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NUCLEAR REGULATORY COMMISSION

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JOINT MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

SUBCOMMITTEE ON SAFETY RESEARCH PROGRAMS

~~AND~~

~~SUBCOMMITTEE ON FUTURE PLANT DESIGNS~~

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WEDNESDAY,

NOVEMBER 6, 2002

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ROCKVILLE, MARYLAND

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The Subcommittees met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Drs. F. Peter Ford and Thomas S. Kress, Chairmen of the above Subcommittees, respectively, presiding.

SUBCOMMITTEE MEMBERS:

F. PETER FORD, Co-Chairman

THOMAS S. KRESS, Co-Chairman

MARIO V. BONACA, Member

GRAHAM M. LEITCH, Member

SUBCOMMITTEE MEMBERS: (CONT.)

VICTOR N. RANSOM, member

STEPHEN L. ROSEN, Member

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

GRAHAM B. WALLIS, Member

ACRS STAFF PRESENT:

RICHARD P. SAVIO

NRC STAFF PRESENT:

RALPH CARUSO

STEVEN M. BAJOREK

FAROUK ELTAWILA

JOHN H. FLACK

WALTON JENSEN

RICHARD LEE

SHANLAI LU

JAMES E. LYONS

JOE MUSCARA

JACK ROSENTHAL

STUART RUBIN

ALSO PRESENT:

MICHAEL CORLETTI, Westinghouse

ADRIAN HEYMER, NEI

LUCA ORLANI, Westinghouse

VICTOR SNELL, AECL

ROB M. VERSLUIS, DOE

GARY VINE, EPRI

C-O-N-T-E-N-T-S

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

8:35 a.m.

CO-CHAIRMAN FORD: Good morning. The meeting will now come to order.

This is a meeting of the ACR Subcommittees on Research and on Future Reactors. My name is Peter Ford. I'm the Chairman of the Research Subcommittee, and my Co-Chair is Tom Kress, Chairman of the Future Reactors Subcommittee.

The ACRS staff member is Richard Savio. Other ACRS members in attendance are Graham Wallis, Victor Ransom, Mario Bonaca, Steve Rosen, Graham Leitch, Jack Sieber, and Bill Shack.

The purpose of this meeting is to gather information for the ACRS Research Report which is due out early next year. This report will comment on the completeness of the NRC Research's assessment of the regulatory and technical challenges for future reactors.

We have their report, "Advance Reactor Infrastructure Assessment," plus further pre-decisional appendices covering more details on ALWR designs, plus an itemization of activities for fiscal year '03. These are the prime bases for our comments in the report.

Thus, we shall hear from NRR and RES on their final reports. We shall also hear from DOE, NEI, and EPRI on their views on research needs for proposed advanced reactors. A segment of time has been set aside for comments from the general audience.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in The Federal Register. A transcript of the meeting is being kept and will be made available as stated in The Federal Register notice.

It is requested that speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

The first item of business is NRR. Jim, would you like to lead off?

MR. LYONS: Yes, I will lead off. I'm Jim Lyons. I am the Director of the New Reactor Licensing Project Office in NRR. We are responsible with the project management of any licensing reviews that will be held as we move forward in licensing new plants.

I want to start off with actually a slide that I showed to you about a month ago. Nothing really has changed on this, but I would like to walk through it just a little bit to put things in context of where we are and where we are going and what we are going to work on.

I guess in good, I don't know, presentation fashion, I will do a little highlights of things to come. Early site permits, we have three of those coming in in 2003. We are going to be here tomorrow to talk to the full Committee on the early site permit review standard and how we're planning on doing those reviews. So I'm not going to get into that too much today.

I just wanted to let you know that those are coming. There's a lot of staff effort that is going into that and to developing how we are going to review these sites to issue these early site permits. That is one part of the Part 52 licensing process, which includes early site permits, design certifications, and then, finally, combined licenses.

CO-CHAIRMAN KRESS: When you talk about early site permits from the viewpoint of research, do you see any research needs for that or is that just a process --

MR. LYONS: At this point we haven't developed any. One of the big areas that has really changed the way we did siting reviews in the past is in the seismic area.

CO-CHAIRMAN KRESS: Yes.

MR. LYONS: And there are some discussions, I think, going on in the seismic area of reviews, on how we would do those reviews and actually using the Part 100 appendices for the first time.

CO-CHAIRMAN KRESS: I guess we are supposed to have a discussion on early site permits later. So I will save my questions for then.

MR. LYONS: Right. Okay, good.

CO-CHAIRMAN FORD: But just as a kind of overview for this meeting's sake, is it planned that there will be a section in the infrastructure assessment relating to ESPs?

MR. LYONS: I don't think there is at this point.

CO-CHAIRMAN FORD: No, there isn't. My question is, I recognize the living document --

MR. LYONS: I think at this point we don't see the need for that.

CO-CHAIRMAN FORD: Okay. So there are no research dollars put aside, regardless of the source of those research dollars, for doing work on ESPs?

MR. LYONS: Right. But if we see a need, it is part of our reviews to ask Research to do certain things for us; we may do that. Right now we are in -- and we will talk about this tomorrow -- but we are in pre-application discussions with the three applicants and with NEI on exactly what the scope and the depth we are going to go to. So we are trying to identify those types of issues and to see where we are going to need help and where we might not.

MEMBER LEITCH: I have a lot of questions about ESP. I think probably tomorrow's discussion is a more appropriate time to ask those, but I mean just the seismic question, for example, how can one approve a site when you don't know the reactor design that is involved? I mean, some of these designs are very tall and others are underground. It seems to me that, in and of itself, would --

MR. LYONS: We'll discuss all that tomorrow.

MEMBER LEITCH: Okay.

MR. LYONS: Yes, a lot of that has to do with the way the early site permit, what do you really approve as part of the early site program, and we will get into that tomorrow.

MEMBER LEITCH: Okay, good, Jim.

MR. LYONS: The other thing upcoming is AP1000, the design certification. We are in the midst of that review. We have already issued our request for additional information. We are slated to issue a draft safety evaluation report on AP1000 in June of 2003, and we'll be coming back to the Committee for those reviews.

Again, I think tomorrow afternoon we have about a two-hour presentation on the AP1000, so we can discuss any of those issues.

CO-CHAIRMAN KRESS: Can I read this chart as being in priority order as you go down?

MR. LYONS: It's more in chronological order of when we see things starting, but in the same place that does kind of define our priorities. Kind of first-in/first-out is the way we have been working.

In fact, we had a meeting with the industry yesterday, with NEI. One of the things we raised was, is there a priority amongst the different projects that they see ongoing? Can industry give us a priority of what do we need to be really working on?

Certainly things that lead directly to a combined license are things that we would focus our efforts on. Early site permits go that way. Plants or designs that are in for design certification are in that way. The pre-application discussions we are having with the other vendors are important to move us forward, but they would necessarily take a back seat to some of the other efforts.

CO-CHAIRMAN KRESS: Is it too early to ask where ACRS would fit into that chart? Is it the red diamonds?

MR. LYONS: The red diamonds are where we see the ACRS having some input at that point or that we would be coming to the ACRS. Those are our dates. Obviously, we would come before that to you, probably a month or so before that, to discuss those issues. That is why I tried to raise those in red, to highlight where we see that.

The ESBWR pre-application, we've got that underway. We've decided what we're working on and where we are going to move forward to. You will hear a little bit in just a little while from Shanlai Lu on where we're looking for help and support on ESBWR and on AP1000.

The reason I've got milestone schedules for AP1000 and ESBWR up here, because those are the ones we've actually developed milestone schedules. The others we are still in the process of developing both through the early site permits and for the other pre-application reviews. So I would see this chart expanding and schedule expanding as we have those milestones established, and then would show how we would fit into that.

But let me walk through some of these others.

MEMBER WALLIS: Could I just ask now, this design certification, AP1000, there's about a four-year process?

MR. LYONS: Right.

MEMBER WALLIS: And then ESBWR, yours ends with a design certification application. Is there another four years of that before -- you are going about six years before you get an ESBWR approved?

MR. LYONS: How do I want to say this? The way that works is, if you look --

MEMBER WALLIS: Maybe it is five years?

MR. LYONS: In this September-October of 2004, that is when we actually would be issuing our final safety evaluation report and our final design approval. That would actually complete the staff's technical review of the design.

Between October of 2004 and December of 2005, that's the time we would see that it would take to actually develop the rulemaking and notice the rulemaking that puts the design certification -- that actually certifies the design as part of the rule.

MEMBER WALLIS: So that's got to be added on at the end of the ESBWR?

MR. LYONS: That's right. So in this case we are looking at about 30 months, I think was our review schedule for AP1000 -- I'm looking back at Larry to give me a yes -- from when we got started.

You have to remember, too, with the AP1000 we were able to realize a lot of efficiencies because we had already reviewed the AP600, and we are really just reviewing the changes in that design. For the other designs, we're starting a lot from ground zero. So our review time to reach a final safety evaluation will probably be longer than --

MEMBER WALLIS: It might be shorter if you did some stuff in the pre-application.

MR. LYONS: That's true.

MEMBER WALLIS: If you did enough work then, you might not have to spend so much time on that --

MR. LYONS: The pre-application reviews --

MEMBER WALLIS: -- design certification.

MR. LYONS: Right. The pre-application reviews help us, help both the vendor and the NRC, decide what are the key issues, try to resolve any of those, so that the vendor feels confident in moving forward with the design certification, so that they don't see any major obstacles.

In the ESBWR, what we are looking at is their codes, their thermal-hydraulic codes and their containment codes, and coupling them together and moving forward. They see that as one of the major hurdles. They feel if they can overcome that, then the rest that they could come in.

On these other reviews, ACR700 is the Advanced CANDU Reactor. That's a new design to the U.S., but it is certainly not a new design. It is an evolutionary design of the CANDU reactors that have been operating throughout the world.

As the NCR staff has to bring itself up-to-speed on some of the issues, one of the things we have done is we have started discussing with the Canadian Nuclear Safety Commission how we might cooperate in reviewing the ACR700, because AECL technologies, which are bringing the technology here to the United States, are also -- AECL is also seeking pre-licensing in Canada and in the United Kingdom.

So a couple of weeks ago we had a meeting amongst the three regulators to see how we might work together, and to what extent we could do that, and to what extent we all have our own regulatory processes. We have to meet and we all have to make our own safety findings, but the sharing of information and the sharing of knowledge we see as something that can be very beneficial.

MEMBER ROSEN: Did your discussions go to the sharing of any future research as well?

MR. LYONS: Yes, we did. We talked to some extent -- the Canadian Nuclear Safety Commission doesn't normally do any independent research like we do. So one of the things we were looking at exploring is whether they would want to cooperate with us.

They typically go to AECL and ask for AECL to do the research. But we are looking at the research that has been done on CANDU reactors and how we might fit into that, and what kind of information we need.

So part of it is learning what are some of the key issues in the CANDU reactors. They have a long history. They can help us a lot in that area. So we are looking to make that a program that helps us become more efficient and effective as we move on.

CO-CHAIRMAN FORD: Jim, I wonder if you could comment: These data you have on the board, there are obviously facts. That's what you have been presented with right now. As you look forward to seeing what the technology needs are, make those in fact successful, you may have a time crunch in meeting those schedules, especially for the gas-cooled reactors.

Do you have any comment about how you are going to avoid that time crunch?

MR. LYONS: Well, I think one of the things, I think this technology assessment, infrastructure assessment, that Research is putting forward is a good way of looking forward and trying to understand, if we are going to do these reviews, if they actually come into fruition, what are the information needs we need and what is it going to take to get ready for those information needs? We see that as one of the key aspects of their plan.

CO-CHAIRMAN FORD: So as we look forward in the next segment, I mean in the infrastructure assessment report, document that we have, it gives you fairly detailed PIRT activities and also implementation questions. Have they been taken into account as you look forward to the funding? When we look at the next section, maybe you could give us a pre-warning. The work that has been planned for fiscal year '03, did it go through a formal PIRT activity as described in the infrastructure assessment?

MR. LYONS: I would have to turn to Research.

CO-CHAIRMAN FORD: Okay.

MR. LYONS: Because what we have focused on from our end standpoint is the work that we've got on our plate. Obviously, with the Pebble Bed Modular Reactor we had started moving forward very quickly on that. When Exelon pulled out in April of this year and that project slowed down in the U.S., because it certainly is continuing forward in South Africa with a decision of whether or not they are going to be building a demonstration unit down there probably sometime early next year, we've kind of backed away from looking at the gas reactor technologies.

The work we are doing on the GT-MHR is at a fairly low level. We're still working with General Atomics to slowly define what we want to get out of the pre-application --

CO-CHAIRMAN FORD: And yet the technical challenges to both the GT-MHR and the PBMR, which you will see is back on your list again, are huge and will need a lot of time to resolve.

MR. LYONS: Yes.

CO-CHAIRMAN FORD: Does that come into the overall NRC thinking as to how they are going to proactively manage this?

MR. LYONS: Well, I think that's where this infrastructure assessment is the first step in doing that, is trying to define those issues and those areas that the staff would need information, and that we would use that to define how we are going to go forward.

CO-CHAIRMAN FORD: Okay.

MR. LYONS: Yes, and let me talk about the PBMR, although it is at the very bottom there, a little bit. We have had some further discussions with PBMR-PTY, the South African company, about their desire to reestablish a pre-application review probably in the beginning of fiscal year 2004. So we are keeping that on the horizon.

I think that is part of why we try to keep communications open with the various vendors, is so that we know what could be coming in, so that we can do as much planning as we can. But from a budget standpoint, it makes it very hard when it becomes uncertain out in the future what actually is coming in and what's going to move forward.

CO-CHAIRMAN FORD: I have one last burning question which is going around in this group. In your thinking about your resources to make this happen, is the longer-range vision this 50,000 megawatts we keep hearing about online in 2020?

MR. LYONS: I mean, we have discussions with the Department of Energy on their 2010 Initiative, and we try to understand. We don't think so much in terms of all those different reactors. We are looking more at making sure that our process is as efficient and effective as we can be, to move us towards that --

CO-CHAIRMAN FORD: But being driven reactively to what is currently coming onto your plate in the next year or two years?

MR. LYONS: Right, yes.

MEMBER ROSEN: Jim, you made mention of the budget and resources. Could you help me understand how much of this is actually funded by the vendors and how much is by the agency?

MR. LYONS: Well, for the pre-application reviews, design certification reviews, those are all fee-billable projects. So once we start into a pre-application review, we are billing the vendor for the work we are doing on that. The same with the early site permits; we are billing the utilities on the work that we're doing on them.

But even though they are fee-billable, we still, as the NRC, have to have that within our budget. We have certain ceilings that we are able to spend. So just because we can bill them for it doesn't mean we can do the work. We have to have the authorization to do that. We are only authorized a certain budget, and we have to work within that.

Obviously, these programs compete with other programs that are on the operating plants, such as license renewal and plant uprates, power uprates, work that is going on now, like on the Davis-Besse lessons learned. So we compete with all those resources.

MEMBER ROSEN: Seen from one perspective, that makes good sense. Obviously, no matter how much money you have, if you don't have the people, trained people, you can't do it anyway.

MR. LYONS: Right.

MEMBER ROSEN: So you are resource-constrained by the availability of trained and experienced people. So seen from that perspective, I really have no problem with it. But seen from the other perspective, that, gee whiz, they're paying for it, it is a little hard to understand why, other than the resource constraint, why one would say it has to be within a budget, a dollar budget, when the dollars really aren't, except I guess a small percentage, coming from the agency.

But that's a good enough answer for me.

MR. LYONS: Yes, and what you will see is, when you start talking about research efforts, if the research efforts directly are applicable to the licensing action that we are taking at the time, then we can bill the applicant. But if it goes beyond what is needed to make our regulatory decisions, then it gets into the big, overall pot that the current licensees pay through their annual fees. That covers all the overhead and a lot of the research work.

MEMBER LEITCH: Jim, I have a process question. Could you contrast between the pre-application review and the design certification review? Is the pre-application review always a prerequisite to design certification?

MR. LYONS: No. The pre-application review is voluntary. It is part of the Commission's Advanced Reactor Policy Statement that encourages early interaction with vendors, especially on innovative, new designs, so that we could try to address some of those issues upfront.

For example, as I was just thinking, it is a good segue. On the SWR-1000, they are doing some testing over the next year or two that we would be interested in observing or being involved, or observing and seeing, even though they are not really looking at starting their pre-application review until calendar year 2004. But they have some things going on that they can help us look at.

But what the pre-application review really does is it allows us to try to define some of the key technical areas that would have to be addressed as part of the design certification and try to resolve them, if necessary, or at least identify the information that would be needed to address those.

MEMBER LEITCH: So the three bottom lines on the chart, the GT-MHGR, the IRIS, and the PBMR don't seem to have a pre-application review or they are going to go directly to design certification?

MR. LYONS: No. The blue lines here indicate when the pre-application review, we see the pre-application review running. In there they talk when we would anticipate receiving a design certification. I would have to get my glasses out to see that.

MEMBER LEITCH: So that would imply, then, that the pre-application review for GT-MHGR, for example, has already taken place?

MR. LYONS: Right. We have started some discussions with them on where we want to go with the pre-application review and have had some meetings with them, and we have some meetings scheduled with them to take us forward to actually define what we are going to address as part of the pre-application.

Usually in these pre-application reviews -- actually, Westinghouse is the one who started it with the AP1000 -- is you do this what we've started to call Phase 1, where you have some discussions on what should we address as part of pre-application and then agree on that. That kind of completes Phase 1. The second phase is to look at what we have decided to look at and then to move forward.

MEMBER WALLIS: Why do you need all this? If you've got a water reactor and you've got all the codes in place, all they have to do is be sure they meet the regulations. Why do you have to have all this pre-application review?

MR. LYONS: Well, in a lot of cases there are issues that the vendor wants to make sure can be acceptably resolved before they commit to actually coming in with their design certification. In a lot of cases, in some of these cases the designs are still evolving as we are in discussions, and they are solidifying their designs.

MEMBER WALLIS: So that's it; they don't really have a design yet? They have a conceptual design?

MR. LYONS: A lot of them are very, yes, conceptual, and then they are in varying degrees of completeness.

I have probably taken up more time than I should because Shanlai has got some more discussion on the user needs that we actually have, currently we are working on, for the AP1000 and the ESBWR. So why don't I turn it over to him?

If there are other questions, I would be happy to answer them as we go through this. I will be here for most of the day to answer any questions that you have.

Thank you.

DR. LU: All right. My name is Shanlai Lu from Reactor Systems, and I'm a reactor systems engineer. I am here to give you a brief presentation about the four user needs.

We have already sent three of them, and one is under discussion with Research. I want to provide a little bit of details, particularly the background and the basis, why do we want to have that and what we want from Research regarding this user need, and what's the application, and also I will give you the status.

Actually, Dr. Jensen and Andrze Drozd from PRA, all are from NRR. They originated the two user needs for the AP1000. So we are going to cover that, too.

So at this point we have already sent the three, No. 1, for years PWR and a few for AP1000, to Research to ask for assistance from Research regarding different technical issues. This one, No. 2, we have been having discussion with Research regarding the TRAC-M development, improvement for the ESBWR application.

So I am going to go through each one of them and tell you the technical basis and why we want to do that, what's the application and the current status and progress.

In turn, for ESBWR application, we got a non-proprietary package from GE. They are talking about an ESBWR. We found that they are going to model, they are going to put GE-12 fuel into the ESBWR core for their pre-application design.

We look at their GE-12 fuel. One feature here is the large water rods, which each water rod operates three fuel tanks' location. Then the part-length rods are here; we have the red one. The water rods, the inlet and outlet are within the active fuel region. So the water goes to here and getting out from there. Then we also have part-length rods two-thirds through the core. It is dependent on the design. It might be, you know, it might be ones that are half. It depends on the cycle.

To model this for LOCA, for transients, and stability, we found our code at this point, RELAP-5 or TRAC-M or TRAC-B, or whatever, we don't have the necessary accuracy or capability to exactly match the capability that GE can handle. For example, the water, we cannot really model the water flow within the rod. We have to lump it into a bypass region.

That's when we started to think about, oh, how we are going to model for ESBWR application, and then we think, okay, maybe let's look at other fuel vendors. Are there any other fuel types we need to cover, the availability. They decided, the utility decided to use a Framatome fuel or Westinghouse fuel.

MEMBER WALLIS: Now this GE-12 fuel, is that just for the ESBWR or is that for other BWRs?

DR. LU: Yes. Actually, we found later

that, after we examined the capability, we said, "All right," and, actually, all of the fuel has already been loaded into the existing operating --

MEMBER WALLIS: Yes, it's already there.

DR. LU: Yes.

MEMBER WALLIS: So why are you now worried about modeling it? It is already there and being used.

DR. LU: Because GE was claiming this one, and they used TRAC-G to model this in the ESBWR, and we want to match that capability as well as we cannot really, you know, tell what's wrong or anything, review their application. We don't have the same level of accuracy in terms of modeling.

MEMBER WALLIS: Do they have full-scale experiments with this fuel?

DR. LU: I think so. They ran that for CPR correlation. That's what I recall.

MEMBER RANSOM: When you talk about models, are you talking about neutronics or thermal-hydraulics?

DR. LU: Both. I will get into, after I show these three slides, I will give you both hydraulics and the neutronics company in terms of some hydraulics I am going to get into there.

CO-CHAIRMAN KRESS: What's the purpose of the water rods?

DR. LU: Okay, the water rod itself -- actually, I should get to the next page. Okay, here the higher fuel economy, and what they want to do is provide additional moderation within the fuel bundle, so that they can have the --

CO-CHAIRMAN KRESS: That's for moderation then?

DR. LU: Right.

CO-CHAIRMAN KRESS: Okay. That's because you have a relatively high void fraction up high and --

DR. LU: That's right.

CO-CHAIRMAN KRESS: -- you want to keep water --

DR. LU: Yes, especially in the upper part of the region.

CO-CHAIRMAN KRESS: The upper part? Okay.

DR. LU: Otherwise, your fuel bundle may be undermoderated. Also, for the LOCA it can provide a heat sink because not all the water can flow out very quickly out of the water during large-break LOCA, then the fan blowing -- you have the flash in the fuel, but still you retain certain water mass there or steam. Then that becomes the heat sink if you uncover the core.

MEMBER WALLIS: Let's go back.

DR. LU: Yes.

MEMBER WALLIS: GE already has a model for this in their codes? GE already has a model for the GE-12 fuel in their proprietary codes?

DR. LU: Exactly.

MEMBER WALLIS: And these codes are available to the NRC?

DR. LU: Exactly, but we cannot just use their proprietary code.

MEMBER WALLIS: At least you know it is in there. You can examine the details of it and see how credible it is.

DR. LU: That is what we are going to do actually for ESBWR review and also for the -- because at this stage they have not submitted that for LOCA review, and also we have not received a submitted package for ESBWR. That is something we are going to look into that, what's the model.

However, as a confirmatory analysis or basis, we want to have a similar level of accuracy within our own codes, so that we can evaluate their calculation results.

MEMBER WALLIS: Now we haven't seen many results from TRAC-M anyway yet.

DR. LU: That is the reason we want to start to use it.

MEMBER WALLIS: So, first of all, it has got to be able to do the things that it has claimed to be able to do, and then it has got to do this as well?

DR. LU: Yes. That's right. Otherwise, because we look at our codes, the RELAP-5, TRAC-M, TRAC-B, TRAC-P. None of them, if right now we have some kind of scenario or transient using one of our operating BWRs, and if we want to model the fuel behavior or the hydraulic behavior within the channel, which has been loaded with GE-12 fuel, we cannot handle it.

MEMBER WALLIS: Maybe I would say we need to move along this TRAC-M because it hasn't really emerged to solve the old problems, and now you are asking it to solve a new problem. So we need to move it along, so that it's a useful tool and actually has been used for existing problems.

DR. LU: Okay. Yes, I think that might be the -- I am not in the position to answer that question. It is probably for Steve.

MEMBER WALLIS: Well, he's listening. I

hope he's listening, yes.

(Laughter.)

MEMBER RANSOM: Could I interrupt?

DR. LU: Yes.

MEMBER RANSOM: One thing you mentioned several times is accuracy.

DR. LU: Correct.

MEMBER RANSOM: It would seem that the uncertainty associated with these codes is a key component --

DR. LU: Right.

MEMBER RANSOM: -- of assessing the accuracy.

DR. LU: Right.

MEMBER RANSOM: Yet, in the research programs I have seen there is no effort that I see addressing this particular issue. Of course, it would be an issue with the NRC codes that you use as an audit-type capability.

DR. LU: Correct.

MEMBER RANSOM: It also is an issue with the General Electric code, too, but that is their purview, I guess, to argue how they are going to deal with that problem.

DR. LU: Right.

MEMBER RANSOM: But as we move towards a risk-informed basis for licensing, it seems this uncertainty is a key component.

DR. LU: Correct.

MEMBER RANSOM: And I am not sure there's any effort underway right now to build into, say, TRAC-M the ability to assess its uncertainty associated with the various correlations, and whatnot, in the code, as well as some overriding consideration to allow for inaccuracies or whatever.

DR. LU: Okay.

MEMBER RANSOM: And why isn't that being requested?

DR. LU: All right, okay. It's not really my position to justify what's going on with TRAC-M development, but my understanding, actually, Research has already initiated the effort, and I think that Joe Kelly and Steve Bajorek have a significant assessment effort to assess the uncertainties of the fuels and the hydraulics and the correlations and physics models.

So that I think it should be better up to them to give to you the presentation about how to address the uncertainties here.

MEMBER RANSOM: Well, it is their job, but

I would think that you, as the license reviewer, would be one to set the need.

DR. LU: Yes, but definitely we will pick up whatever the best can be used for us as an audit. So that can give us additional comfort.

MEMBER WALLIS: Do you have any idea of what is an acceptable level for uncertainties for your purposes?

DR. LU: At this point and until this user need is completed, we can't go over and around the codes and see how well. At that point we probably will get the GE code, TRAC-G code, so we can see how much difference is there. Is there any way we can dig into some results from that TRAC-G results and the TRAC-M results at that time.

Right now this code is not -- right now even we don't have any functionality. We cannot be building a --

CO-CHAIRMAN KRESS: Asking a question a different way, if you had the uncertainties in these thermal-hydraulic models, how would you use them in your decision process?

DR. LU: That's a good question. Actually, right at this point we are developing a confirmatory analysis plan and trying to identify what would be the acceptance criteria for our own analysis. Because if we impose --

CO-CHAIRMAN KRESS: You think the uncertainties somehow ought to show up in the acceptance criteria maybe?

DR. LU: Exactly. Exactly. That would be done, and within that writeup, I guess, we are working on that right now.

But there is one thing I think we should be aware: that we do not have that much of a code development as much as the industry because that QA process costs a lot of money. Right now if we imposed exactly the same standard, we will not get it over there, especially when we don't have a code that can be used for transient LOCA, gas-cooled reactor, and the ESBWR, or AP1000.

So my opinion is we can use it as an auditing tool. It can give us additional comfort. That would be good.

MEMBER LEITCH: I'm looking at the lower tie plate debris filter.

DR. LU: Right.

MEMBER LEITCH: That's a new feature, is it not?

DR. LU: Oh, I think it has been there.

It has been there. No, it has been there. Even for GE-10 or GE-8 we have it already there.

MEMBER LEITCH: Yes, but I am a little concerned that that can be a two-edged sword. Certainly, it is designed to prevent mechanical damage to the fuel.

DR. LU: Right.

MEMBER LEITCH: But are you also concerned that under certain circumstances it could restrict the flow?

DR. LU: No, I don't recall --

MR. CARUSO: Dr. Leitch, this is Ralph Caruso from NRR.

The answer is, yes, we have discussed this with the vendors on quite a number of occasions, and they assure us that licensees, when they design, when they buy fuel, they make sure that the suction strainers, for example, in the ECCS recirculation system are sized so that debris is caught on the suction strainers and not on the fuel.

I believe there is a NUREG Guide that is going to be coming out that talks about this, and we specifically asked that that be included in the Reg. Guide about two or three months ago. Because this came to our attention, this exact issue came to our attention during the discussions that we hold with the vendors periodically. They showed us one of these things, and we looked at it and said, "Wow, that looks like an opening that's a lot smaller than the suction strainers."

We actually had something reported to us. One of the licensees was going to buy a particular vendor's fuel and a particular vendor's debris screen, and they discovered that screen size was smaller than their suction strainers. So they had to delay the feature purchase, I believe, until they did something about the suction strainers.

MEMBER LEITCH: Are you concerned about the pulverized resin on filter demineralizers working its way into that part of the system? I don't know what happens to that resin at, say, 540 degrees. It may completely disintegrate.

MR. CARUSO: I mean, the openings aren't really that small. I have an idea what resin sizes are, and they're very, very small.

MEMBER LEITCH: Yes.

MR. CARUSO: And these are not, these debris screens are not designed to trap resin beads. They are designed to trap things like metal shavings and springs and sort of long things.

MEMBER LEITCH: Yes.

MR. CARUSO: Maybe very, very thin, but long, not resin beads. It is not clear to me that a resin bead could even survive the transport, the temperatures.

MEMBER LEITCH: I think it would probably dissolve at that time, but I'm not really positive of that. Okay.

MEMBER ROSEN: What suction drainers are you talking about, Ralph?

MR. CARUSO: In the ECCS recirculation system, during a LOCA, eventually the plant has to go to recirculation from either the reactor-building sump or the suppression pool or the torus, or wherever. Because they are located in the building sumps, they've got to have screens on them. So there are requirements about sizing those screens that are related to head losses and debris and MPSH, lots of different requirements.

There's a new guidance document, I believe, that's coming out. We included this particular issue in that -- I'm not sure if it is a Reg. Guide or an SRP revision, but we have included it recently.

MEMBER LEITCH: But you are talking about

BWR? I mean this is a BWR issue?

MR. CARUSO: Both. Both. This is an issue for both types.

MEMBER ROSEN: For the BWRs you're talking about torus suction strainers?

MR. CARUSO: Right.

MEMBER ROSEN: And the PWR, containment suction strainers?

MR. CARUSO: Yes.

MEMBER SIEBER: But these debris filters are intended for normal operation mostly. For example, if you had machined inside the reactor vessel during an outage, left some chips or grindings in there, you don't want them to go and fret at the grid straps.

On the other hand, during ECCS the flow regimes are altogether different, where it would seem to me that the fuel debris filters are not in the flow streams in the same kind of way that they would be during normal operation.

DR. LU: We are asking a very ambitious question. If we really want to model the solid particles that are transporting through the entire system, then we would need to develop another code to handle that.

All right, I'll move along.

MEMBER WALLIS: There you're going to have to decide not just how to model it, but how to model any debris that might be on it.

DR. LU: That's right. That is where it becomes a water chemistry issue or the entire plant purification system and the reactor water treatment system.

All right, I will just move along. For ATRIUM-10 we have looked at GE-12 and we found worry. How about other vendors? We have ATRIUM-10. There is square-shaped water rods and part-length rods here. For Westinghouse fuel it is even more complicated, and it has water crossings, what they call water crossings here. There is water here. There is water here. Then there is not only a different fuel type here, they have a larger diameter of fuel pins here.

So our code right now, as it is right now, it can handle 8x8 bundle straight tube, the thick fuel pins, and the non-part-lengths run a four-length rod all the way through.

So we really want to model this and handle it to match the accuracy of the vendor's code. So that we can use an audit calculation, we need this.

MEMBER BONACA: Just a question --

DR. LU: Sure.

MEMBER BONACA: The ABB fuel I think has already been used, that fuel?

DR. LU: All of these fuels.

MEMBER BONACA: Okay.

DR. LU: All of the fuels have been loaded in the existing operating reactor, but the reason we get into this with the triggering point was we were reviewing what we needed to do to handle the ESBWR. It came out with --

MEMBER WALLIS: That's what puzzles me. I've asked the question before. These fuels are being used now.

DR. LU: Yes, it is.

MEMBER WALLIS: And, yet, you say you need to know how they work in order to analyze something which doesn't yet exist. I think you need to know them now to analyze what happens in --

MR. CARUSO: Dr. Wallis, I make the observation that there was a confluence of events that occurred this past summer that really pushed us to make this request from Research. It was the ESBWR plus some other topical reports that we are reviewing from operating reactors where fuel configuration is very important to be able to model it. So all these things came together this summer.

Although we need this in order to be able to evaluate the ESBWR, we also need it right now to do some evaluations for operating reactors. That is because the operating reactors have pushed the fuel and now they are pushing the analyses envelopes with that fuel. Their techniques are becoming more sophisticated. So we are trying to get our techniques as sophisticated as theirs.

MEMBER WALLIS: Well, this is an issue we came up against with uprates, that the uprates look okay as long as you really check on the fuel limits.

MR. CARUSO: That's correct.

MEMBER WALLIS: And so you have to have tools to do that.

MR. CARUSO: That's correct, and as I said, what has happened is this past summer we received some topical reports that involved being able to model this fuel better than we have in the past, and it is both us and the vendors. So it all came together this summer, and we decided to push for this.

MEMBER LEITCH: Isn't the ESBWR, as I recall, the fuel is only 10-feet long versus 12 feet?

DR. LU: Yes.

MEMBER LEITCH: Isn't that another

variable that you would have to consider in your model?

DR. LU: Right now, the user needs, what we worked with Research, should cover that, too. That is one of the software requirements that the Research technical people and NRR people will work together on the software requirement we send to Los Alamos when they code it this way.

So it can handle actually even 8-foot fuel. We can handle that, too.

MEMBER LEITCH: Okay.

DR. LU: Right.

MEMBER LEITCH: Thanks.

DR. LU: All right. Ralph has already addressed the questions about the existing upper reading.

All the new fuel will have higher fuel economy and lower linear heat generation rates, which actually provided a basis for a lot of power breed, and they provided more margins for the BWRs, and especially for the EPU plants.

So we asked Research -- actually, we should say it this way: The technical people from NRR and the Research worked together. We figured out what we exactly needed to do to use TRAC-M to model the fuel bundle, the part-lengths rods, water rods.

Since Framatome mentioned that they planned to use 12x12 fuel for their SWR1000, we put the limit, the code limit, to model 12x12 fuel pins. Right now, for GE-12 it is 10x10. Most of them are 10x10.

Yes?

MEMBER RANSOM: One question: You say more margins for PCT and minimum critical power ratio.

DR. LU: Right.

MEMBER RANSOM: My question would be, who has proven that? I mean, is that something that is claimed or is it something known?

DR. LU: It's something known. Actually, the LOCA generates a smaller diameter of pins, and the water also provides additional heat sink and the part-length rods.

MEMBER RANSOM: So that is sort of a subjective evaluation? Is it confirmed based on actual analysis?

DR. LU: Let me think. I personally have not done any confirmatory analysis on that.

MEMBER RANSOM: But the vendor, maybe that is based on his work?

MR. CARUSO: Dr. Ransom, the analyses for the PCT would be done using the normal codes. The critical power ratio determinations are done by actual tests of bundles in test facilities. The Columbia facility, they do this. The vendors do this regularly.

DR. LU: Okay. All right, so the status right now, I will give you the status. You showed this one. I think it was in July.

Right now the first chunk of code came out from Los Alamos and ISL on October 30, and everything was going very well with the management support from Research and technical people from Research, and we would be able to get the first chunk of the coding on schedule.

MEMBER WALLIS: This is the TRAC-M coding?

DR. LU: TRAC-M coding.

MEMBER WALLIS: And it works?

DR. LU: The source code just delivered has been delivered from Los Alamos and ISL, and I think that it is being tested by Research right now.

MEMBER LEITCH: Your viewgraph says, "Advanced Flowing Water Reactor Fuel Model." Is that in a generic sense? In other words, does this also apply to ESBWR?

DR. LU: Yes, yes, it applies for ESBWR.

You can take the 12x12. Right now we haven't seen that. Although we have heard from Framatome they may use the 12x12 fuel for the SWR1000, we haven't seen that yet. But that is what we call the Advanced BWR.

MEMBER LEITCH: So it is advanced not necessarily in the sense of ABWR but advanced in the sense of any --

DR. LU: Fuel. Right.

All right, I move to the second user need. It is a draft user need being discussed between Research and NRR at this point. What we want to deal with is specific for ESBWR's pre-application review. I think GE has come to give a brief presentation about their features.

Two features of our particular concern is the closely coupled containment vessel interaction during LOCA, because basically they have to depressurize it to the level of pressure, so that the containment of the gravity system can work. That actually requires the code can capture very dedicated pressure balance between the primary system and the containment system. This balance needs to be calculated reasonably well so that we can calculate the ECCS injection correctly.

So basically in July we looked at the

codes with Research technical staff. We had two meetings, technical meetings, that we exchanged the views as to how we are going to address all those features, and we came out with a list of items we needed to improve with the ESBWR, to improve TRAC-M code to address these unique features of the ESBWR. Right now it is being further discussed and considered as the action item, but we don't know where eventually what we are going to have.

MEMBER WALLIS: There's nothing new about gravity.

DR. LU: Yes.

MEMBER WALLIS: So what must be new is the result is more subject to change as a result of uncertainties or something? You're balancing off various little efforts here and there?

DR. LU: Yes, correct. Exactly.

MEMBER WALLIS: So whether it goes this way or that way depends on your accuracy with which you can predict things?

DR. LU: Exactly, exactly, and I will give you two examples here. We discussed some technical items. The reason I did not list that is because we not really come to any agreement as to where exactly it needs to be in the code.

But one of the issues we considered is PCCS non-condensable condensation. You know, you have steam and the non-condensable through the PCCS. That drives your pressure response of your containment significantly differently. If you have different correlation put over there, or how accurate is that, it will be quite different. That is one thing.

The second issue is traditionally for the BWR LOCA, for the containment analysis, basically, you assume basically you have a HPCI, or whatever, the RCIC running. So basically your initial blowdown state you do not have any coupling, and you don't have any backflow from the containment. But this one relies on this backflow, this pressure interaction so closely; then we needed to have very good model or code to calculate the interactions between the containment and the vessel.

So that is the reason we initiated the talk with Research technical staff and we worked together again and developed a list of things that needs to be done. Then we hope this user need can go forward.

MEMBER LEITCH: Now we have a draft, an advance copy of a paper, "ESBWR Advanced Reactor Research," that has a number of other apparent needs here other than the two that you have listed. These are just the two most important in your mind or --

DR. LU: At this point these are the most important because we went through that list and then we are still discussing that right now for the pre-application. If we have this handy, this too handy, we can do some runs already, but without the second one we will not be in very good shape if we want to calculate very accurately containment and the vessel interaction.

MEMBER LEITCH: I am not concerned about those two. I am concerned about the ones that are listed in this paper that you have not mentioned. You are just giving us a summary or --

DR. LU: Summary. A summary, correct.

MEMBER LEITCH: So there are other research --

DR. LU: That is the reason I am saying that other issues under consideration is covering that, whatever you probably have. We are discussing with them at this point.

MEMBER LEITCH: One thing I didn't see there is a whole lot of emphasis on BWR stability issues.

DR. LU: Yes.

MEMBER LEITCH: With this natural circulation chain, no recirc. pumps, it sounds like you are sort of always operating in the region where there is instability in a sense. I guess that is not really the case, but it seems to me we need to be taking a hard look at stability issues, and I don't see that as highlighted here as one of the issues.

DR. LU: Okay. If you look at one of the reasons why we want to have the advanced fuel model, it is to address the stability. If we cannot model that heat source and part-length rods, then the stability characteristics will be different. However, the stability issue is not unique for ESBWR. It is supplied right now. We are reviewing MELLA Plus for the generic application of the BWR, especially for EPU.

MEMBER LEITCH: It's not unique, but it seems to me that when you omit the recirc. pumps, it changes the whole thing significantly.

DR. LU: That's right. In that regard, actually, ESBWR has better stability features because they never use the jet pumps.

MEMBER LEITCH: We will have to hear more about that. That just seems counterintuitive to me.

DR. LU: Well, then that is a question we probably need to ask GE: why they think that natural circulation would work for ESBWR, right?

CO-CHAIRMAN FORD: I have a wider question along the same lines. You have cited four advanced reactors --

DR. LU: That's right.

CO-CHAIRMAN FORD: -- related advanced reactors. Yet, when I look at this Attachment 4 of all the advance reactor activities in 2003, it is much, much bigger than the four that you have given. Why is that? Is there a different model to use, a different funding source, or what is it?

DR. LU: Okay, it's not a question for me. I am technical staff, and I only give the presentation on a technical basis for using these. I think there will be a high-level discussion between Research and NRR. They need to resolve what exactly should be done, and I am giving you the basis of what we have already sent out.

CO-CHAIRMAN FORD: Okay, John, will you comment?

DR. LU: Okay, maybe somebody else can address that question.

CO-CHAIRMAN FORD: It will be covered today because it relates to resources. Okay.

DR. LU: Right. Okay. All right, I will move to the next one for AP1000. This user need was originated by Dr. Jensen from the Reactor Systems Branch.

Following a very successful user need that ADS did last year for Phase 2 review, this particular user need was issued to Research asking for Research's expertise regarding the COBRA/TRAC liquid entrainment.

The issue here is -- I'll go to the next page a little bit. I think it probably has been covered and presented to you. You understand, you know what is the issue there.

Basically, through the ADS and then the entrainment of the liquid from the vessel through the hot leg all the way to the ADS valve, where it impacted the vessel coolant inventory and the depressurization rate, and those issues Westinghouse claims they can handle that.

So Walt Jensen and Steve Bajorek from Research worked on this. I think they are on schedule to resolve all the issues at this point.

So basically that is the support for the Phase 3, AP1000 event --

MEMBER WALLIS: This affected the ADS 4 there. Is that relying on the work which is being done out in Washington?

DR. LU: I do not know the answer.

MEMBER WALLIS: Or Oregon.

DR. LU: Oregon.

DR. JENSEN: This is Walt Jensen, our Reactor Systems Branch.

We are looking at the results from the ATWS tests that are ongoing at Oregon State. There seems to be somewhat more entrainment shown in those tests than is predicted by Westinghouse for AP1000.

We have outstanding questions on that issue. We have a number of outstanding questions on the entrainment issue, which Westinghouse has told us they are going to answer by December of this year.

MEMBER SIEBER: So you could actually say that the problem isn't solved, that you can't predict with accuracy what's going on in the entrainment area right now?

DR. JENSEN: Well, we're still looking at it. It's under review. Westinghouse is giving us a topical report showing sensitivity studies that show that it really doesn't make a great deal of difference for cooling what the entrainment prediction is, that the amount of inventory in the reactor core is relatively insensitive to the amount of entrainment.

We are looking at that.

But there are additional tests being done at Oregon State. We would like to factor those into our review as much as possible.

MEMBER SIEBER: An additional question regarding that: Between the AP1000 and the AP600 there's a different number of valves, different valve sizes, and different header configurations. On the other hand, why doesn't the entrainment issue emerge in the AP600 to the extent that it did in the AP1000?

DR. JENSEN: There were a number of integral system scale tests done that were scaled for the AP600. Some of those were done at Oregon State at the APEX facility. Some were done at SPES.

We felt that the data for AP600 was more applicable than these same tests for AP1000. For AP1000, the hot leg, it is the same size for AP600, but the ADS 4 it's much larger, and I think it is supposed to be like seventy-something percent more flow going through ADS 4 for AP1000.

MEMBER SIEBER: But the Oregon tests are still small-scale tests that are scaled up for either plant?

DR. JENSEN: That is true.

MEMBER SIEBER: So it is not clear to me

that scaling isn't part of the problem.

DR. JENSEN: There have been scaling studies done for AP600 and AP1000. We are still discussing with Westinghouse whether the original Oregon State test at the APEX facility that were done for AP600 would be applicable to AP1000.

There will be additional tests done at Oregon State. They are being funded by the Department of Energy. For those tests, the facility has been rescaled and reconstructed to look more like AP1000.

MEMBER SIEBER: And that is along the lines of the presentations on scaling that we heard four or five months ago?

DR. JENSEN: Yes. Yes, that's true.

MEMBER SIEBER: Okay, thank you.

MEMBER ROSEN: Since we are on this point, can I ask a question about the qualification of these valves for different liquid entrainment levels?

DR. JENSEN: We're relying on this test data. There has been no full-scale test of these large ADS 4 valves for either plant.

MEMBER ROSEN: It seemed to me that they have to be qualified over whatever liquid entrainment range you expect, including uncertainties.

MR. CORLETTI: This is Mike Corletti from

Westinghouse.

Maybe we could talk about this tomorrow, but I guess in regards to the qualification of the valves, I think the entrainment is not a major design feature. Maybe I need a little bit more help with the question in regards to the qualification.

MEMBER ROSEN: Well, valves that are qualified for steam are one thing. Valves that are qualified for steam and a certain quality of water is another thing.

MR. CORLETTI: Okay, yes. These are what we call our squib valves. They are a full-pressure, high-pressure, high-temperature valve. How we model them in our codes is really the valve loss characteristics. So in regard to their operation with steam or water, we are really interested in the pressure drop characteristics of the valve.

MEMBER ROSEN: Well, from a modeling standpoint, for sure, but I am interested in their survivability during the transient or accident.

MR. CORLETTI: Oh, they will be qualified for the duty that they will see, which would include single-phase and two-phase conditions.

MEMBER WALLIS: But the modeling I think is important. We saw that there are transients in this hot leg and you get surges of water that go up the pipe, and there is different amounts of storage of liquid in the vertical leg. Then slugs of liquid go to the valves.

So you have to get the transient pressure fluctuations of the valve throughout the system in order to do an analysis of whether or not they grow or decay, and so on. So the auxiliary transients can be important here. So you've got to get a reasonable model of the valve receiving quite a range of qualities.

MR. CORLETTI: Yes, and maybe to clarify, the valves do not close. These are a one-time-opening valve. So they are not closing against two-phase or steam conditions.

MEMBER WALLIS: No, there is just a resistance once they are opened.

MR. CORLETTI: That's right.

MEMBER WALLIS: Right.

DR. LU: Okay, I'll move forward to the next one, the last item I will cover.

MEMBER WALLIS: I'm sorry, when you say status on schedule, I think you need to have a more critical evaluation of whether or not it is giving you the results that you need. We have been through this, and maybe we need to revisit this with RES. This Committee or the Subcommittee has been looking at these results and had some questions about whether or not the needed results would be achieved.

DR. LU: All right, do you have any comments?

DR. JENSEN: Our schedule that we see at NRR is the questions we have sent to Westinghouse and the answering of the questions, and so far that work is on schedule. We don't plan to hold up the licensing of AP1000 because of any delay in these tests.

MEMBER WALLIS: That's very interesting. So you are going to make the decision whether or not you have the information?

DR. JENSEN: We hope to. Westinghouse has told us that the results are insensitive to the entrainment. We have outstanding questions on that issue. If they can prevail and show us that the sensitivity, it's within the range of our knowledge, then that should be acceptable.

DR. LU: All right, I will go over the last one, and Andrze Drozd from NRR/PRA Branch, he originated this need, asked the Research team to work on the severe accident stuff.

Overall, he has emphasized we are trying to get at whether to evaluate the applicability of the conclusions from AP600 in-vessel retention and the fuel coolant interaction review and to see whether it can be applied, directly applied, to AP1000, and to perform the MELCOR analysis and for risk-dominant accidents.

Right now we have three milestones. The September milestone provided recommended RAIs and prepared the MELCOR input deck for AP1000 and finished on October 2nd, and the review of AP600 in-vessel fuel coolant interaction.

CO-CHAIRMAN KRESS: Does that include the in-vessel retention review also?

DR. LU: Yes, that's my understanding.

CO-CHAIRMAN KRESS: Both of them?

DR. LU: Yes, that's my understanding. That's part of the support; he needs to review that portion.

CO-CHAIRMAN KRESS: Yes. So we haven't seen that document yet. It's just recently been completed?

DR. LU: I don't know too much about that and I didn't do that.

So that's our schedule right now. There

are other tests -- okay, hold on. Richard?

MR. LEE: Richard Lee from Research.

Tom, this is the review of the AP600 previous document written for AP600, the applicability of the methodology, and so forth, to AP1000. But we will be doing analysis of that later.

DR. LU: Thanks. All right, that's basically what I need present. Overall here, the status is the ongoing three user needs requests have been going on very well. The technical staffs from both offices are working together to get all the issues resolved, the technical issues resolved, code developed. Right now everything is on schedule. We hope it stays on schedule so that we can get the code.

MEMBER WALLIS: I think I would be happier if, rather than talking about schedule, you talked about technical achievements that need to be achieved in order to get from A to B, and you could reassure me that these technical milestones have been passed, rather than that some time milestone had been passed.

DR. LU: Okay, okay. Actually, when I prepared this one, I thought it would be, I was thinking, probably 15 minutes or 20 minutes. I did not prepare that. Actually, it was in my original handouts.

I was thinking maybe should I get into the details of what exactly has been achieved and whether that would take maybe another half-an-hour to talk about that. So I did not, but if you need that, we could give you a copy of the user needs.

MEMBER WALLIS: Of what you would have said if you had longer?

DR. LU: I have already exceeded my time.

MEMBER WALLIS: Yes, yes.

DR. LU: But if you need that, we can give you the user needs, what exactly we passed to Research, and then a copy of that, and you are going to see that. Okay?

MEMBER LEITCH: I am just a little confused about the priorities here. We have the draft papers about ESBWR and ACR700. I am a little confused. I would have thought your presentation would be on ESBWR and the ACR700.

DR. LU: Both, the ESBWR and -- no, no.

MEMBER LEITCH: Are we going to hear later about ACR700?

DR. LU: No, that was not from me. That would not be from me, no.

Regarding whatever the draft, the ESBWR paper, I think --

MEMBER BONACA: But the improvements you are making on TRAC-M seem to be supporting also the other two designs, insofar as the needs that you have.

DR. LU: That's right. That's right. For example, the containment coupling with TRAC-M can be used to apply any coupled containment interaction if you do need to model the containment backflow, if we cannot couple the containment analysis from the primary system.

CO-CHAIRMAN FORD: I think if we've got a thing that is on the board of things that still need to be discussed, it is very much your question, Graham, about how the prioritization of these four NRR user needs projects relate to what we have seen in the infrastructure assessment, and hopefully we'll hear that in the next talk.

In the meantime, let's adjourn until 10 o'clock.

CO-CHAIRMAN KRESS: Not adjourn.

CO-CHAIRMAN FORD: Not adjourn? What is the word?

CO-CHAIRMAN KRESS: Recess.

CO-CHAIRMAN FORD: Recess.

CO-CHAIRMAN KRESS: Take a break.

CO-CHAIRMAN FORD: Take a break until 10

o'clock.

(Whereupon, the foregoing matter went off the record at 9:50 a.m. and went back on the record at 10:05 a.m.)

CO-CHAIRMAN FORD: I'd like us to come back into session.

The next presentation is by John Flack on the research presentations and primarily an update on what's happened since our July 18th memo on the REV-1.

MR. FLACK: Right. That is correct.

Good morning. My name is John Flack, the Branch Chief of the Regulatory Effectiveness and Human Factors Branch, which is the home of the Advanced Reactor Group in the Office of Research.

To my left is Steve Bajorek, who will be addressing the ESBWR and the ACR-700 additions to the infrastructure plan.

Basically what I'll do is I'll briefly go through some background on the plan, which we now consider to be really an infrastructure assessment. So as we move forward, I'll be referring to it as that.

We'll discuss the responses to the ACRS comments that we provided back to you. I'll provide an overview of the SECY that's on its way up to the

Commission, which is really a summary of the plan itself, and then we'll talk about the additions, which is, again, the ESBWR and the ACR-700, and then Steve will do that part of the presentation. Then I'll come back and talk to you a little bit about activities that we plan to do this coming fiscal year and then summarize.

CO-CHAIRMAN FORD: John, on the very question of changing the title of that document from plan to infrastructure assessment, is that just tipping your hat to the fact that in that original document there was no milestones, no budgets, no management implementation activities itemized?

MR. FLACK: Yes.

CO-CHAIRMAN FORD: And so this just simply here are the gaps in the technology for putting in advanced reactors.

MR. FLACK: Right, right. The plan would be a bigger thing, which would include actually execution of the infrastructure itself. Having gone through this, recognizing that really the purpose is to identify the gaps that you describe, it's pretty much that.

It's an assessment of needs. Now, when we go to exercise those needs, how much we actually do will depend a lot on how much we see from the applicant and how much has been accomplished in other places as well.

So its real purpose is to do just that. It's to look at the infrastructure, identify gaps, try to link to ongoing research throughout the world, and bring it into a common document, and that's the document.

CO-CHAIRMAN FORD: Now, in the covering letter, I believe, to the infrastructure assessment, mention was made to fiscal year '02 to '06, I think it was, which is a planning time frame.

MR. FLACK: Yes.

CO-CHAIRMAN FORD: So really when you're talking about the technical gaps, it is not time dependent; is that correct?

MR. FLACK: That is correct. Originally we were planning on establishing what work we would need to do over that period of time, but it evolved to more of just a gap analysis, which is pretty much where we are right now.

CO-CHAIRMAN FORD: Okay, and when will we see the plan?

MR. FLACK: Well, the planning process is a process in itself. The idea is to bring forth those things that we will need to do and then prioritize those with respect to other activities going on in the office.

So the actual prioritization is bigger than just the advanced reactors. At one point, the advanced reactor was fenced off. We had monies allocated just for that activity, but as we speak today, it's really across the office. So it actually competes with other ongoing projects within the office for resources.

So we have, and I'll touch upon it a little bit about how we go about doing that planning process.

Okay. With that I'll start. This viewgraph is just to reflect on the meetings that took place that set the stage for the advanced reactor work. Last year there were three key workshops that took place, the first being the ACRS. That was early on, and it brought together vendors, DOE, and the staff to talk about technology challenges associated with these advanced designs.

That was followed with a workshop by NRR, which talked about early site permits and COLs, and then finally there was a workshop by Research that pulled experts around the world to try to understand what the status was on this research going on in the high temperature, gas cooled field.

This year we had a number of interactions, as you remember, with the ACRS. We gave a briefing at the full committee in April, which was very brief actually in contrast to the following meeting which occurred later that year in July, where we did spend a day going through pretty much all of the areas that are in the plan and the technical issues and challenges they presented.

That generated -- well, we went to the full committee following that subcommittee. That generated a letter from the ACRS with a number of comments, and that was in July of this past year.

We responded in August to those comments, and I'll go through those in a moment.

We also appeared before the ACNW for information only. We briefed them on that part of the plan that was relevant to our nuclear waste and materials, and then today, of course, is a joint subcommittee.

So that pretty much gives -- that's not all of the meetings obviously that took place, but those were some of the key meetings that certainly took place.

With respect to the comments in the letter, there were ten comments that were made by the ACRS in their letter, and we responded by first indicating that things had changed from earlier in the year where Exelon and pebble bed, of course, had a high priority and then as Exelon did pull out of the pre-application review, we did shift our focus somewhat, recognizing that there is the need also to continue this work at some level, but not as compressed, as you might say, as it was envisioned when Exelon had it at pre-application.

We do have the application, of course, with GT-MHR, which is ongoing right now, but again, at a somewhat lower level.

CO-CHAIRMAN FORD: Could I ask a question on that one?

MR. FLACK: Sure.

CO-CHAIRMAN FORD: Because the two gas cooled reactors, they are both now on the books. The PBMR will be on the books again. It's not dead entirely.

MR. FLACK: Yeah.

CO-CHAIRMAN FORD: The technology challenges are considerable and will require a lot of research over a long time period. Just because your priorities have changed because of the stress of other advanced light water reactors, is that a good enough reason? Is a risk not still there, the risk defined by the risk of not doing the work times the likelihood of it being actually a successful applicant?

What's the rationale behind dropping the priority on the gas cooled reactors?

MR. FLACK: Well, it lowered it. It didn't eliminate it certainly. I think we're working within a fixed budget, and needs as come up on the horizon as to really what industry is looking for.

We do not, again, want to be a pinch point in the process. We want to be best prepared to deal with designs as they come in as we can. So certainly the ones that appear to be immediate future would take the higher priority since we want to get those through the system as effectively and efficiently as possible.

So as we change our priorities as these new pre-applicants come in, there still remains many challenges ahead in the HTGR world, and so what we have done now is kind of look more towards what else is going on in the world and trying to capitalize in the meantime on what else is out there instead of trying to just forge ahead on our own.

So I think in some sense it's giving us

time to do that, to find areas in which the work is going on and where we can draw cooperative agreements.

At the same time though, it is important that we do maintain a certain level of research going on in our own office in that field. So I don't know if that addresses your concern completely, but again, because of the way the budget is fixed in some regards --

CO-CHAIRMAN FORD: Now, what was the risk associated with that? If you're putting many of your regs. into the collaborative lessons learned from other people, Europeans, Japanese, et cetera, has anyone assessed the risk of your not getting the relevant information from these organized issues?

MR. FLACK: Well, the risk is, again, time dependent, you know. It's the sort of thing as when do I need the information to make what kind of decision.

And there's always a risk that something could happen a lot faster than you thought, and so one has to continuously adjust to accommodate that risk, and that's why this document is really a living document.

Each year we're planning to come back and reflect on where we are at that time and then use it, recognizing the needs that are there. Again, it's a place where we can see the terrain and come back to that and decide at that point how we need to adjust again.

But I don't think there's one answer. I think it's something that's very time dependent and you have to feel your way through.

Okay. As mentioned, the scope has expanded now to these additional advanced light water reactors, and what I'll do now is go briefly through our responses to the ten comments that were raised by the ACRS in their letter back in July.

The first comment was to focus -- and it's more or less our response -- yeah, we'll be focusing HTGR research primarily on the generic level and not have it so much design dependent. There's many challenging generic issues like the fuel and materials that are quite generic and we remain focused on that.

Of course, there's a GT-MHR, and that is ongoing at the pre-application review.

Fission product release for TRISO fuel is a key research area. We see that as a key research area.

By the way, we agreed pretty much with all of the ACRS comments, which is good to know.

The number two will obviously be supporting or play a role in supporting or providing technical basis to some of the policy issues I'm sure that you see coming forward right now.

So, yes, we see that as an important area to continue research on.

Framework for licensing, we consider that at this time of year to be a high priority up to this point, and I do have a viewgraph on that. We have not done a whole lot, but this coming year we plan to do much more.

And number four was we wanted to consider fission product releases for high burn-up fuel, and we've added a piece into the plan on that to continue to consider that and the source term that evolves from the higher burn-ups of the fuel.

CO-CHAIRMAN KRESS: Are you having any success in getting the VERCORS data?

MR. FLACK: Let me see. Where is Richard Lee?

MR. LEE: The answer to your question, Tom, that we are getting the VERCORS data, and we already have the two reports on the high burn-up fuel, the MOX fuel from VERCORS, and they are preparing an assessment report of all the data, and this report is in preparation right now by IRSN, and we are going to get this report once they are completed.

CO-CHAIRMAN KRESS: Wonderful. Thank you.

MR. FLACK: Okay. The fifth comment had to do with selecting design basis events, and we already had started pursuing that as part of the PTMR, using risk insights and discussing not so much design basis, but licensing basis events which cover a spectrum of events, including beyond what we would consider the design basis today.

And this is also part of a policy issue that is now moving up to the Commission on how we select accidents.

Number six had to do with the question of how do we establish priorities, and that, as mentioned earlier, we use PIRT to rank, and we use the planning, budgeting and performance management process to prioritize, and that process is used across the office, as well as, which I hadn't mentioned on there, but stakeholder input, of course, which is through workshops, meetings with the ACRS and others.

CO-CHAIRMAN FORD: Will you discuss this particular item because it relates to Graham's questions and my questions about the ranking of the user need ones we heard just before the break versus the listing that you have supplied for 2003? So we'll hear about this?

MR. FLACK: Well, I could talk about it a little bit now. There's really two types of work that goes on. One is fee billable in support of pre-application, design certification, and so on, and then there's from the general fund a more global kinds of research, which involves infrastructure development.

So both of them, again, come out of the same budget. We have only allowed so much funds, but part of it is, again, supporting through user needs the reviews of licensing submittals, RAIs, evaluation of those RAIs, providing input to safety analysis reports.

And then there's the other part of research that deals with understanding beyond, for example, design basis accidents, margins, providing confidence in decisions, providing technical basis for decisions and the confidence that goes with that.

So that type of research is broader in extent and does go beyond just the immediate need for user needs.

CO-CHAIRMAN KRESS: You don't have to pry into user needs.

MR. FLACK: That's right.

CO-CHAIRMAN KRESS: That's for NRR to do. I mean, that's an automatic priority.

MR. FLACK: We have to do that work right.

CO-CHAIRMAN FORD: Okay. So in answer to Graham's question and mine, I guess, just because we only saw four programs in the previous presentation doesn't mean to say that there's only going to be four programs on advanced reactors --

MR. FLACK: That's right.

CO-CHAIRMAN FORD: -- in 2003.

MR. ELTAWILA: I think in general that's true.

This is Farouk Eltawila again, and Gary is behind me. He can correct me if he wants.

I think the immediate need --

(Laughter.)

MR. ELTAWILA: -- the immediate need right now that you saw it is to try to complete the pre-application review, and so that they identify models that need to be put into the quote to be able to do counterpart analysis to see if there are issues that need further investigation or not.

What you see in the plan that we provide to you, that we have additional information that we need because in order for us to provide NRR with a qualified tool, we have to look at the range and the applicability of all the high ranking phenomenon models in the code.

So we need to arrange the parameter, and we need to look at the experimental data, and we need to run some experimental. We have the facility at the PUMA facility, for example, and we assess the code against it.

And at that time, we will say that the code is ready for the certification. So the immediate need that we have right now is just to make the tool available right now to be able to do analysis, but the final product with a certified quote from the Office of Research, and this code has met all of our assessment process and things like that; that's the additional work that you see in the plan.

The other part of it, again, because we expect it to do the same thing, for example, several accident, we know that there are issues in severe accidents like in AP1000, although you don't see the need right now from NRR because it's not part of the pre-application review, but we are identified it in the plan, and we are going to continue negotiation with NRR and see if these are the issues that need to be discussed and followed on or not.

And that's how we merge together and eventually every fiscal year you will find a new activity to be carried on, you know, that we will perform based on a discussion between us and the user office.

MEMBER LEITCH: I'm still confused on this Attachment 4 that we received, just the one page list of activities scheduled for fiscal year 2003. I don't see any AP1000 activities on that list at all.

MR. FLACK: Yeah, that is more for infrastructure. I'll come back to that list in the end.

MEMBER LEITCH: Okay.

MR. ELTAWILA: Let me answer that question. I'm sorry, John.

MR. FLACK: Yeah, sure.

MR. ELTAWILA: We believe that the only things that we have right now for AP1000 is as indicated by Shanlai Lu, is the issue of entrainment and de-entrainment right now, and we have a program right now at Oregon State University to supplement the work that DOE is working.

That work, although it's not specific for AP1000, it's for code assessments so we consider that part of the developing the infrastructure for our tools and things like that.

MEMBER LEITCH: I see.

MR. ELTAWILA: But we have not identified any major issue that in the AP1000 that would need additional research at that time. Based on the pre-application review, we have not identified any issue.

The work that Richard will talk about about the applicability of the AP600 severe accident data in core melt retention and fuel coolant interaction and issues like that, we are reviewing them right now, and if the issue comes out, that review, we'll be discussing it and we'll identify this issue as happened.

But as far as I'm concerned, I don't try to take too much time here. The issue of in vessel melt retention, NRR did not give credit to Westinghouse for the AP600. It was there. It may work, but we really did not take full credit for it in the certification process.

Whether that's going to be the same way they are going to deal with it for AP1000 or not, that's a need to be determined.

MEMBER LEITCH: Okay. Let me just ask one other question. The list that we -- well, you're going to come back to Attachment 4. I'll defer the question until that time, John.

Thank you.

MEMBER RANSOM: John, I have a question relative to number six. The use of the PIRT process for establishing research needs, that assumes a panel of experts, I guess, would rate and rank them.

MR. FLACK: Yes.

MEMBER RANSOM: Do you have a panel?

MR. FLACK: Well, we choose from experts in the field. We just had a PIRT last week on fuel, TRISO fuel. What are the issues? What are the things that we need to focus on? And how does that rank as far as priority? Which scenarios play out to be the most important, and so on?

MEMBER RANSOM: Well, are you doing this sort of area by area or are you --

MR. FLACK: Yes.

MEMBER RANSOM: How do you do the generic prioritization?

MR. FLACK: Well, I would say the closest thing we got was this workshop that I described back last year where we brought experts in from around the world to try to get a status and to try to understand what other important issues for HTGRs anyway.

And so from there we went forward and from there to identify specific areas. Now, these areas are very complex, just like fuel is in and of itself. So it really needs to be looked at as a specific fuel.

MEMBER RANSOM: Have those results been documented so that they're available to review who was involved?

MR. FLACK: The workshop?

MEMBER RANSOM: The workshop or --

MR. FLACK: Yes, there was a report written on the workshop. We can get you a copy. The PIRT that just took place, there will be a report that comes out on that as well.

CO-CHAIRMAN KRESS: Farouk, could I ask you another question about the AP1000?

MR. ELTAWILA: Yeah.

CO-CHAIRMAN KRESS: In vessel retention.

MR. ELTAWILA: Yeah.

CO-CHAIRMAN KRESS: One of the concerns I had with that was with the higher power of the AP1000, that all of the -- and they will turn on and put the water in there, even though they're not taking any credit for it; that that will hold up the molten fuel for a while and allow it to perhaps stratify and segregate the metal from the oxide.

MR. ELTAWILA: That's correct.

CO-CHAIRMAN KRESS: And then the failure location is likely again to be where the metal is.

MR. ELTAWILA: That's correct.

CO-CHAIRMAN KRESS: And what you have then is an ideal situation for an injection of a hot, molten metal into a water pool that's connected to the containment, which is an ideal situation for fuel coolant interaction, which is like a high pressure metal injection, and actually the failed containment is the same time, have a lot of fine particles expelled to the air.

Is that on your radar as something to --

MR. ELTAWILA: I think you hit the point exactly because we really believe, based on the information that we have seen from Moscow and the Raspolov Programs in Russia, that because of the high power rating retention, the vessel might require some design changes.

But based on the old information that we have, you might need to design the insulation around the vessel and so on. So retention, in vessel retention is not highly assured for high power reactor. So the issue that becomes very important is exactly as you indicated, is ex vessel fuel-coolant interaction, and that's what we are going to focus most of our work on in the analysis and see if there are experimental data to support analysis of that issue or not.

CO-CHAIRMAN KRESS: Thank you very much.

MR. FLACK: Okay. Moving right along, number seven. We did add a piece in the plan to investigate the correlation or the link between activity in the primary and potential latent failures of fuel so that as an indicator for future performance of fuel at higher temperatures or under accident conditions.

That was brought to our attention. That was a new area that we've added, and --

CO-CHAIRMAN KRESS: How are you approaching that?

MR. FLACK: Carefully. I don't know. Stu Rubin is with us. He could probably respond to that.

MR. RUBIN: Repeat that question again.

MR. FLACK: The question on how --

CO-CHAIRMAN KRESS: I wanted to know how you're approaching that particular --

MR. FLACK: We are approaching the relationship of coolant activity with latent fuel failures.

MR. RUBIN: Oh, yeah. The issue --

MR. FLACK: Stu, the microphone.

MR. RUBIN: Yes, sorry about that. Stu Rubin, Office of Research.

The ACRS raised an issue which had been mulling in our own mind for some time, and that is the effectiveness of coolant activity monitoring systems that are going to be used in HTGRs to monitor fuel performance, and they basically do this by monitoring nobel gas activity in the helium.

And so this is the kind of a system that's been used going back to the earliest HTGRs, and the issue in our mind is not so much the detection of failed fuel in operation. That can be correlated fairly easily with test data, but rather, the ability of these monitoring systems to detect what we would call latent failures. These are conditions that may arise from manufacturing, such as so-called fuel, manufactured fuel outside the specification that somehow gets through the QA process, let's say, or weakening of fuel due to operating the fuel at conditions beyond the design, hot spots, let's say, where local temperatures are higher than expected.

These kinds of conditions can lead to a weakening in the fuel that may or may not be detectable by such an on line core monitoring system and only would be revealed by, let's say, an accident condition.

And so our thought was to include in the research plan some work which would involve both analytical work, as well as irradiation testing and accident testing.

And with regard to the evaluating of whether or not the core condition monitoring systems could detect a weakening fuel that would slowly be revealed as failures during operation or not, we would plan to include in the irradiation program testing at higher temperatures to see if those higher temperatures would result in failures during operation, and take that same fuel whether or not it did or didn't result in failures, and then put it through an accident heat-up test.

And so the idea there would be that if the fuel did not reveal higher failure rates due to the higher operating temperatures, but did see increased failures in the accident regime, that might be problematic for an on line monitoring system to detect latent failures due to operations conditions outside design.

And with regard to the fuel fabrication issue, the thought was that you can't very well take fuel that is manufactured at various degrees of variance from the manufacturing specification. That's not a practical approach, but the thought would be to do sensitivity studies with analytical code where you can actually simulate fuel performance during operation and during accidents and crank in different fabrication anomalies, so to speak, and see how that would play out during operations and during the accident sequence.

Again, if the operations phase of the simulation didn't result in increased failures, but we saw it in the accident, that also may prove to be somewhat problematic for an on line monitoring system.

So we are picking that up in the plan.

CO-CHAIRMAN KRESS: Sounds good. Thank you.

MR. FLACK: And more than you asked for, right?

But thanks, Stu.

Okay. Number eight, we're certainly tracking what's going on in Generation IV near term deployment by continuing representation on the NERAC, and aware of DOE activities in that area.

Number nine was research activities to assess the full range of ex vessel severe accident phenomena. I think we just discussed a little bit about that, and that's in the plan.

And ten, there was a comment on license by test concept and the need for large scale testing, and that was also addressed in response to that question and comment within the context of our regulatory process.

So that pretty much covered the comments and our responses to the comments.

I do have one viewgraph on framework, which pretty much you've seen somewhat before. The work, again, will be starting in FY '03. It's currently under development. It's going to capitalize on Part 50 work and risk informing Part 50, utilizing a top-down approach that begins with the goals supported by cornerstones and then strategies and tactics to insure that those cornerstones provide the protections needed to protect the public health and safety.

The undertaking will also capitalize on, you know, risk informing current LWRs, Reg Guide 1.174, and so on, and ground that has been broken in that regard.

It will certainly be key or have to dovetail certainly with the policy issue paper that's coming in front of the Commission in December, and as well as the technical issues that are coming about as we discuss them.

And also using the input from NEI, and I think you'll hear more about that this afternoon, and other stakeholders as we need.

So that's all I --

CO-CHAIRMAN FORD: Now, we heard from Mary Drouin some time ago. We had the impression that the framework in 2003 was low priority. That is no longer the case?

MR. FLACK: Well, I guess the question is how do you put it in perspective. I don't know what context she described it as low priority.

CO-CHAIRMAN FORD: Well, that was the impression that I personally came away from the meeting with, and I think many of the other members also had the same impression.

The reason why it's puzzling is that in the infrastructure assessment you see quite specifically that the framework work is a basis for many of the other priorities and prioritization of many other technical challenges and, therefore, it has got to be high priority.

MR. FLACK: It would be part of that

process, yeah.

CO-CHAIRMAN FORD: So I take it that the framework work is high priority?

MR. ELTAWILA: The answer is it is a funded activity in fiscal year '03, but we don't have funds anyway, so it's irrelevant. I'll answer anyway.

So we are on a continuance resolution, and every two weeks we'll get some money to spend. But for fiscal year '03, we have budget to start the framework. So it is ranked high among the budget activity, and it is going to be funded once we get our full allotment of funds.

CO-CHAIRMAN FORD: Now, what is the timing on that, bearing in mind it's the baseline for all of your subsequent prioritizations? Presumably you've got a very fast objective to be met, milestone.

MR. ELTAWILA: Okay. Let me try to answer that here. I just want to make it clear to you that for light water reactor, they can be licensed and certified under existing framework. So they don't have to wait for the new framework to get certification.

Now, we are talking now about gas core reactor and other non-light water reactor. So the time frame for that is definitely much more relaxed than when Exelon was in the figure and tried to certify the PBMR.

All indication then we're getting from G.E. and from the PBMR, Limited, indicate that their time horizon is on the order for early 2007 to 2010. So we're really going to provide, develop that framework not on accelerated time frame like we were thinking before, but it's going to be continuously developed, but will not get this accelerated --

CO-CHAIRMAN FORD: I'm concerned that some of the technical problems which were based on the framework -- this is for the gas cooled reactors -- will take some time, and even though they commercially may want to go on line in 2010, they've got to be doing the technical work now.

MR. ELTAWILA: We actually, as Stu indicated, we have identified some key issues that need a long lead time, and we're continuing working on this issue, for example, but we are limited not necessarily by resources, and I want to make that clear. We are limited by availability of fuel, for example, to run the test on.

So if I want to run tests on fuel, I have to have the table's fuel or GA fuel to be able to run the test. That's one limitation.

The second limitation is that NRC will not be able to fund this fuel testing alone. So we have to rely on DOE, and DOE has a plan right now. We are continuously interacting with them. So if DOE cannot run the test, they will not be deployed. So we are not really going to be behind the schedule in this case, you know.

So as far as the fuel is concerned, I think we are in good shape because, again, they are not going to deploy until DOE performs the test for this new type of fuel.

There are other issues like material issue and graphite issue, and I think Joe Muscara, if he wants to add something, we are working in this area.

So the critical issues we are working on, and in some cases we are relying in cooperative agreement and we're relying on memorandum of understanding with DOE. So we have not stopped completely, but we are not on the same pace like we were about a year ago.

MEMBER BONACA: Well, first of all, I'm kind of anxious to see what this framework will be, of course, and so that's why I'm interested in this question, but, you know, in the plan there is a clear reference to starting with some thoughts for Option 3, which makes sense.

And so there if you look at Option 3, it speaks of some apportionment quantitatively to prevention versus mitigation, and clearly there we understand how the structure is.

So I've been trying to understand who, for example, for HPGR you would go about answering those kinds of questions there, and if you need to do research on fuel and understanding fuel before you can set certain quantitative criteria there or vice versa.

I mean, that's really what I would like to understand. I mean, I don't have an expectation that you have the framework already ready, but at least a thought process to support it. It would help me if we at some point in the near future, we had just an understanding of how you're reflecting on it. At least it would give me comfort that you're thinking about it if you're not working on it.

MR. FLACK: Oh, no, we are thinking about it. I think the work that is going on on the policy issues paper is very important because I think that's going to set the stage, and a lot is going to depend on how the Commission views those issues and how they go about doing that.

Once it passes through that process, then the question is a technical one really. Can you provide a technical basis to make this come true?

There's one thing in saying it, and the other there is demonstrating it. So I think it involves both sides, the policy as well as the technical, and they really dovetail together as you move forward.

But having said that, I don't think we need to wait for a framework document in order to do what we're doing. I think going forward with the policy issues, and it will evolve, and I think the thing will certainly get back to the ACRS many times on this, I'm sure, but it will be something that is evolutionary. It's going to need to take into consideration stakeholders' comments, and it's not holding up anything at this point in time.

We can move forward and license the plants that are coming in on the pre-application review with the process that we have in place. So it's again moving forward, and I think those are the lines on which it's moving forward.

MEMBER BONACA: Yeah. The point I'm making is that if, however, you have a well delineated process by which you're going to get to that framework, the thought process you're going to develop, and the policies issue may be the first one, in fact.

MR. FLACK: Yeah, I think that --

MEMBER BONACA: Then that may help you in prioritizing what steps you have to accomplish for different designs to bring them to a technology neutral framework.

MR. FLACK: Yes, because it will flesh it out. It will get the things out on the table, the discussions, defense in depth, and what we mean by that, and so on.

MEMBER BONACA: So the policy document will be the first --

MR. FLACK: It's going to be a major step forward in that.

MEMBER BONACA: We will have it some time this month, I understand.

MR. FLACK: Well, it's due up to the Commission in December, and we held a workshop two weeks ago. I guess it was a public workshop on it. I don't know what exactly the schedule is to come back. The full committee probably before it technically gets sent up, yeah.

MR. FLACK: John?

MR. MUSCARA: If I might follow up on

Peter's question about how are we handling the issues that have a long lead time to get a resolution, in the materials area, clearly we did get a reduction in emphasis and budget, and what we have done in this area is to essentially stretch out the program.

Originally we had a five to six year program. Now we have planned a nine to ten year program. What we are doing is addressing the issues first that we need to have answers for, for example, in designing the plans, things, for example, that have to do with fatigue life, crack initiation, those things being addressed in the earlier years.

Items having to do with problems you might expect in service, such as crack growth rates, those now being addressed in the latter part of the ten year program.

So we've had a reduction in budget. We've shifted the program, stretched it out, and addressing questions that we need answer to at the design and licensing stage, and in those areas, we will be doing work on fatigue, stress corrosion cracking and creep.

In the graphite area, we're depending a great deal on work being conducted in Europe, but we will be doing some work in that area also starting in '08.

And I guess let me mention also that we do have work ongoing to review and evaluate design codes and standards and updating those codes and standards because those are some of the things we need to have done early on in the process. So that work is ongoing right now.

CO-CHAIRMAN FORD: You don't think it's going to be ten years before you get the final results of many of these materials questions. You don't think those are going to be limiting on the commercialization of a gas cooled reactor.

MR. MUSCARA: That's correct. That's correct. I mean, those will be questions that will come up during the operation of the plants, and if there is a problem, we'll have enough time to deal with those kinds of questions.

CO-CHAIRMAN FORD: Okay. So we'll be regulating as we go, so to speak.

MR. MUSCARA: For the kinds of problems you expect in service. For the design stage, where you want to design a plant so that it does last its design period, that work gets completed by FY '06.

That is, we will have enough work done to be able to ask questions about is there an effect on the environment and fatigue. We'll have enough work done to identify the problem if it's there, and possibly not enough work to update the codes, but at least we'll have enough work done so that we can request additional information.

CO-CHAIRMAN FORD: This is not a question for you, Joe, but for other of your colleagues. It seems that many of these prioritizations and reactions to what may come down the line is forcing you to go towards a "regulate as you go" stance. Is it healthy?

MR. MUSCARA: I see this as regular as needed. I'm not sure as you go. I think we still have enough lead time to address the issue and determine whether there's a potential problem.

A lot of the questions that we have in the materials area are based on lessons learned from light water reactor, and clearly we think those may happen also in the advanced gas cooled reactors.

But there's no data to say one way or the other. So I think we're doing enough work to be able to identify the problem, determine if updates are needed, and I believe on a timely basis so that they can be addressed either in design or later on during operation.

CO-CHAIRMAN FORD: Okay. Thank you, Joe.

MR. FLACK: Also, if I can just add to the comment, I guess the feedback that we get from operating plants is very important in making decisions, and so as we regulate, we try to raise the questions up front obviously to try to get as many answers and get things nailed down as much as you can, but then feedback as the plant operates is important to validate and confirm what our expectations are.

So I wouldn't necessarily call it regulate as we go, but certainly take regulatory action as we need, if it's not consistent with, you know, what's up front. But it's very important not to underestimate the need to get these questions and answers as best we can up front, I mean, certainly.

CO-CHAIRMAN FORD: Well, do any of my colleagues? I mean, Jack, you are intimately involved in some of the start-ups of the current light water reactor fleet. Does it not worry you? It doesn't?

MEMBER SIEBER: No. I think that's been the past practice for some time now or at least some version of it, and I think that we've managed to address problems.

MEMBER ROSEN: Peter, it does worry me. I guess the history of light water reactor development is the key to understanding why I'm worried. We spent literally the 40 year period from, say, 1960 to the year 2000 working on materials problems that showed up during operation.

Now, if you don't learn from the past, I guess you're doomed to repeat it. So I didn't make that saying up, by the way.

So here we are about to design, license, and build and operate a whole new family of reactors and find out what's wrong with them. You know, we'll do enough work to license them and then deal with the licensing issues.

But we never seem to find the resolve to do enough work to find out, get a handle on what the operating issues might be at a time before we actually operate them, and that's troubling.

And I guess there's a Catch-22 involved in the thought process. You can't know what you don't know about operating until you operate, but I wish there was a way that somebody could come along and cut that knot and help us with it because otherwise you just -- the operator of the plants have potentially the same sort of fate in front of them as the ones that ran the light water reactors for the last 30 or 40 years.

MR. FLACK: Well, there's no question about that concern, but I think the whole concept of trying to look at the infrastructure, what we're doing now, and trying to find out where the gaps are and what questions to ask is really trying to get at that. Be prepared; ask the right questions. What are the areas that are dominating as being the things of the highest uncertainty? What are the risk implications?

All of these questions are the things we're struggling with as we go right now with this infrastructure, and that's why I think it's very important to lay that out now in some systematic way, identifying where we need to focus our resources so that we don't end up with surprises later on.

And it's not an easy thing to do, believe me. It's a challenging top, you know, as you could see in the size of the document. There are just a lot of things, a lot of areas to consider.

MEMBER BONACA: You need to limit yourself to safety issues. That's a possibility.

MR. FLACK: Well, certainly.

MEMBER BONACA: Well, I mean, some of the experience we've had, it's a learning experience, and you know, some of the issues were not of a safety nature. They were really more of an operability nature of the components and the cost to the licensee.

So the burden is heavy on designers for

these.

MR. FLACK: That's right.

MEMBER ROSEN: Yeah, I think you're right, Mario, that what we saw during the light water framework that we just lived through was a whole slew of things evince themselves as operability or reliability issues rather than safety, direct safety issues.

The trouble with that thinking though is that as plants struggle to deal with the operability and reliability issues, they get diverted, and there's a lot of attention paid to those kinds of operability and reliability issues to the detriment of a broader view.

And so I think it's important to create a framework for the new operators of these plants that doesn't have so much distraction in it. I don't know how to do it, but, Peter, you invited questions about who was troubled by it, and I certainly am.

MEMBER LEITCH: And I'd like to add my voice to those that are troubled. You know, when you see the struggle that it has been to remediate some of the existing fleet by changing out materials and applying different chemistry methods, not to mention the cost and radiation exposure to make some of those modifications, it certainly argues against waiting for operation to reveal problems if, in fact, those problems could have been foreseen and revealed in the design phase.

MEMBER SIEBER: I think one of the things that in the past -- and I guess I'm old enough to have lived through that -- the practice years and years ago was to build prototype reactors. The Navy did it. The first commercial reactor was a prototype, had oodles of margin.

And so the safety challenges really weren't there, and the plants were docile. And what people were trying to find out was were pumps adequate; were the flow adequate, you know; can you control the plant; how stable is it?

And you know, obviously the anticipated transience and severe accidents have enough margin to take care of it.

Where the industry began to get in trouble with this, when they would take -- the vendors would say, "Well, I can sell more megawatts in the same package," and so the temperatures went up. The pressures went up. The linear heat flux went up. The fuel design became more sophisticated, and the operators now spent a lot of time worrying about margin, scratching their head in the materials, whether it's a new plant or an old plant, a prototype plant or not. The materials are always out there, and the very minute you fabricate them, they begin to corrode, right?

You know, it's like the day you're born is the day you start to die, and so those problems are always with us.

On the other hand, I think it's a mistake if anybody thinks that they're going to take a new concept of a plant and build a plant with very high productivity and capacity and very little margin and get it right the first time.

And I think you have to take that into account when you do your research, and you need a little extra margin for those things where the uncertainty is a little higher than you would like for it to be.

And so having lived through that process, and I, frankly, enjoyed the process because I learned an awful lot about plants without having so many of the production headaches that plague current day operators. It was sort of fun.

I think that's a way for an industry to grow. I'm not sure that the industry can afford to grow that way now, and the engineering and research tools are much better now.

And so maybe we can skip part of that step and not be so timid. On the other hand, I think that we need like the pebble bed concept some kind of a prototype out there where we can do a little learning. And so that's the basis for my conclusion.

CO-CHAIRMAN FORD: John, if you take those comments, and Mario's comment about, well, let's try and keep the proactive work to safety related items, about a year ago Dana Powers reported on the pebble bed and, by extension, the gas cooled turbine reactor with some fairly severe safety related comments, which are physics based insuperable in terms of the instability of the core, in terms of defense in depth because of the asymmetry of some of the pebbles.

Have those been addressed?

MR. FLACK: Well, they're in the plan. The plan, you know, reflects those areas that he was concerned about. It's work that needs to be done. So --

CO-CHAIRMAN FORD: These are fundamental safety related, you know, physics insuperable problems. Should they not be, therefore, if you take Mario's argument, that they should be done now? They should be examined right now?

MR. FLACK: Well,1 yeah. The PIRT process is really the process by which to determine, you know, the significance of these issues, and we're going through that exercise right now. We had the fuels, for example, PIRT just recently that took place.

CO-CHAIRMAN FORD: And was that discussed, those items?

MR. FLACK: Well, I --

MR. RUBIN: Let me just give you an example. My recollection is one of the issues that Dana had was the effective air ingress into the core and whether or not that would lead to fuel failures to a level that would be well beyond what we would find acceptable.

And the PIRT process that we went through last week got into the phenomena that affects fuel oxidation, including the oxidation rates on the graphite, the matrix material on the various layers, whether they're phenomena of temperature, fluance, burn-up, et cetera, to try to really understand the phenomena at its most basic level and then to build up what the data needs are and what the modeling needs are to truly analyze what would be expected to happen under, let's say, a worse case air intrusion and beyond that worst case.

So that in our plan, and we started with the first step last week of developing those detailed phenomena that play into that concern.

CO-CHAIRMAN KRESS: The strategy we heard before on air ingression accidents was twofold: one, to determine the actual frequency to be very low so that on a risk basis it's a low frequency event and high consequence, but the product may be acceptable.

The other was that the amount of air available for this interaction could be limited so that it could be oxygen limited in terms of the total amount of oxidation you would go through, and that would limit the amount of material interacting and the amount of release.

Are those still on the table as strategies to go with air ingression accidents?

MR. RUBIN: Yes. In fact, at the PIRT, we got a presentation by INEEL of some preliminary studies that they've done for various volumes of air that would be available in an accident and see what level of oxidation and fuel failures that you would see for those, and clearly if there was an unlimited amount of air to temperatures that we might predict for a large break, things do get serious, and that has to be, I guess, weighed against the probability that we would result in that amount of air because you start out with a volume that is the confinement space, and that's not infinite. That's far short of infinite, but you need to think about how you can get some air replenishment through holes, so to speak, in the confinement space and whether or not those holes can be plugged by human actions, et cetera.

CO-CHAIRMAN KRESS: I guess, and this is an ancillary question, is NRC going to put that on the agenda as a design basis accident or would it be beyond the design basis? And do you have some criteria for evaluating --

MR. FLACK: Well, I think, you know, the whole concept of design basis itself is now, you know, considered to be licensing basis and what do we mean by that and so on, is under discussion.

CO-CHAIRMAN KRESS: It's all under discussion.

MR. FLACK: Yeah.

MR. RUBIN: The PBMR and GTMHR have presented a licensing approach, not to start from a new framework for regulation, but a licensing approach which one would eventually plot for various scenarios consequences versus probability, and you've seen those plots, and there are limits for various probabilities in terms of dose limits, let's say.

And one of those data points is air intrusion, and what amount of air for that air intrusion. And one has to reflect upon where that probability is for that level of air for an air intrusion event, and make some decisions on whether or not that needs to be considered in the licensing basis.

But we don't have enough information on the consequence models and the PRA models to think much more at this point.

CO-CHAIRMAN KRESS: Yeah. What concerns me there is that the natural tendency is to use the prompt fatality safety goal as a top level criteria for deciding, and I think that would be a mistake.

And the reason I think that is in our ingression accident, it leads to consequences that are far beyond prompt fatalities in terms of land contamination and how far it goes and latent cancers.

MR. FLACK: Right, right, sure.

CO-CHAIRMAN KRESS: So I hope we don't get stuck on the LERF prompt fatality safety goal as the driving force for this.

MR. FLACK: Well, that's one of the things we'll be looking at as part of the framework development, sure.

MEMBER ROSEN: This discussion also raises in my mind one other nuance, and that is that we always think or I always thought of confinement and containment as functions of a device to keep things from getting out.

Now we're talking about a containment or confinement which has two functions. It's multi-functioned. It's intended to keep radioactive releases from getting out, but it's also intended from keeping air from getting in.

MR. RUBIN: That's true.

MEMBER ROSEN: And those two functions may be contradictory in some designs that I could envision and might create quite a challenge to designers.

CO-CHAIRMAN FORD: John, I'm looking at the time here.

MR. FLACK: Yeah, I know. I am, too.

CO-CHAIRMAN FORD: How are you going to fare under the time needed?

MR. FLACK: Yeah. What I suggest is we'll skip the next three viewgraphs, if I can. They really talk about the SECY paper, which is really the subject that we've been talking about here. I don't see anything new on these viewgraphs that would --

MEMBER LEITCH: John, I just have one question before you leave the framework. If today I'm trying to license an advanced light water reactor, the present licensing is still applicable and would be adequate for licensing an advanced light water reactor. But if I was coming forward with a plan, I might be confused by or I might tend to defer that action pending a new framework being developed, a new risk informed framework being developed.

So I guess I could see a real decision point here, whether to license a new advanced light water reactor with the existing framework or wait for this new framework document, which seems to be quite some time off.

And I guess basically my question is: have we thought about need this document be technology neutral or could it be for light water reactors and another one later for gas reactors?

MR. FLACK: Well, I think that's what this one is really seeking. The work is really focused on the non-light water reactors, the reactors that are not in the immediate future, but ones that relate to the policy issues that are currently now or that will be before the Commission at the end of the year, which are the non-light water reactor policy issues, the containment, the confinement, and that sort of thing.

But there is always spinoff. I mean, it comes down to efficiency and effectiveness of the regulatory process, and that's really what you want, an effective and efficient process.

So what can be capitalized on, the development of this framework even though it may be years from now before it's complete, I would expect there will be spinoff that could be used currently, but I wouldn't necessarily wait for that because I think the process is in place now that can be used to license and certify the design.

So if there is something that comes along that connects the process, certainly we'll take advantage of that.

MEMBER LEITCH: Thank you.

MR. FLACK: Okay.

MEMBER RANSOM: John, I have just one quick question.

MR. FLACK: Sure.

MEMBER RANSOM: On your next slide there, commission paper?

MR. FLACK: Yes.

MEMBER RANSOM: What is that?

MR. FLACK: Oh, the transmittal of this document that you've reviewed is to the Commission. The paper that I talk about on those viewgraphs is just a summary of what's in there, and --

CO-CHAIRMAN KRESS: That's why we call it the Tom King paper?

MR. FLACK: No, no, this is not Tom King's. This is the infrastructure assessment paper. It's two papers.

CO-CHAIRMAN FORD: It's a formal transmission of what we --

MR. FLACK: That's right. The formal transmission of the larger document. There's four attachments to the SECY. The one is the thick document which you've been reviewing. Two of the attachments, one is on ESBWR and ACR-700 that Steve is about to go through with you, and then there's a fourth attachment which lists the activities for FY '03.

MEMBER SIEBER: Would you tell us what the SECY number is?

MR. FLACK: Oh, it's to be --

MEMBER SIEBER: You don't have it yet?

MR. FLACK: Not yet. Right, it's on its way up.

CO-CHAIRMAN FORD: Is this essentially the draft letter?

MR. FLACK: Pre-decisional, yes. That's right.

CO-CHAIRMAN FORD: But essentially that?

MR. FLACK: That's it, yes. It hasn't changed very much at all from what you're seeing.

Okay. AT this point in time, Steve, I'll turn it over to you.

MR. BAJOREK: Thank you, John.

MR. FLACK: Do you want to use this or that?

MR. BAJOREK: No, I'm going to try to use high tech.

MEMBER WALLIS: Why did you pick Steve to make this technical presentation?

(Laughter.)

MEMBER WALLIS: No, I mean, seriously. Why are the only technical presentations which we're getting today having to do with thermal hydraulics? I wold think the hydraulics is in good shape because we got all of this work over the decades, and the things which we need to worry about are the things which are not in good shape, and we just hear generalities about them.

But I just have this strange question. Why is it, you know? Why did you pick to only present thermal hydraulics today in terms of any detail?

MR. FLACK: Well, it was the additions to the plan that we wanted to come to the committee with since you had seen much of it before.

MEMBER WALLIS: Maybe they're the only ones where there's anything concrete going on.

CO-CHAIRMAN FORD: They'll be covered in Appendix 4.

MEMBER WALLIS: Okay. Well, I'm grasping for the right question, but you know, that's what puzzles me.

MR. FLACK: I'm grasping for the right answer, but we were here to brief you on what has been an edit to the plan in our thinking, and things have changed since we started with what was very heavily focused on HTGR and now is shifting to light water reactors because of the immediate need.

And Steve was going to go over those additions to the plan.

MEMBER WALLIS: Just the immediate need, which is why we're here.

MR. FLACK: Which is the pre-applications.

MR. BAJOREK: And kind of in reference to that, too, I'm not going to try to talk just only about thermal hydraulics, but also about some of the fuel issues and also to cover some of the severe accident issues as well.

All right. Well, good morning. One of the things that I would like to at least let you know at this point, I'm going to try to focus most of what I'm going to talk about on ESBWR and the SWR-1000. I can talk about AP1000, those issues if you'd like. I've got some presentation material on that, but I really want to try to focus on some of the new designs, those two in particular.

It really wasn't until, I guess, the advance reactor's research plan was completed in about April. The ink was almost dry when we got four new applications very quickly over the course of the summer. ESBWR, we began talking with General Electric in the beginning. I guess it was around June. They have put in an application now for precertification. They submitted a lot of their documentation, but not all of it at the end of August, the beginning of September. We've begun to take a look at that.

SWR-1000, another passive BWR was submitted also for precertification review. We don't have the documentation on that, but we've had a couple of presentations from Framatome. We've looked at that design. We see a lot of issues and things that we would want to take a look at that are very much related to ESBWR.

More recently we've begun to take a look at I'll call it the advanced CANDU, but the ACR-700 light water cooled, but heavy water moderated CANDU type of reactor, and most recently Westinghouse came in, gave us a presentation I guess it was in the beginning of October talking about the IRIS design.

So over the course of the last two or three months, we've begun to try to reassess our infrastructure. What experimental data might we need to obtain? What code development might we need to entertain here over the next, two, three, four years looking further downstream so that when we have to support NRR and when we have to make decisions for severe accidents and perhaps even fuel related issues, we can start to develop those tools now and have them ready when these four units get into the design certification phase.

AP1000, we think we know what the issues are. They've been on the table now for several months at least, and we have programs ongoing to try to resolve those issues, but it's these newer applications where we have the most concern.

What I would like to do this morning is talk about ESBWR, highlight what are the design changes, the design differences between SBWR and other boiling water reactors that we need to concern ourselves with. Likewise, the same for ACR-700, and try to highlight what are those areas where we think we're going to need code development and potentially more data.

We've tried to address this I would say in sort of a PIRT type thought process. In looking at these designs, and we have to admit that we don't have all of the documentation, and in some cases the design isn't complete, but what are those physical processes which are going to be the most dominant ones that we're going to have to address ourselves with when it comes to the kinetics, the fuel design, thermal hydraulics, and the severe accident issues?

Now, in getting into discussions with NRR and other researchers in thermal hydraulics, severe issues, fuel, it kind of comes up, well, why should you have any research related issues for these newer reactors.

We've been dealing with BWRs, PWRs for 30, 40 years. We've got codes that have been approved for looking at numerous issues here. I'd like to throw out four reasons why we think there is going to be additional work necessary.

First of all, most of these units are essentially driven by passive safety systems. These rely on natural circulation, low driving heads, relatively low flow rates from some reservoir of liquid into a vessel that's partially voided. Regardless of what code you use, one of these codes don't like to do nothing.

They operate better with large driving heads, more of a large break type of scenario when we're trying to analyze problems where the delta Ps around the loop are very small. We find ourselves in the situation that these codes can be very divergent and give us a very wide range of answers if we're off in one of those components, be it the friction, the interfacial drag, the gravitational head that we might expect.

So trying to analyze these very low flow rates and natural circulation leads to relatively high uncertainties.

MEMBER ROSEN: Let me ask you a question about that particular point. Is that uncertainty a function of the codes or of the phenomenon?

MR. BAJOREK: To cover it, I think I'd probably like to say both because I think there are some of those processes which have relatively large uncertainties. So even if I have a code that is perfect and I know how to analyze and model a particular system, those uncertainties can lead to large differences in answers because these transients proceed over hundreds of thousands of seconds.

A small uncertainty in a thermal hydraulic model can propagate in time, okay, and lead to, you know, a large uncertainty in whether it's core uncovery (phonetic), pressure in the containment, you know, a large uncertainty in one of those critical parameters that you're trying to assess.

The other thing that you see time and time again is if you take someone and you have them do a calculation with RELAP. You have someone else do a calculation with COBRA/TRAC. We'll take someone else and have them do a TRAC evaluation. The same problem, the same boundary conditions.

The one thing you can assure yourself, you're going to have three different answers. So I think, yes, the processes themselves, the uncertainty in the models lead to confusion and issues here, but also the fact that we're looking at using computer codes by differing organizations for new systems. That also can lead to uncertainties in what your answer is going to be.

MEMBER ROSEN: But you understand my question is that no matter how good the code is, if the friction factor you're using for a piping system turns out actually to be different than what you thought it was or maybe it varies, maybe it's time variant during a long transient because of some surface phenomena that occur, that without the driving heads of these big displacements, you know, pumping systems, these kinds of small changes which would normally be swapped by the kind of safety systems we've operated in the past, become important in the actual phenomena.

MEMBER SIEBER: In other words, what you're saying is could Plant A, which is supposed to be identical to Plant B, act differently because it has more corrosion build-up or some subtle feature is slightly different?

MEMBER ROSEN: Yes, that's what I'm saying.

MEMBER SIEBER: Yeah, I think that's a real possibility.

MEMBER ROSEN: I'm also saying that Plant

A, if it had the accident five years after operation, would be different than Plant A if it had the accident in the first year.

MEMBER SIEBER: Yeah, and I'm not sure how you deal with that analytically, but I would like to hear.

MEMBER WALLIS: Well, on this passive safety feature, the world has been told for several years now that passive is better. This is a real advance in nuclear safety because we've gone away from these accumulators and pumps and things that drive flows and now we have nature doing it, and that's better.

So now you're changing the tune and saying it may be worse.

MR. BAJOREK: No, not necessarily saying it's worse.

MEMBER WALLIS: Well, there are more uncertainties associated with it.

MR. BAJOREK: The difficulty in analyzing the transient --

MEMBER WALLIS: Well, that's a bad feature. That's a bad feature of a design if you can't analyze it accurately.

MR. BAJOREK: It's more difficult to

analyze.

MEMBER WALLIS: Not sure which way the flows are going and things. That doesn't sound like a good design.

MR. BAJOREK: But I think the focus is changing, however, rather than -- and that's why I wanted to throw the other bullet up here -- is because these traditional accident scenarios that we have been looking at for traditional reactor systems are also changing.

Yes, they're a stronger function of these smaller driving heads and smaller uncertainty in the friction factors and things like that.

MEMBER WALLIS: No, no. I don't think. Is it really so? I mean, if you've got a big tank up here of water and you've got a reactor down here, gravity is going to pull the water from here into here. Now, it's not going to go the other way. So there are some simple reasons why this passive design is good.

MR. BAJOREK: Yes. I think in all of these designs the question has gone away from how high the temperatures will get in your hot assembly to whether you would have core uncovery and what might be the depth of that core uncovery.

So I think that, yes, they're clearly safer and they have more margin than the earlier designs, but assuring our answers have become more difficult because we're looking at different scenarios, and we're looking at processes that we haven't focused on over the last 20 years in our research programs.

MEMBER RANSOM: Just one clarification. It's my opinion though the uncertainty is not in the behavior of the plant, but in the ability to model that behavior.

MR. BAJOREK: Okay.

MR. FLACK: One might almost go as far as to say that the human error has now shifted from the operational side of the plant to the design part of the plant and the ability to analyze the plant.

MR. BAJOREK: This is not so much the case for ESBWR. Maybe it somewhat applies to ACR-700, but in the case of the SWR-1000 and IRIS, we see new plant components, aspects of the plant, features of the plant that we haven't encountered before. So we know those are areas that we're going to have to sharpen our pencils on, perhaps develop some new components.

And finally, I would say it's the state of the art in boiling condensation in two stage flow. We find ourselves looking at processes that inherently have relatively high uncertainty. I think that's where we see problems in the AP1000.

We're looking at entrainment now driving the question on whether we're going to have core uncovery, how deep it is. Entrainment is inherently very difficult to try to model and analyze, and as a result, there's a high uncertainty in those correlations that are really available to us right now to put in those codes. So that's harder for us to get a handle on.

If we take a look at ESBWR, and I think the same can be said for SWR-1000, we're going to be dealing quite frequently with condensation in the presence of a noncondensable gas, another process that we didn't really have to depend on getting a good answer for for large break calculation, but now to try to come up with a quantifiable answer for many of these small break type scenarios in ESBWR and similar types of systems, we have to be able to assess how well we can get condensation heat transfer coefficients in the presence of a noncondensable gas.

And, again, another process that has a relatively large uncertainty that we have to model in a transient that has a very significant length.

MEMBER RANSOM: Steve, one comment that I'd like to have. I didn't see on your list the anomalous behavior of codes, and every code that I've seen so far, and if it's been eliminated in TRAC-MN, why, just tell me, but it's variously called water packing or, you know, phase transitions and things like this, which cause pressure perturbations that do overwhelm the driving heads of these natural circulation reactors.

And so I think that's a key issue. I don't see anything being said about that, but like I say, if it has gone away, why, just tell me

MR. BAJOREK: We won't claim that it has gone away at this point, but I guess in that case we would look at that as being almost a generic problem as part of the codes, whereas for this infrastructure assessment, we want to try to look at those things which are very peculiar or incident to the advanced reactors, but you know, that's a good point.

MEMBER RANSOM: Well, it is something that's important now, whereas in large break LOCA and some of the others, it was overwhelmed --

MR. BAJOREK: Yes.

MEMBER RANSOM: -- even though we're dealing with higher pressures, higher driving heads, and it wasn't so much of an issue.

But I k now from experience in modeling the SBWR that it hasn't gone away in RELAP-5, and I doubt if it's gone away in TRAC-M.

MR. BAJOREK: I would doubt that, too, but I think that also factors into the earlier comment on some of the user uncertainties and the assumptions on input parameters, almost the boundary conditions.

It's very small differences, okay, that either the user throws in or the code decides to toss into the mix that can cover up some of the real effects of those processes that you're trying to analyze.

What I'd like to do is kind of step through the two designs, ESBWR and then the ACR-700; just kind of point out in sort of a broad brush fashion what are some of the major differences that we see that would affect the codes and potential use of data.

Start off with the ESBWR. A couple of points that I think ought to be made is this is a relatively high power BWR system, 4,000 megawatt thermal, and you can see the comparisons to SBWR, ABWR, and the BWR-6. So we're looking at a relatively high powered core, relatively high power density. Of major significance is there's no recirculation pumps. I guess that's a good way to get rid of the jet pump types of problems, but eliminate those altogether and now it's natural circulation that derives your flow, will not only during the accident scenarios, but during normal operation as well.

Now, they compensated for this by making the vessel taller so that you have more of a driving head in the downcomer, a taller chimney. There's significantly more water in the vessel at the start of any type of a transient, more subcooled water to the vessel itself, and that extra inventory helps to make transience a bit more forgiving than what they may have been in the SWR or some of the other types of design.

The higher power is accomplished by having, you know, a lot of more fuel bundles within the core and sort of a wider, shorter core, as compared to the other systems, and of course, it's the passive safety systems.

MEMBER WALLIS: Now, the main thing that's different is the chimney. Everything else we've seen before.

MR. BAJOREK: Yes.

MEMBER WALLIS: And there are many real

questions about how a chimney will behave, particularly if there aren't many baffles in there. There will be large scale circulation patterns. Maybe the steamer will go to one side and swirl around and what comes into the separators will not be a uniform mixture and all.

That's the new thing that you ought to focus on, it seems to me. Everything else you've seen before. All of these other components have been in BWRs for a long time.

MR. BAJOREK: We've seen a lot of work in the compression pools.

MEMBER WALLIS: Yeah.

MR. BAJOREK: One of the newer features that I think Shanlai had pointed out is there is a relatively tight coupling between what goes on in the containment and the safety systems and how it affects delivery from the GDCS back to the vessel. We see that as being different.

I'm not sure we phrased it real well within the advanced reactor's research plan for ESBWR, but we are concerned with this idea of several flow loops that we have to be able to analyze accurately using, you know, code like TRAC-M.

Now, we focused at this point more on

those loops and those low driving head flow patterns that get GDCS into the vessel and drive a mixture of air and steam up through the PCC heat exchangers. We see those as perhaps being a more difficult research issue and potentially more important from the safety issue because that's how you're going to get the decay heat out of this system over the long term.

So that has kind of been maybe the highest of the highs.

MEMBER WALLIS: But you don't know yet. I mean, if you run -- when you've got your TRAC working and you run it, it may be that you show that this is a very robust system. You can put in all kinds of assumptions about entrainments and whatever, interface friction and so on, and it doesn't matter. Gravity brings everything into the right place.

It may be that it isn't a problem. We don't know yet. I think the first thing to do is get this TRAC so that it can run some simulations and do some sensitivity studies.

MR. BAJOREK: I'm going to come to that, and I want to maybe contradict a little bit what we heard earlier from NRR in terms of where we're at with TRAC-M because, in fact, we do have a fairly long list of assessments that we have been working on over the last several months. Okay? We're not as far along as we would really like, but when it comes to taking a look at processes for the ESBWR, we have been doing things like the Oak Ridge level swell experiments, modeling those. We did the G-2 level swell. We're doing Achilles right now.

We're looking at things that help us with the interfacial drag within the vessel. Now, we're still working on those. In comparison to how TRAC and RELAP would behave, TRAC-M seems to be right in there. Some tests are better; some are worse, but we're at the point where I think we'll be able to characterize how well the code is doing, and that's going to be important for looking at this inter-vessel level swell for ESBWR and ESWR-1000, but I'll talk about that a little bit later.

In terms of what we need to do in the advanced research plan, try to break this up into three larger areas. What we might need to do in terms of fuel behavior, be able to model and kinetics, thermal hydraulics, and then I'll talk about severe accident. I'll take what hopefully is the easier one first.

The ESBWR fuel, I think as we saw earlier, is going to be a GE-12 type fuel bundle design. This is the same picture that Shanlai had up there earlier. It has water rods, part length fuel rods, a number of differences in that fuel bundle that makes it a little bit different than some of the earlier designs that have been used.

Reporting in models into TRAC-M to try to account for these geometric differences, but in terms of a research issue, do we need data? Do we need significant code development?

Our answer to that is no, certainly not for ESBWR because our expectation is we don't get much core uncovery. So some of these individual features of the fuel assembly, we wouldn't expect those to matter a whole lot, and I think that is sort of backed up by G.E.'s PIRT that ranks a number of these fuel heat transfer, fuel related issues as relatively low in comparison to other issues.

I think it was pointed out earlier that, hey, wait a second. We've also gotten rid of the jet pumps, and we know that in BWRs there is a question on power stability. In our initial look at ESBWR, we flagged that as well because now we look at a shorter core, which should help, but a wider core which should make stability a little bit worse, and we're going to have to start up this plant without the benefit of the recirculation pumps to drive the flow.

You're at a little bit of the mercy of the flow starting, perhaps condensing up in the chimney region, and having a flow reversal. So we look at stability as something that we need to address.

Our initial reaction is that between what can be done with TRAC-M, TRAC-M coupled with PARCS, experimental data that we've obtained from the PUMA facility where we're running tests right now to look at stability type issues, give us a database to try to assess that.

Our preliminary assessment is that our computational tools and data are probably okay for ESBWR. We think we're at least as good for doing this plant as we are for other BWRs, not to say that there isn't any work to be done, but we think that we're on relatively good footing there.

More work to be done in the thermal hydraulic area. I point out in particular this flow loop that originates in the drywell where in the case of either a main steam line break or a LOCA we would be pushing some fraction of the noncondensable gases to hide out somewhere lower in the drywell, up through the PCC heat exchanger, developing a head of liquid that will eventually go back to the vessel, and perging the noncondensables down into the wet well.

As we've observed and we've talked with General Electric, we think it's going to be very important for us to get this correct. Okay? And we would see the need at least to do a fair amount of assessment, potentially some model development in order to be able to model condensation, the presence of noncondensable gases within this PCC heat exchanger.

There is a relatively large amount of data that's available through the PANTHERS test that G.E. has run. So we think that there's relatively good data there. We have some from other Purdue tests. There's other data out in the literature.

But we see this as being important for long-term decay heat removal because this is what's ultimately going to help recover the vessel, keep liquid inventory in the vessel, and will eventually drive what your containment pressure is during the long-term cooling.

MEMBER RANSOM: And one thing you might point out, Steve, that vent line goes down into the --

MR. BAJOREK: Yeah.

MEMBER RANSOM: It's not shown on the viewgraph very clearly.

MR. BAJOREK: Yeah. The soda straw kind of just dips down into that.

MEMBER RANSOM: That's where the noncondensables go.

MR. BAJOREK: Right, right. And also in those PANTHERS tests, this wasn't a nice, steady flow behavior. It chugged. I guess you would build up ahead before you pushed some liquid in, and the gas would purge itself periodically into the wet well.

So I think in terms of, well, gee, if we've got to get this thing right and this is something that we're going to have to start taking seriously right now in order to get the right models and the right assessments in place and identify if we need any additional data for this type of a flow loop and this type of a condensing system in order to model this appropriate for the ESBWR.

MEMBER ROSEN: You know, we have quite a bit of experience with chugging and large forces in drywell Tauruses, Tauruses and BW MARK Is, for example, and the remedies for that, including those ram's heads and diffusers and the like and the very large forces that can be imparted at least through BWR MARK I.

So are you thinking about those kinds of things here, too, or are we talking about now in process or are the forces that could be expected during these kinds of events similar to what we have calculated would be expected in MARK I events?

MR. ELTAWILA: Can I help on that? I think what you're talking about, Steve, was from the primary system. The driving force was very hot. This is a very low pressure system here. So the charging loads are not going to be as high as the one that we've seen in MARK I and MARK II design. That's why we add the -- I'm surprised that you called it ram's head. You know, that's the old -- they have quencher now, dequencher, and things like that, yeah.

So that's not the same issue. I would like to add, too, that even though that what Steve identified as an important modeling phenomena, what we've seen in the PANDA facility that, again, this is a self-correcting problem. You know, you build up enough pressure and you are going to push the noncondensable out.

So it's a modeling issue, not a phenomena that is going to affect the safety of the plant or anything. It's just how we can make our code predict that phenomena.

And again, so there are a wealth of data from the PANDA facility and to a certain extent from the PUMA facility on that.

MEMBER RANSOM: Along that line, you may be the inappropriate person to ask this question to, but sine I agree that you want to model the phenomena and understand it and that drives the research that you're doing, but the other question is: what is going to be the licensing basis for these points? You know, what are you going to look for?

The core doesn't uncover, and as long as it remains covered, you're not going to have peak clad temperature as, say, an indicator, and I'm wondering has that question been answered as to what are we looking for.

MR. BAJOREK: I think NRR would need to answer that one, but right now in the calculations that we've seen from G.E., peak cladding temperature isn't a real concern. The core stays covered. I think there is even for the GDCS line break there's still a meter of water above the top of the core.

Where I would expect them to put more attention is going to be in containment pressure. After 72 hours, the containment pressure is still within the design limit, but is relatively high, okay, and I think in earlier meetings that's been raised as something that they would want to take a look at because it doesn't meet one of the general design criteria that says that after so many hours' period of time, your pressure should be decreasing, and it doesn't seem to do that.

So I would think that it's going to be the events in containment which are going to be more of the regulatory criteria issues that will drive what's going to go on in the ESBWR.

MEMBER BONACA: The only other one I can think of is reactivity accidents, which would have to do with instability, and I don't know if that's really a concern or not.

MR. BAJOREK: That's not an area where I believe research has gotten into discussions considerably. I think that in terms of analyzing, if we're requested to look at that, I think that the TRAC-M PARKS and the data that we have from PUMA, yeah, we have a pretty good start on doing that.

But I believe that traditionally some of the frequency domain codes, the core and some of the other industry codes to try to look at stability first.

With regards to the ESBWR thermal hydraulic, the issues that we're going to pay particular attention to at this point is going to be the distribution, the effects of the noncondensable gases throughout the containment.

How they're transported through the containment, be it the PCC heat exchangers or the suppression pool, in the plan we've mentioned, well, we also have to take a look at what happens when the vacuum break. We get condensation in some parts of the accident, and the vacuum breakers let gas back into the drywell from the wet wells.

Well, looking at those, invariably it's looking at where the noncondensable gases are, what their effect are on condensation, what their effect would be as they go through suppression pool. Those are the ones that we think at this point are the most important.

We would anticipate having to improve the models in TRAC-M. That's been identified previously as an area that we think is fairly weak. We think that we're going to have to do the assessments for that.

And also we need to really get moving on the assessment of what I would call the integral tests for natural circulation. We have started some of those, looking at things like ROSA 3, FIST, GIST.

We're in the beginnings of those.

We will likely also need to continue assessment of TRAC-M for other types of tests at low pressure that involve lots of natural circulation. Maybe the OSU tests and the APEX facility, not strictly for BWR, but things that we need to do and to assess the code to insure ourselves that it's doing a good job when it's dealing with natural circulation.

And I think as Farouka pointed out, this is an assessment that needs to be done, potentially some model improvement. There's a relatively good database for condensation with a noncondensable gas. We'll look at those. We're probably in good grounds, but we don't want to rule out having to do anything else at --

MEMBER WALLIS: So there are no new phenomena. All of these phenomena have been met before. All of them are modeled in the codes one way or another.

MR. BAJOREK: Yes.

MEMBER WALLIS: What you're concerned about is how well the code represent them. So we're getting back to questions of uncertainties in the codes.

MR. BAJOREK: Yes, yes.

MR. ROSENTHAL: If I might interject, you know, before we just get into the severe accident side, typical Level 1 PRA, you drew an event tree, and you said, "Do I have my normal complement of ECCS?" And you used Chapter 15 very conservative analysis, and if you said yes, you drew a line and you said okay.

And your whole focus was on the unreliability of active components, and the uncertainty in how well you predicated your Level 1 PRA results was tied up in how well you thought that you modeled your active safety systems and the data that supported how good were these active components.

Okay. Now, with respect to Level 1, as I said, just before we get on the severe accident side, you're going to want to draw your PRA and your event trees again, and you're going to be putting in passive systems, and you may find out as you go through that that, in fact, the uncertainties in your predictions are dominated not by active component reliability, but rather by your ability to do analysis and how well do you think that you faithfully replicate what's going on in the plant?

If we are used to thinking in terms of ten to the minus three, ten to the minus four systems for active components with multiple trains, then for the same level of knowledge, we would want to know these phenomena to some degree of accuracy.

And what I'm saying is a concept that's driving us to recognize that we want to be able to do better in our analysis, in our predictions.

MEMBER WALLIS: It's not just that, but the PRA must reflect these model uncertainties because that's where the uncertainties are, and so --

MR. ROSENTHAL: And that would be a new challenge in a new area.

MEMBER WALLIS: This is a new challenge. I mean, some hydraulic models have been around for a long time, but putting some hydraulic model uncertainties into the PRA is a new task, and it seems to be what you must do because that's where all of the uncertainty is. Almost all of it is.

MR. ROSENTHAL: Well, let me just say that I think that we recognize this as an issue.

MR. BAJOREK: Okay. Let me kind of get through ESBWR severe accident issues. We've looked at that. Again, we're looking at this as having many similarities to existing BWRs.

When it comes to doing things with the MELCOR code, we don't see any tremendous needs here.

Most of these are issues that we can deal with in terms of licensing.

Now, ACR-700, okay, we think is probably going to require us to do a bit more fundamental work. This shows just some of the differences between ACR-700 and other types of CANDUs.

The interesting feature is that it's a light water cooled reactor with a heavy water moderator within the outer calandria region. It is not an entirely passive system, but requires accumulators for high pressure injection and uses pumps to supply water at low pressure to the headers, okay, to insure that you have covery of the pressure tubes during a LOCA or other accident.

This shows the pressure tube. Just to point out, there's something like 43 elements in here. The central elements are natural uranium with like a four percent dysprosium poison in them. These are two percent enriched that's surrounded by a pressure tube that has an annulus separating it from the calandria tube and the heavy water moderator in the outer region of the pressure tubes.

When we look at fuel and neutronics types of questions, we see some fairly complex modeling types of questions. We have both light water and heavy water multiple enrichments with dysprosium, which is different than what we have normally used in a code. It's a one type of moderator, a standard, uniform type enrichment. So we know that we have to do -- I'm sorry?

MEMBER SIEBER: Finish your thought and then I'll ask my question.

MR. BAJOREK: We know we have to do additional work in order to model this better and, you know, perhaps a different way than we had in the past. We're going to have to update libraries.

We have some questions on burst and) blockage of the fuel. Okay? But with regards to the kinetics issues, we see those as being tractable with effort to resolve these modeling type differences, potential for experimental data when it comes to some of the fuel performance.

MEMBER SIEBER: Yeah, I withdraw my question. You've answered it.

MR. BAJOREK: Oh. Okay. Thermal hydraulic issues, some of us have kind of talked that maybe the way of getting out of the modeling issues is to convince AECL to take this thing and stolt (phonetic) it to 90 degrees because we've kind of grown up and our codes of matured with this idea that refloods go from bottom up or town down in some cases, but they're along the lines of gravity. It's not perpendicular to it.

So modeling events that will occur laterally along this pressure tube be it the flow patterns in an aided bundle and how those patterns transitioned, what the rewet and the clinch processes will look like. Okay? If you get a dry patch, how stable will it be? What will happen when you try to flood a heated pressure tube from both ends? Will you get any water into this hot patch?

And we get on to the next one. Well, what happens when that tube starts to sag? And if you remember from that fuel bundle and that pressure tube starts to make contact with the calandria tube. We think there's a whole wealth of thermal hydraulic issues that we're going to have to deal with in order to try to model this, in addition to what's the flow distribution as we go from this bank of tubes from the header, as we're potentially draining the system and some tubes at the top are uncovered and they aren't on the bottom.

There's a lot of thermal hydraulic issues that we are identifying and we think are going to have real modeling needs and real needs for experimental data.

I think I covered this one already talking about the heat transfer between this pressure tube and the calandria tube as the bundle heats up an this tube sags and begins to make contact with this or potentially fails the calandria tube, and I'll let the kinetics people worry about what happens when you mix the light water and the heavy water and you have to worry about reactivity insertions.

MEMBER SIEBER: Maybe I'll go back to my older question.

MR. BAJOREK: Ut-oh. I haven't answered it, I guess.

MEMBER SIEBER: When you manufacture something like this combination of pressure tube and calandria tube, I would guess that unless you only made one of them that they wouldn't be concentric necessarily, and because that gas annulus is so narrow, I would think that that variability would have a big effect on what the heat transfer characteristics are, and in addition, in an accident condition, it's changing over time.

MR. BAJOREK: Yeah.

MEMBER SIEBER: How do you deal with something like that?

MR. BAJOREK: You don't know right now. That's one of the things that we're going to have to deal with, and it's clear from some of the things that we've seen from AECL that that has been a problem in their --

MEMBER SIEBER: It's an issue.

MR. BAJOREK: It's an issue because where do they put the spacers, and there's been a lot of work on that.

MEMBER SIEBER: I would think that depending on what that geometry really is would determine what the heat output and the temperature of the fuel assembly would be, and that would have a fairly good uncertainty unless you have a lot of margin.

And it's not clear to me how you would model that.

MR. BAJOREK: We agree. I think there's a lot of questions, and with the ACR-700, we don't have any documentation on that yet. It hasn't been submitted as part of the design certification. This is based on workshop and handouts. We're trying to formulate where we're at and where we're going to go.

MEMBER WALLIS: It seems to me --

MEMBER SIEBER: Did they not have a

damaged fuel assembly in one of those reactors at one time where they might have observed what the behavior was?

MR. BAJOREK: I thought they had, but I'm -- I'm reaching because I remember cracking has been a problem on these.

MEMBER SIEBER: Well, that was a different problem. This was earlier than that. Well, my memory isn't that great.

MEMBER WALLIS: Well, there are so many questions with this ACR-700 which you're not prepared that it seems to me that you may simply have to say we can't make decisions about it, and therefore, we won't accept applications because we're burdened with all of this other work on these other reactors. It would take too long, too much effort to come up to speed on all of these questions that you've raised here. So we won't ever consider it.

MR. BAJOREK: Right now we have with we have, and I think as far as decisions on how to proceed at this point, it's going to have to be up to the management.

MR. FLACK: Yeah, I think it's important to realize that we are in the space of just trying to be proactive and trying to understand what's coming.

It hasn't come yet and so we're really -- we don't know how significant these things will play out until we learn more about the plant, but again, we haven't really entered into pre-application review. Hopefully we'll get a lot of these answers as we move along.

MR. BAJOREK: I guess our point is compared to ESBWR or AP1000 things, we think there are a lot of significant questions and a lot of work that's still going to have to be entertained.

MEMBER WALLIS: But the assumption seems to be made at the beginning that you're going to do enough research to be able to answer all of the questions about all of these reactors coming along, and it probably will turn out that you can't do that.

MR. FLACK: Well, not us as an agency, but I think us as relying on the bigger picture of all the work that's going on, and we're still trying to figure out where all of that lies.

So there will be a trip to Chalk River coming up in December. We'll be looking at what has been done, and certainly we want to get the answers to the questions, but the burden is always on the licensee, the applicant, to come forth, and then it's up to us look at that and see what other questions we have.

But we're still at a very preliminary stage, and we're again trying to be proactive, think ahead, put in where we are today, and as Steve mentioned, we haven't really looked at the plant itself yet.

So at this point there is uncertainty.

MR. BAJOREK: We see some of that with the thermal hydraulics. I mean, a number of issues and problems.

When it comes to severe accidents, the situation or the issues may actually even become more difficult because our initial read of the database, the modeling that has been gone on previously is that there hasn't been a tremendous amount of that due to the way that this reactor has been regulated in Canada.

And we would, again, anticipate a relatively robust need to address severe accident issues, such as the pressure tube/calandria tube failure, how you get fuel failure and melt progression in a horizontal core as opposed to a vertically oriented core, how you fail this calandria in the outer shield tank.

We don't see a whole lot of information. We see very little in the way of test data available even to the designers at this point. We think at this point it's prudent for us to say that if we're going to be the ones to be relied upon to come up with credible auditing tools, we have a difficult task ahead of us.

I think I basically said that.

MEMBER RANSOM: Steve do you k now if AECL has any severe accident codes for modeling CANDU?

MR. BAJOREK: I've talked to a few people on that, and I think their general consensus is no.

MR. SNELL: Yeah, I'd like to correct that. We have adapted the map code for severe accidents.

Oh, sorry. Identify yourself. Victor Snell for ACL.

We have adapted the map code for CANDU. It's been copied with the Canadian utilities, and that's our severe accident tool with them.

MR. BAJOREK: I just want to summarize some of the work that has been ongoing to try to look at these two reactors in addition to some of the others. As John has noted, there's been work to try to develop advanced research plans for ESBWR and for the ACR-700.

We haven't started work on the SWR-1000 or

IRIS at this point, but would anticipate that would be done some time in the future.

The work that's ongoing that gives us a little bit of a head start on some of these, as Shanlai pointed out, and I think I hope I emphasized earlier, we see a very tight coupling between what goes on in the ESBWR containment and what goes on within the primary vessel.

We've recently coupled TRAC-M and the contain code to give us a tool that will be able to exercise and try to look at uncertainties, how uncertainties in containment affect the vessel and vice versa.

In our developmental assessment, we've given all of the BWR related assessments a higher priority now. We've sort of shifted what we're doing, and it started things like the ROSA III, the GIST, the FIST, a number of component assessments in order to try to get TRAC-M qualified for BWR applications, maybe a little bit ahead of where we would want to be for PWRs.

With respect to the ACR-700, we're in the process of resurrecting and identifying work that has been done previously by the staff, more so in the case of the CANDU. There was some work done by INEEL that identified what models they would recommend changing in TRAC-M, what was the database that was acceptable back then for some of these processes, some of which are the same.

They've identified code changes. We also have a partnership with some of the Korean organizations who have also looked at or have been analyzing the CANDU reactors. So we've had some preliminary discussions with them on looking at some of their work that might be useful to assessing the ACR-700.

To summarize, I think it's pretty safe to say that there's been a lot of renewed activity now in these advanced light water reactors. As John pointed out, we don't have all of the documentation yet. We're still waiting for a great bulk of that, but our goal is to try to look at the physical processes, where we're at in our ability to model and assess those things which are going to have the highest uncertainties, and start to formulate plans that will lead eventually to code modifications or possibly to experimental programs.

Thanks.

MR. FLACK: Okay. We're just about on schedule.

There's two more viewgraphs actually to go through. This one is to just go quickly over what we're planning to do in '03, and that was an attachment. It's actually an attachment to the paper, and basically there's three things we're trying to achieve.

One is to expand our current capability. That's pretty much in the codes, the TRAC that you've heard about and MELCOR and also establish cooperative agreements in various areas, primarily in the fuels analysis area, where it's very costly to do this work ourselves, and as well in the materials area, analysis area, where we're looking at the codes and standards that are out there and reviewing them and revising them and also seeking cooperative agreements.

Framework we talked about and PRA, as far as PRA and its application to advanced designs, looking for data and experience is out there that we can use to better be able to quantify risk for those types of plants.

And in the structural analysis area, we're also looking at codes. The seismic -- updating seismic curves and looking at what we can gain from cooperative agreements with Japan is one area that has done some work on modular concepts and designs.

So were there any other questions on that? Yes.

CO-CHAIRMAN FORD: In your Attachment 4, you give lots of subsets for these framework analysis, et cetera. Were those subsets derived by the formal PIRT activity that you outline in the infrastructure assessment plan?

MR. FLACK: I would say most of the subset, the actual subsets come from further development of our infrastructure and asking questions and trying to understand what's out there and capitalizing, leveraging on what else is going on in the world today.

It's not so much comparing one against the other, but recognizing the domain, the spectrum of areas that need to be worked, and from that, again, trying to not actually jump inside doing work in one area, but trying to capitalize on what work has already been done in these areas. So --

CO-CHAIRMAN FORD: But you're capitalizing on the low cost tasks.

MR. FLACK: That's basically it, trying to take advantage, trying to understand what the status and advances that have been made and where do we need to go from there.

So I would say this fiscal year, again, is still trying to establish a vision and building on what already has been done.

CO-CHAIRMAN FORD: But you're no longer confined to the statement about fiscal year '03 to '06. It's no longer a five year plan.

MR. FLACK: No. It's pretty much this document will be revisited again in the next year and revised based on what we know and what we need to know, and so it's a living document, and it projects as far out as we can in that regards.

CO-CHAIRMAN FORD: So it's a rolling plan with input of the technical challenges as given in the infrastructure assessment, and it's a rolling plan as to how you implement that.

MR. FLACK: Yeah, the plan is the broader picture, and that involves resources and where you're going to put them and prioritize them. The infrastructure assessment is really an assessment of our needs, where the issues are, technical challenges, what's out there and where we need to go.

So there's these two parts of it, and the one, the piece about what we actually will be doing is the prioritization process, and that plays out against other things that are going on in the office.

So it's not in the sense of, you know, here's what we need over the next five years and we'll do this in fiscal year '02, '03, '04, '05, and '06. It's to continuously revisit this based on new information as information becomes available, and prioritizing the work as we see it against other work that's going on.

CO-CHAIRMAN FORD: So it's very unlike a structured program that you'd have in many other organizations.

MR. FLACK: I think because it's so far reaching it's difficult to just establish and know all that needs to be known to write something down that's very structured. It's more flexibility there in making decisions as we go and as needs arise and as we can capitalize on things.

And, again, in the sense of infrastructure is one thing, and then how we apply that to a particular plant will depend on how much is available from the applicant. So the more that we can understand and gain from the applicant, the less we'll need to do, but the more that we see that we have outstanding questions that that time will require us to do more.

So it's not clear exactly where that line is drawn at this point. There's always a gray area when it comes down to --

CO-CHAIRMAN FORD: I'm trying to struggle to get away from the uncomfortable feeling that this whole PIRT program is driven entirely by resources, dollars and manpower, as opposed to safety.

Now, is that an unfair statement?

MR. FLACK: Well, I think as far as the PIRT is concerned, the issue is safety, and it's how you prioritize your work. The phenomena that's important will depend on its implication with respect to safety. So within the PIRT process, I think it's intrinsic to the process that safety is foremost.

MR. ELTAWILA: Can I? I really think there is a confusion here about the PIRT. The PIRT process applies only to certain phenomena. A thermal hydraulic code, try to identify the phenomena, and among these phenomena say which is the most important one that drive the risk or influence the behavior of the plant, and from that you try to develop your data and analysis tool.

So that's related to the structure of our database and our codes and things like that, and that's the only use of the PIRT.

The way we project is we use the -- I

forgot the acronym PPM, PM something, you know, but you look at they are measured against the performance goal of the agency, and the performance goal of the agency, the first one of them is maintaining safety.

So you try to look for each of these activities. The work that we are doing for ESPWR or ACR-700, how is it used to address these four performance goals: maintaining security (phonetic), reducing unnecessary burden, and all this stuff?

And that's how we come up with the prioritization to allocate the money.

In addition to that, there is another layer built on that, is the long lead time, you know. For example, you know that your fuel testing is going to take ten years before you get results. So after even you go through all of these processes, you will go further and say do I need this work in a year or two years or five years, and this or that I will look at the resources.

CO-CHAIRMAN FORD: So that comes into the thought process.

MR. ELTAWILA: That's correct.

CO-CHAIRMAN FORD: So if I look at this list here that Graham and myself were looking at and trying to work out where it fitted into what we've heard today, it will all be done in fiscal year '03.

MR. FLACK: Well, no, I don't think it's to say that it'll all be done. At least it will be initiated.

CO-CHAIRMAN FORD: Oh, okay. All right. It will all be initiated in '03.

MR. FLACK: Yes, right. That is correct.

MEMBER WALLIS: Now, I asked a question earlier about why was Steve presenting to us.

MR. ELTAWILA: We know that you think the thermal hydraulic is the center of the universe.

MEMBER WALLIS: No, no, no.

MR. ELTAWILA: So we try to please you.

(Laughter.)

MEMBER WALLIS: No, no. That's not the case. I mean, I'm trying the various hypotheses I have. One is that --

MR. FLACK: It's the area that needs the most work.

MEMBER WALLIS: Yes. Steve is the only person who has really thought about what needs to be done, and in these other areas it hasn't been done, or the other one is that these other areas are in such tremendously great shape, and Steve is the one who needs some help from us. So you put him in front of them.

(Laughter.)

MEMBER WALLIS: Is it true that if we had heard something from the fuels analysis people, like what Steve presented, it would have been something very close to the kind of presentation he gave?

MR. ELTAWILA: Well, there are no new fuel issues for ESPWR and ACR-700.

MEMBER WALLIS: Yeah, but there are for the --

MR. ELTAWILA: Because we can identify --

MEMBER WALLIS: But it is all fuel.

MR. FLACK: Right. We came down I guess it was in July and we spent a day with the subcommittee to talk about the different areas. Of course, fuel was one of them that we discussed, but you know, within that time frame. We spent a number of hours I think while Stu was given that presentation, and then also as one on materials.

Materials is also equally important, and there is a piece on ACR-700 that's in the plan on materials. So there are areas in there which we just don't have the time to cover today, which could easily be covered -- well, it wouldn't easily be covered, but could be covered in subcommittees at the very --

MEMBER WALLIS: Do you think Steve was being typical of the status in these other areas? I mean, of course, the problems are different, and they're for different reactors, but should you take him as being typical of what's going on?

I found that personally what he presented helped me a great deal as opposed to what I read. I mean, it helped me a great deal as a supplement to what I had read.

MEMBER BONACA: It was very good.

MEMBER WALLIS: And probably if I had heard more about materials today, that would have helped me a great deal as a supplement to what I have read.

MR. FLACK: Yes. When you see the attachments, of course, what Steve had covered was most of what's in the Attachments 2 and 3. The other parts are somewhat generic.

There is, again -- I apologize. If we had some time; in fact, if we would like to hear about the materials for ACR-700, there's a discussion of that, but primarily the information that's in the Attachments 2 and 3 right now from how far we can go with them at this stage is primarily the issues that Steve had covered, which is the thermal hydraulics and the severe accidents in the nuclear part of it.

So he covered 90 percent. For SBWR it was pretty much what's in there now.

MEMBER BONACA: It seems to me for all of these plants, the I&C, I mean, digital I&C is also.

MR. FLACK: Yeah. I mean, it's more generic. It's ongoing. I think the systems analysis piece though is very important in not only developing codes for application, but as you develop these codes, you understand the plant better. You understand what the success criteria means.

So you grow with that, and you become aware of the plant, which we sometimes forget that this is how we understand the plant. So that's why it's a critical piece in all of this.

CO-CHAIRMAN FORD: Just one final thing. I asked the question whether all of these activities will be started in fiscal year '03, and you said yes.

MR. FLACK: Yes.

CO-CHAIRMAN FORD: You mentioned two others, the ones we heard about AP1000. Is the reason why they're not on this list -- this is the NRR usually -- the reason they're not on this, is it --

MR. FLACK: Yeah, I guess they were already ongoing, and these were more for things that we were initiating. So, yeah, I think it would be safe to say that the AP1000 could have been added to this list if we were trying to be complete on this.

CO-CHAIRMAN FORD: So these are starts.

MR. FLACK: These are more, yeah, in the context of initiating work.

MR. ELTAWILA: The other reason, John, that some of the AP1000 especially in the severe accident issue is done by the staff here internally. So that just may be reflecting that these are the contract work that is going out, you know. So maybe that's why it was not mentioned.

CO-CHAIRMAN FORD: Well, thank you very much.

MEMBER RANSOM: Peter, I'd like to make one final comment.

CO-CHAIRMAN FORD: Yes, of course.

MEMBER RANSOM: Which has to do with uncertainty again, and you've presented research tasks that are primarily driven by lack of knowledge, you know, that we understand.

But there is another approach, and I'm hoping that the NRC eventually will adopt something along these lines that the Europeans are using now in which they call self-assessment built into a code.

It's not actually self-assessment, but it's like self-sensitivity to the uncertainties that are known and the various models in the code.

And so when they go through the 59 runs that Professor Wallis has identified as necessary to get the 9595 assurance, they can actually tell how much sensitivity to this model, that model, the other models.

It would be nice to see a research driven by the sensitivity, you know, of these calculations to those various models. Are they the most sensitive?

MR. BAJOREK: We're heading in that direction. I think our first goal is to try to get TRAC-M consolidated and assessed at this point because the uncertainties won't mean anything unless we have some basic confidence.

But we have been working with Ally Mosely and Mohammed Mudaris at University of Maryland to start to put together an uncertainty methodology where we would apply it to the code results.

We started earlier in the summer. We're thinking about using AP1000 as a preliminary tool, but the idea here if you could come up with an uncertainty methodology that we could use at least with TRAC-M and start to use that to address some of your questions.

MEMBER RANSOM: Well, the reason I bring it up is some of these methods have to be built into the code, and since you're developing TRAC-M now, now would be the time to actually build this kind of capability in.

MR. FLACK: Yeah, certainly sensitivities runs -- to understand the significance of the uncertainties is certainly an important part of the code development, I would think. So we'll take your comment certainly into serious consideration during the development of the codes.

CO-CHAIRMAN FORD: I'll be asking the members for their comments on specifically the NRC, the NRR and the contributions of this morning. I'll be asking for that later on today.

So thank you very much, indeed, John.

MR. FLACK: Okay

CO-CHAIRMAN FORD: I hope you will be here for this afternoon.

MR. FLACK: Just the one more conclusion slide to mention that, just the two bottom bullets. I think the rest we have already discussed.

CO-CHAIRMAN FORD: All right.

MR. FLACK: The two papers that are going forward.