UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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MEETING WITH THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

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THURSDAY

OCTOBER 2, 2014

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ROCKVILLE, MARYLAND

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The Advisory Committee met with the Nuclear Regulatory Commission at the Nuclear Regulatory Commission, One White Flint North, Commissioners= Conference Room, 11555 Rockville Pike, at 10:00 a.m., Allison M. Macfarlane, Commission Chairman, presiding.

COMMISSIONERS:

ALLISON M. MACFARLANE, Chairman

KRISTINE L. SVINICKI, Commissioner

WILLIAM C. OSTENDORFF, Commissioner

ACRS MEMBERS:

JOHN W. STETKAR, Chairman

HAROLD B. RAY, Vice Chairman

MICHAEL L. CORRADINI, Member

CHARLES H. BROWN, JR. Member

P R O C E E D I N G S

10:03 a.m.

CHAIRMAN MACFARLANE: All right. I guess we've got everybody here, good, good.

So, today, the Commission's going to be briefed by the Advisory Committee on Reactor Safeguards, one of our biannual meetings.

I would like to first of all commend all the members of the ACRS for their commitment to service and their effort to support the NRC safety mission. So, thank you all.

And I know that today's briefers that we're going to hear from are just a subset of the larger group, and I see many of the larger group sitting around. And I want to thank all of you on the committee for your service and for all your hard efforts.

Since our last meeting in March, the Commission has tackled many difficult technical issues including the approval of the Design Certification for the Economic Simplified Boiling Water Reactor. And these efforts are in no small measure a result of hard work on the staff and insightful input from your committee, the ACRS. We, on the Commission, very much value all of that input and we use it in our considerations as well.

So, today, we're going to hear from you on a subset of topics. We're going to start off with Mr. John Stetkar, who's the Chairman of the ACRS, who's going to provide an overview of activities of the committee since our last meeting with the ACRS in December. Gosh, is it December? Wow.

MR. STETKAR: March.

CHAIRMAN MACFARLANE: March, okay March.

MR. STETKAR: It just seems like it.

CHAIRMAN MACFARLANE: It seems like December, right.

And then, Mr. Stetkar is going to open the discussion on Human Reliability Analysis Models.

That's going to be followed by Dr. Mike Corradini, who's going to discuss the ACRS Biennial Review of the NRC Research Program.

Then we're going to hear from Mr. Charles Brown on the proposed rulemaking to revise 10 CFR 50.55a and Digital Instrumentation Controls.

And the final presentation will be from the Vice Chairman of the ACRS, Mr. Harold Ray, on the staff's efforts to address the use of qualitative factors and the development of regulatory analyses and backfit analyses.

So, I look forward to all your presentations.

Let me ask my fellow Commissioners if either or you have any opening comments? No? And then, with that, I will turn things over to Mr. Stetkar.

MR. STETKAR: Thank you, Chairman Macfarlane, and as always, it's a real pleasure to be here to share with you our accomplishments over the last six or seven months since we last met and give you a little bit of a snapshot of what we're actively involved in now and where we're headed over the next six months or so.

Now, with the first slide, second slide, which ever it is, or not. Okay.

Since our last meeting in March, we've issued 14 reports. I'm going to skip the first four because we're going to hear about those topics in some detail in this morning's briefing, so, if we could skip to Slide Number 4, please? Or whatever it is on the list, the next one, 5? Thank you.

We've issued reports on two chapters, partial on Chapter 3 of the USAPWR Design Certification and three chapters of the Reference Combined License Application for the Comanche Peak Nuclear Plant. I'll talk a little bit more about our efforts in that area in a few minutes.

Next slide?

We did issue a report on the Supplemental Safety Evaluation for the SBWR that addressed the steam dyer analysis.

And just in September, we issued our final report on the Reference Combined License Application for the SBWR Fermi Unit 3.

Next slide?

I'm not going to talk about all of these. I would like to mention in particular, however, the Peach Bottom Power Uprate.

That was the first extended power uprate application that we've seen where the applicant used enhanced analysis techniques and actually made modifications to the plant cooling water systems that allowed them to completely eliminate credit for containment accident pressure to support long term core and

containment cooling.

And I'd like to say on the record that the ACRS is very pleased with that licensee's initiatives and efforts to resolve that issue in a manner that demonstrates how analysis and practical engineering solutions can be used to assure maintenance of those vital defense IN depth functions of core cooling and containment performance. So, we were very pleased with that application.

Next slide?

On this slide, the only topic I'd like to note is the first one and that is our review of Chapter 7 of the mPower Small Modular Reactor Draft Final Design Specific Review Standard which addresses Instrumentation and Control Systems.

We view that as a very important topic because the guidance in that particular section of this Design Specific Review Standard, we believe, will provide a very solid template for reviews of Digital I&C systems for all new reactors going forward, whether SMRs or any future design certifications commenced. So, that's a real milestone.

Next slide?

Regarding our current activities and where we're headed in at least the near term in the next six months or so, we continue to be involved with new plants design certifications for the USEPR, to a much lesser extent, the USAPWR, because of their slow down. However, there are still some active topics, at least in our understanding that the staff and the applicant are addressing and we remain available to review those as they come to us.

We are working on the Reference Combined License Applications for the ABWR at the South Texas site and the USEPR at Calvert Cliffs site and Subsequent Combined License Applications for the AP1000 at Levy and we're just starting our review of the Subsequent Combined License Application for the SBWR at the North Anna site.

Next slide?

We continue our active involvement on the licensing of Watts Bar Unit 2. If things go according to plan, I think our schedule currently looks at our issuing a letter on that activity in the February time frame. We have a subcommittee meeting scheduled in January, according to the current schedule if that doesn't slip.

At the bottom of this slide, we've seen now an uptick in license renewal applications. At our current meeting this month, we're addressing the Callaway license renewal and in the next few months, we're going to be reviewing the Sequoyah, Byron and Braidwood license renewals. So we've seen, after a delay, a resurgence to some extent, in the license renewal activities.

Next slide?

As part of, you know, one of the letters that we wrote that I didn't mention and was on subsequent license renewal, as part of that letter, we noted that we were going to actively engage the staff and the industry regarding key technical issues related to the license renewal -- subsequent license renewal process long term issues.

And, in fact, we started that process. We just had a full day subcommittee meeting on the topic of concrete degradation and

aging. We plan to hold meetings on materials issues regarding the reactor vessel and internals, aging of electrical cables and other topics that have been identified by the expert panels.

So, the message there is that we're getting involved early on those technical topics.

The staff is now reviewing an application by South Texas Project for risk-informed resolution of GSI-191, the sump plugging issue. And we are very interested and actively involved in that. We've had one subcommittee meeting on that topic already and have another one scheduled and probably additional meetings in the early part of 2015.

Next slide?

Fukushima remains one of our most active areas of involvement. We've only listed sort of our near term activities on this slide and those topics are addressing the mitigation strategies. We have a two day subcommittee meeting scheduled in late November on that topic and expect to write a letter and we're following the evolution of the BWR filtering strategies issue.

And, next slide?

I'm going to go through these last couple pretty quickly.

Regarding the general area of risk-informed regulations, we continue to follow the evolution of the risk management regulatory framework that's been proposed and is being evaluated by the staff.

We're just starting to become involved in the second bullet, the risk prioritization initiative or cumulative effects of regulation.

We have a subcommittee meeting scheduled on November 3rd regarding that topic and we'll follow it very closely.

Next slide?

The area of PRA and other topics, the Level 3 PRA is a very large activity. In NRC research, we are following that activity very, very closely.

You're going to hear more about Human Reliability Methods in a couple of minutes.

We're following transitions to risk-informed fire protection programs under NFPA 805. We just recently had a subcommittee meeting on that topic to give us an update on technical issues and where the staff is on reviews of those applications.

And with that, to save myself a little bit of time for my next topic, I am going to close the overview.

And the first specific topic that we're going to discuss is Human Reliability Analysis Models and I'll lead that discussion.

There we go.

I'll remind you, as I probably don't need to do, that this project or this activity was initiated by Staff Requirements Memorandum written to the ACRS back in 2006. And that SRM stated that the committee should work with the staff and external stakeholders to evaluate the different Human Reliability Models in an effort to propose either a single model for the agency to use or guidance on which model should be used in specific circumstances.

The staff performed a very thorough assessment of the current methods and models that are out there and after that

assessment, concluded that development of a single hybrid methodology is the best approach and we've been proceeding accordingly.

Next slide?

We've been -- next one? Thank you.

We've been actively involved in this and as you can see from this slide, we've been meeting with the staff at the subcommittee level about every six months for the last four and a half years to track this project.

The full committee performed its first review in May of this year and issued a letter report that I'm going to highlight the conclusions and recommendations during this briefing.

First, before we go further, I want to go off point for a moment and give you a brief overview of Human Reliability Analysis in the context of integrated risk assessment.

And I think these comments will help to provide some perspective for some of our detailed recommendations in this letter that I'll discuss in a few moments.

To start off, it's been my experience that analysts who are involved in this process, unfortunately, often tend to focus too quickly and dwell too much on the tools and computational practices for estimating the numerical values for human error probabilities.

While that's certainly a part of the overall Human Reliability Analysis process, it's not the most important part.

The fundamental intent of Human Reliability Analysis is to first systematically identify event scenarios where personnel

response is needed to prevent an accident or to mitigate the consequences of an accident.

The next part is to carefully understand and characterize the event progression, the evolving plant conditions from the perspective of the operators.

And then to use information from the cognitive sciences, operating experience from the nuclear industry and relevant experience from other technologies to understand how trained professional people may behave when they're faced with those conditions.

Now, in a typical PRA, there's a large number of possible scenarios that we identify and each scenario has its own particular characteristics that may effect personnel behavior. When we're faced with that large number of real world scenarios, we need a process to quantify human error probabilities so that we can objectively rank those scenarios and their associated personnel actions according to their contributions to overall risk.

Once we have that ranking, the risk management process can then efficiently focus attention on the most important scenarios, the most important significant actions. And our understanding of the event scenarios and our understanding of human performance in the context of what are often very unfamiliar and extremely challenging conditions helps us to evaluate those numerical values.

Of course, once we have the risk significant scenarios and important personnel actions and understand the reasons for them,

it's then possible to identify practical methods to improve the likelihood that personnel will perform better in those situations which is the ultimate goal of any risk assessment.

So, with that diversion as kind of an introduction, I'd like to return to the slides and go through our conclusions and recommendations from our letter report.

Next slide? There we go.

First and foremost, this is a work in progress, work remains to be done to refine the proposed methods and models into a form that can be used for practical Human Reliability Analysis and the practical Human Reliability Analysis is important in that context.

In May, we reviewed two interim work products from this project.

Next slide?

The first one is what I'll characterize quickly as the psychological foundation for Human Reliability Analysis and it's described in NUREG-2114.

This is a really good report. It contains valuable information to improve our understanding of theoretical basis for human cognitive performance and the causes for human errors.

And again, as an aside, we tend to use the term human errors in our jargon and often times, that can be misunderstood. Our experience has been that in many cases, when people are faced with a scenario where they have many different options for performance, in the context of that scenario, people evaluate the information they have available. They evaluate their training, they evaluate their procedures

and they make decisions.

And those decisions are in the context of the scenario and in the context of their frame of mind, the correct decision. They proceed to take the actions that they've decided to take and, in most cases, those actions are correct.

In some cases, when we're doing our Monday morning quarterback, we find out that perhaps they could have taken a different action or an action more efficiently.

Those alternatives are often cast in the context of, well, the person made an error. Most cases, they didn't really make an error, they did what we expected them to do in the context of the scenario that they were facing.

So, we're going to stick the term, human error, because that's the typical jargon that we use. But, really, the current understanding of human performance is more in that former context, understanding how people make decisions and why they make decisions in a particular, very difficult scenario.

So, NUREG-2114 provides one element of what I described in my introduction as a basis for evaluation of human performance, and that's the element that comes from the cognitive sciences.

Next slide?

The second work product that we reviewed in May was the Integrated Decision Tree Human Event Analysis System, or because we really love catchy acronyms, IDHEAS methodology.

Elements of this methodology will enhance the

documentation of Human Reliability Analysis process, reduce analyst-to-analyst variability and it use and improved traceability of the bases for differing assessments.

Those are all important issues because the staff's evaluation of the current methods that are out there identified each of those issues as a deficiency to a greater or lesser extent in every method.

So, developing a methodology that provides some coherence in these areas is very, very, very important. And we see elements of this ideas methodology that will accomplish those very important tasks.

Now, we had in our letter report, we had six specific recommendations. Those recommendations are targeted at the staff who are deeply involved in this process. They contain a lot of details and there are even more details in the discussion.

At this briefing, because of time constraints, I'm going to try to stay away from the details and highlight some salient features of our recommendations.

So, what I'd like to do is skip this slide for Recommendation 1 and go to the slide for Recommendation 2. There we go.

This recommendation says that qualitative assessment guidance should emphasize the need to develop operational narratives that adequately describe the entire context of the evolving event scenario.

Now, in the context of my sidebar introduction, I think

you can understand why this is very, very important. It's essential for the people who are doing Human Reliability Analysis to clearly understand the context of the scenario.

Next slide?

We don't have a large compilation of actual experience where we've challenged people to take difficult actions in the face of very complex and often confusing situations. I say that because we can't rely on what I'd call data and statistics to quantify human error probabilities.

Because of that, the methodology relies on a very structured formal expert elicitation process to evaluate the likelihood of human error, again, using human error in the context that I explained earlier, and the associated uncertainty about those human errors.

The slide says for each combination of contextual factors, now what does that mean? Well, contextual factors is jargon, it means things like the human system interface. What are the quality and the availability of alarms displays?

And for example, in certain scenarios, the operators may not have those alarms and displays because we've had a power failure or a fire or the event the alarms and displays that they have might not necessarily be reliable because we've had a partial power failure or a fire that's affected a part of the plant.

The availability procedures, training, experience, distractions that are introduced by the scenario that may cause the operators to focus on one issue that's evolving to the extent that they may downplay other issues.

Conflicting priorities, do I try to put out a fire? Do I try to deal with seismic damage? Or do I try to look at a broad range of alarms in the control room that may not be all that reliable?

So, those are those contextual factors that are considered in these expert elicitations to help us inform the human error probabilities.

Next slide?

Because we don't have that extensive database, if you will, uncertainty, there are uncertainties and we have to acknowledge that and we have to explicitly address those in our analyses.

And the point of this slide and this recommendation is that those uncertainties should be evaluated as an integral part of the assessment process. They're not something, do you finish the analysis and just go patch in some uncertainty at the end of backfit. This is part of the analysis.

Next slide?

There's a lot on this slide, I just going to talk about the first bullet.

As part of the analysis, we evaluate what we call the available time window for operator response. How much time is available for the operator to perform a required action before the plant evolves into a situation where that action becomes irrelevant? And the amount of time that's actually required to perform the action.

Now, there are uncertainties also in those times. We don't know them precisely. One important message here is that, this part of the analysis isn't an academic exercise. The time that's

available is derived from detailed best estimate thermal hydraulic analyses that look at the event progression so that we understand the rates of change of things like temperatures and pressures and levels and flows and all of those things.

In one we evaluate the time that's required for the operators to perform these actions. We look at simulators and evaluations of how much time is required to the simulator? We go through walkthroughs in the plant to see whether it's feasible to enter a particular area, what types of tools are required and so forth. That's the message from that slide.

Next slide?

Our final recommendation was that a formal pilot testing of the IDHEAS methodology should be performed. But I think that we're all aware of a bad example of this process and that is the transition to NFPA 805 where the staff and the industry are now applying a very complex methodology in the light of licensing issues without that methodology having been adequately evaluated in a pilot program.

And this is a complex methodology also. It should be tested in its entirety in a realistic application so that we work out the bugs before it's actually used in practice.

Next slide?

We recommended that that pilot testing be performed by a set of teams of analysts so that we don't suffer from one person who is the expert doing the analysis, that we use a variety of people.

And more importantly, the first bullet on this slide, that

those teams should include members with expertise in power plant engineering, operations, the entire PRA, as well as people who have human performance and HRA capabilities.

The message there is that Human Reliability Analysis isn't performed by the so-called HRA expert, it's actually performed by a team of people with all of those disciplines, people who understand the systems and the engineering people who understand the operations, certainly, people who understand the entire PRA and the meaning of those scenarios, as well as people who understand human performance.

Next slide?

And in closing, the staff has indeed responded to our letter and they actually agree with all of our recommendations. This a good letter. They plan to address all of those recommendations in an update to the current draft report on the IDHEAS methodology and they've stated that they indeed plan to conduct a formal pilot testing of the methodology which we're very pleased with.

And with that, I'm only about six minutes over but I gained a couple in the beginning.

I will pass the torch to the esteemed Dr. Corradini.

DR. CORRADINI: He's taken all my time. Thank you, John.

MR. STETKAR: You're welcome.

DR. CORRADINI: So, could I have the first slide, please?

So, we wanted to talk about the NRC research

program and, as you know, every couple of years we go through a review of the program, issue a report, which I'm sure you all have and looked at.

And as usual, the scope really is to look at the current safety research program organized by RES. And then, beyond looking at all of that, identify one particular area that we think is important to kind of dwell upon. And in Chapter 3 of the report, we talked about understanding severe accident progression, so I'll come back to that with some comments.

And then, finally, I wanted to keep the talk short, I picked a few findings on specific research areas. There is recommendations on all the various research areas, a dozen of them, a baker's dozen of them. But I wanted to pick a couple to emphasize because some of them will already be picked up in subsequent talks.

Next slide, please?

So a general observation and this is not new. When I was in front of you, I think, two years ago discussing this same observation which is the NRC really has succeeded over the last few years in its effort to tie research activities that it undertakes to near term issues that are being confronted by its various line organizations which I've listed.

We will note those, still though, in some cases, research focused on organization needs may sometimes terminate prematurely some work precluding appropriate and needed efforts that would be of use for future regulatory issues.

My one example that I'll bring up, John mentioned

GSI-191. There are issues relative to downstream effects that still are open and we're considering them. And what we found very interesting with an applicant, a particular applicant looking at risk-informed approach for GSI-191 which we thought at least deserves looking into and understanding and even given uncertainties, might have some merit.

Next slide, please?

So, in terms of collaborations in the conduct of research, we've been pleased in the past, and I think we continue to encourage RES collaborations with other federal agencies such as DOE, I'll give examples in a bit, industry, universities and, in particular, international partners to effectively share knowledge and experience that contribute to intermediate long term research objectives.

My example for the OECD, I'll mention briefly what's going on in materials and metallurgy. What I am more familiar with is in thermal hydraulics and severe accidents beyond design basis accidents.

A lot of the work that the agency is doing through the research branch really interacts with and works with the international community through particularly the OECD in a lot of their programs and we're particularly pleased about that.

Next slide, please?

So, let's talk about Fukushima. In understanding severe accident progression, a lot of this focuses in on Fukushima forensics and the ACRS recommends that the NRC, and I'll insert continue to proactively engage with organizations. I said it proactively

engage, but I'll give you an example where they're already in the midst of it -- with the Department of Energy, with Japanese researcher organizations and others in the international community to focus on the forensics of the accident.

Let me take one particular example, Dr. Brian Sheron, head of RES, is now currently the Chair of the CSNI. And in particular, it was under his recommendation that they begin the SARPF group. I asked Brian beforehand what does SARPF stand for, but he said I couldn't remember. It stands for Severe Action and Research Post-Fukushima.

And so that group, which is headed by Dr. Hirano of Japan, is looking at ways in which one can list and prioritize inspection techniques so we can gain information as the units are deconstructed and taken apart so we can gain some information about what might have occurred in severe accident progression that we thought would go one way and it turned out to go a different way.

Such efforts offer a really unique opportunity to better understand boiling water reactor severe accident progression, as well as to develop better measures for mitigating beyond design basin accidents.

A couple other examples, NRC, if I flip it a bit, NRC is leading, as I mentioned, what Brian is doing is participating with the DOE because the DOE is trying to help identify instrumentation needs that might -- that one can rely on if we go beyond the design basis in the accidents space and use those instruments to actually provide readings that we can use and understand the accident progression. NRC is

participating there.

Also, they'll be observing a new gap analysis effort that the DOE is doing to try to understand what are the gaps in research that might need to be done.

Next slide?

So, let me give just a few specific research recommendations. In the area of Digital I&C, Charlie will coming up next talking about this, so I'm not going to steal his thunder. I'll just simply say that we continue to recommend the integration of control of access, safety and cyber security in the design stage and licensing to ensure secure Digital I&C safety systems.

I think Charlie, this is just a personal comment, I think Charlie's done an absolutely top notch job of working with the staff and trying to really lay out the key principles that one has to stay within this area.

In the area of fire safety, initiate R&D to include early detection of incipient fire, effects from fire damage and heat on fiber optic cables and cabinet fire heat release rates. I picked those three with the advice of some of my colleagues and the cabinet fire heat release rates, that's well along. That's already been started and is well along in terms of an activity.

In terms of early detection in incipient fires, that activity is just getting started.

Under reactor fuels, extended burn up and fuel performance simulations will require the RES to develop, and I'll insert also, to improve current analytical methods to evaluate proposed

changes in fuels and cladding.

FRAPCON is one of the key tools the NRC uses for modeling this. You're going to have to improve some of the modeling there if we go to extended burn ups and differences in fuels and cladding and that's something we wanted to note.

Next slide, please?

In the areas of materials and metallurgy, this kind of goes back to what I was saying about international cooperation. We continue to support the active participation and international efforts relating to materials degradation, such as the International Cooperative Group on Environmental Assisted Cracking.

In PRA, the RES should really initiate efforts to ensure that an appropriate characterization of uncertainty is performed in all agency analyses. I should say NUREG-1855, which kind of leads one through how to perform uncertainty analysis we feel is a very good document and really could be used as -- should be used as a guide as to how you do uncertainty analysis in the future.

From a practical standpoint, the PTS, or Pressurized Thermal Shock, in particular, NUREG-2163 is a good example of how one can use uncertainty analysis for a technical issue.

In thermal hydraulics, my final area, RES really should maintain independent confirmatory capabilities that keep pace with such developments in the industry such as computational fluid dynamics, modeling and advances in computer simulation.

And within the agency, TRACE is the main workhorse tool to do thermal hydraulic analysis, but that's really supplemented by

some commercial tools such as Fluent and STAR-CCM.

And we're encouraged by the fact that the staff and Research are using these tools to specifically address individual questions that need some illumination, such as induced steam generator tube failure analysis, looking at flow patterns, the boron distribution effects during a boron injection, and then flow pattern and mixing for a spent fuel pool analyses.

So, those are some examples of where we think things ought to go in the future.

With that, I'll conclude and turn it back over to Charlie.

MR. BROWN: This presentation is going to be on the proposed revision to 10 CFR 50.55a, incorporate by reference, IEEE Standard 603-2009 criteria for safety systems for nuclear power plants.

The brief consists of two parts. The first few slides provide basic fundamentals and characteristics of reliable I&C systems. The remaining slides will provide a summary of our review of the proposed rule language and our recommendations with a discussion of our bases.

Nuclear power plant safety -- next slide, please?

Nuclear power plant safety system designs rely on the following fundamental principles to compensate for failures that could degrade safety system reliability. They are redundancy, independence, determinacy, defense-in-depth and diversity, control of access and simplicity. A somewhat subjective principle but a very important principle to consider during the design process.

They apply to computer platform software-based or

field programmable array digital instrumentation and control systems as well as conventional analog-based systems.

Next slide, please?

As you are aware, today, nuclear plants are being designed with computer-based Digital I&C systems and networks as the backbone for protection, control, alarm, display and monitoring.

Next slide?

Computer-based systems allow enhanced performance but result in a higher degree of functional integration, which I'll comment on in a minute, have new design and failure issues, for example, less inherent inter-division communication independence, signal processing that is not inherently deterministic, software complexity, verification and validation and control of access vulnerabilities.

Just a little perspective on what do we mean by higher degree of functional integration, which is a somewhat esoteric statement?

With analog systems, you can basically process the data, a pressure or a temperature flow, nuclear signal, whatever and if you want to combine them into a more comprehensive algorithm for plant safety protection, very complex keeping it and maintaining it, aligning it and calibrating is difficult.

With software-based or computer-based systems, it allows you to develop more powerful algorithms which enhance your safety performance and position as well as a highly increased accuracy for the functions and the parameters that you're measuring because

you've eliminated the variability of all the analog components downstream of the -- what I call the center itself, okay, which you have to live with what you get.

So, that's what we mean by functional -- higher functional -- at least that's what I mean by higher functional integration.

Next slide?

Also, networks are now used for the communication between plant systems and control spaces and to external site and corporate networks resulting in potential compromised control of access from sources external to the plant.

Next slide?

The use of computer-based systems, which typically are microprocessors or programmable logic devices or field programmable gate arrays and nuclear plant safety systems, does not compromise, well let me restate this, does not compromise the determination of the fundamental principles of redundancy, defense-in-depth and simplicity.

However, they do introduce significant new vulnerabilities that potentially compromise division-to-division independence, determinant safety signal data processing behavior and control of access to plant safety systems from sources external to the plant.

Next slide?

Thus, the use of computer-based systems need new design requirements that are specified by rule in the Code of Federal Regulations as is done for analog systems.

It also should ensure that the fundamental principles that are potentially compromised, namely independence, determinant signal processing and control of access from external plant sources are captured in the Digital I&C architecture and should ensure also that all of these are detailed during the licensing phase.

Next slide?

The present rule 10 CFR 50.55a specifies that nuclear power plant I&C systems must comply with IEEE Standard 603-1991, criteria for safety systems for nuclear power generating stations.

The 1991 Standard does not provide criteria that are sufficient for designs based on computer-based technology.

Next slide?

The proposed revision to 10 CFR 50.55a revision is being advanced by NRR and they recognize the problems with the existing regulation and the standard. They've proposed updating the rule to IEEE 603-2009 which does include some expanded requirements for computer-based designs.

However, and NRR was very good with this, they also recognized that there were many additional needs that were absent from the 2009 Standard which required some type of coverage in the new rule.

Next slide?

Thus, the draft revision proposes to incorporate by reference IEEE 603-2009 subject to the following, it imposes additional technical conditions for the use of IEEE 603-2009, it establishes conditions for applicability of the new and previous versions of the

Standard, it retains the incorporate by reference of earlier versions of the Standard and it provides clarifying definitions for several terms in the Standards and proposed regulation.

The use of computer-based technologies significantly impacts the critical fundamental principles of independence, deterministic signal processing and control of access that are inherent in the use of analog systems.

Thus, a primary focus of our review was to ensure that these new vulnerabilities had conditions incorporated in the new rule that would result in design features that would maintain the inherent nature of these fundamental principles in computer-based safety systems. Our comments and recommendations are the result of this focus.

ACRS comments -- next slide, please?

The proposed draft revision should be published after incorporation of our recommendations with respect to independence, determinant signal processing and control of access.

Next slide?

Independence. Independence and digital applications is not inherently ensured by the existing rule requirement for electrical isolation.

And I want to deviate from the slide momentarily here to just make a following comment.

Independence is probably, of all the principles, is probably the most critical principle because without it redundancy is meaningless. You have no redundancy if your protection divisions are

not independent.

So, what is the difference? Just a little calibration. If you can envision four divisions, each has a computational unit and a voting unit. Each division sends its computational trip signal to every voting unit in every division.

In the analog systems, according to the present rule, those systems, it's easy to verify independence. They're required to be electrically isolated. That means you either have relay contacts going into the voting units which separates them and prevents compromising the voting units in any other division.

Or, if it's a solid-state integrated circuit-type designed voting unit, you isolate it with diodes and you can handle the single failure criteria. It takes care of your other vulnerabilities.

With computer-based systems, that data electrical isolation, is meaningless. You can send it via fiber optics, so what. If you have corrupt data which can lockup, you may remember you move your mouse on your computer and all of a sudden the arrow doesn't move, nothing does anything, that's known as lockup.

And if you generate that in one division, send it to all of them, you'll probably lock them all up. Is that absolute? Absolutely not, but it may. So you have to be able to counter that particular problem.

So, as it exists today, the proposed rule does not -- the existing rule isolation does not work satisfactorily for the software-based units and the proposed rule does not incorporate a specific condition that prevents this loss of independence.

Next slide?

Determinant signal processing. Determinant signal processing behavior depends on program cycle design which can include operating system, operator or other external interrupts.

The proposed rule incorporates a condition for -- under the system integrity part of the IEEE, that's the condition where it goes, which requires predictable and repeatable operation. Not a problem with that.

The difficulty is that it doesn't really say what you mean from where to where. What do you want to be predictable and repeatable?

So, it's not clear relative to that and it really should be clear that it's relative to real plant systems from the sensor plant, excuse me, from sensor data inputs to control device actuation and it should be clarified as part of the rule.

Now, what is the difference between analog and computer-based processing?

In analog systems, those are consisted of resisters, capacitors and inductors. Once you design the system and put it together, you get a response. That response is fixed. Physics dictates how it will perform time after time after time.

In a computer-based system where you have software, you've got how it's programmed, how it makes it calls. What are the interrupts if they have any? Are they external? Although we prohibit, for the most part, prohibit, they're not explicitly stated, there's not a software standard that says that.

So, there's a lot of complications in the software process is far more -- potentially far more variable.

So, that's the difference in determinant processing between analog and why it's critical from analog to the digital-based systems.

Next slide?

Control of Access. Connections between internal plant safety networks and networks external to the plant through a firewall, typically software-based and software controlled, can enable remote access that is not under the control of plant operators.

The proposed rule does not contain any provision that prevents this loss of access control.

One observation I would like to make, as a result of our reviews of new reactors, most applicants have stated that they will specify that plant networks connections to external sources will be done through hardware-based one way devices commonly referred to as data diodes. So, you'll hear that terminology. So, they are -- we are getting that, most of them have done that.

However, it's not explicitly required or called out in the proposed rule as it's being drafted.

This is a significant difference from plants from analog systems where access to systems is basically by technicians under the control of operators in the main control room, as well as the use of other hardware access features such as keys.

Today, with the computer-based systems, if you've got a firewall that somebody can hack through, everything you've got on

that network, which is all the signals going back and forth, both control and protection-type signals and data monitoring are subject to being messed with.

So, that's why it's critical to make sure that network bus is carefully controlled and has no access from the outside.

Next slide?

We agreed with the proposed draft revisions subject to incorporation of three recommendations, revise 10 CFR 50.55a(h)(5)i, independence to specify an independent hardware-based monitor for the common safety system voting processing units that produces a trip if the common unit ceases operation or locks up.

The trip should be independent to the processing unit and executed by the hardware-based monitor.

Next slide?

Second one is Section 10 CFR 50.55a(h)(4) which is system integrity of the proposed rule should be clarified to state that both predictable and repeatable means processing from sensor data input to safety control device actuation and independent of any redundant portions of the safety system or other external input.

Next slide?

Third, Section 10 CFR 50.55a(h) of the proposed rule should specify an additional condition addressing Section 5.9 of the IEEE Standard control of access.

The condition should specify that communications external to the plant should be accomplished using one way hardware-based transmit only devices. These devices should neither

be software configurable nor capable of alteration by external commands or any surreptitious means.

I'd like to make one other observation relative to the proposed revision, give you the perspective that I gave to the committee relative to the staff's job.

They did an excellent job of going through the new rule, the new Standard, the proposed Standard, all the lessons learned from the design reviews and did a fine job of incorporating all these conditions.

Our recommendations are meant to fill gaps that we feel are very critical in maintaining the safe and reliable performance of I&C systems protecting the plant.

That completes my brief. Thank you.

MR. RAY: This was on to begin with.

Okay, the title slide, please?

Last month, the committee completed its review and issued a letter with recommendations in response to the staff proposal to make systematic, transparent and consistent a longstanding qualitative consideration of factors in the development of regulatory analyses and backfit analyses across the full range of agency activities.

Next slide?

As a vehicle for doing this, the staff would expand the scope of SECY-14-0002 which is the existing plan for updating the agency's cost-benefit guidelines.

Specifically, the staff proposal is to develop a set of methods with the objective I mentioned as summarized in the next

slide.

Here, the staff's objective -- here are staff's objectives for this effort. The first, to make the process more systematic is needed to satisfy the backfitting rule, 50-109, as is the second objective concerning transparency.

The third objective to increase consistency in the qualitative consideration of factors will likely be a greater challenge than the first two are.

Next slide?

Although it seems like a diversion from my topic, the existing guidance and the ongoing effort I referred to as SECY-14-0002, emphasized that qualitative analyses are performed and must be used in regulatory analyses where possible.

In improving the evaluation of direct and indirect costs, it's generally straightforward, although the costs, that is, are generally straightforward, although it still may involve significant uncertainties.

But the valuing of benefits inherently involves qualitative consideration of the factors involved.

Another issue is how to make more systematic and transparent and consistent the balance between these two things, qualitative and quantitative considerations.

Next slide?

ACRS Recommendations. The committee recommends approval of the staff proposal to initiate the effort, to identify the methods to make the qualitative consideration of factors in regulatory analyses, as I keep saying, more systematic, transparent

and consistent.

The committee recommends that the effort avoid creating a dichotomy between the quantitative and qualitative methods and recognize, for example, that quantitative analyses are inherently based on qualitative considerations, choices get made in order to decide what to apply the cost benefit to.

Next slide, please?

Because the result of the effort is impossible to forecast precisely, the committee recommends, and the staff has indicated it is their intent, to meet with the committee to review the development progress, thus, allowing more specific comments by the committee where appropriate.

And that's all I could summarize from our letter given that we're just proposing to start this effort.

CHAIRMAN MACFARLANE: Okay, over to us.

And Commissioner Ostendorff was supposed to start with questions, but seeing how he's absent right now, I guess I will start with questions.

So, let's -- no? He's back.

COMMISSIONER OSTENDORFF: You finished quicker than I thought you were going to.

MR. STETKAR: Harold took a course on speed talk. You missed it.

CHAIRMAN MACFARLANE: Well, he made up for the rest of you running over time, that's all I have to say.

Okay, Commissioner Ostendorff?

COMMISSIONER OSTENDORFF: I appreciate all the committee does and I really appreciate the fact that everybody's here and that's always a good thing to see.

And I know that we really benefit from having the ACRS eyes on across the entire range of issues we deal with.

From time to time since I worked at NNSA for a few years, I'm asked to go speak to the Department of Energy Nuclear Executives and I think I did my fourth talk just back in August of this year and I'm always asked a question. What are the two biggest differences or two things you'd suggest are advantages or enhancements the NRC has over NNSA with the Department of Energy?

One of the things I say is I think our personnel rotation practice here at the NRC helps eliminate stove piping and creates very healthy cross pollination.

The second thing I always talk about is the Advisory Committee on Reactor Safeguards and how much we benefit from ongoing professional type of advice. So, I wanted to thank you up front.

I will give a specific, and not single out one area, but I will. The subsequent licenses renewal paper you provided was very helpful in framing my vote, so I appreciate your work in that area, as in all areas.

John, not surprising, I'm going to start out with HRA. We've had some discussion in my office on this. I was just counting up in my head when you were talking, I think I spent 19 years in Navy

training operators either to operate nuclear propulsion plants or when I was a prospective commanding officer instructor how to shoot torpedoes, all of which were high hazard, high consequence events every time you shot one of those torpedoes, in particular.

And we spent a lot of time looking at how to reduce human error and how to enhance operator training. But we never assigned any numerical or quantitative value to the likelihood that somebody would do something correctly and so I continued to be troubled in this area as we've discussed.

I've got to tell you, I go back to your slide 2006, okay, now, we're eight years past that. On slide 18, you say work remains, you know, to look at refining the proposed models.

Our principle of good regulation reliability says that we shall use the best available information. That's our own principles of regulation for the NRC.

And so I get a little nervous when we look at more expert elicitation. Our staff has done that. At what point do we say we've gone far enough? I'm troubled that we're continuing to do research projects. ACRS is recommending to continue this. It's been going on for years.

We've had, you know, Commission meeting earlier this year with other people from Halden and EPRI and so forth and I've got to tell you, am I being overly negative about the use of quantitative measures to assess the likelihood of operator performance?

We has this rulemaking that our staff's working on right now in filtering strategies. What I'm hearing from you is that we don't

have the HRA methods in place right now to provide confidence that that modeling would be appropriate for the Commission to make a decision.

So, I'm going to stop right there and let you comment on any of that that you want to.

MR. STETKAR: Well, that's a lot.

COMMISSIONER OSTENDORFF: Well, I do want to give you -- the rulemaking thing is really bothering me because --

MR. STETKAR: We don't have to shoot torpedoes from these things so that makes a little bit of it easier.

You covered a lot of topics.

COMMISSIONER OSTENDORFF: Well, at least you know the -- I mean, short term, this Commission, these Members to my right and myself and two perspective Members will be faced in making a decision on filtering strategies rulemaking during our terms as Commissioners.

Yet, what I'm hearing from the ACRS is, the ACRS does not believe that the state of art of HRA techniques is sufficient to quantify operator performance. Yet our staff is doing that right now.

MR. STETKAR: I think that, in that particular case, we're following that, obviously, very closely. We had a subcommittee meeting, we're very familiar with the models that are being developed by the staff for the -- to support the filtering strategies rulemaking activity.

We have highlighted HRA as an area that deserves our attention, deserves the staff's attention. And, in fact, we have another

subcommittee scheduled on that particular topic, I lose track of dates, but it's in November.

Do I believe that improvements can be made in Human Reliability Analysis methods? Yes, certainly.

Do I believe that we have the capability to, for the purposes of that rulemaking activity, evaluate human error probabilities in a context that will allow us to structure those scenarios to determine information that can be provided to you, quantitative information and qualitative information, to support that rulemaking? I'd say, we can.

Are there uncertainties? Yes, there are but in many cases, characterizing those uncertainties will help you in the decision making.

Sometimes, the uncertainties don't make a difference if they're clearly differences.

COMMISSIONER OSTENDORFF: But, let me refine because I'm looking at the clock here, let me refine my question.

Right now, NRR and Research staff are working on assigning the probability of an operator conducting a venting operation as part of the filtering strategy rulemaking and trying to use that to assess the benefit of this operator action.

MR. STETKAR: That's correct.

COMMISSIONER OSTENDORFF: Right now.

MR. STETKAR: Yes.

COMMISSIONER OSTENDORFF: Is that model being used right now? Does that model represent what you believe is a proper state of the art HRA model for the staff to use for quantitative

assessment of operator performance? Because that's what they're doing right now.

MR. STETKAR: They're using the best available -- the tools that they have available right now.

COMMISSIONER OSTENDORFF: But it's not a tool that you think -- the ACRS believes --

MR. STETKAR: We believe --

COMMISSIONER OSTENDORFF: -- is mature enough? Is that what I'm hearing from your recommendation?

MR. STETKAR: We believe that that tool -- we've been facing this problem now for 35 years in the risk assessment business in terms of quantifying human error probabilities and having a consistent methodology that will reduce variability in terms of those quantifications. So, this isn't something that's new.

If it was an easy problem to solve, we would have solved it 35 years ago. So, what we're trying to do, and granted, it's taking a long time, I have no excuse for that.

COMMISSIONER OSTENDORFF: I'm not being critical of the staff or the ACRS --

MR. STETKAR: Is there the refined methodology that we would like to see evolve out of the ongoing project? The answer to that question is no, it's not ready for prime time.

COMMISSIONER OSTENDORFF: That's what I was asking.

MR. STETKAR: Is it developed far enough that elements of that methodology can be used? The answer to that is,

yes, it's up on the learning curve.

COMMISSIONER OSTENDORFF: Okay.

MR. STETKAR: So, we're not there but we're getting there.

COMMISSIONER OSTENDORFF: That's helpful.

Okay, Mike, I apologize, I'm going to skip you for right now.

DR. CORRADINI: No, I'm enjoying this.

COMMISSIONER OSTENDORFF: No, no.

Charlie, I've got to go back with our common bond of naval reactors and so forth.

We have certified the AP1000, Digital I&C. Has that passed your proposed standards?

MR. BROWN: We've finally got to the point --

It might be a good idea if I turn that on, I guess.

Yes, we got to the point where they did incorporate into the DCD the requirements for monitoring of the computer-based units, the voting units.

Control of access is on that one was a little bit of an open issue. We didn't take that up to the same degree on AP1000 as we have learned we needed to do on some of the subsequent reviews.

But, yes, AP1000 met the metrics for what we were looking at.

COMMISSIONER OSTENDORFF: Okay. I hear, and I just was -- spoke at two different events over this week and I heard from some in industry and external to the nuclear industry, man,

are we making it too hard to incorporate digital technology in the nuclear arena?

And I look at -- I've shot Tomahawk missiles, I've shot hundreds of weapons before and all the weapons, torpedoes, ADCAP torpedoes and the Tomahawk missiles, all that digital technology. And those have been around for decades, since the early 1980s.

Do we look at all at -- and lethal applications I'm talking about -- do we look at all at or does ACRS look at standards used in other areas, let's say the Department of Defense weapons systems to look at the state of practice for digital technology?

MR. BROWN: The answer, no.

COMMISSIONER OSTENDORFF: Okay, that's fine.

MR. BROWN: An honest answer.

COMMISSIONER OSTENDORFF: Yes.

MEMBER BROWN: But I would characterize that by you have to be aware of -- there's a question that the former Commission Magwood stated -- asked. You look at airplane technology, they've got fly by wire, what's different?

You've got to look at reactor plants where all you want to do is shutdown the reactor or you have feedback control systems where you have to rapidly incorporate data in order to vary, you know, planes and rudders and all kinds of other stuff to make them fly. You have to take a different approach to each of those.

COMMISSIONER OSTENDORFF: And I don't disagree with that.

MR. BROWN: My point being, is that you can't

necessarily look at what it takes to fire the torpedo and say is that what's necessary, or is that sufficient, for what we would do in the nuclear industry.

COMMISSIONER OSTENDORFF: Yes, but we get in -- they still use IEEE Standards and so a lot of the Standards are used in many cases are --

MR. BROWN: But the Standard -- the items I'm talking about don't really, if you look at independence, where does independence come in?

You push a button, it fires the -- does it do it in 30 microseconds or 15 microseconds?

It's not really a function of what you need to do.

Control of access, there's nobody going to access that system when you're boring holes in the water. So, those fundamentals --

Now where you do come in is you can have some redundancy in firing circuits because you don't want a single failure in the firing circuits from causing this puppy to take off or the door to open when you don't want it to.

So, there's a lot of -- so you have to use some common sense when you apply these. And what we've tried to do as part of the committee, is look at these principles and apply them in a way to the new reactor designs that we've been presented with without adding layers of cost or complexity.

When you talked about a monitor on a voting unit, for instance, typically, that's -- you can go buy what's called a 555 timer,

okay, that costs 39 cents, put it, you know, as little block on your platform and if it doesn't get triggered every 200 milliseconds, it tells you to go do something else.

And you're probably resetting that processor anyway if it locks up. It's just that the reset of a processor in these systems, can it be for five to ten minutes?

And the systems I did in the Navy, when we reset the division processor, it had to be backed up in all indications within 250 milliseconds, at the most, with the complex algorithms where you needed more, it was about three or four seconds.

There's a big difference between being able to demonstrate you're going to be able to take care of the plant between, you know, a quarter of a second to two seconds or three and five to ten minutes before that processor and that channel is back up running, that's unacceptable.

So, when you look at it, you have to do something on those voting units because that's the final trip and you can't afford to have those little babies compromised.

COMMISSIONER OSTENDORFF: I appreciate your providing specific examples. That's very helpful.

MR. BROWN: Okay. Thank you.

COMMISSIONER OSTENDORFF: Thank you all. Thank you, Chairman.

CHAIRMAN MACFARLANE: Okay, all right, I'm going to start off with Mr. Ray.

So, you said something I thought was very interesting,

tell me if I got it right.

Qualitative analyses are inherently based -- sorry, quantitative analyses are inherently based on qualitative considerations.

MR. RAY: Correct.

CHAIRMAN MACFARLANE: Okay. Can you elaborate a little more?

MR. RAY: Well, the selection, for example, of what costs and benefits you're going to compare in a quantitative analysis, assuming that's what you're going to do, that selection isn't defined by anything other than your judgment as to what things you're going to look at.

On the cost side, as I've said or tried to say, it's generally pretty straightforward, direct and indirect is a little more difficult sometimes to estimate.

But on the benefit side, I don't know of anything that will define the benefits in a cost benefit analysis other than the judgment of the person who's -- or the organization, the institution that's making the evaluation.

So, that's the sense in which I'm making that comment.

Also, the decision about, well, exactly which benefits are we going to consider? Take for example, public confidence in the agency's actions. Should that be included somehow? I'm sure it is no matter what we say.

CHAIRMAN MACFARLANE: How would you measure it?

MR. RAY: It's going to be considered how do you evaluate in a cost benefit analysis?

CHAIRMAN MACFARLANE: Well, how do you evaluate human life? Is that really quantitative?

MR. RAY: Well, people can make it quantitative, Chairman.

CHAIRMAN MACFARLANE: Isn't that informed by judgment?

MR. RAY: It is. And --

CHAIRMAN MACFARLANE: So, in the end, it's quantitative or qualitative?

MR. RAY: In the end, qualitative factors are inherently part of any cost benefit analysis which is the point.

CHAIRMAN MACFARLANE: Are expert elicitation quantitative or qualitative? Aren't they opinions?

MR. RAY: Expert elicitations are, I believe by definition, opinions.

CHAIRMAN MACFARLANE: Dressy opinions maybe with a Ph.D. next to them? But opinions, yes. So that would be qualitative, correct?

MR. CHAIRMAN RAY: In my dictionary, yes.

CHAIRMAN MACFARLANE: Yes, so in the end, it seems to me that this is a misguided discussion of quantitative versus qualitative because they're not terribly separable.

MR. RAY: Well, again, the staff's proposal is simply make the use of the qualitative factors more systematic, transparent

and consistent.

And no one, I think, can criticize that as an objective and, as I say, 5109 says that your consideration should all be documented and this is merely an effort to try and do that.

The doing of it, though, is what we're saying we need to be engaged periodically to look at it because it's not easy.

CHAIRMAN MACFARLANE: Yes, well, I'm all for documenting these things and being very clear about all your assumptions and everything, I think that's very valuable.

MR. STETKAR: I think, in the interest of time, I'd just like to add something.

A statement you made, I think, hits the point and I hope we've made that point in our letter and that qualitative analysis and quantitative analysis are not separable.

CHAIRMAN MACFARLANE: Thank you.

MR. STETKAR: They are part of an analysis.

Our letter emphasizes the use of quantitative analysis to its fullest extent where you can do that. Quantitative analysis, regardless of the topic, is always informed by some type of qualitative judgment, either in the selection of parameters that will be quantified or in the interpretation of its results.

I did want to add something, quite honestly, you said, well, is expert judgment qualitative?

Expert judgment is qualitative but when we think about expert judgment these days, we don't think about asking, hey, what do you think? That's not expert judgment, that's a wild guess.

We think of expert judgment in the context of a systematic process of expert elicitation and we know how to do that. It's a formal process, it isn't something where you go ask somebody what do you think today and what's you opinion.

There's a structured process that makes sure that, first of all, you're an expert.

CHAIRMAN MACFARLANE: Right. But in the end, though, it's -- you do that because there is no quantitative factor that you can find.

MR. STETKAR: That's true.

CHAIRMAN MACFARLANE: So, that's why you have to do expert elicitation.

MR. STETKAR: That's true, but you do it according to a process where you understand --

CHAIRMAN MACFARLANE: Oh good, that's good, I'm glad.

MR. STETKAR: -- how it's done and it's reproducible.

CHAIRMAN MACFARLANE: Great, but it's -- You know reproducible depending on which experts you go to.

MR. STETKAR: Well, that's as I said.

CHAIRMAN MACFARLANE: Back to the judgment piece and the qualitative piece.

So, anyway, I've always been puzzled by that.

Charlie, maybe for those of us who aren't really so good at all that electrical stuff, the Digital I&C, you know, and this is a

public meeting.

I thought it might be helpful for you to say something about why Digital I&S systems are valuable given all the vulnerabilities that you listed.

MR. BROWN: I tried to do that a little bit with the --

Okay, I tried to do that a little bit with the -- trying to characterize what was the integration, the more enhanced the higher level of integration.

So, I'm going to put this from my own personal experience, not the civilian world experience.

When we moved from standard analog, without giving compromising classified -- when we moved from analog systems to the software-based digital systems, we were able to incorporate -- okay, let me back up a little bit.

Plants have a pressure temperature and flow regime in which they're supposed to operate. They are normally maximally efficient at a particular band that you -- within which you operate. If you move out of those bands, you have reduced capability.

When you go to software-based systems, you can now take all of the available data, you can take your analysis where you have now calculated the capability of the plant over a wide range of pressure temperature and flow circumstances.

And you can build algorithms that allow now, instead of having to shut a plant down, you can allow a reduced -- a different level of operation without having a shutdown.

That is -- now, I'm not -- I've only come across a couple

of functions so far in the review of the new designs where they have gotten more complex -- somewhat more complex algorithms where they're combining things to come up with some other particular function they want to use to shutdown.

They're not as complex as anything I ever dealt with, but if you had tried to do those with all analog, they would have been far more difficult to maintain, to align and to set up.

So that, to me, and the accuracy, there is absolutely no question that you don't have to deal with a whole division, the whole train of drift of passive components, resisters, capacitors and inductors, they drift no matter, potentiometers, they drift, no matter how you --

So, you've got to account for that when you're doing your analyses and that determines your base, your, you know, time for recalibration or realigning.

Once you get past the A to D convert the sensor, then you have to convert it from analog to digital. Once you get past that, there's virtually no error. So, there's a much -- and I'm saying that on a general basis, we can probably find a circumstance where there's some introduced, but much narrow range, which that accuracy improvement also gives you improved plant performance and can allow you to compensate for some problems that you may find in the thermal hydraulic or other physics areas.

CHAIRMAN MCFARLANE: All right, that's helpful, thanks.

MR. BROWN: Okay, thank you.

CHAIRMAN MACFARLANE: Mike, see, I know you

were just relaxing over there.

So, on your Slide 35, I don't know if I can find your Slide 35, you say that, it's the middle bullet, Research should initiate efforts to ensure that an appropriate characterization of uncertainty is performed in all agency analyses.

So, can you give examples of areas where you think the staff isn't appropriately characterizing uncertainty?

DR. CORRADINI: Sure, I'd prefer not to.

Well, the one area where we've asked, so, I'm going to look to colleagues to help me, but one area where we've asked the staff to kind of improve their use of uncertainty would be in SOARCA, for example.

They're in the middle of, and we're actually expecting to hear back from them relative to uncertainties in the SOARCA analysis.

So, it's not to say that what they're doing now is wrong, it's just that it could be better and better would be defined as essentially following to some extent guidelines of 1855.

We're seen, I can't remember now, I'll have to look. John, was it a year ago that we've seen a discussion of some of the uncertainty analysis?

And we gave them opinions back then, suggestions on how to improve it. So, that's one. Can you help me with another one?

MR. STETKAR Well, I think we've seen a lot of activities done by the staff that use models and risk assessment space, for example, to quantify things and decisions are made on the basis of

that.

You know, is it the judgment of the staff that a certain condition is acceptable because it meets some sort of acceptance criterion.

Without quantifying the uncertainties, you really have no confidence in those margins. All you're doing is comparing two numbers and there is uncertainty about both of those numbers.

In a real decision making capacity, I think that it's important to understand what -- and I characterize it in terms of margins -- is there a three percent probability that we might exceed the margin? Is it a one percent probability? Is it a 40 percent probability? Despite the fact that something we're calling a mean value might be slightly below our accepted or above our acceptance criteria.

And that's where we think that quantifying the uncertainties as part of all agency decision making activities is very, very important, as a feed-in to people who are making decisions.

So, it goes across the board, I think, any time that we see a quantitative analysis, the staff should be assessing those uncertainties --

CHAIRMAN MACFARLANE: Absolutely.

MR. STETKAR: -- as part of that analysis.

CHAIRMAN MACFARLANE: I completely agree. I would be shocked --

MR. STETKAR: Are there examples? There are several examples.

CHAIRMAN MACFARLANE: And that was my

training at MIT was that you don't use -- you don't put a piece of data without putting up the error bars as well.

DR. CORRADINI: Well I get -- let me inject one other thing.

I guess as the question becomes more complex and where it's a systems question versus a particular physics question, then the ability to do uncertainty analysis becomes more complex, too. So, the extent that I'm making a measurement, I can do it.

I just came back from a doctoral exam where we're torturing a student appropriately about some particular measurement on CHF. So, there I can be very clear about what's the answer and what's the reproducibility?

But if I take that and I put it into a systems calculation such as when I mentioned SOARCA's example, there's a lot of things that feed into it. There's like two dozen -- and that's where it makes -- that's where they've done, I think, in my personal opinion, a good job, but it could be better.

CHAIRMAN MACFARLANE: Right.

MR. STETKAR: I think, this is a final comment, I know we're short on time.

But, the staff often relies on so-called sensitivity analyses. And the problem with sensitivity analyses, is that what are the consequences if I die immediately?

Well, I can do that analysis, but I've not given you any confidence in the likelihood that I'll die immediately.

Sometimes, sensitivity analyses are useful if they,

indeed, provide extremes. But often, we've found they don't really provide the extremes, they provide some arbitrary benchmarks. And without providing -- putting those into the right context in terms of what's your confidence that that may actually occur?

It really doesn't help the decision process very much. In fact, it can confound it sometimes.

CHAIRMAN MACFARLANE: Okay. Thank you.

Commissioner Svinicki?

COMMISSIONER SVINICKI: Well, thank you for your presentations and to all Members of the committee for their work since our last meeting.

I'll turn first to the committee's letter report on the staff's work on qualitative consideration of factors or whatever we're calling it now.

I acknowledge that the committee speaks through its letter reports but I often review transcripts of your meetings because I wish I had the -- that I was available to attend, but if I'm not, I look at the transcripts.

You conducted two engagements with the NRC staff on this topic one, I believe at the subcommittee level that was closed, I'll get to my puzzlement about that in a minute.

Ostensibly, I guess the staff's request to close that session had to do with the fact that we'd gotten into a timing disconnect where the paper was not publically available. But having reviewed that transcript and since the paper is now available, personally, I don't read anything in there that needs to be closed. But guess I'll make no

comment.

I will confine my commentary to reference to your subsequent open session with the staff and then --

So, I reviewed those two items and then reviewed your letter report and not having attended your letter drafting session, I'm not sure what occurred, maybe peace broke out and you convinced yourself that all of your, I think, very well founded concerns about ambiguities in what the staff is proposing do not appear in your letter report.

And so, I'll state this in a positive way. I found the transcripts to be much more illuminating to my consideration of having to act on the staff's paper than the letter report which, again to be fair to you as Member Ray outlined in his presentation, you've indicated that your recommendation is the Commission approve the staff's recommendation but that you want to stay engaged.

And I interpret the committee's desire to stay engaged in the topic may be to relate to all of the open questions that you had when you met with the staff.

And the reason that I belabor this point is that in reading the transcripts of your engagement with the NRC staff, I found, to be honest with you, some measure of validation over the course of the last 18 months in my meetings one on one with NRC staff on this topic, I have evolved many of the same points.

And so it was very validating to see, at least to the subcommittee level, to a Member, you all raised a lot of the same concerns and fundamentally one was a little bit ironic to me in that some

Members, Member Ray in particular, I think, referenced the fact that it's very difficult to tell what the staff's work is going to result in.

And I take some ownership at the Commission level, I should acknowledge as a Member of the Commission, I was not supportive of the Commission's tasking to the staff on this matter because I felt it was vague and a bit of a throwaway from our decision on containment filters which we, at the end of the day, had said, okay, but, you know, qualitative factors, why don't you go off staff and think about that a little bit more.

And I never like when we issue direction that doesn't give the staff a whole lot of understanding of where they were supposed to head as a result of that.

And as often happens in bureaucratic Washington, the chief proponent of doing this is no longer on this Commission. So, the rest of us now have this paper, the staff struggled mightily and did what they could.

And so, we have something that our expert advisors on the ACRS tell us is not terribly clear. Well, I think it's not terribly puzzling why that is because of the genesis of this entire topic.

But I thought something that was particularly interesting was the thematic concern of Members of the ACRS, again, not in your letter, but in your engagement with the NRC staff which I would characterize as there's a high level balancing of factors that needs ultimately to be done when it is any deliberation not of technical specifics but of high level public policy outcomes.

And what I have -- the feedback I've given any number

of NRC managers is, Congress dealt with that by having a Commission structure here. They put five individuals who do their best to take the technical inputs of the staff to take an analysis that the staff has to the best of its expert ability been able to make as quantifiable and specific as possible.

But it is not, in my view, the staff's job to do a high level balancing of public policy objectives, put that in an algorithm, make it quantifiable, monetize it and feed it back these five high level decision makers.

I think we are here for the purpose of something that cannot be reduced to an algorithm. And so, I thematically thought I heard that in some of the Members questioning. Again, it didn't come through with any clarity in your letter report.

I've talked for half my time now. I will let Member Ray or perhaps Chairman Stetkar respond to that.

MR. RAY: Well, let me just say, Commissioner, as I think you recognize, it's not usual for the ACRS to recommend an ongoing dialogue on a topic that we're commenting on.

We did in this case, I think, in some measure reflecting the need to see specific implementations. How, for example, can anyone object to making a systematic transparent and consistent process that we all accept as existing and necessary?

COMMISSIONER SVINICKI: Well, but I'll mirror something you said in your presentation just earlier this morning.

You said choices have to be made and I like that phraseology because NRC has to make choices and allocation of its

time and attention and, you know, dedicating -- often here, it comes down not to money but to narrow skill sets of NRC experts that we have to put on various priority questions of the day.

And I might pose to the Members of the ACRS, do you think that an agency that has recently validated through some case study work that its cost estimates on a quantifiable side of the ledger are routinely profoundly underestimated sometimes by factors of ten?

Do you think that if we were going to spend some time improving the overall regulatory analysis and consideration of cost and benefits that having validated the profound inadequacies of many of our cost estimates, would our resources be better spent fixing that and figuring out why that is?

MR. RAY: Well, of course, the other SECY that I referred to that's the ongoing analysis we understand to be an effort to do precisely what you're commenting about, that is, improve the accuracy of the cost estimates.

The add-on that resulted in the letter and the review of the that we did was to make the qualitative considerations that we all accept and recognize as very important more, and I won't repeat the three characteristics, but more --

And to me, Commissioner, one of the things I'd like to see as we go forward is that you do have visibility that you indicated that you should have because the decisions do get made at the Commission level properly.

And to say that we're going to make the qualitative considerations more visible to you and to everybody else, it seemed like

something, well, we ought to at least let it go forward.

COMMISSIONER SVINICKI: Well, I think I might, though, suggest that another way of framing something -- it's a clever loophole if the staff were to believe that if we just define a proposal vaguely enough that then makes it something that because you can't find fault with it or we wrap it in the mantle of some absolute good like we're going to improve the agency's processes.

I have to tell you, that as a decision maker, and this might seem a little bit counterintuitive, but when something is wrapped in a general good with no definition, my inclination is to disapprove it until I have some further detail about it, because otherwise, it, you know, it's a very open ended license to expend, I don't how many resources, on something, again, when this agency, I think, is faced with applying its skill sets and NRC managers do have to make some tough choices about that.

So, I acknowledge and you acknowledged in your presentation that the overall objective, I think your phraseology was, how can one argue with this?

And I do think, though, that it's legitimate for the ACRS in its role advising the Commission to say, we just simply think that this proposal by the staff, although appearing meritorious, is simply not well defined enough for proceeding at this time.

So, if the default is to say if something looks like a good idea and details will follow, we recommend that the Commission approve it. I'm not sure that I frame decision making in that way.

MR. RAY: I understand. On the other hand, I'm sure

you understand that the kind of comment that you just indicated you would expect we might make now is a comment that we can still make and that was the intent of asking the staff to review with us periodically because of exactly the reason that you say. And that is that the effort to make more systematic, transparent, and consistent the qualitative considerations may simply be a bridge too far, something that's not doable.

But to say it's not doable now, at the end of the day, the committee felt was something we should let them try.

Now, I think you've raised the question of, well, maybe it distracts from efforts that could be better spent on the cost side improving the Commission's cost analysis. And, you know, that's a decision certainly that you all can make.

COMMISSIONER SVINICKI: Another concern, I'll just close by adding, you know, it isn't just a matter of allocation of resources or having greater definitions. Some Members of the ACRS also in their individual capacity, question the staff on whether or not it may not be beneficial to have an overly regimented system.

There were statements to the effect that we will create the window dressing of a great systemization of this balancing of factors and, at the end of the day, it's really nothing more than a mirage for the kinds of application of judgment that needs to be made.

So, I think there were also concerns that, at the end of the day, creating a highly proceduralized way of doing this may not be best because analysts need to have the freedom to exercise their judgment and decide what factors are relevant.

And at the end of the day, decision makers need to have the ability to do a balancing of factors test as well.

So, it's on the front end and the back end and I think there were many pointed questions for the staff in the transcript about just backing decision makers into a corner with an over proceduralized approach to something that, in many cases, benefits from a bit more flexibility.

MR. RAY: Those comments will still be on the table as we continue our review. That's all I can say and, perhaps, the judgment to say, well, let's give it a try and come back to us was one that can be questioned. But it wasn't a decision not to continue pursuing the concerns that you're referring to.

MR. STETKAR: I think it I can -- and this is a great discussion, you have obviously done your homework and there were all of those. And if you'd read the transcript from the subcommittee meetings, you would have heard a lot more of that type of line of questioning from individual Members.

COMMISSIONER SVINICKI: That is why I regret that that transcript was not publically available.

MR. STETKAR: That was --

COMMISSIONER SVINICKI: The full committee meeting was really a watering down.

MR. STETKAR: We did face on the subcommittee exactly the characteristic that you framed. The version of the paper that was submitted to us was marked predecisional, don't release to the public and that, in fact, is what we were given to review at the

subcommittee level and we had to treat it that way. It literally was a timing issue.

Had we had the subcommittee meeting a week later, it would have been an open meeting that --

COMMISSIONER SVINICKI: See, I just want all your brilliance to be out in the daylight because there are very, very important points you make.

MR. STETKAR: No, honestly, so do we. I mean we had serious discussions about whether that meeting should be open and because the material that we were given to deliberate over and that all of the Members had read in preparation of their comments was clearly marked predecisional, not for public disclosure, Our concern was -- and we had not been able to see what is now the final version of the paper. Our concern was that some Members might ask a question out of context. In other words, something that, perhaps, had changed from the version that we saw in preparation for the subcommittee meeting to the version that was released to the public that, perhaps, was off point, should not have been -- and that fundamentally was the reason for us to keep the meeting closed. We didn't do that lightly.

We do like to have both our subcommittee meetings, as you're well aware, and the full committee meetings, certainly, open to the public.

If I could shed just one -- this is long, but if I could shed one little bit of insight.

We also, at the committee level, recognized -- we thought carefully about this in enclosure one to that SECY paper that

lists the long list of activities that relied -- that have in the past relied on both qualitative and quantitative and, in some cases, only qualitative information to support a Commission determination.

We thought about that pretty carefully and realized that this guidance going forward was going to apply for that whole spectrum of things. Not only things that you might be able to quantify more clearly, like, for example, filtered venting where, as I said, we're developing models, quantitative models for that to support that decision.

But things like security related issues or informing the public about certain transportation routes, those are really, really difficult to quantify in the sense that we normally quantify things.

And yet, the staff makes recommendations to the Commission. The Commission makes decisions on those issues and we felt that certainly a more structured process for incorporating that qualitative information into the staff's recommendations to the Commission merits some thought.

COMMISSIONER SVINICKI: I'll just close by saying, you know, given the different types of issues, and I know the enclosure that you're talking about, and the staff was on unable in questioning by the ACRS to come up with one definition for qualitative factors.

So, it's curious to me that there's diverse set of applications for this. I will candidly admit I'm very skeptical that we would be able to enshrine one approach for analysts in guidance that's going to meet all these different types of things. So, I'll just leave it there. I'm well over my time, my colleagues have been patient.

MR. STETKAR: And in closing, I think we are also, that's why we want to keep following this with the staff.

COMMISSIONER SVINICKI: Okay, thank you.

CHAIRMAN MACFARLANE: Anything else? No?

All right, well, thank you for that very long and fruitful discussion. And we look forward to more of this in the future. So, thanks again for all your hard work.

Okay, we are adjourned.

(Whereupon, the above-entitled matter went off the record at 11:40 a.m.)