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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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FUKUSHIMA SUBCOMMITTEE

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OPEN SESSION

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TUESDAY

SEPTEMBER 16, 2014

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Charles H. Brown, Jr., Chairman, presiding.

COMMITTEE MEMBERS:

CHARLES H. BROWN, JR., Chairman

DENNIS C. BLEY, Member

RONALD G. BALLINGER, Member

JOY REMPE, Member

STEPHEN P. SCHULTZ, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

DESIGNATED FEDERAL OFFICIAL:

CHRISTINA ANTONESCU

STAFF PRESENT:

MAITRI BANERJEE

MIKE CASE

DAVID RAHN

RICH STATTEL

RUSS SYDNOR

T-A-B-L-E O-F C-O-N-T-E-N-T-S

1

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

(8:34 a.m.)

CHAIRMAN BROWN: The meeting will now come to order. Please excuse me if I sound a little raspy, I want to make sure everybody enjoys, maybe I can pass on the goodies here.

This is a meeting of the Fukushima Subcommittee, I am Charles Brown, Chairman of this subcommittee meeting. ACRS members in attendance are John Stetkar, Dennis Bley, Joy Rempe, Steve Schultz, Dick Skillman and Harold Ray. Christina Antonescu of the ACRS is the designated federal official for this meeting, however, filling in for her at this time is Mairtri Banerjee.

The purpose of this briefing is to review the staff's planned activities and discuss progress made to date on Reactor and Containment Instrumentation for Severe Accident Monitoring. Specifically the staff is working on the Enhanced Reactor and Containment Instrumentation, NRC Fukushima Tier 3 Item, which is a comment from the Advisory Committee.

The subcommittee will gather information, analyze relevant issues and facts and formulate proposed positions and actions as appropriate for

deliberation by the Full Committee.

The rules for participation in today's meeting have been announced as part of this notice for the meeting previously published in the Federal Register on September 3rd, 2014. We have received no written comments or requests for time to make oral comments from members, statements from members of the public regarding today's meeting.

Also we have some people on the bridge phone line listening to the discussions. To preclude interruption of the meeting the phone line will be placed on listen in mode during the discussion and presentations and Committee discussions. Also the bridge line will be opened at the end of the meeting to see if anyone listening would like to make any comments. At that time everyone should identify themselves by name during that period if they desire to make comments.

A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice. Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressing the Subcommittee. The participants should first identify

themselves and speak with sufficient clarity and volume so they may be readily heard.

We will now proceed with the meeting. I call upon Mr. Mike Case director of the Division of Engineering in the Office of Nuclear Regulatory Research to make an opening statement.

MEMBER REMPE: Mr. Chairman, before the opening statement occurs --

CHAIRMAN BROWN: I was about to call -- Fine, go ahead. Joy Rempe has an announcement that she must make.

MEMBER REMPE: I need to announce that I must recuse myself from some of the topics discussed today because of conflict of interest from other activities I do. Thank you, sorry for the interruption.

MR. CASE: Okay. Great. Thank you. As you said, my name is Mike Case. I'm really the, I'm still in the Office of Research but now I'm the Director of the Division of Safety Analysis. So I moved over to a different division. I was formerly the Director of the Division of Engineering and that's where I got involved in this particular issue.

So I'm what they call the SES Lead for this

issue. And the issue, as you said, is the Fukushima Tier 3 Item on enhancing accident instrumentation during beyond design basis events.

And to tell you the truth it's been somewhat of an interesting assignment in that it's different in that this is not really a staff-generated issue, at least from the staff on our side. The Fukushima Task Force looked at this and didn't identify this as a particular issue. And the ACRS identified this issue in your considerations of the Fukushima event.

And I am really quite impressed with what I call the safety ethic of Russ and his team, because they didn't really make a distinction that this is an ACRS issue or this is a staff issue. They took it on as a safety issue. And so they have been really diligent of moving the issue forward and sort of taking ownership of the issue as a safety issue and saying hey, let's understand this and let's see what we can do in regulatory space.

The approach we were asked to take by the Steering Committee of the Fukushima Task Force was interesting as well in that, you know, unlike maybe other issues, they didn't give us a bundle of FTE and

a bundle of contract dollars and say go out there team and create this technical basis for this safety issue.

What they asked us to do was to really go out and to work with others to pull together information that would support a technical basis for this issue. And so, once again, Russ and his team I think really did an admirable job.

So we're in the process of pulling that technical information together and so what they've gone out and did, they've gone both domestically and internationally to pull together information on this issue. So they've been out with IAEA, NEA, Department of Energy, DOE, they've been out with EPRI. They've been working with the Tier 1 activities that are related to this. And they've been working with the standard development organizations.

So what you'll hear today is really a status update. So they'll be telling you about the various progress they have made with those particular endeavors.

And since the purpose of the meeting is a status update I don't think we need any formal feedback from the Committee so, you know, you don't have to write a letter or anything. This is more informal so

obviously we're interested in your feedback on the particular issues.

So as they go through the status if you have insights we of course want to hear those. Probably for me the larger issue right now is how do all these pieces fit together to get to a regulatory resolution of this issue. And quite frankly we haven't got to that point yet. So we're still collecting information.

But I thought I'd share a little bit of, at least, my overarching thoughts. And so, as I said before, we really haven't reached this point but we want to get to this point.

Quite frankly, you know, when I look at this issue and sort of the information that I have to date I don't see this resulting in a new requirement in this area, driven a lot by, you know, in order to get like to a rule or some sort of a durable requirement like that you would have to pass backfit tests so when you look at this it's very difficult to see how this, you know, how what we're finding will result in a significant safety improvement.

So I'm not thinking that it's going to result in a new regulatory requirement but it may. I think this issue will have a lot of positive impact on

the Tier 1 issues because it sort of has driven us to ask a lot of those, in those Tier 1 environment, a lot of good questions of how they're resolving some of these instrumentation related issues.

And then I think there's some good potential in the standards development and the regulatory guide area that we can use some of the information that we've developed to sort of at least set out a future staff position on some of these issues.

And so, once again, after you hear the status updates it might be valuable to us as a team to maybe listen to your insights as to how do you all see the pieces fitting together, because that will help us focus some of our remaining activities.

And so that's all I have for an introduction. Once again, thanks, it's always great to be here. And I think I'll turn it over Dave or to Russ?

MALE PARTICIPANT: To Russ.

MR. SYDNOR: I'll start out.

MR. CASE: If you will start us out.

MR. SYDNOR: The first thing I'll do is just describe what we told the Commission and the Steering Committee we were going to do for this, and

we also told that to the ACRS too.

I'm going to reiterate something Mike said about this is primarily a status report. We've been working this a couple of years so we have some preliminary opinions but we're not going to necessarily share those today because we don't have all our technical basis to back those up yet. But we're in the process of deriving that.

We are interested in, or going to try to, Dave and I will try to explain all the various things we've been doing and what we've been looking at. And it's, you know, it's from an international perspective, it's quite extensive how much information is out there in this area. And how much interest there is in this area.

But we're interested in feedback from the Committee today if you think we're missing something. You know, if there's something else that you think we ought to be looking at. So just to go --

CHAIRMAN BROWN: Excuse me, when you say there's interest, after looking at the plethora of, you know, meetings and things you all have attended and the joint discussions, et cetera, and you just made a conclusion relative to what you saw that there was a

lot of interest. But what does that mean?

Are they going down a path to actually do something? Are they identifying parameters how they would do it? And you're all just kind of back here looking at what they're doing? I mean, what is the --

MR. SYDNOR: There's some of all of that I think in what you'll see. I think that will come out in the discussion but in general you'll see a lot of different entities, U.S. entities, national entities, that are looking at the same issues. Some perhaps more thoroughly than others.

And so we're looking at that and trying to discern why. What are the strategies or what are the assumptions that are driving some of those differences.

CHAIRMAN BROWN: Okay, let me phrase it a little -- Mike made the comment that he didn't really see this leading to any particular efforts, either a new rule or a change in rules or regulation, or whatever you want to call it, in terms of what utilities or power providers might be required to implement. He didn't see that coming based on the comments he just made.

Is that perception shared in these other entities that you all talked to in the international community? Are they thinking that yes we really ought

to have something and you all are kind of on a different path?

MR. RAHN: I can answer that a little bit because I've been participating in a lot of the international work. Almost all of the work that we've seen done so far is in the form of guidance, not requirements. So they're leaning towards development of how to develop a good monitoring system. Or how to identify the requirements that go into specifying a appropriate set of information needed by the operators to manage severe accidents.

We haven't seen a lot in the way of rulemaking. We haven't seen a lot in the way of finished standards yet either.

CHAIRMAN BROWN: So they may develop some guidance and/or standards, but yet there would be no, they would be just be pieces of paper laying out there on the table that if some of their providers wanted to do that or felt it was important enough that they could go use those but there would be no execution directed by the --

MR. RAHN: The regulatory agencies.

CHAIRMAN BROWN: -- the regulatory agencies.

MR. RAHN: And I'd say that first you have to have something out there to endorse and then once it's out there and has been, you know, absorbed by the industry and by the regulatory agencies in other countries, that that's the point at which they would identify it's something that must be done. But first I think they have to be led toward what it is first.

MR. CASE: You know, I think that's a great question. You know, like IEEE. IEEE has a standard on accident instrumentation so they're looking at the experience at Fukushima and saying hey what changes do I need to make to my standards.

I've got to look at that from a regulatory perspective. You know, once they make their changes I need to understand are any of those changes significant enough to pass a regulatory test.

And so I, you know, right now maybe I'm not seeing that but once again they're not done yet. So people are looking at it sort of from their perspective and they're looking at it from a safety perspective, which is great.

And so what we're really searching for is are any of those changes changes that will trip a regulatory threshold. So that's sort of the

difference in perspective.

CHAIRMAN BROWN: David, go ahead.

MEMBER SCHULTZ: David?

MR. RAHN: Yes.

MEMBER SCHULTZ: At the same time you're going to be discussing today, and it's been mentioned already, that there is a connection to Tier 1 activities here and you're not only working with or toward those activities but are really following them closely.

MR. RAHN: Yes.

MEMBER SCHULTZ: And providing input to them.

MR. RAHN: Correct.

MEMBER SCHULTZ: And those activities are moving directly to rulemaking?

MR. RAHN: Yes. We're participating in rulemaking activities.

MEMBER SCHULTZ: And so in some complimentary fashion could there not be either an opportunity or a need to apply requirements related to instrumentation moving forward?

MR. RAHN: We are discussing and proposing rule language. But at this point none of that language has been adopted in the current plan.

MEMBER SCHULTZ: Okay. Thank you.

MEMBER STETKAR: You mentioned, you know, people that you've discussed things with, which is a broad term, and interests, which is a pretty broad term, and guidance, which is a pretty broad term. Thumbing through your slides here I see that you've had meetings with OECD, NEA, MDEP, IAEA. Those folks don't promulgate any regulations, they only, if at all, promulgate general guidance and recommendations.

Standards groups promulgate standards. Regulators promulgate regulations. Have you had any discussions with organizations like WENRA to see what the regulators in Europe are actually planning?

MR. RAHN: In the Committee, for IAEA for example, we adopted some language from WENRA categorizations. You know, so in that sense we are using information from WENRA but we haven't had direct contact.

MEMBER STETKAR: Okay. What I'm probing is to see, you know, I think Charlie was trying to probe feet on the ground in terms of individual country regulators both in Europe and in Asia perhaps. So like what they're planning.

MR. RAHN: I suspect that eventually the

Japanese will have something along these lines.

MEMBER REMPE: That was a question I wanted to ask you of the various countries, are you seeing that the Japanese regulators are a bit more aggressive about it these than we are --

MR. RAHN: Yes. We have seen that the Japanese are more aggressive. Yes.

MEMBER BLEY: We have a couple of slides that touch on their R&D plan for this area, which is the most extensive work that we've found in this particular --

MEMBER STETKAR: From the Japanese?

MR. SYDNOR: Yes.

MEMBER BLEY: All right. I have a different direction I'd like to ask about. When you read the testimony of the guys in the plant and their frustration at how the instruments worked, it kind of moves you. Especially if you have ever operated a plant. Have you had any interactions with INPO, WANO or any other operator-linked organizations to hear what they're thinking and if anything's coming this way?

MR. SYDNOR: Under our MOU with EPRI we interface, I'll talk about that on one of our slides, and the initiative they're doing. And some of the

members of that working group are the leads for the owner's groups that are writing the SAMGs. And we've had some detailed discussions of instrumentation issues.

My opinion is industry appreciates this issue, now how far they're, you know, willing to go with the issue obviously the industry doesn't necessarily consider regulation as a necessary step in this regard.

But they are interested in the technical aspects of the issue that the strategies they put in place are tested and I will talk about, there's some new work that they're doing with simulators and simulating severe accident conditions that I wanted to mention during this presentation. But the EPRI project is probably our closest link with the industry.

(Simultaneous speaking.)

MEMBER BLEY: So you haven't had any interactions with INPO or WANO?

MR. SYDNOR: Not INPO or WANO.

MEMBER STETKAR: So you don't know what the operators would really like to have in these situations?

MR. CASE: Well, we do. Dave and Russ do, they used to be operators.

MR. RAHN: The issue that we see is that the operator needs to have as much reliable information as he can to execute the planned mitigating strategies for all types of events. And so the more reliable set of instrumentation he has the better, obviously.

So the issue is that -- The closest we've gotten to is when we kicked off the IAEA consultency meetings in Japan, they brought in a few folks from TEPCO to help inform us as to what the operators were dealing with. They actually I&C folks.

But some of those folks were actually at the plant during the event and had to deal with some of the problems they had with the loss of power and loss of available instrumentation. So we did get to talk to those folks. But I can understand the frustration that the operators must have felt.

MEMBER STETKAR: I probably can't understand the frustration that they must have felt.

MEMBER BLEY: Yes. Folks writing procedures sometimes and folks laying out requirements sometimes really don't focus on the instrumentation and what really will people be able to do at the times they're planning for them to do them. And I'm hoping there's more effort on that now, more focus on that.

But go ahead, you're probably going to cover all these topics anyway.

MR. SYDNOR: Yes, I think every question would have come up in later slides anyway. I just want to briefly go over what we told the Commission, what we told ACRS that we were going to do for this activity, the Tier 3 activity. There are three major tasks.

The first one really started several years ago and was working with the other Tier 1 teams. We had meetings, we communicated with them. Reviewed orders, what they were doing, what they were proposing. Tried to influence them to ask questions when they were dealing with the industry about instrumentation needs and uses.

And so most of that task is done, although in a later slide there's still some that's ongoing because the rulemaking is still ongoing.

And Task 2 was really probably the broader area that we didn't realize how broad it was going to be when we proposed it, because we didn't know the scope and breadth of efforts that were going to be undertaken worldwide on this specific to this issue. And so this was to review previous and ongoing research efforts and other coordinate with international and domestic

entities and standards organizations.

And so we thought we could make some inroads there and I think, you know, we have a good story to tell in that area.

And, finally, Task 3 was to, once most of Tier 1 activities were done was evaluate what had been done in this area and use this as part of our GAP analysis. We would gather information from Task 2, compare to what had been done in Task 1, or not done, through some type of GAP analysis.

We have started some work on that this year. And we'll talk about it briefly, we don't have our final results or come to conclusions yet but we're making some headway on that.

CHAIRMAN BROWN: Before you go on, back up a second. On the Task 1, I'm just going to take this as an example. When you say ensure that licensees and NRC staff appropriately considering instrumentation needs when implementing site-specific actions for Tier 1.

And then you look at Task 2, which talks about information available for severe accident management analyses and stuff like that. In looking through the various documents and paperwork and stuff

like that it was difficult to see where there was a focus on, as opposed to process, where there was a focus on more specific things.

For instance, instrumentation needs have to define what are the parameters you need. What's the range of the parameters you need? What was the experience we had at Fukushima of the instrumentation they had and what were their qualifications? And none of that information was in any of the, at least in the half a dozen documents that I looked at.

And it seems if you're going to provide input to the Tier 1 activities in terms of severe accident management instrumentation that you have to address more than what's the realm of research that's going on in the world in terms of stuff and what are the specifics that should be addressed. So that seemed to be a missing part of this overall project.

Didn't have any real big problem with trying to find out information. That was, you know, obviously you want to try to get as much information as to what's available and what people know. But you also have to identify what you want to know and about those specific parameters and stuff that you're going to need.

And it was a question I raised a little bit earlier, I asked the question in one of your earlier meetings, I mean if you're going to manage, we've got all these SAMGs and severe accident management stuff which is supposed to enable us to deal with these circumstances of the beyond design basis type functions or situations.

But if we don't have information from the plant to tell us how to use those what good are they, if you don't know what to address?

And so it just seemed to me some of this stuff was missing. If I've got the wrong picture and there's really something in there I'm --

MR. RAHN: Yes, you really have to get to the specific guidance documents that are being developed right now. So for example the --

CHAIRMAN BROWN: That from the IEEE standard was it 497?

MR. RAHN: 497, yes.

CHAIRMAN BROWN: Seemed to not really have a lot of detail in it. I mean there was a little PowerPoint presentation written on it.

MR. RAHN: Yes, the IEEE standard --

CHAIRMAN BROWN: Is sparse.

MR. RAHN: Well in the area of a severe accident -- Actually the purpose of the IEEE standard isn't to specify what those ranges are. You know, there's been a evolution in the IEEE standard that has gone away from the approach that was taken in Reg Guide 1.97 Rev 2, which where the staff specified the ranges.

You know, so those ranges and the ambient environmental conditions and so forth do need to be specified before you can identify the right requirements for designing a severe accident monitoring instrumentation program.

However, a lot of the guidance documents that are currently being developed require that to be done. So even though the staff itself is not doing that the guidance documents specify a methodology by which you would get that information. And then it would be up to the people who implement the system to follow that guidance.

CHAIRMAN BROWN: Okay. Go on.

MR. SYDNOR: As part of our Task 3 evaluation that we've done we are putting together much more detailed information. From all these documents we've found were extracting instrumentation requirements that these various entities have proposed

or analyzed the need for. And so we are taking those and building kind of a matrix of instrumentation that we're analyzing and trying to understand differences. Trying to understand gaps.

Some of that's driven by what accident mitigation strategy you propose. And there are differences between different countries and different pieces of the puzzle, whether you're talking SAMGs or whether you're talking FLEX equipment, there's different strategies. Some of that we'll talk about briefly when we get to the later slide.

But we are, I think when we're done we're going to have much more detail. It's in there, you have to dig it out.

CHAIRMAN BROWN: Okay. You can tell I'm struggling.

MR. SYDNOR: It's a status report, not --

CHAIRMAN BROWN: I come from the make it and break it school of thought where you take a direct experience that we had, which is probably the most severe experience, setting aside the Russian experience Chernobyl, where we have a lot of information relative to the actual conditions, both radiation temperatures and pressures. The ability to

know whether you had water levels in certain places, et cetera, et cetera, for the BWR standpoint.

And yet that all just seems to be lying fallow, it's all just spread around the ground and laying there, it's just not being utilized to develop at least a go forward thought process of where do we think we about where we should be.

And you can always do more to confirm some of that but that was a pretty severe downstream, you know, long-term effect type event. And instead we have a ten-year process maybe to get to some idea of what we may do post ten years from now, which is like an eternity.

So it's just a little difficult for me to see where we're going to end up with anything in what I would call, and I don't mean tomorrow or the next year, but within a reasonable timeframe in terms of giving people -- Even if we only make it guidance as to what they should be considering for their plants.

So that gives you a little flavor of what I'm, it probably sounds like the earlier discussions we had in the previous meetings. So, okay, you can --

MR. SYDNOR: Okay. Under Task 1 I had mentioned some of the stuff we had done earlier, one

to two years ago. We're still communicating with Tier 1 teams, primarily the new consolidated Rulemaking Team.

In addition we have, Dave's actually on one of those teams and I have another member on my staff who's from a station blackout standpoint, is on that rulemaking team also.

We've reviewed the Tier 1 activities, I already mentioned that. We've reviewed the guidance documents that were put out. Dave was, and a number of people in his organization and some in mine, supported the spent fuel order. And so that gave us a lot of direct experience in dealing with the industry and with licensing of the order and the guidance and development there.

And some of that got into qualification of the new equipment that we were, new level indicators we were requiring to be installed under that order. And so we can apply some of that experience to what we're doing here.

And in the last bullet I think I mentioned a couple of times, Dave is on the consolidated rulemaking team and we are lobbying them, and it remains to be seen how successful that is. Or, you know, if

it, as Mike was saying, whether it can pass the backfit requirements.

I'm going to let Dave talk about what he's been doing. We have a number of slides on international activities because there's really quite a bit going on there.

This one is one where we think there's been a lot gained out of this activity and this slide and a later slide will talk about that in relation to how we believe we can take what we learned from this and roll it into hard regulatory guidance.

MR. RAHN: So the IAEA --

MEMBER RAY: Excuse me. I've been thinking about something you just said and it took me a second to decide whether I needed to ask a question and I do.

You're talking about backfit requirements for beyond design basis accident mitigation, is that what we're talking about? That's what I heard you say.

MR. RAHN: I think it's more for severe accident management, severe accident monitoring capabilities in --

MEMBER RAY: And we have a way to apply backfit rules to that?

MR. RAHN: Yes.

MEMBER RAY: Okay.

MR. RAHN: So the IAEA effort was to develop a technical document that's going to be used. Initially its purpose was to help new agencies, new regulators and new member countries to identify a path for identifying the appropriate set of information that could used by the operators for a range, a broad range, of postulated events, starting with anticipated operational occurrences, going through transients and design basis events. And then into what they call design extension conditions, some of which include fuel damage. Some do not, some do.

And over that broad range the IAEA Team had set up a committee that was made up of members of accident management strategy folks as well as instrumentation design folks. And together they identified a path toward determining the appropriate set of instrumentation that operators would refer to while dealing with the broad range of events that could occur.

In the area of severe accident monitoring they specifically identified the need for back up power for those instruments. And the approach they took is

that that backup power and the categorization of severe accident instruments should be treated special, different from the design basis event equipment.

So it would have an independent power supply from the design basis event equipment and as well have better qualification from a ability to withstand harsh environments.

So the guidance was put into that document that leads one toward specifying that range of parameters that would be needed to be monitored. It didn't have the numbers in there but it talks about, in qualitative terms, the range that would be needed.

And then there's also guidance put in there as for how to determine that, through modeling or through evaluation of other events that have occurred.

So the kind of documentation that should be sought after by someone who's designing a new accident monitoring system would involve evaluating things like you were mentioning from the accident monitoring information that was available in Fukushima and from TMI and other types of events.

So a lot of folks have interest in the Fukushima data that INL is maintaining. And there's been a lot of interest in qualifying and quantifying

the parameters needed to determine the range requirements for those instruments and the survivability for those instruments.

MEMBER STETKAR: Okay, what is the timeline on the publication of that tech doc?

MR. RAHN: Well, yes, as soon as this document is published, which it's to be published within a month or so.

MEMBER STETKAR: Oh, okay. So it's close.

MR. RAHN: It's been in the publishing mode for a long time.

MEMBER STETKAR: It's in published locations over there?

MR. RAHN: It's in that stage, right.

CHAIRMAN BROWN: That's the first line up there? That's the "Accident Monitoring Systems for Nuclear" -- this next one at the bottom is a separate document, right?

MR. RAHN: Yes, a new one. Yes, that's a new document that just got started, actually the first meeting is going on right now as we speak. They met yesterday and they're going to meet all this week. And they're talking about methods for identifying a better

way of qualifying equipment that must survive in order to provide the information to the operators.

That is being more focused toward equipment qualification. But my personal opinion is I think in order to solve this issue it's going to take a combination of qualifying equipment and maybe thinking outside the boxes how something should be monitored.

But I think the approaches that they're taking is as a follow-on to the first document that I pointed out that survivability analyses need to be performed.

MEMBER SCHULTZ: That first document --

MEMBER RAY: Wait a minute, let me try here for a second. Let me ask my colleagues a question because I'm missing something here.

We're talking about establishing specific requirements for this instrumentation. Those requirements effect, ultimately, what the cost will be of the systems we're talking about. After we've done that then we apply cost benefit, I mean, a backfit rule to determine whether to impose those requirements, is that the way it works?

Well I'm just, I thought maybe you guys

could talk about it and I wouldn't be badgering them with a stupid question. But I don't understand how it works to apply the, to do what you describe, which I understand I believe. And then say well now we're done but it won't pass the backfit test.

Well, what would happen if we went back and did it over again and came up with something different, might that pass the back -- How did you iterate between that ultimate hurdle which the Chairman has talked about recently, the Commission Chairman, and what you're doing now to decide what is the right thing to include in these guidance documents that you're talking about? End of question.

MR. CASE: Is that to the Committee or to us?

MEMBER RAY: That's to you now, because they're --

(Simultaneous speaking.)

MEMBER RAY: They don't seem to want to answer, so maybe you can answer.

CHAIRMAN BROWN: I'll let them answer and then I was going to make some comment relative, but I'm not sure what their answer --

MEMBER RAY: Wait. Let's get an answer

and then we can comment on how things --

MR. SYDNOR: And you've had some discussions on this with the rulemaking team I'm sure?

MR. RAHN: Yes I have. So first of all you can't put something in a rule that's a requirement to put something in that doesn't exist. You know, does not have a commercial available and readily means to be installed in a nuclear plant.

So, you know, what has to happen is that research has to be performed and tests have to be performed and suitability and survivability has to be identified. And then you might find a specification for equipment that will last.

But until that's done, you know, you can't require something to be installed that doesn't exist today.

MEMBER RAY: Well, I mean, that's obvious. My real question, and I didn't make it very clear I guess, is how do you iterate. Supposing we come up with a very neat, great system that will do everything we want it to but it's too damn expensive. Does that mean we do nothing? Under the backfit rule.

MR. RAHN: Okay. I'll give you an example. In post-TMI timeframe there was several

items that were identified as part of 50.34. They were generic issues, generic safety issues, that all had Roman numerals and numbers associated with them.

And one of those items was Roman II.f.2 and II.f.3. Those were requirements that were -- they weren't requirements, they were generic safety issues that were considered as potential for rules to install instrumentation to monitor a core with significant core damage. Okay?

So a generic safety issue was vetted by our CRGR and the CRGR determined that there wasn't a significant safety benefit enough to make it a requirement because of its expense.

However, they determined that a set of nine plants which were on hold, they had licenses on hold for post-TMI, they should be required to install that equipment. And these were plants for which there was a construction permit on hold for TMI.

Now it turns out that none of those nine plants ever got built. So it appears there's a 50.34.f requirement for nine plants to put something in to monitor for severe accidents but those nine plants never got built.

However, in Part 52 they adopted and make

a reference to that clause such that new plants, such as Summer and Vogtle, have to identify at least a survivability analysis associated with the instruments that would be used by operators to manage severe accidents.

So they have a section in there in Chapter 19 that requires them to perform a survivability analysis of that instrumentation. So --

MEMBER RAY: Well I think we should move on. I appreciate the example you cited. I just, you know, you brought up the issue of backfit and I was trying to figure out how on earth that gets factored into what you're describing you're doing. And I guess it doesn't. But once you're done with what you're doing then any backfit consideration would apply to the result.

MR. SYDNOR: Yes, we would have to make a decision that we're recommending rulemaking and then that would undergo a backfit analysis. Simplistically, I mean we wouldn't be doing a backfit analysis at this point.

MEMBER RAY: I understand. But on the other hand you're establishing requirements, or what could become requirements, which would affect the

ability to impose it under the backfit rule. And, like I say, I was sensitive to that because of the remarks that Chairman just made. And so that's why I'm trying to understand how you consider that because you mentioned it, not me.

MEMBER BLEY: Harold, can I try to rephrase your whole line of discussion?

MEMBER RAY: Yes, yes, go ahead. I'm done.

MEMBER BLEY: Well I think what Harold was getting at was, you lay out requirements, you take a look and you say oh it doesn't meet the backfit analysis but it's close. Can we modify the design a little bit so that in fact the cost is in line and it would meet the backfit requirements to get the safety gains that we think would accrue from this?

And is there a process like that or is there proposal, here it is. Doesn't meet it, we're done. Or do you go through some iterative process to try to drive the design to something that will accomplish your goals and still be cost effective?

MEMBER SCHULTZ: Or the better question, why don't you go through a process that would identify a practical solution?

MR. CASE: Okay, well, here's my take on that question. There's really two parts to the backfit rule. First, I have to understand that it's a significant safety improvement. That is the highest hurdle to get through first. You know, then you can assess the cost-benefit activity.

So the reason that I never get into this iterative thing on the cost benefit is a lot of times it will not pass a significant safety improvement.

So when I'm working in the beyond design basis realm, you know, in order to get a quantified significant safety improvement that is very, very, very --

MEMBER BLEY: Because the likelihood of the core damage we're going to start with is so occasional.

MEMBER STETKAR: Because they use change in core damage frequency and we're talking about things after that. I mean the metric that is used is ridiculous for these decisions. It's ridiculous. And it's inappropriate.

MR. CASE: Correct.

MEMBER RAY: But that is what I had in mind in sending the question your direction, was how the heck do they do this --

MEMBER STETKAR: They can't. Using the current values.

MR. CASE: Well you can't do it quantitatively. And so that's where the famous qualitative factors come in. And so that's a big, that's a heavy lift for the Agency to say hey I'm just going to make up a bunch of qualitative factors and say okay, that's a significant safety improvement.

MEMBER RAY: Okay, but I did think that's what we were talking about here was something that was in that domain, ultimately.

MR. CASE: It is.

MEMBER RAY: When you're talking about --

MR. CASE: It's a hard domain to work with. It's a hard domain to make new requirements.

MEMBER BALLINGER: Isn't there another way, shouldn't it be the reverse? To establish a de minimis set of instrumentation which is absolutely required in order for the operator to make an assessment of what's going on in the core. Period. Then where do we go from there.

MR. CASE: Right, well we have that now in the regulations.

MEMBER REMPE: But that's for design

basis.

MEMBER STETKAR: No. No, that's for design basis. That's design basis. Go beyond that. Talk to the operators at Fukushima and ask them what they would have really liked to have once they knew it was a really bad day in the power plant.

Talk to the operators, the ones that survived, at Chernobyl and ask them what they would really liked to have had to let them know that it was a really bad day at the power plant.

Don't start with what's required for the design basis to prevent core damage. We're already past that. It's irrelevant. What's in the regulations to prevent core damage is irrelevant.

MEMBER SCHULTZ: If we try to approach this with qualitative factors I don't think we'll ever get to where we want to be.

MEMBER BALLINGER: When you're up to your waist in seawater if you really want to know what's going on that's the question to ask. What do I really need to see?

MEMBER RAY: But, again, as I think John said and as I felt before, when we're talking about the domain we're talking about now, I don't know how to

apply backfit to that. Because presumably we meet the hurdle that you're talking about in qualitative space.

This is something we're going to do because we want to have some capability in the beyond design basis arena. Not that we're going to subject that capability to the backfit rule.

MR. CASE: Okay, I'll share all my insights. I think the most critical part for our effort is really the Tier 1 activities. We should be asking these, you know, I knew this since day one, we ought to be asking these instrumentation questions in the context of the Tier 1 issues. Because the Tier 1 issues are close enough to passing this significant safety improvement.

So the things that, you know, when you talk about Fukushima a lot of it was driven by the lack of power. So we need to ask that question about instrumentation specifically in the context of that rule. And that's --

MEMBER STETKAR: Mike, that's one issue. But you could have 1,000 fully qualified power supplies for something that fundamentally won't work. And it won't help the operators. So power is certainly a source but having the instrumentation that indeed will

work in the environments that they were exposed to is a different issue.

Because you could power that instrumentation but if indeed it's not qualified for the temperatures, humidity, radiation fields, you could have an infinite amount of power but if the instrumentation is not reliable under those conditions, I mean, it might even be worse for the operators because they could be misled by instrumentation that's providing faulty output.

So theoretically a lot of the Tier 1 issues will solve the power supply issue.

MR. CASE: Right, and the Tier 3 issue is for us to understand whether they fundamentally won't work. And so that's what I'm looking for. I'm looking, in all these studies, I'm looking for somebody to come up with the insight that hey we looked at this and it fundamentally won't work. Once I get, you know, once somebody puts their finger on that issue I've got something to work with. But right now I haven't seen that yet.

MEMBER SCHULTZ: Well that's why I asked the nexus between what's going on here in the Tier 1, because that's the way you need to develop that

integration. Not just a portion of it with regard to the power supply issue, but to really put the instrumentation expectations in front in order to solve the problem or address the problem.

Dave, you mentioned Part 52 and the expectations associated with severe accident, at least evaluations, that is now there as a result of TMI and other things going forward. My question brings back to the IAEA tech doc and I presume that NRC had a role --

MR. RAHN: Yes.

MEMBER SCHULTZ: -- associated with that preparation. My question is, you know, you described this as if it was bringing new processes and information to the fore. I'm trying to understand how that, or in what form that's being brought to table different from what we already know?

MR. RAHN: Yes, I would say that --

MEMBER SCHULTZ: I mean, you described this as working to do, seems to me to be elements of the problem direction that we have had dramatic experience with and already know how to do this.

MR. RAHN: At TMI, right.

MEMBER SCHULTZ: Well not just TMI, but

all of the 32 that have come since. So I'm trying to understand, I mean, we're not waiting for this. I mean everything that I think is in that document NRC is quite familiar with and ought to be integrating already.

MR. RAHN: Right. But I wouldn't say it's ever been captured in one document before.

MEMBER SCHULTZ: Okay. So that its value.

MEMBER REMPE: So my impression of what's in that IAEA document is, one of the things that's in there, is that they're emphasizing plant-specific evaluations. And I believe it's for a range, not just one accident, of risk important events, which is similar to what NRC and industry in the U.S., back in the 90s perhaps, the SA-Keisou information emphasizes one event, Diichi. And I'd like to hear your thoughts on that and its impact.

Plus then talk a little bit more about 52 and what has been done with Summer and Vogtle. Are they looking at a large number of risk important events based on their PRAs from Westinghouse? What, you know, and what exactly was identified in what types of conditions?

MR. RAHN: Well, so I'm not the expert in

Part 52, but I have read their proposed Chapter 19 information. And I'll tell you what, it's not as detailed as I would have liked. But it does require that the equipment be capable of beyond design basis event type, not just design basis but extreme external events.

MEMBER REMPE: But did they apply MAP for three or four different scenarios and identify what pressures, temperatures, radiation, conditions, et cetera need to be submitted?

MR. RAHN: I'm not in the position to answer that question. I don't know the specific list of events that were considered.

MEMBER REMPE: Okay.

MEMBER STETKAR: Harold, do you know, I'm going to put you on the spot since you asked this question. I know when we've looked at the design certifications to date, generally the identification of that inventory of instruments is postponed to at least the COL stage if not post-COL because the argument is it's tied up with the human factors engineering and the design of the control boards and you can't do all of that stuff.

Do you know, for Vogtle and Summer, did

they actually develop a specific list at the COL stage or was it punted to post-COL?

MEMBER RAY: I'll punt it to Charlie because he at the course.

(Simultaneous speaking.)

CHAIRMAN BROWN: I don't remember any specifics at all in those discussions.

MEMBER STETKAR: I know it's been somewhat frustrating, I think for the staff also, that they've asked for these lists of key instrumentation for severe accidents and, at least at the design certification stage, it's generally been pushed forward with the argument that well we can't specify the list of instruments because it's tied up with human factors engineering and I&C and all of the things that tend to get pushed.

MEMBER RAY: Well we also need to remember that those certifications were amendments of a prior certification --

MEMBER STETKAR: That's right. But eventually things come together at COL. You know, they're building Vogtle and Summer and some of this line of questioning is do we know what the list of instrumentations they have settled on. Do they have

a list? And how do we have assurance that they meet the qualification requirements that you specified in Chapter 19 of the design certification, which are, you know, fairly broad requirements. But they're at least requirements.

MR. SYDNOR: We looked at Chapter 19 design certs and COLs and it was not detailed. It proposed a survivability analysis and gave an example of one, as I recall it.

MEMBER STETKAR: Right.

MR. SYDNOR: It also had a list of, I'll call it, my words, preliminary list of instrumentation. I wouldn't call it a final. And when I asked questions about that of the people in NRO it was an expectation that the detailed engineering would execute all of those requirements and they would develop that list. They would do the survivability analysis.

MEMBER STETKAR: But I think that has tended, at least to date I think in practice, to be a post-COL activity.

MR. SYDNOR: I would agree with that.

MEMBER STETKAR: In theory it should be ongoing I guess for Vogtle and Summer right now.

MR. SYDNOR: Or in new reactors, but going

back a year a half we looked at that. It was one of the first things we looked at.

MR. SYDNOR: Do we have anything else to say about the --

MR. RAHN: No, let's move on. So in addition we're looking at this interesting document that was also put together by a team of folks that consisted of operators and I&C folks to put together the task group on accident management of NEA. And it's called Accident and Management Insights After the Fukushima Daiichi Event.

And so this document was kind of developed in parallel with the IAEA document with different folks. But recommendations that came out of that definitely identified that equipment and instrumentation needed for handling severe accidents need to account for the conditions and the time duration that they need to function within.

So that's another independent, independent from IAEA at least. Because I looked at the list of the folks that were on both committees, the IAEA Committee and NEA Committee, and there didn't seem to be any overlap so it seems like these were developed independently.

In addition there's an MDEP effort to identify what would be a good set of requirements for, primarily that's the EPR design containment pressure management. And then as well as reliability instrumentation.

MR. SYDNOR: We haven't seen the MDEP work yet. Just became aware of it recently. They have draft reports in progress, they hope to publish those. The middle bullet there was one I thought was most interesting to our effort and that they were going to look at reliability and qualification of severe accident instrumentation.

Just real quickly on the OECD/NEA report, this is one where, going back to Charlie's question earlier. In that report is a listing of severe accident instrumentation. And some of it is general, you know, it's generic so it's not, it's very high level but I feel we can extract that from that and use that as one of our comparisons as part of our GAP analysis.

It's going to take some effort to do that but it does have some lower level of detail about what they think is needed for severe accident instrumentation.

I'll just talk about our -- The Office of

Research has a Memorandum of Understanding that allows us to collaborate with EPRI, the industry's research agent. And EPRI's actually done a lot of work in this area.

The first two reports there have been done quite awhile, but they were done very quickly after Fukushima. And their main purpose was to support owner's groups severe accident management guideline development. So they're like a technical document which is a basis.

And they did something similar in the early 90s. Some of these are a rework of work that they did in the early 90s, updating it with Fukushima lessons learned.

MEMBER BLEY: Russ, two related questions. One harks back to our other discussion earlier. Let me ask them both first before you answer.

The first one is, and I don't remember, I don't know if the SAMGs have an identified list of important instruments for implementing the SAMGs. I know they talk about the parameters you're going to have to look at.

It strikes me that if in fact the NRC is going to get involved in the SAMGs, and they have a

rulemaking about that, that that's the perfect place to put in the other needs for -- If you're going to do them how are you going to do them if you don't have the instruments to allow you to do them?

MEMBER SCHULTZ: And the understanding of the accidents that you're trying to address.

MEMBER BLEY: That you're trying to address.

MR. SYDNOR: One thing I wanted to stress with this slide is I think the industry recognizes that. And they funded, the third bullet there, the new EPRI project, which is totally focused on instrumentation control for beyond design basis events and severe accidents.

The two bullets underneath that are past work where they did something, some similar work in the early 90s looking at severe accident instrumentation.

So right now they're still trying to figure out how much to bite off off with this project. There's, like I mentioned before, the owner's group leads that are writing the severe accident management guidelines, the generic ones that then the plants will then take and develop plant-specific procedures from, are on this.

And they are participating in this project. The project is far from any solutions on this and quite frankly they're still talking about how far to go with instrumentation. There is --

MEMBER BLEY: These reports are out now? The EPRI --

MR. SYDNOR: Oh the two I mentioned are old, all of these are out.

MEMBER BLEY: Right. I thought they might have been too, but I don't remember.

MR. SYDNOR: One of them, more interesting, in our last meeting with the working group there, and by the way, Dave and I are both participating with EPRI's technical advisory group for this effort through our MOU.

One of the things that came out is that the industry, several plants now are updating their simulators with MELCOR and they're trying to develop a capability of doing severe accident simulations.

And in fact the industry, the B&W Owner's Group has done and initial study at Monticello and they were pretty happy with --

MEMBER STETKAR: BWR.

MR. SYDNOR: BWR. Did I say B&W? I meant

to say BWR. So it's very limited at this time. For instance one of the limitations of that early work they did was MELCOR would only simulate an in-vessel core aspects at this time. And so they don't have their full simulations but it was a major step forward in capability. And they were using it to essentially benchmark their severe accident management guidelines that they're developing with an actual simulation.

And the Sandia work has proven that MELCOR can actually do a pretty good job at simulating severe accidents. So I thought it was very encouraging and I wanted to mention that to the Committee. So I think there's a lot more to come out of this work.

And the one thing I wanted to stress is I think industry does understand the issue with instrumentation. You know, in our discussions on the technical group that comes out now, how they have constraints. They have time constraints. They have money constraints. They have constraints and they're still developing these procedures. They are not the plant-specific procedures are not developed. And so that's occurrent, just time limitation.

They have the generic guidelines, both the BWR Owner's Group Guideline and the PWR Owner's Group

Guideline are available and we're looking at those trying to extract what we see as instrumentation needs out of those.

We've been collaborating with DOE. DOE has actually done a lot of work and they're trying to do additional work. There's a couple of studies that have been done. The Sandia work that I already mentioned where they use MELCOR to simulate the accident.

Idaho and Oak Ridge have studies looking specifically at instrumentation performance. And DOE is -- One future project, actually they had started on it, they're currently experiencing some delays because, again, the plant-specific procedures were not available but the very last bullet there was an intention to do these plant-specific studies for severe accident implementation using MELCOR and using the actual plant SAMGs, put the whole picture together and determine from an analysis standpoint what instrumentation would be useful.

And so there's some problems with continuing that work at this time. DOE was also trying to collaborate with the Japanese study. That Japanese study for severe accident instrumentation is actually

an Appendix through the IAEA doc. And, like I mentioned, we find it a very broad thinking. It was really a research and development plan and their ultimate goal is to actually perhaps develop new instrumentation that would support severe accidents.

But the front end of that study was an analysis where we looked at, worldwide, at what others were doing, lessons learned from Fukushima. And they built a list of instrumentation needs from that analysis. And we're kind of using that as a benchmark for what we're looking at.

MEMBER REMPE: So to provide some information on the DOE, for instance, I'm involved with it, it being plant-specific evaluations would rely on the results from the SOARCA evaluations.

CHAIRMAN BROWN: From the what evaluations?

MEMBER REMPE: SOARCA evaluations. The MELCOR analyses already exists. The decks already exist. So the intent was to extract for the risk important events identified in MELCOR to do plant-specific evaluations.

The other point that it strikes me, I know with some of the evaluations of the TMI events, it's

not just the conditions that the sensors are exposed to, sometimes it's the sampling rate.

For example, if you look at the containment, the hydrogen burn at TMI. The temperatures in the containment never reflected that there was a burn. There was one data point from the pressure that said something happened there. And when they went back in they saw phones melted and things like that said maybe the temperatures weren't quite right.

And also there's more to think about too, that the operators need, it's not just the sensor's survivability. It's also the sampling rate and how the data are provided to the operators.

CHAIRMAN BROWN: Well when you talk about sampling rate are you talking milliseconds, seconds or minutes or half hour?

MEMBER REMPE: At TMI, and I'm sure it's better now. I hope it is, every six minutes was how often the data were, the operator saw it.

CHAIRMAN BROWN: You have to be kidding me.

MEMBER BLEY: This wasn't accident monitoring stuff. This was done in the normal environment --

(Simultaneous speaking.)

MEMBER REMPE: Applications analysis need to be done.

MEMBER BLEY: It's like a log book. Perfectly satisfactory for what its intended purpose was.

MR. RAHN: And now we've also, we had a lot of interest among our own staff of the output of the National Academy's, so their report has several recommendations in it, in Chapter 5 in particular, that we've been paying attention to. I happened to provide one excerpt here from that on the slide.

But in addition they're very strong in making sure that DC power systems and backup power systems are also looked at in a hard manner, in a couple of ways. One way is just their ability to provide the, you know, to last for the duration needed before additional power can be brought in.

But, secondly, they highlighted a point about the timing between failures of the AC system and the DC system. So for example if you lose a DC system you could also lose the breaker controls for the AC system.

In other cases you also need to look at

sometimes we have a distribution of power where some valves may be operated with DC power and other valves may be operated with AC power and those valves may be on the same system. And so if they're in series, you know, and you lose one and not the other you still can't use the system.

MEMBER BLEY: From an electrical point of view that's what they were talking about. From an integrated performance point of view they noted that a control signal that was there to protect you under, I think it was a pipe break condition, was implemented in a way that was identical to what would happen if you lost power. Such that we had some hidden things in there and logic circuits put them in situations that were unplanned because of that.

MR. RAHN: Right.

MEMBER BLEY: That seems a much broader issue and I wonder if you've given that any thought. I don't have, you know, that could be a very broad ranging topic.

MR. RAHN: Yes, it's something that needs to be considered when we look at this potential for a race between the --

MEMBER BLEY: Yes. I mean the race was

set up by the electrical stuff but it was initiated by a phony signal back, by DC being the same thing as the signal they were looking for. So I don't know if you've thought about that, are there other places that we could --

MR. RAHN: No, but when we read this, you know, it triggered stuff in our minds, is there something else we've got to look at. But, no, it was a very interesting report for us to evaluate. And I think it's just another data point that says hey, it's essential to have this equipment and it's got to be qualified for its use.

Other things that we're concerned with is what's happening here in the U.S. with regards to our own standards organization. And so IEEE is the standard that Reg Guide 1.97 refers to. It's IEEE 497. And there's a number in NRR here, Steve Weinman is our representative on working group 61 of the IEEE impact, which has to do with accident monitoring.

They currently have a draft of the next revision. And they're currently vetting that draft. Now there's an administrative issue associated that's holding that draft up from being published. They're trying to do a joint logo with IEC and IEEE and they're

having some difficulties in pulling that off.

But, regardless, by next year that draft standard should be released. It'll either be released as a joint logo or not. You know, so they'll be dealing with that in a meeting this next month and then in January again they're going to bring it up.

But currently they have identified what they call a Category F instrument, so we had types A, B, C, D and E that were initially, I guess they go all the way back to the ANS Standard, ANS 4.5, types of categories of instrumentation. And this new Category F is something that is used for accidents with significant fuel damage.

And so in there there are some criteria in there about determining whether or not they would actually survive, you know. So the standard says they must be able to at a minimum perform a survivability analysis, inform the operators when that information coming from those instruments is no longer reliable.

So that's something that, you know, we would hang our hats on if we were going to update Reg Guide 1.97, we would likely endorse that current revision of the IEEE Standard.

MEMBER SCHULTZ: David, what is SDO

please?

MR. RAHN: Standards Development Organization, sorry.

MEMBER SCHULTZ: Thank you.

MR. RAHN: Yes. It's not good to use --

MEMBER SCHULTZ: Before we go on, because we're going to leave Task 2 it looks like. You mentioned a wide number of organizations and activities within those organizations that are happening to address a number of different issues associated with instrumentation severe accidents. And it's a lot of information to both separate and then reintegrate because that certainly seems what is needed to draw the type of conclusions. I mean, hopefully we're not going to just update Reg Guide 1.97 by saying well there's a new IEEE standard and we're going to adopt that within the document.

MR. RAHN: No, we --

MEMBER SCHULTZ: So I was wondering a couple of things. What is the plan, given all of what's going on, for the NRC to integrate the information that has been generated and is being generated? And is there an end point that is a focal point of when we think we're going to get there?

And I would tie it into Reg Guide 1.97 because you say well we're going to update it, IEEE, and so I'm trying to understand what that schedule might look like? And what the task is.

MEMBER STETKAR: The current version of Rev 4 of 1.97 is actually really short. And all it does is effectively inter-set that IEEE standard. So it's not as meaty as Reg Guide 1.97 used to be in previous incarnations.

MEMBER SCHULTZ: So I may just do this. Let's go back to my original question then in terms of integrating and drawing forward and a plan that can be actualized or used.

MR. RAHN: Well, as Russ mentioned earlier, we have as part of our Tier 1 activity is to integrate that information as we develop our regulatory tools. And so it's not beyond us, as John has pointed out, to endorse something with comments and with clarifications.

As a matter of fact I helped participate in the development of Reg Guide 1.97 Revision 2 when it came out. And we spent a lot of time developing the information in tables that were attached as appendices to that document. You know, I wouldn't say that's out

of the realm of possibility for severe accident instrumentation either.

MR. SYDNOR: But essentially what you're asking is what our Task 3 is all about. It's to integrate all of this, extract the information. Like I said, you know, all of this has pertinent information, some of it at different levels of detail.

MEMBER SCHULTZ: That's right.

MR. SYDNOR: And some of it yet to be done.

MEMBER SCHULTZ: Yes, and it's good, Russ, as you said, that the organization is not totally intertwined so that there is independence. But that does then require Task 3 to have --

MR. SYDNOR: The last slide I'll touch on is our best guess at a current schedule based on what we see this stuff progressing, how we see it progressing.

MEMBER SKILLMAN: Let me just offer an add on to Dr. Rempe's comment, for TMI, the sampling rate to understand what happened in containment. In order to really get the value of collaboration it would be useful to circle back around and touch some of the people that were involved in a couple of these accidents a long time ago, because these people have had a chance

to kind of distill what's important.

I'll give you an example. What pushed TMI-2 into natural circulation? We stopped the last reactor coolant pump. Why did we do that? Because we lost our last pressurizer level instrument. We didn't want to run dry in the pumps.

So a very obscure instrument drove us into a completely new operating realm, natural circulation. Personally that was very successful. But until that event that had never been tried. We didn't know whether it would go into natural circulation.

So, as Joy pointed out, the sampling rate for containment pressure, we're never going to, at least in my mind, never going to really be able to have probes deep in the core that will tell us exactly what the temperatures are. But the in-core detectors at TMI-2 did a pretty good job. They told us pretty much which direction that core was going.

So there may be, among the people that are still around who have been through a couple of these accidents, some information that might add to your new Category F that might not be as expensive as Harold is concerned about, although it may be, that might give those eight or ten practical items that will carry the

day.

I don't think you need 200 or 500. DKE, containment conditions, reactor coolant conditions, how much water is in the basement. A couple of others that are remarkable and obscure.

The automation of your waste disposal system, they'll try to pump outside your boundary unless you block those, you can have offsite releases that you hadn't anticipated. And from within the same generators if you go up in your atmospheric pump valves and you do have failed fuel and failed tubes you now have an offsite release that you might not be able to fully quantify.

So there are a couple of places where talking to some of the folks who were around a long time ago might bring fresh information to this. And I don't believe it would be that difficult. I think these folks would be able to say hey, these are the three or four things that would have really helped us back when that happened.

MR. RAHN: Okay. Thanks.

MEMBER SKILLMAN: Thank you.

MR. SYDNOR: I'd just add I think the work DOE had done with Idaho and Oak Ridge was in that vein

of looking back at TMI lessons learned and how to apply that.

MEMBER REMPE: We looked, at least with the TMI, about 100 references that were around, we didn't do the talking with the people because that wasn't possible though it would have been the nice thing to have done too.

But that was part of the vein of it, to try and see if we could identify certain sensors. What was done, data qualification effort and the sensor survivability assessments.

MR. CASE: Maybe we can tease out the human element of that. You know, maybe when we get to the final report we can use the final report to sort of engage that. There's ways we can get to those, that human intelligence.

MEMBER SKILLMAN: Thank you.

MR. SYDNOR: We'll move on to just, there's three slides but this is really Task 3 effort. It's something we've just started this year trying to begin our analysis of looking at what has been done as a result of Tier 1 activities and these other things.

So these three slides here primarily talk about what we're looking at in relation to specifically

Tier 1 activities, not necessarily what we extracted from these other international efforts yet.

So we've started an analysis of looking back at mitigating strategies to understand what was committed to there by the utilities. We're looking at specific commitments. Specific lists of instrumentation and what they've committed to do as part of mitigating strategies.

I mentioned before Dave and others were part of the review of the spent fuel pool instrumentation implementation of that order. So we've looked at what the utilities have responded to those and we reviewed those in detail.

Just, go ahead, for a quick, as a starting point we took the licensee submittals and we took an initial broad look at all the different BWR designs and the different PWR designs and we're starting to put together a comparison matrix.

And, like I mentioned before, one of the sort of the benchmark we're using right now, because we found it to be the most encompassing, is the SA-Keisou analysis of what you ought to consider for severe accident instrumentation.

So we're benchmarking that against what

we're finding in these licensee submittals and trying to understand the strategies behind the submittals.

MEMBER REMPE: But., Russ, my understanding is the SA-Keisou -- did I say that correctly, is only on another Fukushima event. And as Dana pointed out, the next accident's going to be different, it's something we didn't think about. And so do you have any comment about that?

MR. SYDNOR: Do you know which accident is going to occur?

MEMBER REMPE: The only way I know to try and cover my bases is to look at a lot of different risk important sequences, because no I don't.

MR. SYDNOR: I'm not sure how else to --

MEMBER REMPE: Yes, I know. I just --

MR. SYDNOR: I think in new reactors that's exactly what the Chapter 19s are. They do the external events and develop the risk significance.

MEMBER REMPE: That's the intent, but then I actually have a copy of the Vogtle FSAR in Chapter 19 and, again, it's not clear to me from what I've read but I wasn't involved when this was done, but what's the cutoff frequency, what's the duration time. And it's just not clear to me how that was implemented.

But if it were done in a very systematic and methodical way then you have a difference between the new plants and the existing plants that exists, but it would be good to explore what's required to meet those requirement is 10 CFR Part 52. And I'd be interested in what you learn as you dig into that.

MEMBER RAY: Well of course both Vogtle design certification amendments and the COLAs have all preceded the developments that were to be imposed upon them. So that we're not going to find, I don't believe, in any of the material from that time, any of the outcomes from the work that you're describing here now.

MEMBER REMPE: But they were required to look at severe accident instrumentation.

MEMBER RAY: Yes.

MEMBER REMPE: And I just, it's not clear to me what the process is that NRC instituted that they had to follow.

MEMBER RAY: Or will have to follow.

MEMBER REMPE: Yes.

MEMBER RAY: That's the B

MALE PARTICIPANT: It hasn't been done yet.

MEMBER RAY: That's the dilemma in this

case.

MR. SYDNOR: Another thing, in addition to mitigating strategies, we're looking at the BWR Owner's Group and the Westinghouse Owner's Group, which is the PWR Owner's Group, looking at their guidelines for emergency planning and severe accident management guidelines. And we're extracting from those what they're requiring for severe accident instrumentation.

We're reviewing also the purpose, assumption, approaches and considerations because there are different strategies one can take as far as accident management mitigation. And, again, we're using the SA-Keisou as sort of a benchmark comparison there.

But, for instance, mitigating strategies assumes, there's two main assumptions. That you've had the station blackout and the loss of ultimate heat sink and therefore it focuses on water injections, recovering DC power and hooking up portable equipment.

In looking at the severe accident management guidelines, we're reviewing those and we've identified a list of instrumentation that the operators are directed to use in those.

Now, again, these are not the

plant-specific ones, so these generic guidelines plants haven't taken those and populated all of that yet. But that's the next step, they're in the process of doing that. And some of that was why that previous benchmarking at the simulator was going on because they were trying to understand how difficult that is and understand how to do that adequately.

So, again, we're reviewing the purpose, assumption, approaches and considerations of that because it's not, what we've found so far is that we need to understand the strategy that they're utilizing because the strategy forms the basis for the instrumentation that they're specifying.

And in this case they consider, these are more aligned, the guidelines are more aligned, we find so far, more aligned with SA-Keisou analysis because it considers worst cases. It looks at various core melt sequences and damage to the reactor vessel, damage to containment and works through each of those events.

MEMBER SCHULTZ: So, to go back to Joy's question, or comment, about what is the next event. The question is is that sufficient. Is it sufficient to do a worst case approach and develop some sort of set of instrumentation that's going to handle worse

cases?

Is that in fact going to be the best success path? And is it going to be successful from the comment that Harold had made earlier? Do you not derive a set of instrumentation that's so expensive that, well we're not going to go there.

MR. SYDNOR: Or I would propose, or are there other strategies you could implement as part of your prevention and mitigation procedures?

MEMBER SCHULTZ: All right, having said that, I'm not trying to discourage any of this from, this where the meat of it is. This is where the activity that you and Dave have identified as the real focus is the severe accident management guidelines and the mitigating strategies to pull together and to ask the questions over and over again, is the instrumentation considerations appropriate. Have we got the right instrumentation that will support the severe accident management guidelines to support the mitigating strategies? And if not, what do --

MR. SYDNOR: I think we'd agree with --

MEMBER SCHULTZ: Okay.

MR. RAHN: I wanted to just add that it's not just the instrumentation but it's operator aids

that are used along with that instrumentation. There's a lot of need for interpreting what the instruments are saying. Even though, the instruments will not be perfect, but you need to at least understand the uncertainties associated with it and how those uncertainties can increase as the accident progresses.

MEMBER SCHULTZ: Exactly. And that's what Dennis and John were getting at earlier as well. Is you have to understand, you have to know when the instrumentation is helping and when it's not.

MR. RAHN: Right. So currently the industry's EOPs, especially the BWR's group ones, have pointers to where's the worst case number you can read reliably on this particular water level instrument, for example. So something like that needs to be promulgated a little further into the SAMGs.

MEMBER BLEY: Is that on those big flow charts?

MR. RAHN: Yes.

MEMBER BLEY: I don't recall ever seeing that.

MR. RAHN: Oh yes. Yes, there's a bottom range, bottom number. If you see a number on this instrument below this you can't rely on it.

MEMBER BLEY: Okay.

MR. RAHN: Yes, before I came to the NRC my company used to develop some of those operator aids. And we automated some of ours, we had laptops with, you know, maps of the, it had like a little diagram of the containment and the reactor and we had all the water level instrumentation on there, and reactor pressure and temperature conditions.

And you could punch in whatever any one instrument says and you put in the dry well temperature and the containment temperature, I mean, say the containment and the reactor building temperature it will compute for you what the instrument ought to read.

MEMBER BLEY: Oh, okay, we used to have a number graph. But that was a long time ago.

MEMBER STETKAR: That's when people knew what a number graph was.

(Laughter.)

MALE PARTICIPANT: They don't require any power, other than --

(Simultaneous speaking.)

MR. SYDNOR: So the last thing I wanted to talk about this morning was, you know, our timeline. And this timeline hasn't changed. I think I added a

plus on somewhere on here because of some of the unexpected delays. But this was the timeline that we proposed in the SECY and in dealing with the steering committee.

And it gives you sort of frame, I didn't intend to go through all of these. But, you know, our intention is to develop our recommendations next year. Due to some of the delays in some of the research that may stretch into 2016.

MEMBER BLEY: But you are keeping touch with the Tier 1 folks?

MR. SYDNOR: I don't know if it was issued yet but the latest SECY, every six months they give a SECY to the Commission.

MEMBER BLEY: Yes.

MR. SYDNOR: One of the enclosures is --

MEMBER BLEY: Is that. Okay.

MR. SYDNOR: And so this is what we've been working towards. And for the most part the schedule's still pretty much holding up. And so, that's all we had this morning unless there's any more questions, comments. Appreciate the feedback that we've gotten today.

CHAIRMAN BROWN: I guess I have one other,

not a new question, but just, I don't want to call it a take away either, but maybe a direction comment. And that's all of the stuff, and I'm going back to Ron's comment developing a de minimis set of instruments and their capabilities, specific capabilities.

I mean, we have a limited number of types of instrumentation that we're going to have to deal with. I mean it's either temperatures, pressures, levels, flows and that have to operate in some environment. Pressure, temperature, radiation environments.

And it would be, to me, this is me, not the Committee. This would be me for subsequent discussions would be to see where we start laying out what I would call some boundary conditions for these to say here's kind of a starting point to evaluate whether these conditions will give us value added relative to any subsequent regulations or guidance that we put out.

So to make that decision you need some type of analyses to see whether those boundary conditions that you can meet with instrumentation are going to satisfy the needs of the operators for some fairly critical, or what I would call very severe, something

similar to what we experienced in Japan.

That's pretty severe, I mean, that's hard to envision, you know, melting and melting and melting and spreading stuff all over the place with very, very high radiation.

That's got to be at least a consideration for boundary conditions for environmental qualification that these instruments would have -- And what data, somebody else mentioned, what data did the operators there feel that they were missing in terms of making decisions as to how they, what actions they took.

We're going to be looking for some feedback on where you are. And I guess I would like to have some evaluation of that, of the specifics, as opposed to the more general details that you've discussed so far. That's my final, maybe final. If nobody else has anything here I was going to go to the public comments in the audience. Is there anybody in the audience that --

MEMBER SCHULTZ: Well I have a comment I wanted to make.

CHAIRMAN BROWN: Oh, Steve. I'm sorry. Yes, thank you.

MEMBER SCHULTZ: Because I wanted to get some more information if you can share it. We talked about the nexus between the rulemaking activities that are upcoming or ongoing and this activity. And you indicated you've written proposed language for rulemaking opportunities, they haven't yet been adopted.

And I guess I could leave it at that. But just to mention that with regard to the consolidated rulemaking, we're going to hear a lot about that in November and expect to write a letter in December associated with that rulemaking activity.

So we ought to continue to talk in the near term and know in the near term what is happening in regard to your proposed language and the response that you're getting to it. Because the Committee, I think, will be very interested to understand where that's at end of November, early December when we're about to write our next letter associated with rulemaking in this area.

CHAIRMAN BROWN: Thank you.

MEMBER SCHULTZ: Comes down to we need to find a way to keep us informed.

MR. RAHN: Yes. They did have, you know,

they were here to see you guys about a month and a half ago.

MEMBER SCHULTZ: Yes.

MR. RAHN: And, you know, at that point there was an opportunity to talk about it. But maybe it's time to revisit that.

MEMBER SCHULTZ: Yes. Well we have a full meeting coming up with them, subcommittee with the Fukushima Subcommittee in our subcommittee week in November. It's a two day meeting and Mike Snodderly is the staff member that's working on that meeting with me. So we'll look to communicate with you and find out status before we go into the Full Committee meeting.

CHAIRMAN BROWN: Steve, would you like to have a brief discussion of this, where they are in the severe accident management dispensation at that meeting?

MEMBER SCHULTZ: That would be the right time, yes. That's the right time to pull it in. So I'm going to meet with Mike today on the objectives.

CHAIRMAN BROWN: Okay. So your take will be on seeing whether the, what the scope of what we want to incorporate in that meeting.

MEMBER STETKAR: It's Thursday/Friday of

that week.

MEMBER SCHULTZ: Right.

MEMBER STETKAR: It's November 20th and 21st. I saw you jotting down notes. You said that's November, Full Committee?

MEMBER SCHULTZ: Said November Subcommittee week, Thursday and Friday of that week we have the subcommittee meeting but would then be bringing it to the Full Committee, we expect to, in the December week. The first week of December.

MR. RAHN: Thanks.

MEMBER SCHULTZ: Thank you.

MR. CASE: Thanks, those are good insights.

CHAIRMAN BROWN: Okay. Any other member comments or questions?

MEMBER RAY: What was the purpose of this meeting, Charlie?

CHAIRMAN BROWN: Just to kind of see where they were and what they were doing. It was an information subcommittee meeting just to see what are they planning, what have they done, who have they talked to, where do they think they're going.

MEMBER RAY: I'm just laboring to connect

that with the what plants are ultimately obliged to do, you know.

CHAIRMAN BROWN: Yes, I got that flavor quite clearly. And I agree with you. My concern is that we develop this so high level, overarching scope of what may be necessary whereas there may be some fairly simple approaches to providing some instruments that will provide information.

And we're going to bypass that in favor of complex systems that are costly. That if you make this stuff cost several million, a million dollars in order to do it it's not going to be very useful because it'll be rejected because of the low frequency aspects of these type of events.

MR. CASE: Right. I haven't seen that idea yet. You know, I am 100 percent interested in that idea. That low cost, this is the magic pill that really brings information to this area, we're looking for that. But so far --

CHAIRMAN BROWN: Well I made a comment in one of your -- There are high-temperature thermocouples available that you can use. There's mineral-insulated cable that's very resistant to radiation that provides temperature information. You can read these suckers

with a $90 fluke instrument that you can connect to a pair of terminals that are running out into some remote operator station. And you can put 9 volt batteries in that, you can use it for about five years.

MEMBER BALLINGER: They're self-powered.

CHAIRMAN BROWN: Not all of them are self-powered. If you got self-powered you got to have stuff to generate the self, it depends on what you use. The point being that there are methods of measuring pressure and level that you can generate without all types of fancy instrumentation that are usable by folks.

You don't have to have something that, a computer that runs everything, you can use a piece of paper, graph paper, where you plot output voltages and then say okay this is what it ought to be over a calibration range and you can present that information out to operators in a remote location with cables that are capable of doing it.

And if you don't have high powered electronics in the radiation field it will work for a long time. Blacksmith technology is fairly good. Vacuum tubes actually work pretty well in these environments.

MEMBER BLEY: They're hard to find.

CHAIRMAN BROWN: I've got a whole box full of vacuum tubes, okay?

MEMBER BALLINGER: It won't be long before you will not be able to go to Radio Shack and get them.

CHAIRMAN BROWN: Yes. That's also the case. So that is the point of the earlier comments I made relative to we can make this thing so complicated as to why not take a look at the information on what are the boundary conditions and what are the simple things that we can do to bring information to, the operator is the key.

That was the key in Fukushima, what did the operators need? And they ran out of not only power but also the ability to get information because the instruments were too suspect.

MR. RAHN: Yes, it's really the entire, it's the instrument channel that has to be, it's not just the instrument. You know, somehow you've got to get that signal out of the containment. And right now the limiting factor isn't the instrument if you're talking about temperature. A lot of times it's the inboard electrical penetration.

CHAIRMAN BROWN: Yes, exactly.

MEMBER SKILLMAN: Charlie, I would add this comment. I think you will find this to be accurate. From the time of the accident to 10 days, 20 days, 50 days, 100 days after the accident, the operator's line of vision will change.

Early on they're focused on core temperature, hydraulics, heat transfer, decay heat generation rate, reactor coolant system inventory, inventory transfer from the reactor coolant system pressure boundary to outside the boundary.

As time goes on, if there's any stabilization on the primary, their lens begins to focus on other things. Where is the water going? What is it's specific activity? What are the radiological consequences? What compartments can we get to? What can't we get to?

So in the first 24, 48 and 72 hours there's this blistering focus solely on RCS and some consideration about offsite. But as time goes on considerations for offsite for releases begins to come into view. And the instrumentation for that is commonly very, very simple. Not sophisticated. Sometimes neither durable nor robust.

So when we talk severe accident management

we've really had a major, major catastrophe in the reactor coolant system, whatever it might be. In the course of time some of the earlier considered not to important instrumentation begins to be very important, and you can't get to it.

And the reason you can't get to it is because the radiation level is just so high. And sometimes even your radiation instruments aren't functioning because they weren't qualified for the conditions that they saw during the course of the accident.

And so the river becomes how do you really make sure that you can steer your way through the 30 days after that accident when an awful lot of this secondary instrumentation is really not obvious to anybody. Can't get through the doors, you can't get to the compartments. Some pumps may not have functioned because the power for them was defeated and now you've got six inches of water on the floor. And what came up in the water was isotopes that were soluble from the core, so you're locked out of the building.

So there's more to this than just focusing on the sophistication in and around the reactor coolant system. The outer boundaries of the plant become

equally complicated in terms of how you steer your way through the later days.

MR. CASE: Okay. Well I need to think about that one. We do not have a lot of thoughts out in that area. You know, we're more focused on the sort of the accident management part of it and not --

MEMBER SKILLMAN: I know, and that's why I raised the comment.

MR. CASE: The major accident management.

MEMBER SKILLMAN: What happens is very quickly the accident consumes the station footprint. And the station is beside itself to prevent radioisotopes from going on beyond what is that licensed boundary. And that becomes a real challenge.

You know, maybe one of the most important sets of instrumentation you have is the meteorological instrumentation so you can bring in the helicopters. Where do they land? What's the wind direction? What's the temperature? Things you really wouldn't think of if you just focused on the core and the reactor coolant system pressure valve.

That's why I say some of the folks that have been around these accidents might say you know there are a couple of other things you might want to think

about.

MEMBER SCHULTZ: Certainly came up at Fukushima.

MEMBER BLEY: And other places.

MEMBER SKILLMAN: Thank you.

CHAIRMAN BROWN: Okay. Any more member comments? Turn to the --

MEMBER REMPE: Dennis wanted --

CHAIRMAN BROWN: Oh, Dennis?

MEMBER BLEY: No, I was --

CHAIRMAN BROWN: Oh, I was going to check out here first. Is there anybody out here that wanted to make a comment?

MR. STATTEL: I'd like to make a comment if you don't mind.

Hello. I'm Rich Stattel from I&C in the NRR. My comment has to do with the, you had a discussion regarding the prescriptive lists of instrumentation. And it kind of reminds me back of some of the discussions we've had when I was in the industry and also when I worked in the New Reactors realm. And we used the term minimum inventory. Right?

In the New Reactors, when I was working on

the ESBWR project, we kind of ended up in a kind of hybrid situation where we put a minimum inventory list into our design certification with the understanding that there would be an analysis, a task analysis, and we'd HFE input and we would revise that list going forward. So that's my recollection. I believe most of the new reactor designs ended up in similar situations.

But there was mention of Reg Guide 1.97, the prescriptive lists that are in Reg Guide 1.97 initially. And I didn't hear any discussion about why those lists were pulled out. They were retracted from Reg Guide 1.97 and there was a couple of reasons for that.

One was the list, there are basically two lists in the original version. One applied to boiling water reactors and one applied to pressurized water reactors. And over the years we recognized that those lists weren't really a good fit because there were a lot of different versions of those reactors and we ended up imposing requirements for instrumentation that weren't necessary for a lot of the reactors. And there were also requirements that should have been necessary that weren't included in those lists.

So Reg Guide 1.97 over the years evolved into let's perform the analysis. Let's get the input from HFE and we'll get the right list. Basically we'll develop the process for doing that.

MEMBER BLEY: For a plant.

MR. STATTEL: For a specific plant. Right? So I just wanted to mention that because it seems like every time an event occurs in the industry there's always this push to put a prescriptive list. If we get spent fuel pool level, if we get this, and then apply that to the entire industry.

And I want to makes sure that the lessons we learned over the last 15/20 years are considered because there are truly plant-specific, unique inputs that should be going into the development of those types of lists. Right?

MEMBER BLEY: Thanks.

CHAIRMAN BROWN: Thank you, Rich. Are there any other comments from the -- No one here? Okay.

Is there anyone on the phone lines? It is open, if somebody's on the phone line would you probably please just say something so we know it's open?

MEMBER STETKAR: I don't hear any of the telltale noises to say that it's open.

CHAIRMAN BROWN: I don't hear any snap crackle and pop. So hold on a minute we're checking. He said it's on.

MEMBER BLEY: Nobody's there?

CHAIRMAN BROWN: Then nobody must be there. So given that we don't hear any response from the phone lines, if there's any other comments from the staff or anyone else? Okay then we will close the meeting. Thank you very much. We appreciate it.

(Whereupon, the above-entitled matter went off the record at 10:21 a.m.)

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# Enhanced Reactor and Containment Instrumentation

## NRC Fukushima NTTF Tier 3 Item:

## ACRS Recommendation 2(e)

ACRS Subcommittee Meeting

September 16, 2014

Mike Case and Russ Sydnor, RES/DE
David Rahn, NRR/DE

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# Enhanced Reactor and Containment Instrumentation

ACRS 2(e) – "Selected reactor and containment instrumentation should be enhanced to withstand beyond-design-basis accident conditions".

NRC Staff Team Members, Offices Represented:

Mike Case – Management Lead - RES

Russ Sydnor - RES

David Rahn - NRR

Paul Rebstock & Pong Chung - RES

Dinesh Taneja - NRO

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# Enhanced Reactor and Containment Instrumentation

## Key Project Activities – (SECY-12-0095)

Task 1 - Ensure that licensees and NRC staff are appropriately considering instrumentation needs when implementing site specific actions for the NTTF Tier 1 Recommendations 2.3, 4.1, and 8, and Orders EA-12-049 and EA-12-051.

Task 2 - Obtain and review information from previous and ongoing research efforts for severe accident management analysis. Coordinate with and support international and domestic entities (e.g., IAEA & DOE) and standards organizations (e.g., IEEE/IEC, ANS).

Task 3 - Evaluate results of Tier 1 NTTF activities in coordination with the information obtained from applicable research efforts (international and domestic) to determine requirements for appropriate regulatory framework.

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# Enhanced Reactor and Containment Instrumentation

## Task 1 – Activities

- Staff is still communicating with Tier 1 Teams.
- Reviewed Tier 1 activity orders and guidance documents, e.g. JLD-ISG-2012-01, NEI 12-06, NEI 14-01, and others.
- Directly supported related Tier 1 activities – e.g. SFP Instrumentation order and guidance development, reviewing licensee overall integrated plans.
- Directly supporting Fukushima NTTF Consolidated Rulemaking team, and proposing rule language for consideration.

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## Task 2 - International Collaborations/Activities

- International Atomic Energy Agency (IAEA)
  - IAEA Technical Document, “Accident Monitoring Systems for Nuclear Power Plants”
    - Captures design practices for establishing design criteria to support the accomplishment of accident management strategies and to monitor post-accident conditions
    - Adds new recommended design criteria for monitoring design extension conditions (those with and without resulting significant fuel degradation)
    - Includes appendix for SA-Keisou (Severe Accident-Instrumentation and Monitoring Systems) R&D Plan
  - New Working Group- I&C Equipment Qualification Best Practices
    - Severe Accident I&C Equipment Qualification and Survivability Analysis for severe accident conditions will be addressed in a new IAEA TECDOC.

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## Task 2 - International Collaborations/Activities (continued)

- OCED/NEA –
  - Report of the CNRA Task Group on Accident Management, NEA/CNRA/R(2014)2, "Accident Management Insights after the Fukushima Daiichi NPP Accident"

    "….., instrumentation that enables performing well-timed operator actions, surveying the effectiveness of the actions and monitoring their progress of the accident should be included. The systems, equipment and instrumentation should withstand the harsh conditions of the accident (e.g. very high temperatures, high radiation levels etc.), taking into account that it may be required to remain operable for a considerable period of time (several months or more). Consideration should be given to both fixed and mobile equipment."
- MDEP –
  - EPR Technical Experts Subgroup (TESG) for Severe Accident – developing two reports;
    - Management of pressure in containment during a severe accident
    - Reliability and qualification of severe accident instrumentation
    - Final reports – November 2014.

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## Task 2- US Collaborations/Activities

- EPRI Technical Report TR-1025295, Severe Accident Management Guidance Technical Basis Report, 2012:
  - Supports SAMG writers
  - Volume 1: Damage conditions, High-level Steps, and Effects
  - Volume 2: Accident progression physics and calculations
- EPRI Technical Report TR-1026539, Investigation of Strategies for Mitigating Radiological Releases in Severe Accidents; *BWR Mark I and Mark II Studies, September 2012*
- New EPRI Project – Instrument and Control for Beyond Design Basis Events and Severe Accidents
  - EPRI Technical Report TR-103412, Assessment of Existing Plant Instrumentation for Severe Accident Management, 1993
  - EPRI Technical Report TR-102371, Instrument Performance Under Severe Accident Conditions: Ways to Acquire Information From Instruments Affected, 1993.

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## Task 2- US Collaborations/Activities

- DOE -
  - Sandia Report, SAND2012-6173, “Fukushima Daiichi Accident Study” (Status as of April 2012)
  - Idaho National Lab report INL/EXT-13-28043, “TMI-2 - A Case Study for PWR Instrumentation Performance during a Severe Accident” March 2013
  - Oak Ridge report ORNL/TM-2013/154, “Fukushima Daiichi – A Case Study for BWR Instrumentation and Control Systems Performance during a Severe Accident” April 2013
  - Future DOE research:
    - Research collaboration with NRC, EPRI
    - Collaboration in a Japanese study on instrumentation performance at Fukushima
    - Plant specific studies on severe accident instrumentation needs and performance

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# Enhanced Reactor and Containment Instrumentation

## Task 2- US Collaborations/Activities

- NAS report- Lessons Learned from the Fukushima Nuclear Accident for Improving Safety of U.S. Nuclear Plants, 2014
  - **Recommendation 5.1.A, excerpt:**
    - Instrumentation for monitoring critical thermodynamic parameters in reactors, containments, and spent fuel pools.

      *". . . robust and diverse monitoring instrumentation that can withstand severe accident conditions is essential for diagnosing problems; selecting, and implementing accident mitigation strategies; and monitoring their effectiveness".*
- Interface with SDO -
  - Plan to Update RG 1.97, Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants, based on the planned 2015 update to IEEE Standard 497, "IEEE Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations." Adds New Category "F" Instruments for accidents resulting in fuel damage. Category F provides the most direct indication of the parameters needed to execute the SAMGs. Requires a qualification process and a survivability analysis to determine the seismic and environmental constraints for reliable use.

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# Enhanced Reactor and Containment Instrumentation

## Task 3 – Review of Tier 1 results

- NRC Order EA-12-049 on Mitigation Strategies (MS)
  - Requires a three-phased approach for maintaining and restoring core cooling, containment, and spent fuel pool (SFP) cooling
  - Completed no later than two (2) refueling cycles after submittal of the overall integrated plan or on 12/31/2016, whichever comes first.

| Phase | Licensee may use |
|---|---|
| Initial | Installed equipment |
| Transition | Portable, onsite equipment |
| Final | Offsite resources & equipment |

- NRC Order EA-12-051 SFP Instrumentation

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# Enhanced Reactor and Containment Instrumentation

## Task 3 -Reviewing Licensee submittals for Mitigation Strategies

- Review of BWR MS
  - Fermi-2 (BWR4, Mark I)
  - Nine Mile Point-2 (BWR5, Mark II)
  - Clinton-1 (BWR6, Mark III)
  - Hatch 1&2 (BWR4, Mark I)
- Review of PWR MS
  - North Anna 1&2 (W, 3 Loop)
  - Oconee 1,2&3 (B&W, 2 Loop)
  - Calvert Cliffs 1&2 (CE, 2 Loop)
  - Diablo Canyon 1&2 (W, 4 Loop)

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# Enhanced Reactor and Containment Instrumentation

## Task 3 - Reviewing BWROG and WOG EPGs/SAMGs

- Currently evaluating different approaches - Japanese SA-Keisou versus US NPPs' Mitigating Strategies (MS) instrumentation
  - Reviewing MS OIPs and 6-month status reports to identify the list of instrumentation and comparing those instruments with SA-Keisou list.
  - Reviewing purpose, assumptions, approaches, and considerations
  - SA-Keisou: assumes worst-case, various Core melt / RPV-damage / Containment-damage conditions
  - MS: assumes Station Blackout (SBO) and Loss of Ultimate Heat Sink (LUHS) and then considers successful water injections with available DC power, portable generators, and pumps from alternative heat sink.
- Currently evaluating BWROG and WOG EPGs/SAMGs instruments
  - Reviewing Owner Group's EPG/SAMGs to identify the list of SA instrumentation operators are directed to use to mitigate accident event.
  - Reviewing purpose, assumptions, approaches, and considerations
    - BWROG, WOG, and SA-Keisou all consider the worst cases with various Core melt/ RPV damage / Containment damage conditions

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# Enhanced Reactor and Containment Instrumentation

Project Plan Timelines:

Task 1 – Interface w/pertinent Tier 1 activities – Ongoing

Task 2 – Research & Collaborations

- IAEA Tech Doc, Severe Accident Instrumentation: 2014-2015
- DOE & EPRI Fukushima Instrumentation studies: 2014-2015
- Tier 1 activities results for instrumentation: 2014-2015
- Provide input to SDO organizations (ANS, IEEE) – 2015 (+)

Task 3 – Regulatory Framework determination

- Provide periodic updates to JLD and Commission
- Complete analysis of Tier 1-related research studies on instrumentation needs and environments – 2013 -2015
- Evaluate relative safety significance of implementing the research recommendations—use PRA methods, if appropriate
- Develop SECY for Tier 3 item resolution – 2015 (+)

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# Enhanced Reactor and Containment Instrumentation

## Acronyms

| | |
|---|---|
| BWROG | Boiling Water Reactor Owners Group |
| CNRA | Committee on Nuclear Regulatory Activities |
| DOE | Department of Energy |
| EPR | European Pressurized Reactor |
| EPRI | Electric Power Research Institute |
| IAEA | International Atomic Energy Agency |
| LUHS | Loss Ultimate Heat Sink |
| MDEP | Multinational Design Evaluation Program |
| MS | Mitigating Strategies |
| NAS | National Academy of Sciences |
| OECD/NEA | Organisation for Economic Co-Operation and Development / Nuclear Energy Agency |
| OIP | Overall Integrated Plan |
| PWROG | Pressurized Water Reactor Owners Group (WOG, BWOG, CEOG) |

# Enhanced Reactor and Containment Instrumentation

## Acronyms (Continued)

| | |
|---|---|
| RG | Regulatory Guide |
| RPV | Reactor Pressure Vessel |
| SA | Severe accident |
| SAMG | Severe accident management guideline |
| SBO | Station Black Out |
| SDO | Standards Developing Organization |
| WOG | Westinghouse Owners Group |

# Enhanced Reactor and Containment Instrumentation

## Back up Slides

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# Enhanced Reactor and Containment Instrumentation

Tier 1 Dependencies

- Seismic and Flooding Walkdowns RFI
- SBO Rulemaking (now combined with EOP/SAMG/EDMG Integration rulemaking)
- Mitigating Strategies Order
- Spent Fuel Pool Instrumentation Order
- EOPs/SAMGs/EDMGs Integration Rulemaking (now combined with SBO rulemaking)

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# Enhanced Reactor and Containment Instrumentation

## Current Regulatory Framework

- 10 CFR 52.47(a)(8) –technically relevant portions of TMI-2 related requirements in 50.34(f), especially 50.34(f)(2)(ix)(c), 50.34(f)(2)(xvii), and 50.34(f)(2)(xix)
- 10 CFR 52.47(a)(23) and 10 CFR 52.79(a)(38) – design features for the prevention and mitigation of severe accidents
- RG 1.97, Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants

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# Enhanced Reactor and Containment Instrumentation

## Major Accomplishments

- ✓ Reviewed Tier 1 Activities
- ✓ Reviewed DOE Modeling of Fukushima event
- ✓ Met with DOE and EPRI regarding research activities
- ✓ Participating in IAEA Tec Doc development
- ✓ Met with ANS Standards Board
- ✓ Interfacing with IEEE SC, (IEEE-497)

## Plan/Path Forward

- Implement Program Plan
- Work with ANS SDO to identify criteria for Severe Accident Instrumentation
- Support IAEA issuing Tec Doc on Accident Monitoring Instrumentation
- Collaborate with EPRI and DOE
- Support IEEE SC on Accident Monitoring efforts
- Identify criteria arising from Tier 1 outcomes
- Determine need for Rulemaking (or alternative approach, e.g. Generic Communication)