those are the lessons learned we want to -- not to repeat. All right?

So, what it did was eventually -- because all the other chapters are moving on. Right? Chapter 7 is eventually squeezed to review details that came along later in a shorter amount of time. What that does is even the second round submittal was not as good as even some of the chapters still, so the number of RAIs had to be significantly increased. That resulted in eventually use of significant design acceptance criteria, as well as number of RAIs were in the hundreds on certain topics. So, those are the lessons learned.

MEMBER BROWN: I wanted to make along that line, on these initial integrated Digital I&C designs that we were getting, it was like squeezing blood out of rocks to get sufficient detail during the licensing phase of our evaluations to show that we the fundamental principles of independence, et cetera, et cetera, determinism, et cetera.

So, you want to get the stuff in the

licensing basis. You don't want to have to depend on inspection to confirm that you've got the fundamentals, the licensing basis principles fully defined at the licensing basis time. And then have the other stuff which can be expressed in the inspection world and addressed after the licensing, later in the COL process, be done by those folks because it's more predictable. But the detail design, you want to get enough of that that gives you those overall principles and you don't get trapped with a DAC in some cases which are kind of squishy, and you're depending on people four years later to confirm the --

MEMBER BLEY: As I understand it, Charlie, and you guys help me out, I think you expect them to come in with a Part 50 license request, which means it would have to be a complete design. Am I right on that? No?

MEMBER RAY: No, to the contrary.

MR. MAGRUDER: Now, there is a potential Part 50 application out there, but the first thing we expect to see is actually an application from mPower for --

MEMBER BLEY: That'll be a design --

mR. MAGRUDER: -- design certification.

TVA has talked about potential Part 50 application for their Clinch River site, but the first step of that would be a construction permit application which would not require details.

MEMBER BLEY: Right, that's true.

MEMBER RAY: The issue Charlie describes is a natural consequence of the procurement cycle for a new design. I mean, nobody wants to get out -- you want to get your license first and then get vendors committed and that sort of thing. And you want to have as much flexibility as you can. You don't want to have to invest in these details that Charlie is looking for earlier than necessary, so it's a natural tension that exists.

MEMBER BROWN: Absolutely. Harold is right on the money. I mean, they want the maximum flexibility and they would like to give you as little information as they can so that they can do whatever they want later in their design process, but yet you can't have -- you want your licensing basis for the fundamentals locked in place sufficient deal. Not all little pieces, that's not the point. It's the fundamental architectures and that's what this is -- my aim is to have, hopefully, they will develop this in that framework so we get to where we went after

multiple meetings trying to get that detail during the AP1000 ESBWR. That one was really brutal, and a little bit of that coalesced at AREVA, I think, the ESEEPR one came out somewhat better. There's a little tweak in there that still -- pardon? Go ahead.

MEMBER STETKAR: I was going to say there's a difference between a real design and not a real design.

MEMBER BROWN: Yes. So, I mean, it's -- this is going to be a little bit of juggling back and forth to make sure the right balance is maintained here. But, I mean, in my mind it's -- we want the licensing detail, but we don't want it to constrain the guys -- the designers so that they're locked into some level of intimate detail that's really not productive, or doesn't add to the fundamentals. So, how do you do that is going to be interesting.

MEMBER SIEBER: Yes. One of the problems, though, in the I&C, particular Digital I&C area, is that the devil is really in the details. And that's why I am uncomfortable with the DAC process without generalized statements and somebody someplace along the line has got to dig out those details to determine whether the architecture really fits the description. So, the whole process to me is sort of an

uncomfortable one; notwithstanding the fact that industries, applicants would like to put off as long as they can the decision as to what system they'll buy, what the architecture is, and the inner workings of the systems I think is just as important as its fundamental architectural design.

MR. JUNG: The Staff understands that. Later presentation will show on that subject of level of details and the use of DAC and ITAAC.

MEMBER STETKAR: Okay, if that's -- because I was going to ask. I certainly understand painfully the incentives for the first bullet on your slide there. And maybe some of your examples might -- I was trying to think of what unnecessary information would be eliminated by this -- you know, your second bullet says well, eliminate unnecessary information from being docketed. So maybe if some of your examples --

MR. JUNG: We'll cover that.

MEMBER STETKAR: Okay, great. Thanks.

MR. JUNG: So next few slides I'm going to go over some of the lessons learned that we had. Numbers doesn't mean it's really number one, it's number one, meant it was one of them. We thought it was very simple to explain, very significant.

The structure of the current SRP, there's

the next couple of slides will show what it means. It is system-based. It is based on RPS, ESF actuation system, interlock system, information system from 7.1 through 7.9, and then we have about a dozen Branch Technical Positions on top of the ISGs. Some of the members remember ISGs. So, all those are based on very specific either systems or certain small issues.

However, those are based on traditional SRP structure. If you think about license amendment for interlocks, then you'll go to 7.6 and elicit all the regulations, including Quality Assurance and Qualification. You name it, it's self-sufficient structure. So, that structure really doesn't fit with the modern advanced I&C designs for the complete plan where all these functions are generally very much integrated, and the members have seen PSMS or PMS for AP1000. That's the platform architecture, and all these functions would be performed within the boundaries of the platform.

That's completely different thinking in I&C that has over the years evolved. Of course, being digital it brings a lot of different issues, so Staff generate additional BTPs and ISGs on top of that. So, the challenge was there are a lot of repetitions of these regulations in each section of the SRP. And a

lot of the issues and areas that Staff has to look and evaluate, it gets repeated. And Chapter 7, very complex issues, would -- typically, what we do -- what I would do is assign certain members to 7.0. Why you don't care of 7.1, why you don't care of 7.3, why don't you look at 7.4 or 5.

So, next slide. So, you people get the licensing -- the regulatory basis listed in certain sections. It's just I highlighted only three, but actually, a lot of them gets repeated about 10 to 20 times in different parts of the SRP. So, individuals would go and we expect them to look at the SRP, make sure these regulations are complied with, and then you tell me how these are met. So, a lot of individuals —-- you know, different Staff member will have to go and start looking at it. And they soon realize well, it's in 7.22, so I have to work with the guy. Of course, there's a contractor in some cases. The contractor will have to figure that out.

So, some of the regulations like GDC-1 for which is very vague. I think overall is a good regulation, yet there's not a lot of Staff guidance on it, and people will talk, and they write an SER. Oh, you're writing the SER on -- that's going to be covered here, there, and a lot of these inner workings

of the Staff. It's really challenging.

And, as you can see, a lot of the regulations are actually written for safety systems, or safety functional requirements. It's not necessarily for the -- certain GDCs are written for I&C at all. It is for reactivity, or one of the regulations, ECCS systems. Chapter 15 reviews it, Chapter 6 reviews it, so we have to have a relationship with them.

So, as you can see, the same regulation is being addressed about 10 to 20 times within Chapter 7. Along with that you have a contractor, you have multiple members, and then you have other chapters who are looking at that as a global -- for example, Chapter 7 will look at the Quality Assurance. So, there are different pieces of inner workings, the interfaces that cause a lot of -- even if we do a little pointer to it, Applicant changes the format or something, then everything has to follow through. So, this fundamental structure inefficiency has really caused the Staff to spend a lot of unnecessary -- a lot of time on trying to make sure it is all connected right, make sure right words are used, conclusions are consistent.

MEMBER SKILLMAN: What consideration have

you given to the benefit of the existing review process? What I'm hearing you say over and over again is that the present process is very cumbersome. It is dissected in a way that requires multiple different reviews and can lead to numerous RAIs. But there has been great safety in the complexity of this review.

If you take the reactor trip system, there is a review reactivity, another for DNB, another for the net effect of the trip system on auxiliary systems, on control rod drive control system, so on and so forth. So, what consideration has been given to the benefit of the present system of review compared against the benefit of what you're now proposing?

MR. JUNG: Those are system-specific, the guidance we already have on, for example, OT delta T equations and things like that. Those existing guidance would remain as the system-specific section of the structure. What we are proposing is -- for those sections we have a set of lessons learned. For example, Delta T, those are core physics. Some of the areas we learned that some of the equations have changed, but our guidance wasn't really highlighted. Make sure if those equations are changing, make sure work with Chapter 15 to make sure those equations are valid and is right equation to meet the regulations.

Sometimes those interfaces weren't clear. We learned that through somehow talking to Chapter 15, we have this. Did you know about this? Oh, I didn't know that. So, we're going to have improvements on those sections separately. But what we are doing is those sections that are repeated in regulation or coverage that we know is a genetic safety system requirement, like independence, independence between safety and non-safety systems, those are independent to either reactor systems or interlock system. Those are genetic interface between all safety and non-safety system interface. It gets identified, reviewed and evaluated, and make a determination on safety.

Right now those independent -- as per an SRP the word "independence" is listed and mentioned more than 250 times. Some of them are actually intermixed with the independence of the organization, or independent V&V requirement. It's spread all over -- actually, my Staff will have to do word searching on what do I have to review for independence right now, and it gets repeated so much times. And some places there are even sometimes not clearly conflict shown up.

We're going to combine all them into one section, physical separation, electric isolation,

communication of function or independence, in one section identify all those interfaces, make a determination right there.

So, same consideration we have had on very specific details on system functionality and requirements, we're going to maintain it and potentially make it better.

MR. SANTOS: Dan Santos, NRO. I just want to add to what Ian said, and to your question. I think we're preserving the benefit of the current approach because we're not throwing away the current guidance. We're simply restructuring that. So, the fact that we need to make sure we're properly implemented those functions as derived from the safety analysis and others, that's going to remain.

Actually, I think with the new approach we can now impose a better what I call peer review, because even though you see repetition, you really -- you are not really getting that backup or peer review backup from one guy to the next. I think with a more systematic approach, then we can assign the assignments to provide that type of backup or more peer review from the guys. So, hopefully --

MR. JUNG: The benefit of what we are looking for, you'll see it later on of the other

lessons learned, is the Staff are -- the current SRP would -- the efficiency we're going to gain from Staff hours put on more safety, important aspects including those that are system-specific functionalities. Right now we are spending so much time on trying to figure out all the structures, and then a lot of time spent on process -- programmatic or process-driven elements like software development process, which multi-year, thousands of hours on those.

The benefit of investment of those areas versus really looking at the design itself, it can better focus on interfaces to other systems, because the benefit of having efficiency would allow the Staff to really look at inner workings of the systems. Especially mPower and beyond, we expect there are going to be areas that we should really look at it closely. And some of the core physics, for example, things like that compared to large light water reactors, we expect to see some changes to something that we have to write safety classification issue where -- and even diversity, defense-in-depth type of things where acceptance criteria is based on offsite consequences of Chapter -- Part 100.

For those criteria that we have we need to look at it very closely in terms of is these new small

modular reactor designs, and some of those criteria may need to be well understood before we make safety findings.

MEMBER SKILLMAN: My concern is that with the integration of the systems, platform-based systems one can envision two or three years from now a combined RPS, ESAS, control rod drive control system, and three or four more systems burned on on EPROM and that becomes the control system for the plant. And now the focus is on the EPROM as opposed to assuring that each of the independent functions functions as it's designed to function to protect the core.

So, at least my thought is we need to be careful here that we don't get so carried away with efficiency that we fail to focus on what these independent systems are really there to be independent for, to protect the core.

MR. JUNG: Absolutely.

MEMBER BROWN: Hold on. That is one of the fundamental problems we have with these integrated systems, because the Reg Guides even allow at one point. I've forgotten what the last Reg Guide was we reviewed on this which says well, if you want to put all this stuff under one big controller, you've got to tell us how you're going to maintain all these other

features. Personally, I didn't even like to hear the word everything under one controller, because the temptation is to do exactly that. So, the purpose -- let me finish real quick. Okay? Is to do exactly what you're talking about. How do you make sure you haven't lost the independence, the diversity, the defense-in-depth, the redundancy, and the diversity in the manner of integrating these systems into what does that platform look like? And that is a major concern to make sure we don't lose sight of those fundamentals.

Right now you have to dig through a rat's nest of pieces trying to stitch that together, as opposed to getting it right up front, show us how you're going to do that and meet those. And then we'll say okay, now you apply all the other criteria that we have in terms of that framework or that architecture that you've developed. So, that is a very real concern and one of the reasons for trying to get this up front now to get these principle design approach as opposed to I'm going to give you a bunch of little criteria and design requirements, and then we'll hope it meets these other things afterwards. And it didn't in some cases is what we found, so it's a good question.

MEMBER SKILLMAN: Thank you.

MEMBER BROWN: We do need to keep moving here.

MEMBER STETKAR: I was just going to interject. I wholeheartedly support the notion that each of the specific safety functions must be preserved, but we do have an awful lot of painful experience from the past, and not just in Digital I&C, but throughout the safety review process of focusing emphasis on a specific individual piece that we can carve out. That does not give us an integrated safety review, because everybody focuses on a specific box without the context of how that box is integrated with the rest of the plant. And that extends out to things like cooling water systems. That's why it's not -- so, that's another reason that I think that kind of a broader umbrella approach, especially within these integrated control protection systems makes a lot of sense, while still preserving those individual safety functions.

MR. JUNG: Thanks for the comment. Okay, key lessons number two. Some of them are interrelated so we already delved into number two. As you know, Chapter 7 SRP itself is about close to 500 pages long and very voluminous. Putting that onto somebody new coming in, this is your tool for review. Reading

through it takes about a couple of months, so very highly technical conversation, regulations and all that. One of the reason it's voluminous is because there's a lot of repetitions.

Anyway, the -- Charlie mentioned a couple of times, some of the safety significant elements are -- going in Staff will start looking at 7.1, or whatever section they have. The traditional structure, these are little background introduction and then regulations are listed, start reviewing those. A lot of times start with GDC-1 or 50.55(a)(1) in some cases. That doesn't really get you what you have to really focus on, so some of the safety-significant elements, looking back clearly independence was so critical to us. And it took a lot of time and a lot of RAIs, but it wasn't -- the current -- Staff guidance really highlights that the answers. If you had a lot of experience probably you can figure that out, but if you are new reviewers, then probably it was probably hard. Diversity, defense-in-depth, you have to look all the way through 50.7-19, all the main chapters of the SRP would have mentioned about two dozen times. You have to go to 50.7-19, and then we developed ISG-2, even though we still learned the lessons. We had an interaction with

HRS not too long ago. We had still unclear aspects. We are still developing it.

So, all this distraction of you have to do all the different things before you get to the really safety-significant ones. What happen -- what could happen is difficult if some safety-significant issue might be identified nine months into your review. RAIs goes out. Of course, a lot of people unhappy, why are you raising that issue?

But there are some examples we wish we had those issues identified up front. Applicant knows what to submit, what to demonstrate, acceptance review goes through, no problem. So, a lot of these distractions, especially we spend so much time on a lot of programmatic elements, quality assurance of software, quality development process. A lot of those elements -- some of them are even like a discussion on the validity of even in some cases use of DAC. We spent so much time on while the other reviews are still waiting to be done.

So, we like to make some certain decisions that which one needs to be addressed up front. Okay, what is the significance, so we like to make -- these more safety-significant elements are highlighted in our new guidance up front. Those are identified and

addressed. That's one of the lessons learned we have is we've got to make more important elements highlighted, emphasized in our guidance.

MEMBER BLEY: Have you actually started writing the guidance?

MR. SANTOS: Yes. I just want to add that what you're seeing here with the regulations is just the tip of the iceberg. In I&C it explodes when you start bringing in the Reg Guides. The IEEE standards that have multiple daughters. Our current guidance is very flexible, meaning it gives an Applicant in some cases three, four methods of how to read the regulation. And in some cases there's hybrid proposal, so for our reviewer it's very confusing. So, for DSRS this effort, we want to be -- create what I call a self-contained Chapter 7, where it brings all the things you need. Okay? And when there are multiple situations offer one proposed guidance that meets the regulation. They can deviate, but provide a more concise set of guidance, more closely associated with the context of the technology that's being presented. I think that would be a tremendous amount of savings and clarity there, so I just want to -- that goes --

MR. JUNG: It's related to that. I&C technology, as you know, the industry practice will

continue to evolve. The software --

MEMBER BROWN: Be careful.

MR. JUNG: What I'm saying is -- what I'm trying to get at is Staff guidance is developed to provide -- we develop the Regulatory Guides or even SRP, we start mentioning certain standards. Those -- a lot of standards are industry practices for the designers or implementors. Something that we learned that as you introduce, as you start endorsing certain standards that's reaching the level of detail of what necessary, what we need as a regulator to be able to review and approve it. Suddenly, you introduce the level of the detail, the criteria expectation of the regulatory perspective reaches all the way down to the floor of the individual offices of the designers. The burden gets shifted to the NRC to have the confidence that they are actually doing it right. That's tremendously burdensome to the Staff. The IEEE standards goes out to certain -- the independent organization. Their independence is good for independent V&V. By the time you get to certain criteria that in some cases we end up reaching at their actually education level, and things like that, it's really burdensome for the Staff.

So, those are some areas, the burden of

what Applicant and designer has to do. What we need, what kind of clear commitments and things that can stand over time whether new revision of IEEE standards or something comes along. We will still stand NRC's fundamental position on what it is. That line is not clearly drawn right now. So, if my Staff choose to go really verify that, the burden is significant. That's where a lot of people struggle with as the guidance has gradually expanded as we endorse a lot of the industry practices.

Right now I think you might have mentioned the IEEE standards that we have either endorsed and expected to use. I think gets to thousands of pages in addition to 500-page in SRP. That doesn't capture hundreds of pages of Reg Guides, which endorses another set of IEEE standards.

I think it's something that the Agency should look carefully. It's something that -- what's not working? Well, industry is supposed to do all that. Is it something NRC Staff needs to really go out that much detail in licensing stage for something that may not be built in 30 years down the road. It's something that we need to look carefully on, what is the licensing level of details. That's something we are struggling with, but certain decision is probably

hardest, and is good for my Staff because no decision, they'll struggle. So, that's something we are working on.

(Off the record comments.)

MR. SANTOS: For the sake of time, we're going to --

MEMBER BROWN: Don't skip number 12.

MEMBER SIEBER: Oh, you want 12?

MEMBER BROWN: Oh, yes. I don't care what you do. You've just got to put it up there. You don't have to talk about it, just --

MR. JUNG: We have mentioned already.

MEMBER BROWN: I know. I don't care. I want to make sure we drive that home.

MR. JUNG: For Charlie's sake, I practiced this slide the most last two days.

(Laughter.)

MR. JUNG: Okay. Staff agrees with the ACRS, especially with Charlie, that the current Staff guidance is not well structured to demonstrate how they conform to the fundamental design principles it has related to -- I'm going to repeat this; redundancy, independence, deterministic behavior, diversity, as well as simplicity.

MEMBER STETKAR: I think Ian's intent was

to convey the notion that it's burned in so deeply that it goes without saying.

(Laughter.)

MEMBER BROWN: I would like to say that, or think that. But I -- no, hold on for a minute. That's why the emphasis on architecture focus which is technology independent needs to be captured under this umbrella of how we approach the licensing basis.

It's got to be technology independent because it is, and that has not been the focus as it was recognized very -- first when I got here -- for those new members the ESBWR I&C design, I sat in on a meeting July of 2008. They gave us one sheet, a big box which showed boxes of here's a protection system, here's a SFAS system, here's a this. That was it. And then they had a listing in the DCD of every Reg Guide, every GDC which said we will conform to every one of these. You can approve this now.

I mean, it was an absolute abomination, and it took two and a half years, and a change of I think their I&C Director to finally come through and deliver a pretty well thought out architecture definition which showed that they -- with a few tweaks after we questioned them, came out okay.

How do we get that approach, the

architecture approach within this framework? It significantly simplifies the Staff's job in their presentations and ability to convey to us that they've done the complete review that's satisfactory for the licensing basis, and applies a structure underneath to make sure that all the check boxes get checked, but don't have the check boxes be the primary focus. So, that's why I wanted him to do -- you can go on to slide 14 now.

MEMBER STETKAR: Don't skip 13.

MEMBER BROWN: John wants 13.

(Laughter.)

MEMBER STETKAR: I just want to ask. I don't want to get into detail but just flash it up here. At a high level -- and this is what I don't know. Have you started discussions with the SMR vendors regarding the general topic of DAC, and the strong incentives for minimizing, if not eliminating DAC?

MR. JUNG: Yes. I just want to make sure, the Commission has provide DAC as an available tool; however, in the discipline of I&C given the current state of technology and the proposed implementations the Staff feels very strong that there is no real need for the Applicants to exercise that option. And we

have already started communicating that.

MEMBER STETKAR: I certainly hope that that continues, because that --

MR. JUNG: Yes.

MEMBER STETKAR: Okay, thanks. Now, you can go forward.

MEMBER BROWN: Thank you, John. That's a very, very good point.

MR. JUNG: With the notion that I have to echo that this has to be understood that making a safety finding in Chapter 7, if an Applicant can demonstrate without platform or technology-dependent variable, we believe they can. We've done it in some of the newer designs.

What we are realizing is it's not important to have certain vendor label on -- Westinghouse, something, or Common Q something. What's really important is how would you have an architecture and the flow of information, separation and independence that can be demonstrated at a higher level that will give not only the flexibility for future design, whatever platform, that can not only meet. It's actually probably better off, and that's the fundamental principle that we are applying. That will give you a clear picture of why we discourage, to

use the word carefully, discourage the use of DAC for I&C.

I think the Applicant has listened to us. They're amendable at this point.

MR. SANTOS: One thing we've got to watch very closely is that the lack of completeness of quality of an application is not an excuse for the use of DAC. So, we're going to be watching that very closely.

MEMBER BROWN: Yes.

MR. JUNG: So, right now I'd like to highlight there are four elements of this effort. Right now, we'd like to restructure. It's restructure without changing any guidance. Once restructure is done, we're going to incorporate the improvements to it. Some of the improvements that we are thinking very hard and working hard is the remaining three areas.

We'd like to have an integrated hazard analysis approach, meaning the hazards in a global span of the hazards not on a piece by, and 7.2.1 have these hazards over there. We would like to cover all hazards for software, hardware, internal, external, design-basis, beyond design basis. We always understood what the regulation governs, or policy

governs, or what we learned through an operating experience. We'd like to cover that.

And Sushil is here to explain, I believe, we had developed the user needs to research to help with us, so she has started working on that. Another element is related to the topic on the level of detail to be able to make the safety findings in the licensing stage that covers also the use of DAC or not for I&C. We'd like to define that. We'll work with an Applicant.

Also, for --

MEMBER BROWN: Are you going to use words like "architecture" in your final development of these things? I mean, we've emphasized that in each one of the other things. And it's a key element to get us up under these core principles --

MR. JUNG: Yes, it's critical. We've got to define what level, architecture level -- some of the guidance go all the way down to actually at the very low level, the nexus to overall safety might be very, very difficult to reach. When those others actually takes more time because so low-level on certain small boxes.

MEMBER BROWN: Well, that's why you want the high-level architecture that we've been trying to

achieve on the most recent new plant designs.

MR. JUNG: Yes. Answers to your question, yes.

MEMBER BROWN: Okay, thanks.

MR. JUNG: And, also, software development process I discussed earlier, which has been typically a critical path item that took multi-year, thousands of hours to do it. One of the reason being, Staff guidance is written in such a way, Staff needs to delve into very detailed software development process information, plans, execution of the plans. And despite the overall QA requirement, despite I&C software requirements on additional requirements and independence, guidance on independent V&V, Staff has guidance expected -- Staff expectation in the guidance almost makes -- the Staff needs to do on top of all that, we have to review and approve the process and process implementation. That's why it was so difficult.

That's one of the reason Applicant's quality and level of detail, we'll work through different channel. What we are trying to define is what Staff can do, what we can handle to provide some efficiency while providing as good or better safety coverage in the licensing. So, one of the concepts

that we developed is the use -- leveraging third-party, is a unique -- rather than -- it's very simple to NUPIC audit of the QA, so we rely on NUPIC to assess the QA.

Similar concepts, but we are given opportunity because Northrop Grumman has gone through this third -- applied this third-party concept. I'll explain that very briefly, and Charlie has some experience in applying this what we call CMMI Concept, third-party assessment. We'd like to leverage that. That could potentially put the -- some burden of the Staff back into the Applicant and third-party assessor.

Restructuring guidance, this is where we have made a lot of progress. Staff has been working on restructuring based on some of the lessons learned that we discussed. We are removing a lot of repetition, unnecessary repetitions in the guidance, structuring the guidance into more of integrated systems. We are looking at the -- removing repetitions, what we are trying to do is one issue is reviewed at one place and documented in one place, rather than putting that to two dozen different places and somebody has to continuous coordinate that.

I talked about independence. For example,

determinism. It'll be discussed in one place, and it'll be reviewed in one place. It'll be documented in one place, so when you get to our SER you will see one section on determinism. And you'll have details and basis for why determinism has been clearly addressed by the Applicant.

Next one I have to repeat that, Charlie, right? So --

MEMBER BROWN: You did fine.

MR. JUNG: Restructuring of the guidance to be consistent with the fundamental design principles. I don't want to repeat that, unless you --

MEMBER BROWN: That's fine.

(Simultaneous speaking.)

MEMBER SKILLMAN: A question to Charlie. Is the definition of determinism widely held and understood?

MEMBER BROWN: Deterministic processing is what we talk about in this circumstance. In other words, once you take data from a detector it goes straight through to the end and nothing stops the process. In other words, you've got a 50 millisecond cycle where every function is processed, every function is processed. In other words, you don't stop halfway through and say with an executive over there,

say oh, gee, I want to go over here and do a little self-test while I'm going a protection function.

That's kind of allowed if you look at it. You don't want that. Or if you have an interrupt-driven system where you stop the process to go get data as opposed to bringing it all in where the normal cycle just picks up data and then puts in the appropriate routines, and they're all done in series.

There's a number of ways to do that. There's one that actually is interrupt-driven, and it's -- we had considerable issue trying to work our way through that. And, finally, were able to come through it. They are more complex.

So, that's -- what we mean is everything gets done at once in a one-shot through.

MEMBER SKILLMAN: Thank you, Charlie.

MR. SANTOS: I just wanted to add that current guidance covers a lot of elements that can be categorized as what you do to get deterministic behavior. But they're scattered, so part of the effort is just to bring it under the --

MEMBER SKILLMAN: Thank you.

MR. JUNG: Current Staff guidance has a definition. I would like to make sure that that's something that's well understood by everybody, as

well.

MEMBER SKILLMAN: Thank you.

MR. JUNG: It's not -- these are -- researching of guidance. These are not all of them.

MEMBER BROWN: Let me make one other ——-- just to make sure one other point. There are a number of functions that you may perform in a protection mode that are not fast-changing. Temperature doesn't change real fast in many circumstances.

MEMBER SKILLMAN: Low pressure.

MEMBER BROWN: Well, low pressure can change depending on what the circumstances are.

MEMBER SKILLMAN: But it might not depending on what the scenario --

MEMBER BROWN: So, certain temperature functions you may not want to process in every one single 50 milliseconds, but what you do is you structure that 50 milliseconds to be the same cycle. It's just it does another module as opposed to this particular one. So, you can skip it a couple of times. So, you can bypass that and go on. That's -- there are a number of different ways to do it. I just wanted to make it clear that slow moving functions don't have to be done every time. Fast moving functions like rate protection and other type things, nuclear do have to

be done.

MEMBER SKILLMAN: Thank you.

MEMBER BROWN: That's the only clarification.

MR. JUNG: Okay. Another element that we are considering is -- Dan Santos is current Chair of the Multinational Design Evaluation Program under NEI, OECD working with other regulators and some of the vendors to come up with certain common positions in I&C space. They have developed certain common positions for regulators to use in a consistent and harmonized way. We'll consider that.

And, of course, is updating latest -- incorporating latest guidance that's been issued. That's an ongoing process in guidance development, some of the Reg Guides, or ISGs, and things that's not in current SRP. Current SRP will incorporate, so that the latest ones are covered in our DSRS.

There are a lot of other lessons learned. We are still capturing it. That's where some of the meat is going to come along in terms of defining how to incorporate some of the lessons learned.

MEMBER BROWN: You're talking the Multinational Design. I've got some -- just to let everybody know, I've got some inherent biases against

that because if you look at some of the designs that have been imported from across the ocean to over here have had to have significant changes. In other words, they have more tolerance -- they appear to have more tolerance for a less redundant, less independent, less deterministic set of design architectures than we -- let me put it this way, that I am comfortable with. Hopefully, the Staff is also uncomfortable, but they've made that effort to try to get them into the realm of what we are comfortable with, not we as a Committee, but we as a regulatory body. Did you have something else?

MEMBER STETKAR: I was going to say that may be changing as those designs migrate -- start to migrate across borders.

MEMBER BROWN: Yes, I'm not --

MEMBER STETKAR: Let's just put it that way.

MEMBER BROWN: I'm not saying you don't coordinate with them and look, but you -- I'm just --

CHAIR ARMIJO: Don't spend a lot of time.

MEMBER BROWN: Don't spend a lot of time trying to say gee, they do it over there, so it's got to be okay, because I don't buy that. And we -- you shouldn't either unless you can show a very good

reason why it meets our criteria. That's all.

MR. JUNG: Yes, one thing is not captured here is something that we worked hard on. It's already paying dividends on this. The removal of non-applicable regulations and guidance. For example, IEEE-279 is just not completely applicable to advanced and new reactors. It's been mentioned more than 200 times and discussed in the current SRP. There's a whole section on compliance with 279. I think it removed probably dozens of pages out of the current SRP by just removing that regulation and discussion along with that.

And then we have discussion of qualification more than 130 times. Although, Chapter 3 reviews them all too much, and then Chapter 7 continuously discuss qualification. Although we have a role, qualification of I&C equipment, our EMI, RFI, we are very sensitive to that. So, our role is to make sure technically folks have the ownership, and we provide our technical expertise to make sure that qualification is sufficient.

But what could happen is unless you are well trained on interfaces people will look at it and struggle through it at the end of chapter. SER has already gone through ACRS and was fine.

MEMBER BROWN: Yes, but you can't evaluate -- I mean, if we see Chapter 3 before we see Chapter 7, which has happened I think more than once, then you don't know -- we don't know as a Committee, have you all been factored in, and do the -- are the issues of interest to us from an I&C standpoint really captured under that process. And that -- I struggle with that a little bit because that seems to me the cart is getting before the horse in that circumstance. I think I made the cliche properly.

MR. JUNG: Yes. I mean, I think it's just clearly working with the Chapter 3 folks and the PMs to make sure what it covered, what's coming, and what area is still open. In some cases I remember there are certain qualification issues still open in Chapter 7 and Chapter 3. So, those are the interfaces we want to make an improvement, clear improvements in our guidance. When you work on this, make sure Chapter 3 is coordinated. Those interfaces can be another clear success for our -- okay.

So, the next slide shows a -- it's not final. We are still brainstorming about it, and we are still rearranging it, make sure we are still capturing the right regulations under these columns. So, this is current status of what we envision. Staff

is working on, is 7.0 is -- we need some introduction of how it's laid out. And then 7.1 will focus on the fundamental design principles under which we'll have -- under independence we'll list -- we'll have introduction section, and then areas of review, and then regulation regarding independence will be compiled and listed. All the Staff guidance and acceptance criteria will go right under it.

And then once we have that structure, improvements going to be imposed on it in terms of based on lessons learned. For example, identification of all interfaces between safety and non-safety, that cause a lot of problems because in some upper reviews, some of the interfaces showed up in a more detailed diagram three years down the road. We didn't know there was such an interface, so we're going to ask the Applicant just identify them all up front. Tell us why those are good practice as a part of the independence.

MEMBER BROWN: They ought to be able to identify that as part of the fundamental overarching architecture that they've put forth.

MR. JUNG: Right.

MEMBER BROWN: I mean, they ought to be able to do that.

MR. JUNG: Right now it doesn't do that. The Staff guidance is sort of -- if those are there, then we do it, but it doesn't tell the Applicant you have to identify. So, you can see the trap where given the Applicant, there are different engineers preparing, so I know I have an independent issue of interface here, but there might be other engineers not really thinking of that interface as their issue, because they're talking about maybe I'm interested in interlock function. So, not about independence, but about interlock between CAT non-safety systems. So, it's a lessons learned. It's ongoing. A couple of design centers identify those issues really late in the game, and in some cases they ended up changing the design at the last minute.

That's the structure. If you're going to preserve and make it better in terms of the system-specific requirements and guidance.

MR. SANTOS: That's what I say, we'll preserve it.

MR. JUNG: Right. And then we'll improve upon it by adding interfaces and some of the new things we learn. And then next slide. And then there --

MEMBER BLEY: You'll still be endorsing

IEEE standards in other things. Right?

MR. JUNG: Yes, we're not creating new guidance --

MEMBER BLEY: So, there will still be that morass, but at least you'll have the ties to it all in one place.

MR. JUNG: Yes.

MEMBER BLEY: Because you pretty much have to.

MR. JUNG: Yes, we have to. Endorsing, not endorsing those are Agency decision as a whole, so we'll --

MEMBER BLEY: And there's federal mandate that you --

MR. JUNG: Yes, but in terms of licensing -- yes, we'll have to do. But in terms of how to utilize that more efficient and effective manner in our licensing stage versus perhaps use the ITAAC inspection as a verification, that's the balance we like to have. Right now, a lot of --

MEMBER BLEY: There will be guidance on how they should present stuff?

MR. JUNG: Yes.

MEMBER BLEY: Organize this stuff so you can find your way through it.

MR. JUNG: Right.

MEMBER BROWN: We can read this one. Why don't you move on?

MR. JUNG: Okay.

MEMBER BROWN: If nobody has any questions on it.

MR. JUNG: Okay. I'll turn it over to Sushil here regarding an integrated hazard analysis of a few slides just to give you what's going on with the integrated hazard analysis, and what that means and the background.

MR. BIRLA: Thank you, Ian. Good morning. I am Sushil Birla with the Office of Nuclear Regulatory Research. I'm a Senior Technical Advisor there supporting the I&C community and the NRC.

The subject of integrated hazard analysis has been mentioned several times by Ian earlier. Hazard meaning potential for harm is quite well understood for external hazards such as fire, flood, tsunami, and so on. And it's quite well understood for electronic hardware where techniques exist, mature techniques exist to analyze for hazard techniques such as faulty analysis, failure modes and facts analysis. But when it comes to hazards contributed through engineering mistakes, defects, the state of knowledge

is not all that clear.

So, the purpose of this activity to support this integrated approach that Ian has mentioned is to bring together existing knowledge on how do you evaluate hazard analysis at the requirements phase, at the architecture design phase, coming down to software and so on.

The concept of architectural design -- hazard analysis of architectural designs starts from the plant level I&C architecture. That's where the relationships with non-safety systems comes in. Several members have mentioned the question well, what about multiple SMR units getting together? Well, that would naturally bring in the effect of that. The analysis should show that there is no adverse effect. It certainly has the potential for raising complexity, but the onus is on the Applicant's hazard analysis to demonstrate that has been properly taken care of. Then it proceeds down to the I&C safety system level, and then to the software in the I&C safety system, so on.

The problem is that what are the architecture specifications that are verifiable that assure you that the desired system properties, such as independence are preserved.

Today, the requirements of a high level in the abstract they have to be flowed down, the right requirements and architecture constraints have to be created such that they are verifiable. Not just verifiable, but verifiable independently; that means the evidence of verification should be verifiable by a third party not involved in the process. Those are the criteria of how specific you want to be.

The last bullet Ian has already mentioned a number of times. I'm going to skip over that.

MEMBER STETKAR: Sushil, before you leave that slide, you quickly got through one thing that's there and one thing that's not there.

When your first two bullets say well, for external hazards we have a mature way of thinking about that process, and for I&C hardware we have mature techniques. Some people would argue with that, but indeed I subscribe to that. There's the third sub-bullet under the third main bullet that is a single little word called "software." How have you thought through this integrated hazards analysis approach for software? And if you've not, how are you working in research to address that issue?

MR. BIRLA: Okay.

MEMBER STETKAR: Because everything else on

this slide, I sort of understand basically how to do. Not so much that software sub-bullet.

MR. BIRLA: Yes. If you take principles of architectural design, what you start with at the plant architectural level and use the same principles recursively at the safety system level, and then the software architecture that goes in that safety system and flow down that software architecture to the finest screen on which these safety findings depend. That is the approach we are taking in this hazard analysis.

That goes down to the point of including design and implementation constraints as a part of the architectural specifications. In other words, if those design and implementation constraints are not even there, then the potential contributing hazards have not been addressed properly.

MEMBER STETKAR: I think what I'm struggling with, and we'll need to pursue this. And you're aware of kind of our interactions --

MR. BIRLA: Yes, of course.

MEMBER STETKAR: -- in the PRA space and the deterministic space, if you will.

MR. BIRLA: Yes.

MEMBER STETKAR: The notion of -- I know how to do a failure modes and effects analysis for

hardware in principle. People seem to be struggling with how to do the equivalent for software, in particular because I can't get anybody to even tell me what the failure modes might be. So, I think it's important as we go forward for us to understand sort of that vision about how you do some sort of equivalent type of hazard -- if you want to call it a hazards analysis, or --

MR. BIRLA: Right.

MEMBER SKILLMAN: -- an FMEA, or something of that nature for the software and the integration of the software and the hardware. Obviously, this is pretty premature but it does affect kind of ongoing interactions between I&C and other folks who are in research who are struggling with that same sort of general issue for other purposes.

MR. BIRLA: Yes.

MEMBER STETKAR: So, that's what -- I just wanted to sort of pulse you on how far you'd thought about that software issue.

The other thing that I don't see here, and I was going to ask Ian earlier, but I decided to wait until we got to this slide, is in all of the multi-armed or multi-tentacled, or whatever you want to call it slides that we saw about how Chapter 7 reaches out

into a whole bunch of different areas, and how complex it is. Then on this slide in terms of hazards, I've seen no mention of cyber security. How have you thought about that?

And we've had some discussions in the past about this notion of integrating the safety system design functions of an integrated protection control system with the cyber security aspects at an early stage of the evaluation process. And the reason I left it to here is I can think of a bullet that says a hazard is a cyber security intrusion. So, I was curious why -- and I looked through your slides and cyber security doesn't show up anywhere else. So, have you thought about that, and does this new approach explicitly integrate that issue as part of the assessment?

MR. BIRLA: Yes, so you're absolutely right. An intrusion, unwanted intrusion, unauthorized intrusion regardless of the motive, whether it's malicious or negligence, any intrusion that can interfere with, or defeat, or compromise the safety function is a hazard. So, yes, absolutely fits in the conceptual framework very well without having to explicitly say that it is malicious in intent.

MR. BERGMAN: I would like to -- yes, we

need to be clear on that point, because that is --

MEMBER BROWN: I was waiting for you to talk.

MR. BERGMAN: Because that's -- and I've used the term cyber, is to a certain extent a free rider on the safety review that the finding would be -- and whether it's -- would not be that it's malicious or not. It would be this type of thing occurs.

If we make a finding that a malicious event is precluded, and I know we have a disagreement over this, is considered -- cyber is a form of sabotage and, thus, it is covered under Part 73, not under Part 50. But it doesn't mean that the exact same type of hazard due to inadvertent, or ineptitude, or however you want to look at it, hasn't been evaluated as part of the safety review. But we should not be making under Chapter 7 findings against cyber security. Just like we don't make findings for any other type of sabotage in that chapter.

MEMBER BROWN: This issue is not going to go away.

MEMBER STETKAR: I kind of expected to hear that. I'm just obviously pulsing it. We're thinking about kind of rethinking the way that these reviews are structured. You know, does this not give us an

opportunity to do -- to add that into the mix, because I can see how it would easily fit into this type of concept.

MR. BIRLA: Yes. And you saw that right. Now, if you partition that issue into threats and vulnerabilities, the examination of vulnerability for any potential -- now, you get the idea.

MEMBER STETKAR: Yes, that's -- I'm not talking necessarily about a threat assessment, but at least an evaluation of the design protections from a vulnerability assessment.

MR. BIRLA: So, my idea here is to view that as a class without being explicit about the intent, so that we can work into that approach of the vulnerability analysis.

MEMBER STETKAR: Okay. I just wanted to -- I needed to pulse you on that. I thought Charlie would, but --

MEMBER BROWN: I'm still trying to figure out how to attack their impregnable castle and get a cross on this. Well, one of the recent designs we looked at, if you breach one firewall you can actually compromise the data coming from the plant that goes to the control room. And it's a matter of how -- I've got to figure out and make sure I understand that before I

say anything.

MEMBER STETKAR: You got me, that's details of the design.

MEMBER BROWN: It's the detail of the design, but it was presented to us, and it was shown in the thing, but it's been ignored relative to its point. So, anyway, it will come up again.

MR. BERGMAN: Well, not trying to advise the Committee, of course --

(Laughter.)

MR. BERGMAN: If I desire to do what you wanted to do, my course of action would be to pursue rulemaking because we're pretty confident how the rules read. Being a member of the Staff not involved with that rulemaking, it's relative newness and the fact that it went through a very involved process to be generated, and was kept in Part 73, I would cautiously think about proposing a rulemaking, especially when at about the same time the Commission deliberated the Aircraft Impact Rule, which began in Part 73, but ended in Part 50 as a design and safety issue. So, they made that decision in one case and not the other. And you can't read -- there's nothing written down that explains the rationale for taking the two different approaches. But that was the

approach that was taken, and --

MEMBER STETKAR: Well, all I'm saying, Tom, is that this may give us an opportunity to -- if there was a rationale, to revisit that rationale.

MR. BERGMAN: If there were a regulatory basis, it would be easy to do. The problem is we can't -- we, Staff, can find a regulation to link it to at this time.

MEMBER STETKAR: Understand your constraints.

MEMBER BROWN: Yes, I know. I've read 73.54 at least 450 to 1,000 times, and I read it slightly less constrained than you all. But that's a subject for another time, and I will -- I understand your point.

MR. SANTOS: What I like about this concept of integrated hazard analysis is that it enables an Applicant to really think about their systems, their plant without really being constrained by the regulatory structure per se, which is a good exercise in my mind from an engineering standpoint that they've got to do. Rather than oh, I'm going to draw this line between design basis and beyond design basis, and start with that as opposed to this is my universe.

MR. BIRLA: Yes. Dan has stated it very

well. This is Sushil Birla again. It provides us a --

MEMBER BROWN: Are you on slide 19 now?

MR. BIRLA: Yes.

MEMBER BROWN: Okay, thank you.

MR. BIRLA: Provides us an integration framework where things pick naturally, and you don't lose the picture of the forest going after one clause at a time individually. So, NRO has sent a User-Need Request to Research. It consists of two deliverables, as you see in the two bullets here. The first it to be delivered to meet the -- Stu's timing requirement of November 2012. And the second is integration into the DSRS that Ian mentioned.

We will be meeting every two weeks on this project between Research and NRO so that they have the awareness of whatever information we have uncovered up to that point so that they can pick up those ideas in thinking about how they want to organize the DSRS. So, right now my thinking is organize it around the hazard analysis.

So, this picture shows the relationship of hazard analysis to the overall SAR. Specifically, the result of hazard analysis scoped in our activity is safety requirements, design constraints, architectural

specifications that are verifiable. It excludes from its scope the whole area of verification.

So, that is the dividing line, the vertical line above at the 12:00 position that you see between the licensing space and the ITAAC space. So, we did not have a clear dividing line because we did not have -- how many times do you see the word "architecture" in our guidance? We didn't have the concept of architectural specifications and constraints very well articulated, so that's really a key contribution of this work.

And then when verification activities are performed, what you generate is individual pieces of evidence component by component item, and the 6:00 triangle says that the Applicant would need the SAR, have another activity to show how that evidence integrates to show that the -- I use the term safety goals, but what I mean here is the safety requirements that the safety system was supposed to satisfy. That's the end of my presentation.

MR. JUNG: Briefly, I think the scope and level of detail aspects of this area is big for us regarding the use of DAC. We are discouraging that. And to be able to implement that we've got to define the level of detail that is sufficient, necessary and

sufficient to make a safety finding in an effective and efficient manner. We would like to work in this area discussing with Charlie in terms of architectural level of constraints and requirements, as well as better defining clear elements that can be easily verifiable through ITAAC process, as well. That will put the burden more on to the licensing review with sufficient details.

In some areas we're going to need more details, or more clear information like diagrams and -- - logic diagrams and things like that. But in some cases, like those process-driven programmatic elements, we're going to define more as inspections activities in some cases. And then we're going to need a verification method, language that are clear. So, it's a balance between we need more in this, more clarity and more information, in some cases less, but you've got to still backup with the clear verification methods that that really -- if those are significant enough, then we need that balance. It's going to be hard decision, but I think we better make a decision. Otherwise, individual Staff member will struggle through.

MEMBER BROWN: Keep in mind, okay? This is my thought, okay, is that you can't verify via ITAAC a

satisfactory independent architecture for your safety plan. It just can't be done.

MR. JUNG: Understood, yes.

MEMBER BROWN: I don't know whether you call it DAC, ITAAC, or whatever, it just will not work. Your independent design, the fundamental principles have to be defined in terms of the figures represented to you for the architecture and how they interact, the divisions, the channels, whatever you want to call them, safety channels.

MR. JUNG: That's the goal. We'd like to reach a safety finding based on the details in the licensing stage that clearly demonstrate those principles up front. Verification with the implementation of the details that are not really -- Research is not necessary to make the finding. If we are finding something that should have been in licensing finding, that's something that we need to deal with through the framework we have. I think we have some experience I think we can define that.

Leveraging third-party assessment, maybe I'll turn it over to Dan.

MR. SANTOS: Okay. Basically, we learned through the Applicant that they solicit -- Northrop Grumman in this case would be the I&C vendor, and

during this mPower-specific program we want to see and leverage their track record already established in creating other safety critical, mission critical system. It's not that we're trying to impose new requirements or anything. We're trying to see what are they good at already that we can leverage.

And what we found here is that they have experience with this framework model. It's called the CMMI. The first thing I want to do is demystify it. Okay? This is --

MEMBER STETKAR: Please do.

MR. SANTOS: Let me start with that. It's not a process. It's not about defining a process. It is simply a process improvement framework. Okay? That guides the developer, in this system developer through a set of best practices to in a more disciplined manner show that they understand and can follow their own processes. That's basically what it does. Okay?

What we've found in our reviews is that we will, and will continue to review what are the right processes for software development established by IEEE standard. That does not change, but what we found is that in some applications given a number of reasons, we were spending thousands of hours becoming what I call pseudo-quality arm of their quality -- of

vendor's quality assurance department helping them and reviewing how they actually follow their own processes they committed to. Okay?

For example, software configuration management. We know what the process is established by IEEE standard. They say they comply to it, but for whatever reason we got in this trap of well, this is how you really need to do it, and you see what I'm saying? So, it's like our level of maturity was lacking in some of the applications, so we are spending too much time. If I have a vendor already that can demonstrate that is mature enough to follow their own processes, that will save tremendous amount of time. And that's what we are seeking with this, nothing more. So, it's just that the worry is kind of ooh, what is that? But we just want to demystify it a little bit.

So, that's all. We see this as an efficiency improvement. I think based on my experience there will be efficiency gains later on also in inspections because the inspections can then be better focused in some areas. Right now, we go to an inspection and you have to look at do I trust anything here about the development process, with another thing in mind, I can go more specific, these more specific

areas.

MEMBER BLEY: Is this process something they do, or something their other customers have imposed on them?

MR. SANTOS: In the case of DOD, there are some DOD contracts, for example, that will require them a certain level of maturity. There's five levels as part of their --

MEMBER BLEY: But you introduced this talking about third-party assessment, so it can't be their own assessment.

MR. SANTOS: No, typically there's a certified -- SEI is the Software Engineering Institute at Carnegie Mellon. They have a certified program for SCAMPI method of assessment, third-party assessment. That will come in and assess them against that.

Again, that doesn't guarantee that you're getting the product you need, or that they have the right process. It's that do they have that -- are they following this framework for process improvement. So, I just -- that's all we're trying to do here.

MEMBER BROWN: This is an expansion. It's been a while since I looked at the Carnegie Mellon --

MR. SANTOS: Correct.

MEMBER BROWN: -- standards. Yes, we

looked at that in our program years ago, and it establishes about five levels of software competency or something, whatever you want to call it in terms of your ability to develop software. Level one means you get spaghetti code, people are kind of sitting around just doing whatever they want to do and they don't worry about the standards to which they do it. I'm being a little bit facetious. And as you progress up the chain, you've imposed upon yourself some standards in terms of how you actually do your programming and software, and how you write your codes so that you don't put yourself in trouble. It requires you at the increasing levels that you comment every step of your code so that you know why you did that step, and you have a set of requirements, software requirements that you then have to verify that are certified that they have to walk through and demonstrate that their code meets. So, you go through this qualification. It's like an ISO standard. If you go through and quality to this, and you may -- I think you have to maintain it. You have to go requalify periodically. I've forgotten whether that's in there or not.

Level five is very hard to achieve, and it's very, very expensive to do that. And it's also very, very expensive to a customer. Level three seems

to be a rough level where a large number of people delivering systems have kind of settled in, and it seems to be okay. That's -- and my program before I left, that was roughly the area where we didn't push a whole lot harder. I mean, even we ran out of gold at some point.

MR. SANTOS: Yes, it's very expensive, as Charlie mentioned, and as you get to higher levels you introduce things like very formal error defect tracking, feedback mechanism, quantitative measures. This is very rigorous as you get higher up in levels. And, again, we're not trying to impose any new requirements. We're just trying to leverage what this vendor already brings.

MEMBER BROWN: The thing is the NRC -- the Staff will never be able to be code verifiers.

MR. SANTOS: Correct.

MEMBER BROWN: They do not have the resources to do it. Whether this really will be the total answer, don't know, but they've got to go do something to get a better handle, in my opinion, on trying to get a handle on software verification, as opposed to just relying on the vendor. Oh, yes, we'll go through the software verification process. There ought to be some standard.

MEMBER BLEY: There are -- and I just became aware of this through some other work I've been doing. You guys must know about it. Maybe it fits in here. There are automated software analysis tools that look at software trying to determine if there are, let me say traps in the software, places where problems could be hiding that are pretty elaborate and automated. And they're used apparently in other industries quite a bit. Are you familiar with those, and do they form part of this thing?

MR. SANTOS: I am. And, again, CMMI will not require you to do that. But if the vendor includes them as part of your process, and that falls in one of the category of CMMI, then CMMI will assess --

MEMBER BLEY: I mean, right now we're trying to make sure we don't have problems in the software through insuring the process is a good one. But there are tools to actually look at software and see if it has --

MR. SANTOS: Yes, and we encourage the use of those tools.

MEMBER BLEY: But you don't require it.

MR. SANTOS: Correct. And that will be part of --

MEMBER BLEY: But you're familiar enough

with it, if they use it --

MR. SANTOS: Yes.

MEMBER BLEY: -- you can understand it.

MR. SANTOS: Yes. And in some cases, you know, I cannot require, but we have asked those questions, why -- are you aware of this?

MR. JUNG: Some of the industry standards actually strongly recommends automation tools knowing line by line annual verification of the software.

MR. SANTOS: Yes. CMMI won't require that. That's why it's important, we will continue to retain our involvement of understanding the processes for which they develop their system. That is not going to go away.

MR. JUNG: Dennis, it doesn't really fit in all cases. Those are significant new codes, probably those are good practice to do it. But like USAPWR, certain designs that have gone through the development for last 30 years, it's been implemented in Japan. Most of the software codes really didn't change, so actually they have instituted from the beginning manual line by line verification, 30 years, millions of hours of verification, and on top of it they have to do independent V&V. Those tools are probably unnecessary as they develop the USAPWR, some of the

software changes they have to do is sometimes very minimal.

MR. BIRLA: Since I got asked, this is Sushil Birla. Your question was about the awareness in the technical staff of the technology, the use of those tools.

MEMBER BLEY: It was also do you require it, but I hear --

MR. BIRLA: As Dan mentioned, the NRC does not explicitly require the use of tools. But those techniques are showing up in the FPG type implementations.

MEMBER BLEY: I'm sorry, in the what?

MR. BIRLA: The FPG implementations.

MR. JUNG: Field Program --

MR. BIRLA: Basically, it is logic that is going to be running on some fabric that is -- that are no moving parts, as opposed to software where there's an operating system managing and so on. But the essence is is your logic correct or not? That question is being addressed by the verification tools used in the development process of code core implementation on the floating point 8A type technologies.

Now, there is a research project at EdF in France where they are examining that kind of a process

where from a high-level specification language that is used in the hardware world like VHDL, you automatically generate the logic, and then use automatic verification tools to verify whether the logic is correct.

And in this research project they recognize that solely depending on one verification tool does not give you the certainty that you need, so under -- the research contract is sole source by the way. So, they've got four different verification tools with the premise, note that word, that if one doesn't catch it, the second will. If second doesn't, third will, if third doesn't, fourth will. However, they are not at a point where they can assure that all four different verification tools, they've got the coverage they need yet. So, that's where the technology is at.

And in the pure software world where the application software is running on some microprocessor with some operating system, you can just imagine how distant we are.

MEMBER ABDEL-KHALIK: I must say that I'm conceptually troubled by third-party assessments. And the first question, is there any other place within the Standard Review Plan where third-party assessments are used?

MR. JUNG: I already mentioned, for I&C.

MEMBER STETKAR: Under QA.

MR. JUNG: I mentioned that, a NUPIC audit, for example, we rely on NUPIC audits results as a basis for going into --

(Simultaneous speaking.)

MR. JUNG: Another thing we forgot to mention is it really doesn't -- the element that does not really change the Applicant's conformance to the regulations or the process they defined. That's the one that level -- they have to define the process. They have to tell us are they committing to follow IEEE standards for configuration management and control, or define -- describe that if they deviate -- they still have to define the level of detail for us to have assurance that this process -- if that particular process is followed through that that's going to be -- because if they say I'm going to just do ISO9000, we're just going to reject it, for example. But they have to define generally -- they have to define that. They have to provide independent verification and validation. All that typically we expect, and they're going to define that.

What we are relying on on the CMMI, the third-party is providing is that yes, they have a QA

program. They have all that. But from an Agency perspective to insure -- to have the additional confidence. In the past, Staff looked over a lot of details to see. Tell me exactly how you're going to do it.

So, in operating reactors, of course, you had an output, for example, so you actually looked at the output, read audit, and all that. What we are --

MEMBER ABDEL-KHALIK: My concern is really -- it's a slippery slope issue, and whether you're getting sort of in a direction where you're abrogating your responsibility by shifting the responsibility to a third-party. And if you assure yourself that that's not the case, then perhaps that would address my concern.

MR. SANTOS: Very good sensitivity. I agree with that. And we need to do some training in all areas, because we cannot abandon our review of the process and understanding of that to justify the safety finding. What CMMI in this particular case is really doing is avoiding us to fall in the trap of having to review things we really should have been reviewing in the first place. But we need to make sure we keep that discipline that when units starts divesting what I call NRC's role in assuring safety

finding, I -- yes, we are fully aware of that.

MR. JUNG: That's not the intention.

MEMBER ABDEL-KHALIK: I know it's not the intention, but it's this slippery slope --

MR. SANTOS: We've got to be very careful. That's right. That's why I said, we've got to demystify the title of -- we have all of that.

MEMBER SIEBER: It's not only what your intention is, on the other hand there is public perception as to what the value of third-party reviews are.

MR. JUNG: There are a lot of nuances. I don't think we need to get into that discussion. But we are very familiar with that. We'll be very much aware of that.

Can we skip the --

MR. SANTOS: Yes, I already did.

MR. JUNG: Challenges, very briefly. It's a collaboration, continuous collaboration with an Applicant, because we are given an opportunity to really do it, because of the Applicant we are doing now, because we could have done it through next SRP update. The downside of that is if we wait for two more years, a lot of lessons learned by the people who worked on it now, some of them are going to retire

next couple of years, so we'd like to capture that and actually use it and learn. And we'll learn some lessons through that. We expect that. So, right now we have a real formal SRP update we could incorporate some of the outcomes of this.

Schedule is very challenging, by November. Big document here, we are trying to incorporate a lot of lessons. We are very conscious about these lessons learned going into broadly applying to other areas and future advanced reactors, even other large light water reactors, and operating reactors, will work with NRR and Research for that.

We are very conscious about the technical consistency across offices, applying lessons learned broadly, and for future SRP update. Right now, I think it's scheduled under budget process 2014 time frame. That's what I was told for next SRP update for the broader Chapter 7.

Okay, status and schedule. Staff worked -- has been working very hard and last several months working with the B&W, and we have a very early draft. We did a lot of restructuring by just removing a lot of repetitions, and deleting non-applicable side of it. We are actually half of what it used to be just by sizing it. Right now it's about 250 instead of 500

pages. That's tremendous success, it's easier for my Staff to just focus on areas. They don't have to worry about what's out there, and what do I have to do with this.

The current goal, November time frame to get this DSRS, not just for this Chapter 7 but other chapters to go out for public comment as a draft. In between these particular Chapter 7 efforts are unique and very challenging, and requires a lot of interactions. We're going to do a lot of interactions in public settings with the B&W, Northrop Grumman, and almost like every couple of months to reach that point.

The next draft we are pursuing is sometime March-April time frame, have something decent that we can start sharing publicly. So, we envision, I think ACRS is very much interested in this subject, so we'll probably work with Christina to see if we can come to the Committee maybe spring time.

MEMBER BROWN: If you can skip the summary phase of it, go ahead. It was not -- it was really just kind of a repeat, and we're running a little bit -- in the interest of finishing.

I anticipate a Subcommittee meeting at some point. What you all need to let us know --

Christina know when you want to do that so that we can insure that the -- at least the relevant -- those who are interested in listening to this. This is like doing PRA, TH meetings.

(Laughter.)

MEMBER BROWN: So, if you would make sure you communicate with Christina and let us know what time frame you want to do it. I don't want it to be at the Eleventh Hour and 59th minute. We ought to make sure we have enough time such that our input can be factored into what you try to do at the end of the year.

MEMBER SCHULTZ: Charlie, one comment on the presentation. Early on in the discussion you mentioned that one of the key benefits was that the Staff would alleviate the need to perform multiple or common reviews and so forth; and, therefore, you'd have more Staff resources for other things. And you mentioned peer review as one approach that could be used beneficially to improve the safety case.

In regard to the overall process, how are you assuring that the resources in the peer review area will be applied in a robust fashion?

MR. JUNG: Right now, I think peer review process already is an ongoing process. But we are

trying -- the Staff -- there are a number of Staffs and budget, and resources and schedule given is a matter of if -- Grade 15 engineer, for example, they are usually assigned as an overall lead providing a lot of help on the lower grade staff members. Even now is happening, typically the lead engineer will do the peer review throughout the review process. But the efficiency we're going to gain will make those existing peer review process even more systematic, and being able to look at the issues globally more, and having more time focusing on more important areas, not for those issues, 15 engineers trying to figure out the nexus to different sections of the SRP. We cover that regulation, rather than their question should be are they really -- are we really addressing fundamental design principles independence. Clearly, they'll provide that additional benefit addressing real safety issues better. I think, so that efficiency in allowing more time for the senior engineers --

MEMBER SCHULTZ: I expected this, but I wanted to hear that you were focusing on a robust process that would use that resource --

MR. JUNG: Yes, that'll give me also higher confidence to the Staff, since they have more time we expect them to do a better job.

MEMBER SCHULTZ: Thank you.

MEMBER BROWN: Are there any other questions from the members?

CHAIR ARMIJO: I'd like to compliment the Staff. I think you're doing a good thing in clearly the swamp, putting a better architecture up front, all the important stuff that Charlie has been teaching us. And I think you're already seeing benefits even at this early stage, so I think it's a good thing.

MR. JUNG: Thanks so much.

MEMBER BROWN: I didn't get any notifications of public -- anybody on the phone line or anything like that. Is there anybody that would like to articulate anything?

(No response.)

MEMBER BROWN: With that, I would -- again, I would like to thank you all. I'd like to -- for a very good presentation. Looking forward to a Subcommittee meeting. I do want to compliment the Staff because they have taken the lead based on what we've done over the last couple of years to take this approach and really incorporate it into their review process and lay out a structure. So, they've been very proactive, and they've been very gracious in coming and talking to us, and insuring that we're cut in all

the way along the line, so I want to thank you for that. I think it's important for us to understand where this is going, because it's kind of a new and untouched area for most folks. So, thank you again. With that, I'll turn it back to you.

CHAIR ARMIJO: Okay, Charlie. Thank you very much. What we're going to do is take a break now until 10:45.

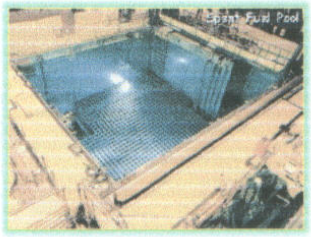
(Whereupon, the proceedings went off the record at 10:31 a.m.)

U.S.NRC

Investigations of Zirconium Fires during Spent Fuel Pool LOCAs

Overview

- Cooperative agreement between NRC and twelve foreign countries.
- Sandia National Lab is performing the experiment.
- Two test phases to be completed over a 3-4 year period.
- Validate severe accident codes for whole pool LOCA analyses.
- Phased experimental approach.
  - Study physical phenomena separately
    - Provide input parameters to accident codes.
  - Examine nature of Zircaloy fires in prototypic assemblies
    - Validate codes predictive capability.
    - Develop mitigation strategies.



Spent Fuel Pool

1

U.S.NRC

SFP Experiment Objectives

- Provide full scale thermal hydraulic and zirconium ignition data for severe accident code validation under air flow conditions:
  - Gas flow conditions
    - Spent fuel pool complete loss of coolant accident (LOCA)
    - Complete loss of water during refueling
    - Dry cask storage performance
    - Air ingress during late stages of core melt-down
  - Prototypic components
    - Eliminate scaling arguments
    - Represents fuel design intricacies
  - Code validation
    - Closely coupled into experimental design
    - Pre-test (Blind) and post test code data is compared to experimental results to ensure code adequacy

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