Official Transcript of Proceedings ACRST-3245

NUCLEAR REGULATORY COMMISSION

ORIGINAL

Title: Advisory Committee on Reactor Safeguards
504th Meeting

PROCESS USING ADAMS
TEMPLATE: ACRS/ACNW-005

Docket Number: (not applicable)

Location: Rockville, Maryland

Date: Thursday, July 10, 2003

Work Order No.: NRC-997

Pages 1-328

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

TR04

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

504th MEETING

+ + + + +

THURSDAY, JULY 10, 2003

+ + + + +

ROCKVILLE, MARYLAND

The ACRS met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Mario V. Bonaca, Chairman, presiding.

COMMITTEE MEMBERS:

MARIO V. BONACA, Chairman
GRAHAM B. WALLIS, Vice Chairman
STEPHEN L. ROSEN, Member-At-Large
GEORGE E. APOSTOLAKIS, Member
F. PETER FORD, Member
THOMAS S. KRESS, Member
GRAHAM M. LEITCH, Member
DANA A. POWERS, Member
VICTOR H. RANSOM, Member
WILLIAM J. SHACK, Member
JOHN D. SIEBER, Member

ACRS STAFF PRESENT:

JOHN T. LARKINS, Executive Director - ACRS/ACNW, Designated Federal Official

SHER BAHADUR, Associate Director - ACRS/ACNW

HOWARD J. LARSON, Special Assistant ACRS/ACNW

SAM DURAISWAMY, Technical Assistant ACRS/ACNW

MIKE SNODDERLY, Senior Staff Engineer

MAGGALEAN W. WESTON, Staff Engineer

RALPH CARUSO, ACRS Staff

NRC STAFF PRESENT:

FRED BURROWS, NMSS/FCSS/FM

SMANTHA CRANE, RES/DET

AMY CUBBAGE, NRR/DRIP/NRL

KATHY HARVEY GIBSON, NNSS/FCSS/SPIB

FRANK GILLESPIE

HERMAN GRAVES, III

JAMES HAN, RES/DSARE/SMSAB

MARY K. HILEMAN, RES/DSARE

BAKR IBRAHIM, NMSS/DCOM

T.C. JOHNSON, NMSS/FCSS

PHILIP JUSTUS, NMSS/WM/HLWB

GARY KAPLAN

JOEL KLEIN

JOEL KRAMER NMSS/FCSS/SPIB

RALPH LANDRY, NRR/DSSA/SRXB

NRC STAFF PRESENT: (cont.)

STEVE LaVIE, NRR/DSSA/SPSB
ALAN LEVIN, RES/DD
STRANLAI LU, NRR/DSSA/SXRB
GARY MIZU, NRI-OGC
JAMES E. MORRIS, NMSS/INMS/RGB
ALEXANDER MURRAY, NMSS/FCSS/SPIB
ANDREW PERSINKO, NMSS/FCSS/SPIB
MUHAMMAD M. RAZZAQUE, NRR/DSSA/SRXB
BRIAN RICHTER, NRR/DRIP/RPRP
BRIAN SMITH, NMSS/FCSS/SPIB
WILKINS SMITH, NMSS/FCSS/SPIB
JOHN STAMATAKOS
JOSEPH STAUDENMEIER, RES/DSARE/SMSAB
BRIAN THOMAS, NRR/DRIP/FRAS
GEORGE THOMAS, NRR/DSSA/SRXB
ALI TABATABAI, ACRS (LINK)
EDWARD D. THROM, NRR/DSSA/SPSB
SPYROS TRAIFORDS, ACRS (LINK)
CHRISTOPHER S. TRIPP, NMSS/FCSS/SPIB
BILL TROSKOSKI, NMSS/FCSS/SPIB
REX WESCOTT, NMSS/FCSS/SPIB

ALSO PRESENT:

LEE ABRAMSON, RES/DRAA/PRAB
DAVID ALBERSTEIN, DOE

BENNETT BEACY, RES/DRAA/PRAB

ED BRABAZON, DCS

ARTHUR BUSLIK, RES/DRAA/PRAB

NANCY CHAPMAN, SERCH Bechtel

BOB FOSTER, DCS

ROBERT GAMBLE, GE

TEKIA V. GOVAN

HOSSEIN HAMSEHEE, RES/DRAA

LANE HAY, SERCH Bechtel

JAMIE JOHNSON, DOE

MARK KLOSKY, DCS

JUNICHI KURAKAMI, Japan Nuclear Fuel Cycle Development Institution

EILEEN McKENNA, NRR/DRIP/RPRP

PAIGE NEGRES, GE

SCOTT NEWBERY, RES/DRAA

ALEX POLENSKY, Morgon, Lewis & Bockics, LLP

ATAMBIR RAO, GE

TOM ST. LOUIS, DCS

SAM THOMAS, DOE/WNSA

TOMMY TOUCHSTONE, DCS

ROBERT L. TREGONING, RES/DET

GEIT VORA, RES/DET/MEB

DAVID WEROER, MPR Associates/DOE

STEPHEN ZAH, DOE

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

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

(8:31 a.m.)

CHAIRMAN BONACA: Good morning. The meeting will now come to order.

This is the second day of the 504th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting the Committee will consider the following: Mixed Oxide Fuel Fabrication Facility, ESBWR pre-application review, proposed criteria for the treatment of individual requirements of regulatory analysis, expert solicitations report for risk-informed events, Part 50.46, and proposed ACRS reports. A portion of this meeting will be closed to discuss the proposed ACRS Report on Safeguards and Security.

This is meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act.

Dr. John Larkins is the Designated Federal Official for the initial portion of the meeting.

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

A transcript of portions of this meeting is being kept, and it is requested that the speakers

use one of the microphones, identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

I would like to announce a change in the agenda. The agenda item regarding the ESBWR pre-application review, which was scheduled to be held between 8:35 and 10:30 a.m., is now scheduled between 12:45 and 2:45 p.m. The agenda item regarding Mixed Oxide Fuel Fabrication Facility is now scheduled to be held between 8:35 a.m. and 10:30 a.m.

Before we proceed with the meeting, I would like to begin with some items of current interest. First of all, we have a number of people to welcome on board.

We have a summer intern, Gilena Monroe, who will be with us for the summer period. Unfortunately, she's coming today and then she is leaving before the ACRS meets again. So it's going to be a short --

(Laughter.)

We're glad to see you here. Welcome onboard.

We have two Senior Staff Engineers joining us. One is Dr. Bhagwat B. Jain. Good morning. He will join us as well, effective July 15th. He is

going to be part of the staff.

The other person is Marvin Sykes. He also is going to be a Senior Staff Engineer with us. Welcome on board.

Another issue I would like to bring your attention to is items of interest. There are quite a few items of interest there.

First of all, you will find NRC announcements, quite a bit of organization and management changes that may be of interest to you.

We have a couple of staff requirement memoranda you want to look at, a number of speeches, operating plant issues, and an interesting letter and the congressional correspondence where Chairman Diaz has been required to evaluate the potential efficiencies that would be gained by consolidating or eliminating the Regional Offices, dated June 26th, 2003. You may find that of interest.

With that, I will move to the first item on the agenda, which is the Mixed Oxide Fuel Fabrication Facility, and Dr. Powers will lead us through this presentation.

MEMBER POWERS: I will. I will try.

CHAIRMAN BONACA: He will try.

MEMBER POWERS: Members should turn to

Item 4 in their notebook, and you'll see that we have on the agenda about two hours to cover a variety of topics.

Last month we gave you a thumbnail sketch of all that's been going on in connection with this Mixed Oxide Fuel Fabrication Facility, highlighted some of the issues and findings from the Subcommittee meetings, and today we're going to take some of the central features of those items and go into them in some depth.

Right now the staff is proceeding along on a plan to issue a Safety Evaluation Report in September. They have some few open items that we will discuss. I believe the plan is to issue an SER in September, regardless of the resolution of those open items, though, quite frankly, I'm very optimistic that we will close those.

I propose deferring any letter from this Committee on the SER or the application until September, unless we identify some fault in the current ongoing activities that we think need to be commented on in the interim. Quite frankly, I don't think there's anything of that type.

We have a jam-packed two hours here of a lot of stuff, much of which you're going to have, at

best, a passing familiarity with, whether you've derived it from previous presentations or your own reading on this. We're going to go fairly quickly through this material. I'm going to be rigid in enforcing time schedules. So I urge speakers to move to the salient points with some confidence that, despite their advancing ages, most of the members can, in fact, read the viewgraphs and the associated material.

With that, I will ask Drew Persinko if he can start us off on this issue and outline what we're going to be hearing here.

CHAIRMAN BONACA: Go ahead, Drew.

MR. PERSINKO: Good morning. My name Drew Persinko, and I am the MOX Project Manager in the Office of Nuclear Material Safety and Safeguards.

First, I would like to thank the Committee for accommodating the rescheduling of this session, due to some unforeseen events that have occurred.

I'm going to give some brief introductory remarks before we get into the real meat of the presentation, the real hard-core technical issues, but I think it's important to get kind of an overview of the MOX facility.

Depicted in this slide is both the

geographical and jurisdictional boundaries for the MOX facility as well as the Pit Disassembly and Conversion Facility. As you can see, it's depicted that weapons-grade plutonium will arrive at the Pit Disassembly Conversion Facility, which is under the jurisdiction of the Department of Energy. The material, the powered plutonium oxide, that comes out of the PDCF is planned to arrive at the MOX Fuel Fabrication Facility, which is where the NRC becomes involved in the project.

The NRC is responsible for licensing the Mixed Oxide Fuel Fabrication Facility, and it's also responsible for the reactor side of the project, too, which involves processing, reviewing the MOX fuel into the reactors. Currently, the Catawba and McGuire Reactors are the two reactors that are planned for the project.

As you can see on the facility, the MOX Fuel Fabrication Facility is in fairly close proximity to the PDCF. Both are located on the Savannah River site.

MEMBER WALLIS: I think there's also a recycling of waste back to the DOE?

MR. PERSINKO: Correct. The waste from the facility is temporarily stored at the Fuel Fab

Facility, and then it's transferred back to DOE on the Savannah River site for processing. This is just to give you the high-level picture of location and geographical boundaries.

What's not shown on here, though, is also about a year ago there was a change in the project. Some of the material will be coming to the MOX facility that was previously destined to be immobilized. So it will be coming to the MOX Fuel Fabrication Facility and not going through the PDCF. That's not shown on this slide, though.

We just want to depict a high-level view of the process. The first three boxes on the top are the aqueous polishing part of the process, the wet side of the process. It's the purpose of this is to further purify the plutonium dioxide that's received at the facility.

This is similar to the process that is used at the La Hague plant in France. It involves dissolving the plutonium oxide in a nitric acid using silver as a catalyst. The petroleum nitrate is then purified, removing impurities such as americium and gallium and uranium. It's using a solvent-extraction process in post columns. It also involves recovering the solvent -- extracting the Pu or generating the

solvent and recycling the nitric acid.

Then there is the conversion part of it where the material is converted back to a plutonium oxide through oxicalcination and precipitation. At this point the plutonium powder is blended with depleted uranium oxide, and the bottom part of this slide is the dry side of the process, which is similar to the Melox, the process that's used at the Melox facility in southern France.

It involves blending the plutonium oxide with the depleted uranium oxide in two-step blending, and it is much the same as a fuel fab facility. It is pressed into pellets. Pellets are inserted into rods, and the rods are made into assemblies, and then that's transported to the reactors.

The licensing --

MEMBER LEITCH: There's a statement made in some of our reading that says, "The alternate feedstock, the diversity of impurities and the level of impurities is higher." Is there any precedent for processing this kind of material? In other words, do they do something like that in France or --

MR. PERSINKO: No.

MEMBER LEITCH: -- is this a unique situation?

MR. PERSINKO: I don't know about the DOE. They may be doing it at the DOE, but in France they reprocess the spent fuel, and they're not dealing with weapons-grade plutonium. They're dealing with spent fuel, and it's a different mixture in France than what's here.

MEMBER POWERS: I would inject that the basic chemical process can be used to purify stuff that's real, honest-to-God garbage. I mean it's a robust recovery processing technology that's been developed.

MEMBER LEITCH: So we ought not be particularly concerned, then, about the level of impurities or the diverse nature of those impurities?

MR. PERSINKO: Well, we have looked at it as part of our chemical review, except you'll see the open items you have later, but they're not directed specifically at the alternate feedstock. It's just some concerns we have with the process that's regardless of alternate feedstock.

MEMBER POWERS: I think it's safe to say that it complicates the operation of the facility, which may be more of a concern in the second stage of the process. It's also safe to reiterate Peter's concern about the issues of material corrosion in the

system that gets exacerbated by any time you have a diversity of chemicals in the system.

MEMBER LEITCH: Okay.

MEMBER POWERS: So I wouldn't ignore it.

MR. PERSINKO: The licensing of the facility is being performed under -- although there's several regulations that do apply, the primary regulation that applies is the 10 CFR Part 70, Domestic Licensing of Special Nuclear Material.

For plutonium facilities, a two-step process is permitted, and that is what we are doing. There is an approval, a construction authorization approval, a construction authorization, and then there's a second review, which is the operation and the possession of special nuclear material.

We are currently only at the construction step right now. That's all we're talking about right now.

Part 70 requires for the start of construction of a plutonium facility that the NRC approves the design bases of the principal structure, systems, and complements. I emphasize design bases because that's all we're really -- that is what we are required to review and that is what we have been reviewing.

So, assuming a favorable decision for construction, the operating license application will be at a lower level of detail than what we are currently reviewing because the regulations only require design basis at this point.

It also requires a quality assurance program be approved. I would like to point out that the regulation in Part 70 does require that for a plutonium facility that the quality assurance program be an Appendix B program, similar to or the same as reactors.

We have reviewed and approved the QA program for the facility already, and it requires that an Environmental Impact Statement be performed. We have issued a draft EIS. We received numerous comments on it. We issued a draft EIS. We received numerous comments on it, and we are currently in the process of addressing those comments. We plan to issue a final EIS in September.

MEMBER LEITCH: That QA plan you discussed is for the operations phase? I mean, for the construction phase only?

MR. PERSINKO: For the construction phase, procurement. It's not operations, but it includes more than strictly construction. Also, I believe it

covers procurement as well.

MEMBER LEITCH: But there will be another QA plan for operations?

MR. PERSINKO: I think it will be updated. It will be updated for operations.

MEMBER LEITCH: And I suppose one of the things that concerns me is the qualification and training and staffing of the plant, the facility. They will all be issues that will be discussed in the operating phase?

MR. PERSINKO: Well, they will be issues in the operating phase, but I think there's also issues about training now that we look at as well, to make sure that it has the right training aspects of it currently as well and the right qualifications.

In fact, it's not part of the QA -- well, it's related to the QA plan, but that was one of the issues in the criticality area that we looked at. But the QA plan does address the 18 criteria that are in the Appendix B, in QA 1, Appendix B. But it will be updated for operations.

MEMBER LEITCH: Okay.

MEMBER KRESS: Does the EIS deal with transportation issues?

MR. PERSINKO: Yes, it does.

I just want to point out the last bullet: "Determine principal structure, systems, and components versus the term 'items relied on for safety.'" Sometimes we forget ourselves and we use those terms interchangeably. So if we do, bear with us.

The term "principal structure, systems, and components," also referred to as PSSCs, is a term that's applicable to construction. It's in the regulation that applies to the construction of the facility. The term "items relied on for safety," often called IRFS, is a term that will be used at the license application, the operational phase, possession and use phase.

It just has to do with the terms in the regulation. The two are very similar in nature. PSSCs for this project primarily have been proposed at a systems level. The IRFSs are expected to be, assuming a favorable authorization, the IRFSs are expected to be at more of a component level.

MEMBER APOSTOLAKIS: So the PSSCs are what we would call safety-related SSCs in reactors? Is it the same thing?

MR. PERSINKO: It's similar, yes, I think so. It's similar. We don't use the term "safety-

related," but I think it has a similar --

MEMBER APOSTOLAKIS: Yes, that's why I'm asking.

MR. PERSINKO: Design bases, I want to just emphasize once again that that's what we're looking at, per the regulations. The definition we have used is the definition that's in 50.2.

MEMBER APOSTOLAKIS: So this exists now? I don't understand. You say --

MR. PERSINKO: What's that?

MEMBER APOSTOLAKIS: -- "information which identifies the specific functions to be performed."

MR. PERSINKO: That's correct. That was what's in the construction authorization request.

MEMBER APOSTOLAKIS: Okay.

MR. PERSINKO: That's what we are reviewing right now.

The next phase: This is the heart, I would say, of 10 CFR Part 70. I think you've had discussions with other people from NRC about Part 70 and the performance requirements. It's not a risk-based approach; it's a risk-informed approach, whereby in the accident scenarios you have consequences on one axes and likelihoods on the other.

This is in the revised Part 70. It

applies --

MEMBER WALLIS: This jargon about "highly unlikely" means absolutely nothing to me.

MEMBER APOSTOLAKIS: Is there any quantitative guidance as to what is unlikely?

MR. PERSINKO: It's not in the regulations. It's in the Standard Review Plan.

MEMBER APOSTOLAKIS: Then there is guidance?

MEMBER WALLIS: Do you mean modest theft and things like that or something?

MR. PERSINKO: Correct.

MEMBER WALLIS: So there is a quantification? What is it?

MR. PERSINKO: In the Standard Review Plan, though, but not in the regulation.

MEMBER APOSTOLAKIS: So what is it? What is an unlikely event?

MR. PERSINKO: "Highly unlikely" is on the order of about 10 to the minus fifth, unlike --

MEMBER APOSTOLAKIS: Per year? Per year?

MR. PERSINKO: Per year.

MEMBER APOSTOLAKIS: Yes?

MR. PERSINKO: Per accident scenario, though. It's not a cumulative risk analysis.

And "unlikely" is in the order of 10 to the minus third to 10 to the minus fifth.

MEMBER WALLIS: So "not unlikely" is quite likely to occur during the life of the plant or something?

MR. PERSINKO: Yes. Yes. The applicant has proposed non-quantitative definitions that it intends to use for these terms, and that's in the construction authorization request as well, but in the Standard Review Plan there are some suggested quantitative numbers.

MEMBER APOSTOLAKIS: The "high consequences public dose" is greater than 25 rem.

MR. PERSINKO: Correct.

MEMBER APOSTOLAKIS: Now does it say anywhere that this is from a particular sequence or cumulative?

MR. PERSINKO: No, it's a particular sequence.

MEMBER POWERS: It's sequence by sequence. We have been over this many times. This is the ISA approach.

MEMBER APOSTOLAKIS: The what?

MEMBER POWERS: This is the ISA approach.

MEMBER WALLIS: And you have workers and

public, and then you have people who are not workers who are treated as workers.

MR. PERSINKO: That's correct. You have workers. In this particular facility we could spend a whole couple of hours on it, if you would like.

MEMBER WALLIS: No, we don't want you to do that.

MR. PERSINKO: But just to let you know that there is -- because this facility is an island and within a DOE site, there are facility workers, which are the workers that work right at the MOX facility; there are site workers, which work at the Savannah River site, and there are the public, which are the people offsite.

I will just point out very quickly, and we can get into it, but it's rather complicated. But there are also, per the definition of a worker in Part 20, you could have a worker who is, our definition of worker who is on the Savannah River site. It's a person who does not experience a radiological -- a worker is a person who does experience a radiological dose in the course of his or her normal course of duties.

So, for example, according to NRC's interpretation, which is in Part 20, if you're a

cafeteria worker on the DOE site, you're considered a member of the public for Part 20 purposes. For Part 70 purposes, however, there is a provision in Part 70 that deals specifically with the performance requirements, that if you meet certain provisions, certain training requirements, certain notifications about the risk of the facility, that person can be treated as a worker for the purposes of the performance requirements.

MEMBER KRESS: Is there an equivalent table of this for other types of consequences other than radioactive, such as heavy-metal poisoning or plutonium exposure, that's --

MR. PERSINKO: No, these are the -- well, there are doses. There are also requirements in the -- there's dose requirements. There's also requirements in the Part 70 regulations dealing with chemicals, but we have to be careful with that because we have very carefully in Part 70 -- for example, we don't regulate chemicals for the sake of regulating chemicals. We only regulate them according to the regulation which talks about licensed materials and hazardous chemicals derived from licensed materials, and if a chemical release can affect the safety of the plant in some other way.

MEMBER KRESS: I see.

MEMBER APOSTOLAKIS: So there has been analysis like this for the proposed facility? How many sequences that lead to high consequence have been identified?

MR. PERSINKO: I don't know the exact number.

MEMBER KRESS: It's a small number, though. It's like three or four.

MR. PERSINKO: I don't remember.

MEMBER KRESS: So, you know, when you add up these --

MEMBER APOSTOLAKIS: When you add them up, you don't get --

MEMBER KRESS: You don't get a lot. It's not like --

MEMBER POWERS: We'll discuss that over the course of the presentation. There's a specific item on the estimated risk to the public.

MR. PERSINKO: I just want to explain also that the performance requirements, when you read the regulation, talk about IRFS and meeting the performance requirements. So it strictly applies to the operational phase, but the applicant has adopted this approach in order to identify the PSSCs as well,

which is I think a good idea because it gives you some guidance. Otherwise, there's no guidance in the regulation as to what is a PSSC.

Okay, I would like to talk about schedule a bit. We have a little history here. Also, we received an Environmental Report back in 2000, December of 2000. We received the construction authorization request, the first one, in February of '01.

Staff issued its first draft Safety Evaluation Report for construction in April of '02, at which point, slightly before we issued that SER, the applicant -- there was a program redirection whereby the immobilization part of the project was cancelled and a large part of the material that was destined to be immobilized will be going to the MOX facility. So that required some upfront modifications to the policy part of the process.

So, based on that, the Environmental Report and the Construction Authorization Report were revised. That's why you see there was a revised ER sent in in July of '02, a revised Construction Authorization Report in October of '02, to accommodate the material that was formerly meant to be immobilized.

The staff has issued a draft EIS for public comment in February of this year. It was out for public comment. We received the public comments. The public comment period is closed and we are in the process of finalizing -- of addressing those comments.

Staff also issued a revised draft SER for construction in April of this year, which is the subject of today's meeting. We also intend to issue a final EIS and a final SER in September of '03. We intend to issue an EIS Record of Decision and a Construction Licensing Decision in October of '03.

That concludes my presentation.

MEMBER POWERS: Any questions on the overview?

(No response.)

If not, I will ask Gary Kaplan to give us the applicant's perspective on the general facility and mission and layout and the discussion of their safety philosophy, both with respect to prevention and mitigation.

Gary, I'm dying to know: What is this, Hastings doesn't like us anymore? We have offended him?

MR. KAPLAN: I think he's in Bermuda this week.

MEMBER POWERS: What?

MR. KAPLAN: I think he's in Bermuda this week.

MEMBER POWERS: Bermuda? From now on, we're going to visit him directly. If he's not going to show up here, we're going to go where he is.

(Laughter.)

MR. KAPLAN: Good morning. My name is Gary Kaplan. I'm the ISA lead for the MOX Project.

If we go to the next slide, as you know, the mission of the MOX facility is to transform plutonium so it's unusable.

If we go to the next slide, we briefly talk about the facility layout. The key features on this slide are the actual MOX processing area. It's the largest building in the center. It's the BMP. You'll find the label there.

The aqueous polishing building is adjacent right to it, contiguous building. It's the BAP to the lower left.

Another major feature right here is the Emergency Diesel Generator Building, over here in the lower right corner. Notice the stack is right over here, and it's approximately 100 meters to the edge of our fenceline over here, and it's approximately five

miles to the site boundary of the Savannah River site. So those are some of the key features of the layout.

MEMBER POWERS: Could you point out on this slide where waste is accumulated and then transferred back to this thing we were seeing?

MR. KAPLAN: Let's see, well --

MEMBER POWERS: It's mainly chemical waste.

MR. KAPLAN: Right. It's just briefly stored in the -- let's see, which building here? I believe in the AP Building there's a storage area, and then it would be shipped by or transferred by pipe to this event oversight facilities. I'm not sure which direction. I believe it will be stored in the Aqueous Polishing Building.

MEMBER POWERS: Right.

MR. KAPLAN: Okay, the next couple of slides, we have those. You can go to the next slide. I'm going to give an overview of the process of what we are doing for the CAR, what we've done for the CAR, and what we're doing for the license application, as well as the final slide I'll talk a little bit about our terminology and try to clear up some of the discussion with defense in-depth.

The ISA that we are performing is an

integral part of the design process. It's an iterative process with design. As the design evolves, the ISA, we perform more sophisticated and detailed analysis as necessary.

Initially, in the CAR, based on the site description and the preliminary design, we identify hazards and events associated with the NF design and operations. We considered natural phenomena that are relevant to the Savannah River site. We considered external, man-made hazards from nearby facilities, nearby railways or roadways or airports.

From that, for some of the natural phenomena and the external, man-made hazards, we did initial screening evaluations to determine if they were credible. For instance, we screened out avalanches, tsunamis, things like that, based on where the site is, very low-likelihood events.

The one man-made hazard that we did an evaluation of was aircraft crashing into the facility, and delayed probability event from accidents.

MEMBER APOSTOLAKIS: Now the aircraft is non-intentional?

MR. KAPLAN: Non-intentional, correct.

MEMBER POWERS: That's correct.

MEMBER WALLIS: The seismic is a little

problematic.

MR. KAPLAN: Which one?

MEMBER WALLIS: You've got this one event, seismic --

MR. KAPLAN: Right.

MEMBER WALLIS: -- one event every 500 years, more or less.

MR. KAPLAN: And certainly we considered seismic. That wasn't screened out, right.

Based on the potential unmitigated consequences of these events, we identified a safety strategy, and from that we identified the principal SSCs required to either mitigate or prevent these events.

As Drew's little matrix showed, you can either attempt to mitigate the consequences or you can prevent the consequences. Either way, you can satisfy the criteria 10 CFR 70.61.

Once we identified the principal SSCs, we then identified specific design-basis.

MEMBER POWERS: Gary, I think that comment that you can either prevent or you can mitigate is a little too stark. You still have a requirement of defense in-depth in this facility.

MR. KAPLAN: That's correct, right.

MEMBER POWERS: So I wouldn't portray it as it's one or the other.

MR. KAPLAN: Right.

MEMBER POWERS: You end up having to do both.

MR. KAPLAN: We do both, and we'll talk about that in the last slide. What we credit, in principal SSCs we normally do one or the other. There was the box in the middle that kind of allowed you to do part of both, either reduce the likelihood somewhat and reduce the consequence. The range is so small in there that we didn't use that box anywhere. We either made the event highly unlikely or we reduced the consequences down very low.

MEMBER POWERS: Well, it seems to me that I would not just --

MR. KAPLAN: Couch it that way? Right.

MEMBER POWERS: And I just comment or harken back to your approach on Red Oil, where you're saying, okay, I'm going to keep the temperatures low --

MR. KAPLAN: Right.

MEMBER POWERS: -- but I'm also going to clean the solvent.

MR. KAPLAN: Sure.

MEMBER POWERS: I mean, you can't rely on one thing to keep everything low.

MR. KAPLAN: That's correct.

The design basis that we have described in the CAR included the safety function values, where appropriate, and commitments to codes and standards that we're going to design the facility to.

One example of this would be we identified, as you said, earthquake as a natural phenomena hazard. In an event scenario we would come up with the building could fall and disperse plutonium. So we come up with a strategy: Design the building to withstand the earthquake, and we describe that.

We identify the appropriate magnitude earthquake that we're going to design to, and we've provided all the structural code and standards in the CAR that we're designing to, as well as methodology.

MEMBER APOSTOLAKIS: What is that earthquake? Do you know?

MR. KAPLAN: I think it's a .2 g earthquake.

MEMBER APOSTOLAKIS: Point two?

MR. KAPLAN: Right. It's anchored with a different --

MEMBER APOSTOLAKIS: Is it another -- oh, yes, that's --

MR. KAPLAN: Right.

MEMBER KRESS: You choose that by sound frequency?

MR. KAPLAN: That's correct.

MEMBER KRESS: Driven by New Madrid?

MR. KAPLAN: Not the seismic. Does anybody in my crowd know what that is driven by?

MEMBER POWERS: It's driven by Charleston, and there's another fault zone just north of the Savannah River site. It also changes your frequencies, but it's consistent with the design of facilities on the Savannah River site.

MR. KAPLAN: Right, and there is a discussion letter today on seismic --

MEMBER POWERS: Right.

MR. KAPLAN: -- that I think will cover some more detail on that.

Okay, if you go to the next slide, continuation of the process: As the design evolves, we do more detailed analysis, and major steps are: We identified detailed event scenarios that identify specific IRFSs and also we challenged those IRFSs to determine if they can withstand all the different

events.

The main type of analysis we're doing are process hazards analysis. We're doing haz ops, "what if's," fault tree analysis, where appropriate, to challenge and identify IRFSs.

The next major step is we demonstrate that the IRFSs are effective through supporting calculations. The majority of these calculations are standard design calculations. An example would be, following up on the earthquake example is they're doing design calculations to demonstrate that the building will withstand a .2 g earthquake, and that certainly supports the ISA.

We also do, as necessary, failure loads analysis on the specific IRFSs to ensure that they can withstand the challenges. A good example that we've already talked a lot about is the HEPA filters. We've identified HEPA filters as a major, as a principal SSC, and we have done failure modes analysis to determine, will soot, temperature, other factors, how they can impact the HEPA filters, and then we do evaluations to demonstrate that we can handle the soot, the temperature, things like that.

The next major piece is we demonstrate the event likelihood satisfies the performance criteria of

10 CFR 70.61. What we have committed to at this point is compliance with the single-failure criterion, worked out a contingency for criticality events.

We're going to identify means to detect failures of IRFSs. We've committed to specific codes and standards, and we've committed to the 10 CFR 50 applicable Appendix B QA program.

I think that covers it. That gives you a high-level overview of our ISA process from the beginning all the way through the license application.

MEMBER POWERS: I think it's important for people to understand that the ISA, in summary, comes in the second step for this.

MR. KAPLAN: That's correct. That's correct.

MEMBER APOSTOLAKIS: The second step? Which step is that?

MEMBER POWERS: At this point we're still working with the design basis.

MR. KAPLAN: That's correct. The second, with the license application, we will summarize all these calculations that demonstrate the IRFSs can perform their job.

MEMBER APOSTOLAKIS: Now this likelihood that you estimate, is that a point value?

MR. KAPLAN: No, on an event-sequence basis we're going to demonstrate that we meet single-failure criteria.

MEMBER APOSTOLAKIS: But it says, "likelihood."

MR. KAPLAN: Well, this is how we're meeting the likelihood criteria.

MEMBER APOSTOLAKIS: I see. You don't have an explicit, quantitative measure of the likelihood?

MR. KAPLAN: That's correct. As part of the license submittal, we will not have, that's correct.

MEMBER APOSTOLAKIS: And single failure includes passive failures --

MR. KAPLAN: Sure.

MEMBER APOSTOLAKIS: -- and everything?

MR. KAPLAN: That's correct.

MEMBER APOSTOLAKIS: But a system?

MR. KAPLAN: Well, we do have an event-sequence basis. So for all these hundreds of events that we've identified, we will show that we meet single-failure criteria.

MEMBER APOSTOLAKIS: I don't understand what that means, the "sequence." I mean, I can

understand, if you give me a system, that there would be no single failure failing the system.

MR. KAPLAN: Right.

MEMBER APOSTOLAKIS: But if you give sequences, you mean that there would be no sequences with one event in them? Is that what you mean?

MR. KAPLAN: There would be no sequences where we don't meet the single-failure criteria applying the IRFS. It's a little different than reactors because a lot of our events, you know, we have distributed material at risk throughout the facility as opposed to a reactor. So there's lots of isolated events that don't really depend on an entire system. It might depend on more isolated features.

MEMBER APOSTOLAKIS: That's fine, but how does one apply the single-failure criterion to a sequence? I mean, that's where I don't --

MR. KAPLAN: Well, I happen to have my probability expert with us. Maybe he can help. Mark?

MEMBER APOSTOLAKIS: You have to come to the microphone and tell us who you are.

MR. KLOSKY: Mark Klosky, DCS.

I think what we're trying to illustrate here is that we identify event sequences, and in so doing, identify the requisite features that we've

identified as at this stage principal SSCs, but later to become IRFSs. What we're saying is that no single failure to the system, the system being the IRFS, will result in the event sequence occurring.

MEMBER APOSTOLAKIS: So you're going back to the system then?

MR. KLOSKY: Yes.

MEMBER APOSTOLAKIS: You're not applying --

MR. KLOSKY: The system, correct, yes.

MEMBER APOSTOLAKIS: Which means, though, there would be no event sequence with just one event? Right?

MR. KLOSKY: Yes.

MEMBER APOSTOLAKIS: Okay.

MR. KLOSKY: That's correct.

MR. KAPLAN: Okay, we'll go to the next slide. This slide illustrates the defense-in-depth philosophy and it attempts to clarify some of the associated terminology.

If you assume in the middle we have the hazard and/or the event, our first layer of defense from these hazards and events are what we call additional protection features. These reduce the challenges to the IRFSs by either preventing or

mitigating the event before it would impact or require the IRFSs to take action.

These are protection features normally associated with normal operations such as trained operators, normal operations alarms. More specific ones might be the nitrogen blanket that we have in the glove boxes, the hand-held fire extinguishers, things that we don't credit in the safety analysis as principal SSCs or IRFSs. They're certainly in the facility and provide additional protection.

MEMBER WALLIS: This is a very interesting, sort of qualitative cartoon, but what really matters is the degree of total protection, and the fact that you have three stages doesn't assure a certain degree of protection necessarily.

MR. KAPLAN: That's correct. This is just trying to illustrate there were some terminology questions --

MEMBER WALLIS: It's not qualitative if it's a cartoon.

MR. KAPLAN: Right.

MEMBER WALLIS: But this is some measure of total protection achieved by this process?

MR. KAPLAN: To meet the 10 CFR 70.61 requirements, all we're crediting are the principal

SSCs or IRFSs, and that satisfies that portion. We believe the rest of this satisfies the requirements of 10 CFR 70.64, the defense-in-depth requirements. We don't have a qualitative --

MEMBER WALLIS: So there's no measure of defense in-depth?

MR. KAPLAN: That's correct. We don't have a quantitative target at this point, that's correct.

MEMBER WALLIS: So there's no indication that having three steps is better than two or anything except as a qualitative thing?

MR. KAPLAN: Right, that's correct. And this wouldn't really indicate that we have three. There might be 10 layers in there, that's right.

MEMBER WALLIS: It doesn't help you to decide whether to have three or four if you don't have any missions.

MR. KAPLAN: The next layer of defense are the actual principal SSCs and IRFSs. Those are the features that we credit to satisfy 70.61.

Note that we've committed to the single-failure criteria. So this is where, just in this layer alone, we have redundancy and/or diversity at this point, just in this one layer.

The next layer are what we call --

MEMBER POWERS: You specifically said, "redundancy and/or diversity" there. Talk to me a little bit about your philosophy on when you select between redundancy, mere redundancy, and when you go with diversity.

MR. KAPLAN: These facilities are based on no extra line design. I believe in most cases we have redundancy.

MEMBER POWERS: Yes, I think you're basically going with a redundancy design.

MR. KAPLAN: That's correct. There are some cases -- I'm trying to think of some specific examples where there's diversity in what's used. I don't have any off the top of my head. I don't know --

MEMBER POWERS: But if we look at the principal safety features that you have, for instance, take emergency power, basically, a redundant system. That's a highly redundant system.

MR. KAPLAN: That's correct.

MEMBER POWERS: What, four different electrical power sources coming into the facility?

MR. KAPLAN: There's the standard power. There's the standby diesels. There's the emergency

power, and we have batteries also, if necessary.

MEMBER POWERS: Yes.

MR. KAPLAN: Right.

MEMBER POWERS: And if we look at HEPA filtration, basically, a redundant system.

MR. KAPLAN: The part that's credited is basically redundant, that's correct, but there's multiple players of HEPA filtration also outside of that redundancy.

MEMBER POWERS: That also seems to be another critical design feature that Drew mentioned. You have adopted a zonal kind of construction to this facility?

MR. KAPLAN: That's correct.

MEMBER POWERS: And so you have essentially four nested zones with pressure differentials between each of them?

MR. KAPLAN: Between, yes, the glove boxes and the public, right.

MEMBER POWERS: So those are the essential design bases that we're looking at in this stage on this. It basically is a redundant system, basically, a classic zonal kind of strategy?

MR. KAPLAN: That's correct. Well, in the glove box is where the plutonium is. There's one

ventilation system that's surrounded by another ventilation system in the room, surrounded by the building ventilation system. That's correct.

That's one of the examples of a defense-in-depth feature. Those are features that we don't credit in the safety analysis, but they are IRFSs for some other event, where we have decided to upgrade them to IRFSs for an additional protection.

An example is the building ventilation system. It's not credited to satisfy any of the requirements of the 70.61, but we have that feature there. So that provides another layer of defense.

MEMBER KRESS: When you identify something as an IRFS, does then put the requirements on testing, inspection --

MR. KAPLAN: Oh, sure.

MEMBER KRESS: -- and quality assurance?

MR. KAPLAN: That's correct.

MEMBER KRESS: And things of that nature?

MR. KAPLAN: We apply the whole QA program to it, that's correct, as well as additional management measures that we've specified.

Then, to finalize the terminology, all of these combined would be our defense-in-depth philosophy. So we've kind of used two sets of defense

in-depth, one for specific features as well as the entire license.

MEMBER POWERS: Let me ask you this question: We've discussed prevention and mitigation features, but in the end, when you have an event, you have to put the facility into a safe configuration, and that's a problem because there's material in the system; you can't get the material out of the system, and it has to be there.

What is the safe configuration for your facility?

MR. KAPLAN: The safe configuration is what we've committed to in keeping the glove box ventilation system basically running. That's the safe configuration.

On the AP side, for short durations we can shut the processes down and be in a stable configuration.

MEMBER POWERS: It seems to me you move the fluid to tanks in the AP system.

MR. KAPLAN: That's correct.

MEMBER POWERS: You shut the furnaces down. You maintain the ventilation. That's your safe configuration?

MR. KAPLAN: That's correct.

MEMBER POWERS: At that point you can continue with that situation essentially indefinitely?

MR. KAPLAN: That's correct, for long periods of time. That's right.

So the major system that has to keep running is the ventilation system. That's similar to what reactor systems would be like. It's completely independent and separate.

MEMBER POWERS: And that's essentially you're providing them complete ability?

MR. KAPLAN: That's right.

MEMBER POWERS: Yes, that's right. I think it's important to understand that in the design basis here.

MR. KAPLAN: That's right.

MEMBER POWERS: That there is a safe configuration; there is prevention; there is mitigation in this facility. Okay.

MR. KAPLAN: Okay.

MEMBER POWERS: It is only when you come to the construction phase of the application that we get any real estimation of the residual risk that this facility poses?

MR. KAPLAN: Excuse me.

MEMBER POWERS: It is only at the end, in

the construction phase, that we get what this Committee would recognize as the completed ISA, which is some indication of the risk this facility poses to the public? You get the results of the ISA?

MR. KAPLAN: You get the results of the ISA. I mean, you have some indication now.

MEMBER POWERS: Oh, yes, right. Yes, we have some indication, but the formal results of the ISA really appear as part of the construction.

MR. KAPLAN: As part of the ISA, you were saying?

MEMBER POWERS: Yes, that's right.

MR. KAPLAN: That's correct.

MEMBER POWERS: Okay, good. Thank you.

MR. KAPLAN: Okay, thank you.

MEMBER POWERS: We move now to some of the major technical issues associated with this. Drew, are you going to walk us through and introduce your various speakers here?

MR. PERSINKO: Yes. Okay. For criticality safety, it's going to be Christopher Tripp. Following that, we will have fire safety, Rex Wescott. Red-Oil discussion will be Alex Murray, and then the next one will be Rex Wescott also. Seismic is going to be John Stamatakos.

MEMBER WALLIS: Is someone taking about explosions in fires and such?

MR. PERSINKO: Yes, fire safety, Rex Wescott will talk about, and explosives we'll cover also.

MR. TRIPP: I'm going to talk a little bit about the criticality safety review for the MOX Fuel Fabrication Facility. First, I'm going to go through the design bases a little bit and then discuss the open issue that we still have.

These are the 10 design bases for the facility that are described in Chapter 6 of the CAR. They mostly consist of programmatic design criteria that we have reviewed at the CAR stage. They give us confidence, hopefully, that the design, if we see a design, it will be found generally acceptable.

We found favorable, made favorable conclusions, with the exception of the second one on this list that I'll discuss in some more detail in a minute.

MEMBER WALLIS: Now the second one, I was curious; we know nothing about this coming in. It seems to me this magic number of .95 would seem to me rather strange. I mean, what really matters is the probability of getting a k-effective of one. There's

nothing magical about .95?

MR. TRIPP: Right, that's true. As long as the true k-effective of the system is less than --

MEMBER WALLIS: Point nine-five plus or minus a sigma of, you know, .05 or something is probably unacceptable.

MEMBER POWERS: I'll remind you that we're working on design bases here.

MEMBER WALLIS: Oh, this is a "funny world" word?

MEMBER POWERS: No, no, we're working on design bases.

MEMBER WALLIS: Well, okay, we're in the regulatory world then.

MEMBER POWERS: We're working on design bases, which you use as the basis for your design.

MEMBER WALLIS: Yes. Well, why is this the basis? The real basis should be, what's the probability of getting a k-effective that's unacceptable?

MR. TRIPP: Well, yes, and I think what we have used was a setting a conservative margin that gives us some confidence that we don't exceed a k-effective of one in the real world.

MEMBER WALLIS: If it is really

conservative, yes, and maybe you'll get into that.

MR. TRIPP: Yes.

MEMBER WALLIS: So coming in and not knowing the history of this kind of stuff, it seemed to me strange you just focused on the maximum k-effective, because it isn't by itself a hazard of any kind.

MR. TRIPP: Right.

MEMBER WALLIS: It isn't a reassurance of any kind really, either.

MR. TRIPP: Well, what we're doing is we're setting some limit in k-effective that gives us assurance that's it's sub-critical really. The only distinction we really need to make is between sub-critical and --

MEMBER WALLIS: Well, you're going to talk about an uncertainty in that then, yes. Okay, we'll go ahead, please.

MR. TRIPP: Yes, that includes the uncertainty.

I'm not going to belabor each of these. Several of these come out of the regulations. The first one comes from the baseline design criteria in 70.64.

The second one is really a design basis;

we consider it a design basis because this has to be known prior to doing the design calculations to set the sub-critical limits. You need to know what the acceptance criterion is before you can complete the design.

The third comes from 70.61(d), and it deals with a margin of sub-criticality and requirement to identify the abnormal conditions in the facility. Criticality accident alarm systems are required by 70.24(a), unless specific exemption is requested and granted.

In terms of management measures, that really applies to how the QA plan will be applied to criticality safety-related IRFSs. Since we haven't identified specific components relied on for safety, this is more a description of the safety grades and how they apply to criticality controls, rather than specific management measures applied to specific controls.

Our technical practices include commitments to ANSI/ANS-8 Series standards for criticality as well as technical requirements on, how do you perform criticality calculations, what type of controls are -- what type of requirements apply to different controls, and so forth?

The final one is basically because of the inherent conflict between a desire to use water-based suppression for fire protection and the desire to exclude water for criticality purposes.

So if we can go to the next slide, we identified that one of the design bases is identification of the dominant control parameters for the major process areas, and that's really defined at a high level at this point. For instance, we would be talking about controlling mass and geometry for a particular system. It is more at a systems level than at a component level.

So we were specifically asked to address the waste processing at the MOX facility. The first thing is, of course, repeating what Drew said, the waste is going to be stored at the MOX facility and it's going to be processed under DOE jurisdiction.

So for criticality purposes, the main concern is prevention of getting significant quantities of fissionable material into the waste streams that can then be transferred to unfavorable geometry. The control strategy has been identified as consisting of these items: dual controls and concentration of mass, so that there's at least two barriers prior to getting fissionable material into

the waste streams.

Here's the double contingency. Rather than identify the specific controls, identify the specific type of controls that will be used, active controls may consist of things like in-line monitors. Passive controls would be items such as siphon breaks, overflows, and so forth. Dual independent sampling is also frequently used.

We have bought off that we think this is a reasonable approach.

MEMBER WALLIS: What is this waste like? Is it a liquid or slurry, or what is it? Is it a mixture of things? It's piped to DOE. So, presumably, it's a slurry or something?

MR. TRIPP: Yes, it would be in a liquid form.

MEMBER WALLIS: It's all dissolved?

MR. TRIPP: Yes. Well, the waste, for instance, the waste from the aqueous polishing would be, it should be very low-concentration liquids. So the idea is to get the concentration of plutonium to --

MEMBER WALLIS: There's no solids that can settle out?

MR. MURRAY: If I could just interrupt, my

name is Alex Murray. I'm one of the Chem. Safety Reviewers for the NRC.

For the waste materials at the proposed facility, they should be clear solutions without solids.

MEMBER WALLIS: Thank you.

MR. MURRAY: Okay.

MEMBER POWERS: Well, to be fair, one of the major concerns you have is that you will, in fact, get plutonium in solution over there and have a precipitation of plutonium hydroxide coming out because you've failed to control the pH of the system properly. But, basically, you're working with clear liquids here. I mean, you hope you're working with clear --

MEMBER WALLIS: So there's going to be some assurance that you can keep the liquid clear?

MR. TRIPP: Right. That's what these designs are attempting to do. There are filters, and so forth, on the system as well.

So this is consistent with what we see in the usual nuclear industry at other facilities, and it's also the same type of approach they've adopted for things like ventilation and reagent recovery systems. So, really, at the design basis level,

that's pretty much the extent of what we reviewed at this point.

MEMBER FORD: It's pretty well exactly the same process as used at La Hague, materials, controls, for this particular part of it, correct?

MR. TRIPP: Yes, the same general approach.

MEMBER FORD: And there's been no problems at La Hague, materials problems?

MR. TRIPP: Materials problems --

MEMBER FORD: Materials of construction problems? I don't know the answer to it. I'm asking you. Have there been problems of materials of construction degradation at La Hague?

MR. TRIPP: I'm not sure how that relates to the criticality safety of the waste.

MEMBER FORD: Well, it doesn't, not specific to that, but we're just talking about the waste of liquid, clear liquid, and trying to get rid of it. This is not, presumably, water.

MR. TRIPP: It's not water, but it's a combination of things that basically has extremely low levels of fissionable materials, so very low amounts of plutonium.

So what happens after that is, from my

point of view, is not really a concern. Maybe the chemical reviewer could talk more to that.

MEMBER FORD: Okay.

MR. PERSINKO: I would just like to point out, though, that we did not do a rigorous review of the La Hague plant. I mean we visited the site. We talked with the engineers over there, as well as the regulators. So we are familiar with much of the plant, but we didn't do a rigorous review of the La Hague facility.

MEMBER POWERS: I think what it is safe to say is that over the last 40 years we have accumulated an enormous amount of experience working with these particular solutions and liquids and a variety of different materials and what-not. It's probably safe to say that, if the materials are kept within their planned concentrations, that there are no degradation modes, unanticipated degradation modes.

MEMBER FORD: That was the point of my question, Dana. All over the world you have had problems of degradation of materials of construction in waste facility plants, just gigantic chemical plants. I'm just pointing to La Hague because that seems the nearest equivalent of any problems.

MEMBER POWERS: You can point to the Purex

facility and places like that that have had longer lifetimes. What we know is we have become very expert in this because we have made every mistake possible, and sometimes more than once.

(Laughter.)

But, again, what you can't say now is, if you get outside your range that you have designed this material to, how fast does the material degrade, because I can always say, "Wait, we get farther and farther and farther," and, eventually, yes, you can corrode this material. But if you stay within the range that you expect, you're okay.

MR. KLOSKY: Mark Klosky, DCS. I just want to clarify a couple of things about the waste.

I think we mentioned the process, that we have the solvent-extraction process that is separating the impurities. In this case that's what we're taking about. Prior to going into the waste, we have monitoring plutonium concentrations. So, with respect to criticality, as Chris indicated, the plutonium concentration is low.

I understand your question to be, what are the material concerns? We're using the stainless steel construction, and with respect to safety, we have evaluated consequences and determined that the

radiological consequences and chemical consequences that could potentially arise due to leaks do not exceed the performance requirements of Part 70.

Further, the material is in an acidic medium; it's a nitric acid medium containing the material, which in this case if we're talking the weapons-grade plutonium, actually has limited quantities of impurities, not the same impurities that accompany the separated nuclear fuel from commercial facilities, which have the added damaging effect of the radiolysis, the radiation damage.

So our environment here is actually less corrosive than that of a commercial reprocessing facility, due to the non-inclusion of the fission parts.

MEMBER POWERS: First of all, I have to apologize to all the speakers. Dr. Ford asked me to include the materials degradation in the issues that I sent to you, and, of course, I promptly forgot to do it. So he's bound and determined to make me pay for this.

(Laughter.)

But there are interesting material issues here. I believe it is correct that the stainless steel naturally passivates in sufficiently-

concentrated nitric acid and becomes corrosive in sufficiently dilute nitric acid. In addition, there are chlorides and things like that that exacerbate the attack on materials.

MEMBER FORD: I guess my final question on this for the time being is: Are all these piping systems inspectable?

MEMBER POWERS: Inspectable? That's a good question.

MEMBER FORD: Are they above ground, below ground? Where are they?

MR. KLOSKY: I will say that one of the PSSCs identified by the applicant is a material surveillance, maintenance and surveillance program. So that is identified as a PSSC.

As far as your question about whether all the pipes are inspectable, I don't know, maybe the applicant could answer that, but I believe the pipes in the process cells are not inspectable.

MR. ST. LOUIS: I'm Tom St. Louis with DCS.

All of the piping and materials are accessible for inspection. We have many components that are in process cells that are normally closed and are not normally accessed, but there is a means to go

in for access.

All of these areas are monitored for leakage, and if there's leakage, there are procedures planned to shut down the plant and access the area to do repairs.

MEMBER FORD: But the waste stream that goes to DOE in the pipeline, above the ground or below, are they inspectable?

MR. ST. LOUIS: Yes.

MEMBER FORD: That's above ground?

MR. ST. LOUIS: No, it's a buried line, a double pipe.

MEMBER FORD: It's in a tunnel or something?

MR. ST. LOUIS: It's a double-pipe construction, and it is monitored for leakage. Now we actually have three waste streams that go to DOE. One is the high alpha, which is most of the chemical waste; a stripped uranium waste stream, and then we have a low-level waste stream that goes to a different treatment facility.

MEMBER FORD: Thank you.

MR. TRIPP: I'm now going to discuss a little bit about the one open issue here, which was identified NCS-4 in the draft SER. This relates to

the determination of the k-effective limits.

The codes that are used to calculate sub-critical limits have different amounts of bias and uncertainty for the different systems. So what DCS has done is they have defined five AOAs, or areas of applicability, to which all the plant processes can be divided.

The code has been validated in each of these areas separately and a different upper sub-critical limit determined. Again, this is to ensure, give you a certain amount of confidence that the process is sub-critical if you're below that limit.

Another portion of this is that, because the design applications are not exactly identical to the benchmarks, there may be other aspects of the bias that are not taken into account when you do the calculation of the benchmark. So some additional administrative margin is applied.

What we have accepted at other facilities is traditionally .05 for the abnormal condition case. In addition, we have had a lot of discussion about what should be the margin for the normal case. An approach that has been adopted at some facilities is that it's been allowed to be determined on a case-by-case basis because some systems are much more

sensitive to changes in the system parameters than others in terms of their effect on k-effective.

Because this depends on design, it really can't be determined prior to the design. So what we have said, agreed, is that the abnormal condition margin of .05 would be acceptable as part of the design basis, and then some normal margin would be determined as part of the design, depending on the sensitivity of the particular system.

So the methodology for doing that is something that we have not gotten a complete handle on as yet. So those are really the two aspects of determining the limits.

MEMBER APOSTOLAKIS: So it's essentially expert judgment? I mean, it's not -- is there any supporting calculation that considers possibilities and their likelihood of occurring? I mean, why .05 and not .1? How much does that bind?

MR. TRIPP: Well --

MEMBER APOSTOLAKIS: If I go to .04, am I in trouble?

MR. TRIPP: Yes, the value really has not ever had a historical technical basis. It's always been based largely on judgment, and this is throughout the designer history, not just at the MOX plant. It

applies to transportation as well. It's in the rule, Part 71.

MEMBER APOSTOLAKIS: And it's always .05?

MR. TRIPP: Well, no, there are some inconsistencies from one licensed facility to another.

MEMBER APOSTOLAKIS: Because it's judgment?

MR. TRIPP: That's part of the complexity of this.

MEMBER WALLIS: It seems to me in this era it ought to be risk-informed.

MR. TRIPP: Well, it ought to be risk-informed. Part of the problem --

MEMBER APOSTOLAKIS: Probability-informed.

MR. TRIPP: Part of our goal is to make it risk-informed by allowing it to depend on the system. In other words, if you have a system that's very sensitive to changes in k-effective, it should have more margin than a system that's relatively insensitive.

MEMBER APOSTOLAKIS: Yes.

MR. TRIPP: I think that's where the risk-informing comes in. That could be based on calculations, sensitivity-type calculations.

MEMBER WALLIS: Eventually, you have to

bring in the awful word "probability."

(Laughter.)

MEMBER POWERS: I guess I will inject that, historically, we had a couple of criticality events that killed some people, and people found that objectionable and they said, "What do we do about this?" From that, a fairly prescriptive regime was established. The most visible element of that regime is the double-contingency principle.

We have established what I would call a standards-based safety system with respect to criticality as opposed to a defense-in-depth or other kind of criticality. Quite frankly, that has served us very well.

So I would be reluctant to say, in the name of purity or religious fervor, let's risk-inform this prescription that's come down.

MEMBER WALLIS: I don't think that's the idea of any kind of purity. I think you know better what you're doing if you have some measure of the risk. Maybe it's work, but you may be lucky. You know better what you're doing if you have a measure of what you're achieving. I think it's a rational thing. It's not a question of purity.

But I don't want to get into a debate with

you about that. I would just sort of urge the staff gently in that direction.

MEMBER POWERS: Well, before you urge too much, remember, we're doing one MOX facility. I don't think we're planning a regime of MOX facilities. I don't think Drew could stand it.

(Laughter.)

MEMBER WALLIS: This isn't just for MOX. This is for anything. Whenever you're talking about safety, there ought to be some measure of how safe it is.

So let's just go on with it. Okay?

MR. TRIPP: One additional thing is that, for the second area of applicability, the MOX pellets, rods, and assemblies, that is equivalent to the low-enriched part of the plant. We're dealing with 6 percent material.

We've accepted already a margin of .05 for normal conditions for that. So that's how we're attempting to be --

MEMBER APOSTOLAKIS: So there is some sort of evaluation -- say, pick one of those, the plutonium nitrate solutions --

MR. TRIPP: Right.

MEMBER APOSTOLAKIS: -- of how k-effective

can approach one? Is there some assessment of how that can happen?

(Laughter.)

MR. TRIPP: Yes, that's all part of the evaluation process.

MEMBER APOSTOLAKIS: What does that include? And why is it an open issue, because they haven't done it or what?

MR. TRIPP: It's an open issue primarily because of the lack of benchmarks for plutonium in MOX systems. It makes it much more difficult to validate the codes than for other, for low-enriched or high-enriched fuel applications.

MEMBER APOSTOLAKIS: Would humans come into the picture anywhere here, some human error perhaps?

MR. TRIPP: Human error?

MEMBER APOSTOLAKIS: Well, I mean, is it possible? I don't know how they do it. Or is it all machines?

MR. TRIPP: Well, yes, there's humans as analysts. Analysts have to model the systems, and so forth. There's a lot of human judgment that comes into effect

MEMBER APOSTOLAKIS: But it cannot affect

k-effective?

MR. TRIPP: It can affect k-effective.

MEMBER WALLIS: That's why we model k greater one, right?

MR. KLOSKY: Mark Klosky, DCS.

Let me try to differentiate between the probability of moving the system from normal conditions to a limit, and at this point it's .95, for argument's sake. There's a certain sequence of events that have to occur for us to approach .95, and then, as Chris illustrated, there's a certain probability that .95 represents critical.

In benchmarking the code, what one does is take critical experiments, determine bias, determine uncertainty, but, as Chris has illustrated, there is an inherent uncertainty, or perhaps beyond which Chris can elaborate, that NRC feels a certain margin needs to be added. You could statistically account for the number of exponents using statistical measures, of course, but I guess the question of representative of the data to the application is where the NRC is, I think, coming from, but I'll let Chris speak to that.

MEMBER WALLIS: But if NRC feels it is a good enough margin, that is not a very defensible position.

MR. TRIPP: Well, it is a bit of a quandary. There never has been a lot of guidance or, frankly, consistency in approaching this issue.

MEMBER APOSTOLAKIS: Is there a place where I can go and understand this issue better? Is there a report that describes all this, how the calculations are done, and so on?

MEMBER POWERS: Oh, how the calculations are done?

MEMBER APOSTOLAKIS: Yes, and the kind of issues that are taken into account.

MEMBER POWERS: Well, I'm not 100 percent sure what you're asking here, but if you want to know how you calculate k-effective -- yes?

MEMBER APOSTOLAKIS: No, no, no, no.

MEMBER WALLIS: What's the process of evaluating --

MEMBER APOSTOLAKIS: The process of doing this.

MEMBER WALLIS: Right.

MEMBER APOSTOLAKIS: That's the question. I mean, there's must be somewhere where it is described.

MR. TRIPP: It is. Well, it's described in the -- first of all, it's described in the Standard

Review Plan somewhat. There are also a number of NUREG documents that have been prepared that discuss in-depth validation methodology, and we can provide you references to those.

MEMBER APOSTOLAKIS: Good.

MR. TRIPP: And the Validation Report, DCS has submitted a Validation Report that goes through this in great detail.

MEMBER APOSTOLAKIS: Well, maybe that will be the one.

MR. TRIPP: Okay.

MEMBER WALLIS: Is there any kind of inspection check that is some sort of an indication of what k-effective you're actually achieving?

MR. TRIPP: Not really. I mean, you don't know the true k-effective of the system. That's why you have to back off with a conservative margin. If it goes critical on you, you know you're over one.

(Laughter.)

MEMBER WALLIS: So that's a yes or no. It's a rather frightening test.

CHAIRMAN BONACA: Well, he explained the concern is that you may estimate it is at .95 and the reality becomes critical.

MEMBER WALLIS: It may actually be .98.

CHAIRMAN BONACA: Okay, so you want to have assurance of margin. The question that's being asked is, could you explain for one of these processes where the issue is? I mean, why are you concerned that the calculation you are making, in planning for that activity, may lead you to a one when you believe that you calculated .95?

MR. TRIPP: Well, each of these has a -- for each of these areas, there's a number of benchmarks that are analyzed. They calculate k-effective, experiments that have a k-effective very close to one. They calculate a spread in the k-effective values.

CHAIRMAN BONACA: Okay.

MR. TRIPP: So you apply a statistical methodology to determine sigma on that.

CHAIRMAN BONACA: Okay.

MR. TRIPP: And there's a confidence limit associated with it. So it's a statistical methodology you go through.

MEMBER APOSTOLAKIS: Well, that's what I want to read about.

MR. TRIPP: Okay, you can read about that. That's in the Validation Report --

MEMBER APOSTOLAKIS: Okay.

MR. TRIPP: -- which is separate from this CAR.

CHAIRMAN BONACA: Going a step further, the concern now is?

MR. TRIPP: Well, the basic concern now, we could look at the next slide. That really illustrates the four areas where we have remaining concerns.

CHAIRMAN BONACA: Okay.

MR. TRIPP: But they all revolve around the first one, essentially, and it's the lack of plutonium and MOX benchmarks with certain physical characteristics such as benchmark experiments that contain certain absorbers that are desired to be credited; for instance, borated concrete, cadmium, steel, and so forth. Also, benchmarks for certain neutron energies, certain plutonium isotopics, hydrogen-to-Pu ratio and that sort of thing. There are gaps in the data, and there are questions about which benchmarks are applicable in which range.

CHAIRMAN BONACA: And you're concerned that, without this validation of the computer code, the computer code may not give you the .05 margin?

MR. TRIPP: Right, right.

CHAIRMAN BONACA: Okay.

MR. TRIPP: Without the validation, you may calculate something as sub-critical when, in fact, it may be critical.

CHAIRMAN BONACA: Okay.

MR. TRIPP: So I've talked about the first one a little bit. The second one I'll talk about a little bit more is there is a new methodology that's been developed over the past several years by Oakridge National Laboratory, which is sensitivity uncertainty methodology.

MEMBER APOSTOLAKIS: So that's available, too?

MR. TRIPP: That is. Yes, there are NUREGs that you can read about that.

MEMBER APOSTOLAKIS: How many NUREGs? You keep saying, "NUREGs." You have a number of NUREGs for each item? Isn't there a single place where I can go and find out?

MR. TRIPP: There are a number of reports that are prepared that all deal with validation methodologies.

MEMBER APOSTOLAKIS: A number of them? If I read the latest, would that be okay?

MR. TRIPP: Well --

MEMBER APOSTOLAKIS: This seems like an

overwhelming amount of information. For every item, there's a number of NUREGs.

MR. TRIPP: Well, yes, it's a complex process. It's kind of difficult to get your hands around it. That's true.

MEMBER WALLIS: How do you train someone to do it?

MR. TRIPP: Experience, using the code --

MEMBER POWERS: I'm going to have to ask members to move right along. We've got more contentious issues ahead.

CHAIRMAN BONACA: I think the most important point right here for the Committee is to understand how far are you from resolving these open -- well, how far are they from resolving these open issues? You have a history here in the back of how you raised the issue; you received information and --

MR. TRIPP: Yes, why don't we turn to that --

CHAIRMAN BONACA: Okay.

MR. TRIPP: -- because you can ask any specific questions about those issues, but I'll move along here.

We received the latest revision of the Validation Report in January. We had received a

couple of prior revisions. It comes in three parts, and it's separate from the CAR. I think one of them is on the third revision now.

But we received the latest version in January. We had a meeting in March to discuss the major issues which appear on the previous slide, and we received the SCALE 5 code from Oakridge in May. That's been under development. It has not been released to the criticality community for general use. We're the only ones, outside of the developers, that have access to it at this point in time.

We are using it to do our independent, confirmatory calculations.

MEMBER RANSOM: Isn't that a DOE code?

MR. TRIPP: Yes. It's prepared by Oakridge under contract to NRC.

MEMBER RANSOM: Okay.

MR. TRIPP: And it was also used by Oakridge as part of supporting the DCS submittal for the part that deals with MOX and plutonium powders.

We issued an RAI. I should point out that we have only -- we had actually received an updated version of the Validation Report addressing these issues within the last week. So we're in the early stages of reviewing it.

They appear to redefine some of the ranges of parameters to much narrower ranges in some of the parameters, and it looks as though that may address some of our issues.

MEMBER WALLIS: Do they monitor how well-mixed the powders are? That must have a great effect on criticality?

MR. TRIPP: Yes.

MEMBER WALLIS: Are they monitoring it all the time of how well-mixed the powders are?

MR. TRIPP: Yes. Well, from the point where the powders, where the depleted uranium and plutonium powders are blended together, the homogeneity is very important.

MEMBER WALLIS: Yes.

MR. TRIPP: It has a big effect on criticality.

MEMBER WALLIS: It's monitored all the time? It is monitored?

MR. TRIPP: Yes, it will be monitored. The amounts of uranium and plutonium will be monitored that are going into the tank.

MEMBER WALLIS: And how well-mixed it is very important?

MR. TRIPP: Right. Right, it has to have

the right moisture content. They have a mechanical stirrer, and so forth. I believe it's also sampled to ensure that.

MEMBER RANSOM: Will Framatone be using French data or is there any French data on this process, criticality, I guess, data?

MR. TRIPP: Are you referring to benchmark experiments?

MEMBER RANSOM: Right. Well, benchmark codes, I guess.

MR. TRIPP: Well, they're actually using a different code than what the French used. They're using the SCALE code, which is an American code. The French use the Apollo code, which is the French code. So although they're doing the design, they're using different tools to do so; plus, we have different isotopics. So for the ranges the physical parameters are somewhat different.

So, in conclusion, we found the acceptability of all the design bases except for the k-effective limit. We knew very early on in the review -- in fact, before we even started working on the MOX -- that this would be probably the most challenging part for criticality safety, due to the scarcity of available benchmarks.

We are in the process of reviewing the Validation Report, the most recent one that was just submitted in July, and we are using this new code to resolve some of the open issues. Hopefully, we'll have it resolved by September.

MEMBER RANSOM: How is this related to -- at least from my experience, most criticality accidents have happened as a result of inventory control problems, you know, in different parts of the process.

MR. TRIPP: Right.

MEMBER RANSOM: And you want to prevent accumulation. So is this tied in with some kind of inventory control process?

MR. TRIPP: Yes. For instance, in the blending, you're measuring -- you have like a flow totalizer to measure the amounts of powder that are going into the blend tank, or in the glove boxes you have mass limits. So it requires you to track the amount of material.

Then in the ventilation, we're using this same philosophy we're using for the waste storage, where we have two barriers. So there could be a slow accumulation over time, and I would expect that to be monitored, but we haven't received detailed

information at this stage, at the CAR stage on that.

MEMBER POWERS: I would like to move on to the next topic, if we could.

MEMBER WALLIS: Well, things are going to heat up a bit.

MEMBER POWERS: Is this fire safety?

MEMBER WALLIS: Yes.

MR. WESCOTT: Hi. My name is Rex Wescott. I'm the ISA Reviewer, and I'll be talking about the MOX fire protection review.

Next slide. There was concern in the Subcommittee about the plant's design basis in regard to fire. 10 CFR 70 does not contain explicit requirements for facility fire protection analogous to what you might find in 10 CFR 50.48 or Appendix R. Instead, fire protection is implicitly addressed by the performance requirements.

The applicant must assure that 10 CFR 76 requirements are complied with under all credible fire scenarios. At the MOX facility, this compliance is assured through a combination of prevention, and I define "prevention" as no incipient fires. In some areas, prevention can be no emission sources, but I think overall no incipient fires is probably a good definition for prevention.

We define prevention in the AP process cells, where actually emission is prevented, and you find prevention in the inerted glove boxes, glove boxes that are inerted by nitrogen. So if you do have an ignition source, you won't have a fire.

Another means of fire protection and suppression and/or combustible loading controls -- and I put these together because what they do is they allow a fire, but they don't allow a fire that's going to lead to a release. And you find this --

MEMBER WALLIS: Another method of sort of prevention is this requirement to keep the temperature of liquids five degrees below the flash point? That would seem to me a pretty small margin.

MR. WESCOTT: I'm not sure about -- well, I mean keeping liquids below the flash point is certainly a means of fire protection because, after all, if you get to the flash point, you still need an ignition source to start a fire. I mean, just allowing the liquid to get above the flash point is not going to start a fire in itself.

MEMBER WALLIS: I just wondered. It just struck me that five degrees didn't seem to be much margin.

MR. KLOSKY: This is Mark Klosky, DCS.

We've had recent communications with NRC. We're amending that response. We're going to an LFL argument, and it's --

MEMBER WALLIS: A what argument?

MR. KLOSKY: Based on the percentage of the flammability limit.

MEMBER WALLIS: Flammability?

MR. KLOSKY: Yes. So we are going to amend that response. We're working with NRC. It's an open item.

MEMBER WALLIS: Thank you.

MR. WESCOTT: Yes, I think that's a chemistry open item, is probably one of the reasons I'm not terribly familiar with it.

We define suppression and combustible loading controls in the truck base, the secured warehouse. In the glove box area, you have clean agent suppression because they are moderator control areas, and you have, basically, combustible loading controls in the fuel rod and canister storage areas.

Now the third means of fire protection is fire barriers. What fire barriers do is confine the internal fire to one fire area, and where the fire can be tolerated, and you also protect against external fires using fire barriers.

Go to the next slide. The fire protection strategy for MOX does not incorporate a universal design basis fire, such as, say, a 1-kilowatt power fire for one hour or something analogous to that.

But we do have the fire protection strategy dose incorporate some quantitative values. For example, fire area boundaries are a minimum of a two-hour fire, as per ASTM E-119. Compartment air temperatures into the ventilation system are limited to 2,000 degrees Fahrenheit. That's at the intake, to protect the final HEPA filters. The dilution of the air brings it down to less than 400 degrees, which is the design basis for the filter at the final filters.

We have some material confinement barriers, like the various transport casks, which are actually as per DOE design. They do have a temperature and time limit on them. So the idea there is to make sure that the fire in a compartment affecting these particular transport casks is limited by controls or suppression to something less than that temperature --

MEMBER WALLIS: It's a strange number. It's 800 degrees C.

MR. WESCOTT: Yes, 800 degrees C is right.

(Laughter.)

That's right. I'm sorry, I stuck with English units here.

The next slide. The one remaining open item in fire protection is that the applicant has evaluated fire scenarios where temperatures could exceed the E-119 curve. What we're concerned here is the possibility that the very fast rise in temperature, primarily due to liquid hydrocarbon fires, could put a stress on the wall that's not really being taken into account with a standard fire test. What we need is a demonstration or an evaluation, an explanation, that the fire barriers can withstand the rapid fire development without compromising their integrity.

Next slide. Now I'm going to replace this slide with a slide I prepared last night from a response we got from the licensee that may better explain the problem. This is really more of a cartoon than an actual presentation of the problem.

MEMBER APOSTOLAKIS: I'm just curious, while they are getting ready: We had a presentation by the staff two or three years ago, when they were talking about their fire research program, and there were all sorts of limitations listed in the standard fire curve. Now we turn around and use it.

MR. WESCOTT: Okay, maybe I'll have to go back to the other slide.

(Laughter.)

But this is the licensee's response to us.

MEMBER APOSTOLAKIS: Okay.

MR. WESCOTT: This is the E-119 curve. This is a standard curve. These are the results of some of their fire modeling.

Now, with hydrocarbons, the type of curves they're getting there is not unexpected. In fact, that's always been a trouble with the E-119 curve when you're dealing in the petroleum industry, and the petroleum industry has really done a lot of research and has developed some new rating curves. In fact, I think they've developed a 1708, D-1708, curve, which is shown on the slide I just had taken off.

In fact, if we could go back to that slide now, it will show the problem. This is the E-119. This is the D-1708 that was developed I think primarily by the petroleum industry. What we're hoping is that, maybe by comparing the walls -- well, it's really up to DCS how they want to deal with this problem, but one possible solution may be to compare their walls with walls that meet this hydrocarbon curve and be able to show that, not only would the

wall withstand an E-119 curve fire, but would also withstand a hydrocarbon-type fire.

MEMBER APOSTOLAKIS: So remind me what the curve means to begin with.

MR. WESCOTT: Well, it's temperature versus time.

MEMBER APOSTOLAKIS: Yes, and what does that mean?

MR. WESCOTT: Well, what they do, how they run a fire test, is they have these furnaces, and this curve was developed, oh, probably in the 1920s or so from what they called "fire crib tests," where they set on fire cribs of wood that they think will approximate what you would find in a building, a house, and measure the temperatures.

Well, once this curve is established, then in your testing facility you have gas furnaces and you fire these, so that the temperatures are met as a time. You have a wall. Say you're testing a wall. You have a wall set up, and you have thermocouples on the other end of it, on the other side of it.

The criteria is normally 325 degrees Fahrenheit because that's often the point where paper or other ordinary combustibles will catch on fire.

MEMBER APOSTOLAKIS: Yes.

MR. WESCOTT: So to pass the rating, it's got to withstand, you know, it's got to stay below 325 on the other side, and then just to make sure, they hit it with a fire hose after it's all fueled. That kind of shows that it has maintained its integrity.

MEMBER APOSTOLAKIS: What are the units in time? I can't read it.

MR. WESCOTT: Oh, those should be hours. Well, let me see, I don't know whether it's --

MEMBER APOSTOLAKIS: It's longer than hours.

MR. WESCOTT: No, in minutes, I guess. Minutes, minutes, those are minutes. Let me see if I have --

MEMBER APOSTOLAKIS: So I have a fire on one side for 20 minutes at a certain temperature, then if I follow this curve, I'm guaranteed that the other side of the wall will be 300 degrees or something?

MR. WESCOTT: That's right, or less. That's the whole intent.

And that concludes my presentation.

MEMBER POWERS: We have had, in our discussions, one other issue having to do with the suppression system being used in some of the compartments, where they were using this --

MR. WESCOTT: Intergen? Right.

MEMBER POWERS: -- Intergen gases. The question was one really of rediffusation, and what-not.

MR. WESCOTT: Right.

MEMBER POWERS: Have you looked at that at all?

MR. WESCOTT: Well, we had the Intergen people in and we were talking to them. I think Intergen works very good on normal diffusion flames like you get from hydrocarbons or a lot of combustibles burning. They didn't completely address what it would do to a smoldering-type fire, which I think is what you're concerned about.

In my opinion, and I don't know how Sharon is going to deal with this, but I think before we really determine whether Intergen is proper or not, we have to know exactly what kind of combustible we're talking about in the compartment. Intergen is still probably going to be useful for knocking down the initial fire. I mean, it may be very possible to knock down the fire with Intergen and then go in there manually and use other agents.

That gets into the pre-fire planning that is normally taken in a licensing stage. So I don't

think it's a serious problem. Personally, I think Intergen would probably work to knock down a hydrocarbon fire --

MEMBER POWERS: No question.

MR. WESCOTT: -- you know, quickly, provided you take out all the delays and aborts and that kind of thing that you normally find with the gassing systems, but that can be done.

So there are solutions, but, yes, as far as the inability to put out a smoldering, deep-seated fire, we haven't resolved that yet with a gaseous agent.

MEMBER POWERS: Okay.

MEMBER WALLIS: I'm sure we need to move on. Did you resolve the soot, the soot in the filters?

MR. WESCOTT: Yes, that's been resolved.

MEMBER WALLIS: Okay, thank you.

MR. WESCOTT: Is that it?

MEMBER POWERS: Steve, you didn't have any other additional comments?

MEMBER ROSEN: No. I was going to ask about the soot question as well.

MEMBER POWERS: Okay. We'll move now to one of my favorite topics, Red Oil.

MR. MURRAY: Okay, thank you very much. Good morning. My name is Alex Murray. My colleague is Bill Troskoski. We have been working with other members of the NRC staff reviewing chemical safety and related issues. The one I'm going to talk about this morning is Tributyl-Phosphate-Nitric Acid reactions, often referred to as "Red Oil".

Next slide, please. On this slide I just summarize a very quick description of what a Red Oil is. It is a chemical reaction between Tributyl-Phosphate and organic materials and Nitric Acid and nitrate materials.

MEMBER APOSTOLAKIS: So the reaction itself is the oil, Red Oil?

MR. MURRAY: Well, "Red Oil" as a term is just, if you will, a nickname that was given to some events, and in some experimental testing to try to replicate the phenomena a reddish color has been observed.

MEMBER APOSTOLAKIS: But when you say, "Red-Oil," you refer to the reaction?

MR. MURRAY: Yes.

MR. TROSKOSKI: Yes, it's a Red-Oil reaction --

MR. MURRAY: Yes.

MR. TROSKOSKI: -- similar to many others in the chemical processing industry.

MR. MURRAY: Yes, yes. It is a chemical reaction.

One of the things about the reaction is, like many chemical reactions, it can generate heat, thermal energy, and non-condensable gases, which can pressurize vessels and containers.

As with many chemical reactions, its rate depends on a number of factors: the chemical species which are present, the concentrations, and temperatures and pressures, and so forth. Impurities can exacerbate the phenomena. Primarily, metal irons tend to work in a way like a catalyst.

MEMBER POWERS: I have seen some speculate that, in fact, you have to have radiolysis or a radiolytic decomposition products, in fact, to have that.

MR. MURRAY: The phenomena has been duplicated in tests without radioactive materials, but definitely a radiolysis does exacerbate the phenomena, yes. Yes, no doubt about it.

MEMBER POWERS: And in this particular system, we don't have the kind of radiolysis you have in fuel recovery systems?

MR. MURRAY: One does not have the gamma-type radiolysis and fission product, but one can have the intense alpha radiolysis.

MR. TROSKOSKI: Which is why the applicant has done a controlled residence time and exposure --

MR. MURRAY: Right, right.

MR. TROSKOSKI: -- to limit that damage.

MR. MURRAY: Yes, that was a proposed control for the applicant on radiolysis.

The key concern about the Red-Oil phenomena is it can be potentially explosive and cause damage to system components.

The next slide, please. This is just a little summary of the background of why we are concerned about Red Oil. There have been four reported accidents with equipment damage and release of materials within a facility and/or on site. There has been one accident where there has been a significant offsite release, and that was in 1994 at Tomsk, in the former Soviet Union.

If you look at the historical record of the reports of incidents where operators have noticed pressure fluctuations or have heard odd sounds coming from equipment, the conclusion has been that has been a Red-Oil event that started but did not propagate

through to an explosion.

Now the applicant, DCS, has recognized the Red-Oil phenomena as an explosion event or potential explosion event, and they have proposed a prevention strategy to protect the facility worker, the site worker at the DOE site, the public, and the environment.

MEMBER WALLIS: Can I ask you, is there a science for predicting these things? Is this chemical kinetics and all that kind of stuff?

MR. MURRAY: There is some science to it. There is a lot of empirical test data which is available as well. There are operating guidelines, if you will, controls which are used by the Department of Energy in their facilities.

MEMBER WALLIS: So a lot of it is empirical?

MR. MURRAY: Yes.

MEMBER WALLIS: Yes?

MEMBER POWERS: We should interject here that in one of our Subcommittee meetings the licensee brought forward its chemical staff who are undertaking what I would say is one of the more mechanistic assaults on the issue. I think that's more of a longer-term effort than it is going to resolve this

particular design bases.

There have been episodic attempts to try to develop an acute mechanistic approach. Quite frankly, the presentation that was made by the applicant was one of the better ones I had seen in this effort, but you can't hope -- I think we would be foolish to hope for mechanistic understanding of this mysterious issue in the near-term.

MEMBER RANSOM: Is this a reaction between miscible or immiscible components? Is it like a solid-liquid phase reaction or liquid-liquid?

MR. MURRAY: Liquid-liquid-based reaction.

MEMBER RANSOM: So they are miscible in phases, basically? Maybe?

MR. MURRAY: There's some cross-solubility, but most of the reaction appears to occur in the organic phase.

MR. TROSKOSKI: And, again, there are a lot of intermediates that would be in the gaseous phase.

MR. MURRAY: Yes. One of the things to remember about the Red-Oil phenomena is it includes a lot of intermediates of different types of species. Their formation rates and their relative quantities depend very heavily on the specific environment at the

time.

MR. TROSKOSKI: You have TBPs, butyls --

MR. MURRAY: Yes.

MR. TROSKOSKI: -- and a whole host of other characters that interact in different parallel paths.

MR. MURRAY: Yes.

MEMBER RANSOM: Is the gas phase a product of the reaction or does it participate in the reaction?

MR. MURRAY: Yes.

MR. TROSKOSKI: Yes to both really.

MR. MURRAY: Exactly, exactly.

MR. TROSKOSKI: That's why it's so complicated.

MR. MURRAY: Yes. At the gas phase, reactions can actually exacerbate the consequence of the phenomenon.

MR. TROSKOSKI: Some of the experiments they have done, for example, if you have adequate venting and you're pulling off the intermediates, you will only get just maybe 10 or 15 percent of the theoretical amount of heat generated because the reaction doesn't go to completion because of the contribution of the volatiles that are being pulled

off. That's why when we get to venting it's so important. It actually lowers the available energy of the reaction because it can't all go to completion.

MR. MURRAY: May I have the next slide, please? Okay, on this slide we have summarized the applicant's approach. The applicant has proposed three PSSCs, principal structure, systems, and components, with five safety functions to address and prevent the phenomena. The applicant has also made a distinction about open versus closed systems, which I will discuss a little more in a moment.

The PSSCs, the offgas system, the process safety control subsystem, and the chemical safety control system, which is an admin. control. I have listed the safety functions there.

Next slide, please. On this slide I have just put forth the definitions of open and closed systems that the applicant is using. For an open system, it is capable of fully venting the runaway reaction, if you will, the Red-Oil reactions themselves which generate these intermediates and flammable gases, and this is heavily based upon experimental results conducted for the Savannah River site. The safety factor is approximately 2.5 over the minimum required. It also assumes the presence of 100

percent of organics in any of the vessels, which would be categorized as open systems.

Closed systems, however, are defined a little differently. Rather than being based on their capabilities of venting, they are based on their abilities to mass-transfer material out, so that you have evaporative cooling of the system. Evaporative cooling means you stay, remain at the nitric acid water azeotrope temperature, or you do not exceed it, which is approximately 120 degrees Centigrade.

Now in a closed system the vessel can have significant fractions of organic materials. The applicant just mentioned tens of a percent, but the vessel itself cannot be 100 percent full of organic material.

They have proposed a safety factor, based on essentially a heat balance, if you will, of 1.2 times the energy input into the system from external heatings, such as via steam heating, plus the energy generated internally by the Red-Oil reaction.

MEMBER WALLIS: This is a safety factor on the energy balance --

MR. MURRAY: Yes.

MEMBER WALLIS: -- to keep it cool?

MR. MURRAY: Yes, yes. And a key

distinction between a closed system as compared to an open system is that, if a Red-Oil reaction starts initiating in a closed system, the system itself is not capable of fully venting the runaway reaction. So it could pressurize.

MEMBER WALLIS: So runaway reaction is different from just maintaining an energy balance? It's like whether a fire initiates or not? So it's the rate of change of energy production with temperature and things like that?

MR. MURRAY: That's correct.

MEMBER WALLIS: You have to analyze that whole thing?

MR. MURRAY: Yes. The chemical reactions do increase their rates exponentially with temperature. Usually, we use an Arrhenius type of relationship, yes.

The next slide, please.

MEMBER WALLIS: This looks like a no-no, this last bullet here.

MR. MURRAY: I'm sorry?

MEMBER WALLIS: This is a real no-no. I mean, you're supposed to be able to vent a runaway reaction, aren't you?

MR. MURRAY: That is the distinction

between an open and closed system. With a closed system, the concept is that you have sufficient evaporative cooling and mass-transfer of reactants out.

MEMBER WALLIS: You stay away from the runaway reactions?

MR. MURRAY: That is correct.

MEMBER WALLIS: If you did get it, it would blow up the vessel?

MR. MURRAY: If the venting becomes inadequate, you could overpressurize the vessel, yes.

MEMBER ROSEN: Would you actually overpressurize the vessel or are there relief features?

MR. MURRAY: At this time we're looking at this from more of a systems approach. At the ISA or operating licensing stage, we would look at specific components. It is likely there would be some form of relief devices.

MEMBER WALLIS: So you're working on that?

MR. MURRAY: Yes.

MR. TROSKOSKI: If you recall, they still have committed to do a haz op as part of the ISA, and for unit operations that's where you really get your -- you nail down the safety of the system ops at that

stage. That's when they will determine whether or not they actually have to go back and change some of the PSSCs; that's recognized in the regs.

MEMBER ROSEN: Well, that's a complicated, convoluted answer to a simple question. The question is: Would you put on relief devices if you predicted that under certain circumstances the system could pressurize?

MR. TROSKOSKI: That would be one pathway you could take. Another pathway would be cooling of some sort.

MR. KLOSKY: This is Mark Klosky, DCS.

To address your question, our alternative is to put additional features, IRFS, to further reduce the frequency of that runaway reaction to the point that we meet the performance requirements. So I think the NRC had alluded to our safety strategy as one based on prevention of the runaway reaction, both in the case where we have an open system and also even in the event that the system is closed. Or I should say it the other way around.

But the principal SSCs that we have proposed act towards preventing a reaction from the point at which it would overpressurize the system. So we have redundant temperature systems to shut the

system and basically never get to the point that the runaway reaction is such that it accelerates.

In addition, we have a means to provide the cooling, such that we don't exceed the boiling point of the solution, and that is via the evaporative cooling. So in either case, we have multiple features to preclude the runaway reaction.

MEMBER ROSEN: I guess you're one of those people who doesn't believe in defense in-depth.

MR. KLOSKY: No, I think we do. I think our defense-in-depth feature, in fact, is -- we have credited our filtration system as providing defense in-depth in fact.

MEMBER ROSEN: Filtration?

MR. KLOSKY: Our HEPA filters. So even if the event does occur, the radioactivity will be confined.

MEMBER ROSEN: In other words, it will explode the vessel? The vessel explodes --

MR. KLOSKY: Correct.

MEMBER ROSEN: -- and into the cell?

MR. KLOSKY: Into the cell.

MEMBER ROSEN: And probably ignites a fire, and then the HEPA filters ultimately control the release?

MR. KLOSKY: That's correct.

MEMBER POWERS: I have to admit that, in thinking about this issue, what you have outlined there is a fairly classic approach to defense in-depth; that is, you've established one barrier. If that fails, you have yet another independent barrier.

In thinking about it, I thought microscopically in terms of temperature control and purity control on the Tributyl-Phosphate as defense-in-depth measures.

MEMBER ROSEN: So what is this extraordinary, even heroic, approach rather than preventing explosion in the first place, preventing pressurization by simply having a relief device? I mean, what is it about rupture disks or something like that that is an anathema to you, to the applicant, and, presumably, to staff's acceptance of it? I mean rupture disks are used all the time in the industry for prevention of explosion of vessels that are overpressurized.

MR. MURRAY: If I can continue -- well, I think the applicant is going to address your question.

MR. KLOSKY: Yes. There are two aspects to that. I think, as the NRC has discussed, some of the intermediates are volatile, butane, for example.

So one might be able to accommodate the overpressurization, but previous events have, in essence, released quantities of butane. They didn't overpressurize the system but they had subsequent explosions.

So the fact of the matter is you lead to basically put the multiple layers of protection to preclude the event, and then, in fact, if the event occurs, to have the means to filter any radiological release.

So, in other words, simply making a vent, you know, three inches larger doesn't get you out of the woods in all cases. We have very combustible gases that are released as well that we have to account for in any highly unlikely case where we do have a runaway reaction. So that's our approach to defense in-depth.

MEMBER ROSEN: Okay. You're saying that, if you release the contents of this vessel that's running away, it would explode anyway?

MR. MURRAY: I'm not quite sure what you mean by "release the contents," but if I can --

MEMBER ROSEN: The vessel is pressurizing.

MR. MURRAY: Yes.

MEMBER ROSEN: You insist on -- there's no

sort of rupture disk or relief valve because what I understand from this response is that, under those circumstances, if you did vent that vessel, the products that came through the vent, when they hit, presumably, the environment in the cell would explode anyway?

MR. MURRAY: It depends on many factors. It depends on the rates of generation, the back-pressure that exists before the relief or the device actuates, and so forth. It's a complex phenomenon.

MR. TROSKOSKI: It's the rate of reaction that you're worried about because you're always going to have that reaction going, a certain amount of it, at the lower temperatures and concentrations and pressures. But one of the things they found is that, if you have a back-pressure on it, you've got a controlled reaction going; you're removing the heat that's being generated, but if somehow you were to back-pressure it up to even two atmospheres, you would concentrate the gaseous face and increase the kinetics such that you would not take off and go to a runaway condition.

So to say venting to prevent overpressurization, that will not necessarily terminate the reaction once it starts if you've got a

critical back-pressure that's been built in there.

MEMBER ROSEN: So that's a much better answer to me. It is that the rate of reaction is so high under certain circumstances --

MR. TROSKOSKI: Yes, and pressure, too --

MEMBER ROSEN: -- a rupture disk would not be able to sense it quickly enough to prevent the destruction of the vessel in any --

MR. TROSKOSKI: Exactly. That's why you've got to prevent it from going over the edge to begin with, yes.

MEMBER ROSEN: Now I have some sort of physical understanding of what you're dealing with.

CHAIRMAN BONACA: We've got a problem because we have right now four minutes left on the agenda and we have almost half the presentation in front of us.

MR. MURRAY: Actually, I'll go. The next slide, please.

MEMBER WALLIS: This will be resolved by September is really what we need to take away, is it?

MR. MURRAY: To help assist the staff in evaluating this, the staff has conducted a top-level fault tree analysis. I just have pulled two sections from the tree. This shows the split between open and

closed systems.

For open systems, the staff has concluded that the control strategy proposed by the applicant gives adequate assurance. However, for the closed system, the staff still has a lot of questions and currently has not made a conclusion of adequate assurance.

If I could have the next slide, please? As part of this top-level fault tree analysis, we did develop a tree through for the closed system, and what we found was that there are essentially three reaction schemes or areas or types of reactions which seem to occur and contribute significantly to the phenomena.

There's a lower-temperature route, which becomes very significant about 90 to 100 degrees Centigrade. There's a middle-temperature route, which becomes extremely significant somewhere around 130 degrees Centigrade, and then there's a high-temperature group of reactions, which starts becoming significant at about 150 degrees Centigrade.

The staff has found that for the middle group of reactions, which becomes significant at about 130 degrees Centigrade, in closed systems that we have concerns about adequacy of meeting the prevention strategy.

The next slide, please. On this last slide, I'm just summarizing the staff conclusions and concerns to date. With an open system, the staff has found that the approach appears capable of meeting the highly-unlikely likelihood if such a system is designed and proposed at the operating license stage.

However, the closed system approach the staff does not currently accept. We're still doing some evaluations, and we are having discussions with the applicant about this. We are concerned that, at least based upon our analyses and our understanding of the phenomena and a look at analogies which are available that deal with facilities, for example, that the likelihood of the closed system of limiting or preventing this event is not highly unlikely.

We are concerned about some differences between this closed system approach as compared to existing facilities such as at the DOE Savannah River site. We have noted that a lot of the concerns seem to come down to some limitation on the reaction rates, such as limiting the temperature, if you will, the solution temperature that could be in the vessels or in the evaporative.

Now, currently, the applicant is to provide additional information based upon some reviews

and contacts they are making for existing facilities which exist around the world.

And that concludes my presentation.

MEMBER POWERS: Any additional questions?

MR. MURRAY: Any questions?

MEMBER WALLIS: I know we want to move on. I just hope that, when we do resolve this issue, there is some information in there, so there's a place where we can find it, so that we can look at it, if we have questions about the runaway reaction, and so on. Actually, a document would --

MR. MURRAY: Yes, you are aware that the staff has two draft Safety Evaluation Reports, and those have --

MEMBER WALLIS: But not just words, but actually see some curves and analysis?

MR. MURRAY: Yes.

MEMBER WALLIS: Okay, thank you.

MR. MURRAY: Yes. You're welcome.

MEMBER POWERS: Drew, I suggest that we move immediately to your concluding remarks on the remaining open items.

MR. PERSINKO: One thing I do want to say is I think I heard one of the members say that this will be closed by September. I don't know if it will

be closed by September. It may; it may not.

All I can say is, as with all the open items, we are continuing a dialog with the applicant. In some cases I think the open items are closer to resolution than others, but I can't guarantee that they will be closed by September.

Okay, let's talk very briefly, then, about the remaining open items. Staff had a concern concerning titanium fires, the possibility of titanium fire igniting. Staff has adopted a prevention, has accepted a prevention strategy.

DCS proposes to use NFPA 70 regarding overcurrent protection ground faults in electrical system coordination. Staff is looking at that. Staff is discussing whether or not perhaps IEEE 242 would be a better standard for protective devices, and we are continuing to discuss that with the applicant.

The UO 2 burnback issue, MP-1, the issue here is that potentially UO 2 particles could be oxidizing and could travel through the ventilation system and potentially impact the HEPA filters. There are metal pre-filters. Staff is looking at the issue, but the issue that the staff is looking at is the metal pre-filters have a certain size -- I forget the number -- .05 microns below which it would not filter

out. The staff is looking at whether it thinks the size of the UO 2 particles could potentially go through the metal pre-filters.

I would like to point out, as with all these, we are discussing it with the applicant. I'll point out that in this case there was an NRC Information Notice 92-14 concern uranium oxide fires at fuel cycle facilities.

Hydroxylamine nitrate/hydrazine, the item is CS-2. This is another explosion event. The issue here is that HAN is used with nitric acid to strip plutonium from the solvent after the removal of the americium and gallium. Hydrazine is used to impede the reaction with the nitrous acid and, thus, increase the HAN availability.

This is another issue of the HAN is autocatalytic decomposition. There was an explosion that occurred at Hanford in the 1990s. As a result, DOE studied the phenomena. It developed what is known as an Instability Index to link the various parameters involved, such as chemical concentrations, molar ratio of nitric acid to HAN, temperature, concentration of metals, and pressure.

DCS has chosen not to use the Instability Index because they feel that it doesn't accurately

represent their system, the reason being that they don't think it adequately takes into account the influence of plutonium. Instead, DCS has proposed a model that they feel better reflects their system. It's a series, I think, of five partial differential equations that need to be solved.

So the staff is looking at that proposed model. The staff is using commercial software currently to test the DCS model. Staff has done some runs of the DCS model. In some cases we were able to replicate the results obtained by DCS.

However, in some cases we still have some questions that we need to pursue about the model. I don't think we fully understand it yet, and that's an issue that we need to further discuss with DCS and perhaps visit the DCS offices in Charlotte to get a better hands-on feel for that model.

Another issue is the -- and this is really four issues. It has to do with design bases for hydrogen flammable gases. It has to do with the lower flammability limit. The applicant has proposed using a design basis of 50 percent for its lower flammability limit. Staff thinks that 25 percent is a better number.

It really comes down to an interpretation

of NFPA codes, NFPA 801 and NFPA 69. Staff has interpreted it to mean certain things, and I think the applicant has looked at it and I think they're reaching different conclusions.

This is one where we haven't had the most recent discussion with the applicant yet. We need to meet with the applicant. They are going to document their conclusions, and then I think we will follow it up with a meeting with the applicant.

Emergency control room habitability, CS-10, this is a matter of, what would be the proper design bases for the emergency control room operators in order such that they would be aware of certain chemicals entering the control room and be don protective gear?

DCS has proposed TEEL-3. I probably should have talked about CS-5b first, but TEEL is a Temporary Emergency Exposure Limit. I will talk about that in a minute, but they have proposed TEEL-3s initially.

They have subsequently discussed -- staff has discussed the issue with the applicant. Staff thinks that an IDLH value is perhaps a better one, an Immediately Dangerous to Life and Health value. Where the IDLH values are not available, DCS will rely on

TEEL-2 values. I think that the applicant has -- I think we're very close to resolving this issue, based on what I understand the applicant will be proposing.

The last issue is CS-5b. This has to do with the TEELs, Temporary Emergency Exposure Limits. TEELs were developed by the Department of Energy's Subcommittee on Consequence Assessment and Protective Actions. It was not done as part of the MOX Project. The purpose was to serve as a temporary guidance until the American Industrial Hygiene Association publishes emergency response planning guideline concentrations for various chemicals.

There's various TEEL levels: TEEL-0, TEEL-1, TEEL-2, TEEL-3. They all have a qualitative effect associated with them, such as mild transient health effects or no irreversible serious health effects, et cetera.

There are two concerns the staff have with this. One is that TEELs are really not an NRC-developed item or term. They were developed by a committee of various DOE and DOE consultants from across the complex and elsewhere.

But it's not cast in stone. Once you say it, I mean it can be easily changed the next day, actually, too. So that was one concern the staff had

with TEELs. That could be overcome by committing to a value rather than a TEEL.

The other issue staff had concerns with was the actual values proposed by DCS staff, thought that these were, some of these were too high. So where we are on this one is the staff has taken this item. Staff recognizes that this issue is broader than the MOX project. It has implications across other fuel cycle facilities as well.

Staff has assigned this to a senior NRC technical individual not associated with the MOX project to look at this on a broader basis. It's our action at this point.

What I have here is my concluding slide: Where were we and where are we today? Back in April of '02, we issued our draft Safety Evaluation Report. We had approximately 56 open items. As you can see, through the discussions, they actually went up a little bit afterwards. The total went up, but at the same time some of them were being worked off. So you can see --

CHAIRMAN BONACA: But did they go up because there were new items or because you went back and --

MR. PERSINKO: I'm trying to recall now

why. They went up in the course of the discussion with the applicant in trying to resolve certain issues.

CHAIRMAN BONACA: Right.

MR. PERSINKO: But it's been level at 66 now since January of '03, and there's been a progression to resolving the issues. There are currently 12 open items, 10 of which are with DCS for DCS action and two are with NRC.

Like I said, we plan to continue to dialog with the applicant up to a point. We will continue to dialog as long as we can and then some, but there's going to be a point where we're going to have to say -- I mean we'll continue to dialog, but if we don't resolve it, we will be writing our Safety Evaluation Report, and we still intend to issue a Safety Evaluation Report in September right now, but it may include open items in the FSER right now.

MEMBER POWERS: What's driving putting out the Safety Evaluation Report in September?

MR. PERSINKO: It's a commitment we made from day one, from a very long time ago, and I think the staff feels an obligation to meet its schedule.

CHAIRMAN BONACA: Regarding issues such as the Red Oil, for example, are you looking for insights

on what took place in the licensing of the French facility?

MR. PERSINKO: We have contacted some of the French facilities. We're also looking for what's done at DOE. We're looking for that for insight, though. I mean we are not using the French facility to license this plant. We do look at information from the French, as well as what's done at DOE.

MEMBER POWERS: Any other questions to pose to Drew?

(No response.)

We have some challenges right now. My own intention is to proceed along on the same imperative that staff feels that they have. We have an imperative to report back to the Commission. So we'll be writing a letter to the Commission in association with this SER wherever it stands, and we'll do it for the September meeting.

CHAIRMAN BONACA: I would suggest that it would probably be when the SER is issued.

MEMBER POWERS: Yes.

CHAIRMAN BONACA: Keep it on the open items --

MEMBER POWERS: Yes, we'll have to write to the Commission at that point and intend to do so.

My feeling is that I'm still very optimistic. I'm naive and stupid. I say everything is going to get resolved or resolved enough.

(Laughter.)

But, regardless, we'll write at that point.

I think it is important to remember two things in thinking about this facility. One is it is governed by Part 70, which is governed by, contains a rather different approach, and it is not our intention in this letter to address the wisdom of that regulation or any revision to that regulation, but, rather, to speak to this facility as it stands relative to that regulation.

The other thing to bear in mind is, as I said earlier, we're doing one MOX facility. We don't have on the books 5, 10, 15 of these. That may happen in some future time, but not now. I'm not interested in charting a new approach to the regulations of these facilities and new approaches to criticality safety.

CHAIRMAN BONACA: Looking at the issue of the open/closed system for Red Oil, if I remember, the philosophy that you applied for explosions was, or the applicant applied, was that they would focus on prevention rather than mitigation. So you're looking

there for assuring that the event of an explosion is low enough that you would be comfortable with it, and they're pursuing the same path, but you're not convinced that the process right now allows you to reach that conclusion?

MR. PERSINKO: That's correct. We have the same goal: to prevent it with adequate margin. I think it's a matter of technical/professional judgments on when is enough enough and what are the right temperature values.

CHAIRMAN BONACA: Do you feel that it depends too much on administrative guidelines? That's another issue of --

MR. PERSINKO: Do you mean the Red Oil?

CHAIRMAN BONACA: Yes.

MR. PERSINKO: I'm going to defer that to the chemistry folks.

MR. MURRAY: We're still trying to complete analyses, if you will, a fault tree analyses on the closed systems. One of the concerns in a closed system is some of the admin.-type controls cannot respond in enough time.

CHAIRMAN BONACA: So it's an issue of defense in-depth in part, whether they rely on these controls?

MR. KLOSKY: Mark Klosky, DCS.

I want to just follow up on that point. I think you're correct in the statement that the preventative strategy pertains to both systems, open and closed. With respect to the administrative controls, our controls on the steam temperature are engineered controls and do not rely administrative features.

CHAIRMAN BONACA: Okay, thank you. That's good clarification.

MEMBER POWERS: Well, in addition, you have purity control/temperature control, and now we're discussing venting controls.

MR. KLOSKY: Right.

MEMBER POWERS: Now these are all pretty much design and operation issues.

CHAIRMAN BONACA: Right, yes.

MEMBER POWERS: Any additional comments, Drew?

MR. PERSINKO: No, I don't think so. I mean, I guess I like -- the regulation was written, it is a fairly recent regulation, within the last few years. The Commission, during the Part 70 regulation rulemaking proceeding, was very clear to the staff that a quantitative analysis was not required. So, I

mean, that's clear by the Commission. So we have this regulation which sort of has a quantitative, you might think a quantitative underpinning, but, yet, it does not require that there has to be quantitative analysis performed.

MEMBER POWERS: In addressing this issue, I'm not willing to take that -- advise the Commission on the wisdom or lack of wisdom of their decisions on that. We may want to do that but separately from this. I mean we want to stay within what the constraints are here. I mean that has always been the purpose.

Subsequently, we will be looking at the ISA on this at some point. One can imagine at some point we'll be looking at the ISA. Again, I'm not interested in taking on the issue of whether ISA or PRA is the appropriate thing in connection with the facility, but we may want to take that issue on and advise the Commission separately.

CHAIRMAN BONACA: Although, I mean, this is a facility which is quite different from a nuclear reactor. It's, in fact, a series of shells, of areas, and so on and so forth, and it even lends itself better to this approach than we would have on the normal reactor, I think.

MEMBER KRESS: Our sister Committee, ACNW, took that issue up and advised the Commission that the ISA is a good way to go at this time, but eventually they might want to think about going to full PRA, as best I remember their advice.

MEMBER POWERS: That's exactly right. I'm, again, not interested in taking that issue on. I think we work within the constraints of regulation in connection with this facility.

I simply comment that, by and large, the chemical industry has not gravitated toward the kind of PRA that we are looking at, and I have to believe that you have to give some credence to the fact that they have elected not to do that. I mean you have to understand you can't automatically assume that we should. This ISA approach looks attractive.

MR. PERSINKO: I think when you do a PRA is also a function of the hazard or the risk of the facility. That has to be taken into account, too.

I think, as was sort of alluded to earlier, I look at a reactor as a close-coupled system. What I mean by that is an event occurs and a whole series of events happen right after that. Automatically, a lot of things happen.

In a materials facility, it's more

distributed throughout the plant and things can happen at different points. It's not like you're trying to prevent one thing like, say, a core melt. So I think it's a different type of animal.

MEMBER ROSEN: Can I get away from the philosophy questions for a moment and just talk about closure of this open-versus-closed, this closed system discussion?

I continue to be mechanistically interested in how that's resolved. I presume that we will follow this as we go forward?

MEMBER POWERS: Count on it.

(Laughter.)

Thanks, Drew, and thank you, people from DCS. Your comments were valuable to us, and good luck on your work to resolve all these issues.

I'll turn it back to you, Mr. Chairman.

CHAIRMAN BONACA: Okay. With that, we will take a break now until five after 11:00.

(Whereupon, the foregoing matter went off the record at 10:50 a.m. and went back on the record at 11:07 a.m.)

CHAIRMAN BONACA: Let's get back to the meeting and the next item on the agenda is proposed criteria for treatment of individual requirements in

regulatory analysis, and Dr. Kress will take us through this presentation.

MEMBER KRESS: The title is a little bit cryptic. What this is about is when the staff has to do a regulatory analysis to see if some regulation can be put into place that causes the requirements to be put on a licensee.

The regulatory analysis calls for cost benefit and the analysis cost benefit criteria, and it is possible when you put together a rule that the rule could have several requirements in it. And now all the requirements may be fully necessary that the rule is meant to solve, and in fact some of the requirements may be just supportive of the whole rule. Now the question is for such a possibility that you may end up if you bundle all of these requirements together in one requirement the whole system may be able to pass the cost benefit criteria.

But one or more of these parts may by themselves fail a cost benefit if you just used it as a separate requirement. So the question is how do you deal with that situation, and how do you prevent just sticking in requirements in a bundled thing that overall meets the cost benefit.

But we may have some in there that should

not be in there. So the staff has developed a way to deal with this, and that is what this is all about.

CHAIRMAN BONACA: Well, the hydrogen rule was a catalyst behind --

MEMBER KRESS: Yeah, the hydrogen was, because there was several parts to it, like whether to keep the fans powered, as well as the igniters, and so that I think was the catalyst.

CHAIRMAN BONACA: So we may want to keep that in mind as we go to the presentation, and it will help us understand.

MEMBER KRESS: Right. Okay. With that, I will turn it over to whoever.

MR. RICHTER: Thanks, Dr. Kress. I am Brian Richter, in NRR, and as Dr. Kress mentioned, we are here to discuss bundling, what it is, the concerns that it has raised, what the staff has done in response to these concerns, what cementers have said about what has been done, what the Commission has done, and finally what the staff is proposing to do in the future on this.

The objective for us being here today is, and at your invitation, of course, and we are interested in getting your consent on the approach that we are proposing on the bundling issue.

Given that this guidance we are proposing is better than the existing guidance and addresses issues that have not been raised before, we are hoping that contained consent would allow us to get quicker use by the staff in the regulatory analyses.

However, if the staff is able to obtain comments to improve the approach, and if needed to obtain additional information, it could be inserted in a new revision that would be coming down the road to the Guidelines 0058, which would be Revision 5.

Right now, of course, Revision 3 is out there and what we are hoping to do is include some of these approaches in Revision 4.

MEMBER KRESS: What is this -- have you released this proposal to public comment?

MR. RICHTER: Yes, correct.

MR. SNODDERLY: Excuse me, Brian. Brian, this is Mike Snodderly. Is it true that -- and as stated in the Federal Register notice, that the public comment period ended July 2nd?

MR. RICHTER: That's correct.

MR. SNODDERLY: Okay. Could you also give the committee some idea of the number of comments you received and the schedule that you think it will take to resolve those?

MR. RICHTER: So far we have received one comment that, and that was from NEI, and I will go into that in the slides. Dr. Kress basically explained the issue that we are dealing with.

The background also was mentioned dealing with combustible gas control. There were three actions in correspondence, in SECY papers, and SRMs, that related to the bundling issue.

The combustible gas control 50-44 was one, and in the SRM that came down on that one the Commission agreed with the staff's recommendations, but they challenged the staff to establish a process solution.

MEMBER WALLIS: So we are dealing with a process here in this discussion?

MR. RICHTER: Well, in the regulatory analysis process. The second item of course was fitness for duty, and that was one another one that got -- that was controversial, and the industry came in expressing concerns.

The staff suggested that the OMB package be rescinded and the Commission agreed to that, and the SRM that the Commission came down with directed the staff to ensure that the individual rule changes are integral to the purpose of the rule, and cost

justified or qualified as back fit exceptions.

And then with SECY 01-0162. again with 50.44, and the SRM that came down on that, the Commission agreed with the staff's proposal and directed the staff to implement a disciplined, meaningful, and scrutable methodology for evaluating the value impact of any new requirements that could be added by a risk-informed alternative rule.

MEMBER KRESS: Let me ask you a question about that.

MR. RICHTER: Sure.

MEMBER KRESS: As I recall in the combustible gas problem that they did sort of a sensitivity uncertainly analysis, and it was more of a sensitivity, but they had -- when you took the high end of the sensitivities, and the low ends of the sensitivities, and did subtractions of the costs and benefits on those, that it was indeterminate, in the sense that you crossed over the line.

Now, how do you plan -- suppose that happens again in some other back fit. Have you got a way to deal with that issue now, or is that part of the guidelines that you are going to put together?

MR. RICHTER: I think basically the idea for the Reg analysis is always meant to be as a tool

for the decision makers at the Commission, and to provide them with that information I think is very helpful for them to have to decide which way they want to go with any given action then.

MEMBER KRESS: But when you have it in these places where it is hard to decide what to do because the ranges of the sensitivity are such that you really have on both sides of the thing is that there is no way to provide some guidance on what to do, or is that just left up to the judgment of the --

MR. RICHTER: Correct. I think you show the best estimate, but then you show what occurs with the ranges and it is up to the Commission then to decide. I mean, the staff might make a recommendation, but it is the Commission's final choice.

MR. GILLESPIE: Brian, Frank Gillespie. I am going to add a complication into the example, because I am the only one that raised my hand on 50.44, because it gets to some of the other proposals, and it was wasn't just stretching the limits if you will in the gray area.

There are also two completely different phenomenological questions which were discreetly separable. There was igniters which were generally

focused on early containment failure, and then there was recombiners which were focused on late containment failure.

And then mixed, because it was all the hydrogen rule that had a phenomenological cost overlap and used the cost overlap to try to justify the igniters, because if you didn't have the recombiners, you would save so much.

So I think the separability of the technical issue is also in question here. It is not just the cost part of it, and I think that is important I think for where Brian is going with this. Does that sound familiar?

MEMBER KRESS: Yes.

MR. GILLESPIE: I think we had that discussion. Do you remember that?

MEMBER KRESS: Yes, I remember it.

MEMBER LEITCH: Can you help me with the document that we are dealing with here, the regulatory analysis? Is that -- I have not heard that term. Is that a document?

MEMBER KRESS: Yes, it is a back-fit document. This guideline, this regulatory analysis guidelines, the NUREG, that is an extremely interesting report to read, and each one of us ought

to get a copy of it and read it.

It tells us how to do these back-fits, and it is very well done I think. It is well worth reading.

MEMBER LEITCH: And that is the document that
we are relying on here?

MEMBER KRESS: Yes. Well, it is the guidance that they are modifying.

MR. MIZU: This is Gary Mizu in the Office of the General Counsel. I just wanted to add a little bit to that. We have back-fitting guidance and we also have the regulatory analysis guidance, which is what we are talking about here.

And although there is an overlap, there are aspects of backfitting which are not covered by the regulatory analysis guidelines. And just to give you a little bit of history why these regulatory analysis guidelines exist, it is because early on in the Reagan administration the President issues an executive order directing Executive Agencies to do regulatory analyses.

And even though that executive order didn't bind an independent commission like the NRC, the Commission voluntarily agreed to do regulatory

analyses. And I think in the late 1990s, Congress passed a law which actually made regulatory analyses binding upon all components of the Federal Government, including the NRC.

So now we are required to do these regulatory analyses, and so our guidelines are intended to -- I mean, they are part of this continuing effort to allow agencies to analyze potential activities and determine whether they make sense.

I mean, that is what we are fundamentally trying to do here. These guidelines are to help an agency understand whether proposed actions, whether they be rule making or the issuance of orders, or whatever it may be, whether it makes sense. Are the benefits justified and are the costs justified.

MEMBER WALLIS: Well, I was going to say that I am glad that Frank spoke up, because we don't usually get involved with the regulatory process per se, but he says that it is an issue of separability of mechanical issues, and if the mechanical issues are tangled up, then there seems to be something that the ACRS should be concerned with.

MEMBER KRESS: Well, we used to. They are always dealing with some safety issue.

MEMBER WALLIS: Well, if it is just some kind of bureaucratic process, we don't usually get involved.

MEMBER KRESS: Yes, but we do get involved in regulatory analysis, because that is sort of --

MEMBER WALLIS: Because the technical issues have to be sort of weighed, in terms of economics, and reasonableness.

MEMBER KRESS: Well, when we get involved with any kind of rule making in there, and that is always associated with rule making.

MR. RICHTER: This slide goes over quickly the activities that the staff has undertaken so far basically for the formation of a working group. We had a preliminary policy published for comment and called for an open meeting. That meeting was held and we revised our approach based on comments received, and --

MEMBER WALLIS: Were these comments from industry?

MR. RICHTER: Correct.

MEMBER WALLIS: A typical public meeting in other words?

MR. RICHTER: Exactly, yes. You have been there? We went before the CRGR and received their

endorsement, and received approval from the Commission to go forward with it, and that was published.

It went out for public comment and it was mentioned in April, and we got one comment on the due date from -- or one letter from NEI on that date, and that is all that we are aware of having received so far.

These are the criteria as they were published on the most recent FRN on that. First, if an individual requirement is necessary, and that is needed in order to the objectives of the rule, and contain consistency with Commission policies, it does not need to be analyzed separately. In other words, you could bundle it.

MEMBER KRESS: And how do you decide on whether something is necessary or not? Do you have some criteria?

MR. RICHTER: We went over -- let me try to find the exact words.

(Pause.)

MR. RICHTER: The NRC maintains that if an individual requirement is integral to the purpose of the rule, then that fact alone is a sufficient basis for its conclusion. And in fact a decision on its inclusion or exclusion is not discretionary.

However, if the NRC finds that if a requirement is not deemed integral, it should be included if it is -- oops, I am going ahead into some else. But basically it is judgment based on whether it is integral and necessary, or whatever, and words that one feels more comfortable with.

I think that there is mostly agreement, except in the example that Frank brought up, and which was a technical difference really. But we hope spelling this out covers that issue.

MEMBER LEITCH: If I understand then to pursue Frank's hydrogen example, since the igniters and the recombiners deal with separate phenomena, at least phenomena that occur at different times, we are saying that they should be stand alone analysis to justify those?

MR. RICHTER: Correct.

MEMBER LEITCH: Okay.

CHAIRMAN BONACA: So in the case of the rule, if it had been shown that you needed monitoring of the hydrogen as a fundamental element of the rule, then you would not have to analyze its value separately?

MR. RICHTER: Right.

CHAIRMAN BONACA: And in the rule itself

we found that it wasn't justified. But that is really the criteria that you are using?

MR. RICHTER: Yes.

MEMBER WALLIS: So this second part here really is equivalent to saying that this individual requirement is cost beneficial per se within the context of the whole thing.

MEMBER KRESS: Yes, it has to be cost beneficial by itself is what they said.

MEMBER WALLIS: So this is a roundabout way of saying it, is that it adds cost benefit to the whole bundle.

MEMBER KRESS: Yes, but that is what it means, that it has to be cost beneficial by itself.

MEMBER WALLIS: All right. Now, more cost beneficial is simply in terms of plus and minus cost and benefit, and it is not a question of ratios or anything?

MEMBER KRESS: No. That was the debate that we had a long time ago, of whether using ratio or the difference, and they came down on using the difference.

MR. RICHTER: And hat is OMB guidance as well.

MEMBER KRESS: Yes.

MR. RICHTER: I mean, you can use the ratio of on a --

MEMBER KRESS: Yes, that is sort of additional information.

MR. RICHTER: Yes.

MEMBER KRESS: And then when we talk about cost benefit here, we are talking about the difference.

MEMBER WALLIS: That is clear?

MEMBER KRESS: It is pretty clear in the guidance.

MR. RICHTER: The next bullet on Slide Number 10, if an individual requirement is unrelated to the overall regulatory action, and it should be included only if it makes the bundle requirements more cost beneficial, and it passes the back-fit test, if applicable.

CHAIRMAN BONACA: By itself, or bundled?

MR. RICHTER: By itself.

CHAIRMAN BONACA: By itself. So you have to then --

MEMBER KRESS: Well, you have to almost analyze these things separately anyway.

CHAIRMAN BONACA: You're right.

MR. RICHTER: This aggregation is only

appropriate if it produces substantively different result alternatives with potentially meaningful implications on the cost benefit results.

And while this -- and while not directly, but it is sot of the same guidance that we are looking at in terms of uncertainty, and to point out to where the Commission or the decision makers, where this line might be where on one side it was cost beneficial and the other isn't.

If an individual requirement in a voluntary rule is justifiable under back-fit criteria, the NRC should consider imposing this as a mandatory back-fit.

MEMBER WALLIS: I am not quite sure about this produces substantially different alternatives. Does that mean that you get more possible tanical ways of resolving whatever the question is?

MR. RICHTER: I'm sorry, what --

MEMBER WALLIS: The second bullet, the substantially different alternatives, this aggregation per say doesn't produce does it? It allows them consideration.

MR. RICHTER: I think in terms of the analysis, the results.

MEMBER WALLIS: Then it permits. This

aggregation then permits alternatives. It does not by itself produce anything.

MR. RICHTER: Yes, I see your point. Yes.

MEMBER WALLIS: So it allows more flexibility.

MEMBER SHACK: What does this aggregation cover that isn't in the first three criteria? I mean, the first criteria covers all requirements that are necessary, and the next one covers those that are supportive, and the third one covers those that are unrelated. What am I going to disintegrate to a different scale than that?

MEMBER KRESS: Good question.

MEMBER WALLIS: Maybe it is a reaffirmation of the first three.

MR. RICHTER: I guess the emphasis there would be on --

MEMBER KRESS: On alternatives.

MR. RICHTER: Yes, substantively different alternatives.

MEMBER SHACK: Well, if something is absolutely necessary, then maybe it isn't dependent, but I just have a hard time seeing where I would use it, versus the first three. The first three I can understand.

MR. RICHTER: I don't remember way back when as to how this particular bullet was derived, but at least we are consistent.

MEMBER SHACK: Redundancy is a major NRC flaw.

MR. RICHTER: And lastly mandatory back-fit. As I mentioned, NEI were the only cementers that we are aware of so far, and it is has been a little over a week now. And their comments were similar or identical with the comments received on the preliminary proposal criteria, and those were the ones published before the public meeting.

NEI stated that they did not feel that their comments had been addressed in preparing the proposed criteria. Basically their concerns are that they feel that the criteria is necessary to evaluate the bundling of individual requirements into a single regulatory analysis.

And that the distinction on risk informed voluntarial alternatives should be cost justified and integral or necessary, and not cost justified or integral, which is what the staff had been proposing.

And in the second bullet, they claim there is a lack of scrutinable guidance by the NRC. And related to that is saying there is too much use for

objective judgment in making bundling decisions, and we are requesting another public meeting on the issue.

MEMBER KRESS: So you have not resolved these.

MR. RICHTER: We think we did, but not to their satisfaction.

MEMBER KRESS: I see.

CHAIRMAN BONACA: Could you go back a moment. On the first bullet or sub-bullet --

MR. RICHTER: Which is that? I'm sorry.

CHAIRMAN BONACA: Well, the one that says not cost justified or integral.

MR. RICHTER: Okay.

CHAIRMAN BONACA: I mean, I don't understand when integral would not be cost justified. I guess I don't understand. I thought the integral here in this context meant necessary.

MR. RICHTER: Yes.

CHAIRMAN BONACA: And by necessary, you have already provided the definition which said that it was cost beneficial. Oh, no, I see. I see. It says necessary, meaning that the objective of the rule, and it does not require a test of cost effectiveness.

MR. RICHTER: Correct.

MR. GILLESPIE: Let me give you an example, 50-69. The industry might say that if you separate out the need for a quality PRA that that in and of itself, that the cost of that is not justified necessarily if you separate it.

But the staff used a quality PRA as being integral to being able to meet the mission of the rule. Now, that is kind of an extreme example and it is not that we are fighting with --

MEMBER KRESS: That is a good one though.

MR. GILLESPIE: -- NEI on that, but that is the rule that is a cost beneficial alternative rule that is risk-informed, and the quality of PRA is a point that they are making. They are pushing too high for a high quality PRA. There is costs involved.

And it is not integral to the purpose, and we are saying that it is integral to the purpose of the rule. And that is where you get to the end of the order.

MEMBER WALLIS: I would be inclined to support you folks.

MR. RICHTER: Great.

MEMBER KRESS: And what do they mean by this lack scrutable guidance thing? It seemed pretty scrutable tome. What guidance were they talking

about?

MR. RICHTER: The proposed guidance in the Federal Register notice.

MEMBER KRESS: I see.

CHAIRMAN BONACA: But the cost benefit approach is still the same, and it has not changed.

MEMBER KRESS: Oh, no, that has not changed.

MR. RICHTER: And at some point it does involve the judgment and the staff's position is that if one tries to spell out every possibility as to when to do this or that --

MEMBER KRESS: If things come down clearly to cost benefits, you won't have a problem.

MR. RICHTER: That's right.

MEMBER KRESS: It is when you are getting close to the border of the criteria, and the uncertainties are pretty large, they become murky then, and that may be where the --

MR. RICHTER: But our position is that as long as that is spelled out in the analysis to give the decision maker the opportunity --

MEMBER KRESS: The decision makers know what they are dealing with if you tell them what that is.

MR. RICHTER: Correct.

MEMBER KRESS: Okay.

MR. RICHTER: So the working group -- unfortunately, most of the working group is on leave right now, but as soon as we come back, we will get together and try to resolve the comments. Then present what we have agreed with to management, and see if management agrees that another public meeting is worth it or not.

Hopefully then we can draft the revised guidelines input, and submit it to the Commission. The revision will also include additional information on the handling of uncertainties. Ashok Thadani wrote to Bill Travers on October 1st of 2002 on the, quote, revision to NRC's regulatory analysis guidelines in RES Office Letter 1, to conform to OMB's information quality guidelines.

In it, Research wanted to the Reg analysis guidance to more closely conform to the treatment of uncertainties as prescribed in OMB's information quality guidelines.

There was an attachment to that which contained Research's review and recommended revisions, which are consistent with the general discussion of COM SECY-02-0037, which was approved by the Commission

on July 31st, 2002.

MEMBER SHACK: What was that SECY?

MR. RICHTER: It was a COM SECY-02-0037, July 31st of 2002.

MEMBER KRESS: I am interpreting the fact that these are the only comments that you got back to mean that the industry in general is not too unhappy with.

MR. RICHTER: I would like to interpret it that way.

MEMBER KRESS: Usually when they are not too pleased, you get lots of comments from --

MR. GILLESPIE: Yes, I think you are right. I think that these comments reflect the ongoing discussion about quality PRA and risk informed alternatives, and the cost of doing a high quality complete PRA, versus the alternative.

And the other one is a residual one from the first example, which was the fitness for duty rule. The drug testing case and the quality of drug testing was separable from some of the other issues in it.

And they are still reeling from that, but I don't think you could set up guidelines that would identify, and other than highlight, you should look

for that.

And also this idea that you have got two different phenomenological effects on hydrogen control that we ended up looking at. Well, not that we are kind of consciously aware of it, I think that is probably the best that we can do, which means that I a not sure that another meeting is going to solve these questions.

MEMBER KRESS: It doesn't seem like another meeting would.

MR. GILLESPIE: I am leading a little bit there.

CHAIRMAN BONACA: The first bullet from NEI really refers only to the fifth criterion that you had provided. I mean, that is the one on voluntary alternatives.

MEMBER SHACK: No, I think it really goes to the second one.

MEMBER KRESS: Yes, it goes to the second one.

MEMBER SHACK: Where it is supportive.

MR. RICHTER: Yes, very much so.

CHAIRMAN BONACA: But it speaks of risk-informed voluntary initiatives.

MEMBER KRESS: I know that.

CHAIRMAN BONACA: And if you look at the fifth criterion, it requires a voluntary rule.

MEMBER SHACK: You see, they only want you to have an interval.

MR. GILLESPIE: Right.

CHAIRMAN BONACA: But I wonder if it is again applicable to the fifth criterion or the first one.

MEMBER KRESS: Or the second.

CHAIRMAN BONACA: Or the second.

MR. MIZU: The thing about that first sub-bullet, where they talk about risk-informed voluntary alternatives, judging from what NEI had previously argued in the 50-69 meetings, it is not so much that they are concerned about it being risk informed. They are concerned about it bering a voluntary alternative.

CHAIRMAN BONACA: Voluntary.

MR. MIZU: And the reason why is because the way that the Commission or the way that the staff has previously evaluated both from a back-fitting standpoint and from a regulatory analysis standpoint a voluntary alternative, is that you are not required to do it. You make your own judgment whether it makes sense to you from a technical and a cost beneficial

standpoint for you to implement this alternative.

And the industry is coming back and saying, well, look, you are going to waste a lot of time and you are going to waste our time, and no one is going to use an alternative that you develop if you in fact -- even if it was voluntary, presumably you are developing it because you think you want people to use it.

But no one is going to use it if it in fact contains non-cost justifiable provisions, which I think on its face seems reasonable, and I guess that part of the analysis that we are trying to do here would in fact take into account those kinds of considerations, but not necessarily in the way that the industry wants us to do the evaluation.

I mean, we understand that you develop an alternative which pulls this inordinate cost, and contains minimal benefits. No one is going to use it and the Commission's regulatory objective is not going to be achieved.

But if no one is going to use this 50-69, then what is the whole purpose of wasting 5 years and multi-million dollars worth of staff FTEs to develop this alternative.

And we understand that. The problem is

that I think they are fixed to ensure that we have a good cost beneficial alternative would probably not be a good approach of doing it, and we think that this is a better approach.

MEMBER KRESS: Well, when I look at that, I see, well, you are not going to have a voluntary alternative in your set of alternatives unless it is first all integral, and if this is all parts of an integral, because you have already said that you are not going to have a necessary integral.

You also are not going to have it in there as an alternative unless it is cost justified on the whole. So I don't understand -- I really don't understand their comment.

MR. RICHTER: Our response in the FRN reads that they NRC maintains that if an individual requirement is integral to the purpose of the rule, then that fact alone is a sufficient basis for its inclusion.

MEMBER KRESS: Yes.

MR. RICHTER: And in fact a decision on its inclusion or exclusion is not discretionary. However, the NRC finds that if a requirement is not deemed integral, it should be included if it is cost justified. This alone is a sufficient basis, because

cost benefit methodology directs one to select the alternative with the largest net benefit.

MEMBER KRESS: Sure.

MR. RICHTER: This is clearly stated in OMB guidance, and guidance contained elsewhere in NRC's Regu analysis guidelines.

MEMBER KRESS: Yes, I think that is a good reply. The only problem I might have with it is deciding whether something is critical or necessary, and that takes that judgment. I mean, there is not a clear cut thing, but you have always got to deal with that.

MEMBER WALLIS: But that is what they are after isn't it, is this Criterion 1, which is that by requiring something that isn't necessary, you can get away from cost benefit.

MEMBER KRESS: Yes.

MEMBER WALLIS: And they are worried about that, because the agency will how say, well, all these things are necessary.

MEMBER KRESS: Well, you don't get away from the cost benefit. You just -- you have to remember that this is bundling.

MEMBER WALLIS: IT's bundling, and you just don't do it separately.

MEMBER KRESS: Yes. But there is another part of it, which says that the regulatory analysis --

MEMBER WALLIS: So you don't et away from cost benefit.

MR. MIZU: You don't get away from it, but I think to understand what the industry is talking about, and how this bundling can hide things, let's suppose you have an element which is integral, okay, but it is very close to the line, okay?

The costs are relatively high and the benefits are perhaps just a little bit higher than that, okay? And then you have another benefit which is not integral, but cost beneficial. But this cost beneficial element is very high. I mean, you have a very low cost, and very great benefit.

And you throw it into the mix. So you have these two things, and that when you do the overall aggregated analysis, you are going to show a very big benefit, and that very big benefit is sort of swamping or obscuring if you will the fact that the integral method is kind of close.

And that is what the entry is saying. You need to be aware of that, and that is where the -- when we talk about the judgment of the reviewer to say perhaps this is a situation where this aggregation is

necessary to present the true nature of what is happening.

MEMBER KRESS: And that goes to this aggregation wouldn't it?

MR. MIZU: Yes, and in that case, this aggregation would likely be a better thing to do.

MEMBER KRESS: But this aggregation means that you identify separate components and count them as one?

MR. MIZU: Right. And NEI complained that the -- that we didn't provide them sufficient guidance or we did not provide the NRC sufficient review so that that process of deciding when to disaggregate is "scrutable."

Well, I just gave you an example. How do you write down judgment in a way that would allow the NRC reviewer to take into account all of the potential different ways that these different requirements could be bundled together.

MEMBER KRESS: Well, we just have to fess up that you can't get judgment completely out of it. You have to got to rely on your good judgment.

MR. MIZU: Exactly.

CHAIRMAN BONACA: But it seems to me also that the fact itself that now in the benefit analysis

that you have to disaggregate and evaluate both sides good, and so why not. I mean, the analysis become much more clearer than it was before.

I mean, that already answers the concerns of NEI.

MEMBER KRESS: And you generally do this aggregation anyway when you are doing the cost benefit, because that is the way you decide on the different policy efforts, and so it generally shows up.

CHAIRMAN BONACA: That's right.

MEMBER KRESS: Are there any comments or questions?

MEMBER SHACK: Doesn't Bullet 2 still slightly scrape the back-fit rule? The back-fit rule says that you not only have to have a cost beneficial thing, but you have to have a substantial --

MEMBER KRESS: Oh, that is still in there.

MEMBER SHACK: Well, doesn't Bullet 2 get you -- doesn't it sort of scrap that substantial part?

MEMBER KRESS: No, I think that would still be there.

CHAIRMAN BONACA: Okay.

MEMBER KRESS: Which page are you on?

MEMBER SHACK: Page 9.

CHAIRMAN BONACA: Page 9, the second bullet.

MR. MIZU: You have to remember that not everything is redacted and so you may have situations where -- I mean, you assumption is that every new requirement has a back-fit, and that is not necessary true.

For example, 50-69 would in fact not be a back-fit.

MEMBER KRESS: That's right. Any other comments or questions?

MEMBER WALLIS: What do we have to do, Tom, about this?

MEMBER KRESS: Well, I was struggling with this, and they would like a letter, particularly if we think that this is a good fix or a good set of guidance, and I am considering having such a letter. I think that this addresses the issue that was brought up by the Commission and it addresses it in a pretty good way, and I can think of no other way to do it actually.

So I am thinking about just a simple letter that --

MEMBER WALLIS: A simple letter?

MEMBER KRESS: Yes, that says something like that. But we can talk about it when we get to the letter writing session.

CHAIRMAN BONACA: Okay.

MEMBER WALLIS: I think it should be simple, and should not get embroiled in all sorts of legalistic --

MEMBER KRESS: Right, I don't want to do that.

MEMBER SHACK: That is a cost benefit itself, and I think you would love to weigh in on this.

MEMBER KRESS: Yes, that is one of your themes throughout here.

MEMBER WALLIS: All rules of cost benefit, all regulations based on cost benefit?

MEMBER LEITCH: I really have sort of an unrelated question, but the other side of the coin really. Let's say that industry -- I guess it is really related to risk.

Let's say that industry comes in with a change that they want to make in a plant that has several different components to it. One of them increases the risk, but several others are included, and perhaps my example unrelated, that decrease the

risk. So that the net reduction is a very small change in risk.

MEMBER KRESS: That is a very interesting observation because that relates to 1.174.

MEMBER LEITCH: Yes.

MEMBER KRESS: And how you deal with bundling there.

MEMBER LEITCH: Yes.

MEMBER KRESS: And I think that is a good question.

MEMBER LEITCH: And I don't have any -- you know, does this raise the issue of do we need to clarify what our position is in that matter, or is it already clear? I'm not sure.

MEMBER KRESS: I think that issue has been before the staff and I am not sure if they have come up with any guidance or not.

MR. GILLESPIE: I have been involved with meetings that have wrestled with the question, but I have never been involved in a meeting that wrestled with the answer.

So I think that is a good point. That causes us then to jump into discussions to defense in depth and saying that I am changing my initiating frequencies, and so I am giving up mitigation, and at

that point the discussions usually get so complex that we never actually gone to a resolution. It may be time to revisit it in the 1.174 space.

MEMBER KRESS: I think that is a real interesting question that we ought to have on our table to think about.

MEMBER LEITCH: You will recall that we had a licensee come in with an application for power uprates a few months ago, and they were doing a number of things.

But one of them was improving the reliability of the stand-by liquid control system by I think using enriched boron or I forget exactly how they were doing it.

And they were making the case that this power uprate was actually decreasing risk, because the slick changes more than offset the other changes, although it was not a fully risk-based analysis. So it is not really a perfect example, but it shows how one can play with the modifications a little bit and get some strange things going on.

MEMBER ROSEN: But in that case that brings up the question of whether the slick capacity increase was integral to the change.

CHAIRMAN BONACA: That's right, and are

they related.

MEMBER ROSEN: And should in fact be credited.

MEMBER LEITCH: Well, it seems to me --

MEMBER ROSEN: If they had not asked for an upgrade, would they have done the slick change? And the answer is no, and so it seems to me --

MEMBER LEITCH: But it is independent of it. I mean, you could do the slick with or without the --

MEMBER ROSEN: That is arguable.

MEMBER LEITCH: Well, the slick is really independent of the power --

MEMBER ROSEN: But it is arguable.

MEMBER LEITCH: Well, it is arguable.

MR. GILLESPIE: I think you would end up in this kind of condition that we probably would not have approved the upgrade if the increased margin wasn't there, because we have got a new fuel design and some other things that are going on.

So it may in fact be integral to the ability to have sufficient shutdown margin and some other things. And that is the difficult part. You have to get the system and the fuels people over here to say how did you guys interact on that question.

I don't know that it is obvious that it is not integral or it has set the conditions up such that the upgrade could be approved.

MEMBER KRESS: Well, let me tell you how I feel about that issue since we are just on the subject. Now 1.174 allows Pat to come in and request a risk-informed change of any type if he wants to. Now, let's take one where we have got a bundle for the two of them together, and pass all the 1.174 guidelines.

Now if I take the slick one, for example, what that does is lower the risk. I could have had a 1.174 just for that change alone without anything else. All right. That put me in a status of CDF and LERF down there.

Now I say I have got a new condition. Now I am going to do the power uprate. Now if the power uprate fits the rules from that point, then that ought to be allowed, too.

So if you bundle them together and you end up there, that is the same thing as doing them separately. So it ought to be allowed if you end up with the bundle making you meet the criteria, because you could have done it separately in a risk informed change.

You could have done them separately and it would have taken just twice as much business, that's all.

MEMBER ROSEN: But the more difficult situation is that the power uprate would not have passed by itself.

MEMBER SIEBER: That's right.

MEMBER LEITCH: But that's all right then, because you have a new plant, and then it passes.

MEMBER SHACK: But 1.174 disagrees with you, I believe. They discuss bundling and I don't think you are allowed to --

MEMBER KRESS: Well, that is not surprising that 1.174 disagrees with me.

MEMBER WALLIS: Well, I think the slick really was integral to the power uprate application. It really reassured us that this was okay. That they were tied together.

MEMBER KRESS: I don't think that is what integral means though. But anyway I think that this is probably a good fix, and I thank you guys. You did as good as you can, and so we thank you.

MR. RICHTER: Thank you.

MEMBER KRESS: And I turn it back to you, Mr. Chairman.

CHAIRMAN BONACA: Any other questions? If not, we will take a recess until 10-of-1:00.

(Whereupon, a luncheon recess was taken at 11:51 a.m.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

(12:55 p.m.)

CHAIRMAN BONACA: All right. The meeting is back and we have now a presentation about the ESBWR Pre-Application Review. Since Dr. Kress is on some official mission, we will start and Dr. Wallis will lead us into this presentation.

I would like to just point out that the -- Dr. Ford?

MEMBER FORD: I have a conflict of interest because I am a GE retiree.

CHAIRMAN BONACA: Okay. So you are not allowed to say anything.

MEMBER FORD: You can still ask about materials.

CHAIRMAN BONACA: You can ask questions, but you can't answer any.

MEMBER FORD: You can ask questions of fact.

CHAIRMAN BONACA: Okay.

MEMBER POWERS: And here comes Dr. Kress so we can walk through this properly.

MEMBER KRESS: And we will get through it a lot faster. I guess you guys have already introduced this and started.

MS. CUBBAGE: I am Amy Cubbage, and I am the project manager for the ESBWR Pre-Application Review. I just found out my new organization's new reactor section in NRR.

I just wanted to give a couple of minutes overview of what the staff is doing in association with the pre-application review, and then I will turn the bulk of the presentation over to General Electric.

The pre-application review scope is listed here, and we are looking at the TRACG application for ESBWR LOCA and containment analyses, and qualification of the TRACG code; the test and analysis program description and PIRT, and we are also looking at the SBWR and ESBWR test programs, as well as the SBWR scaling report.

The product of the pre-application review will be a safety evaluation report on the TRACG application and testing program. Although the scope of the pre-application review is very limited, GE has submitted extensive volumes of documentation in support of the review.

The staff has reviewed this information and has generated over 300 requests for additional information. All of these questions have been discussed with GE in telecons and meetings that have

taken place over the last six months.

GE understands the staff's questions and they have been very responsive to the issues. They are in the process of preparing their responses to the questions and those will be due back to the staff in August.

MEMBER WALLIS: I am a little puzzled. I'm sorry. I didn't ask you this question at the subcommittee meeting, but how can you write a safety evaluation report on a code? A safety evaluation report has got to be on a substantial thing like a reactor isn't it?

MS. CUBBAGE: We write safety evaluation reports on topical reports that describe the analysis methodologies.

MEMBER WALLIS: Then maybe when you do it, we will ask you what the criteria have to be or something, because this just sort of seems anomalous to write about the safety of a code.

MR. LANDRY: If I may, Graham.

MEMBER KRESS: Safety evaluation reports is just a name.

MEMBER WALLIS: It is just a name? Okay. All right.

MR. LANDRY: Graham, this is Ralph Landry

from NRR from the staff. The safety evaluation report on the code is a document that will define whether or not the code adequately represents the phenomena that we anticipate occurring in an accident or transient condition in this particular design.

And the way in which we do that is review the modeling in the code, and the correlations in the code, and compare the code with the testing program which has been testing phenomena in features unique to this design.

And we look at those comparisons and determine, yes, the code adequately represents the phenomena that are anticipated to occur in this design, and then write an SER which says that the code is applicable to them, the ESBWR design.

MEMBER WALLIS: So the word safety is sort of analogous, because there is no safety criterion applied to this.

MR. LANDRY: Not at this time.

MEMBER WALLIS: Because as we all know, you don't have safety criteria that apply to codes and the way in which they represent data.

MR. LANDRY: The safety criteria come into play when we do the design certification review.

MEMBER WALLIS: Right. That's right.

MEMBER SIEBER: Your SER though is limited to the transients that you test it against, as opposed to just saying that TRACG is good code for everything. It is limited to ATWS and LOCA, and abnormal --

MR. LANDRY: Yes, that has always been the case, that when we write an SER that we specify that this particular version of the code is applicable to these particular plants or these particular events.

MEMBER SIEBER: That's right.

CHAIRMAN BONACA: Thank you.

MEMBER SIEBER: And my notes say that you had three of those, right; ATWS, LOCA, and abnormal occurrences?

MS. CUBBAGE: For the pre-or-current scope of the preapplication review, we are looking at LOCA, ECCS, and containment. My next slide here for design certification, the scope will include the other applications.

However, transients, ATWS, and stability, will likely be covered in a later phrase of the preapplication review when we receive additional submittals from GE. The schedule has not been set for those yet.

MEMBER SIEBER: Thank you.

MS. CUBBAGE: And also --

MEMBER WALLIS: I am still a bit confused about -- I'm sorry, but at the subcommittee we heard a lot about why this is a good reactor and so on, and really that is not part of the scope of this at all.

MS. CUBBAGE: That's right. The design will be thoroughly reviewed during the design certification basis.

MEMBER WALLIS: So does that mean that we should ask GE to focus more on the experiments and why they are good tests of the code, or should we hear all the other material?

MS. CUBBAGE: Well, I think that the design just provides the context for understanding the testing and analyses that have been done, and so they provided that as background information to you, as well as to the staff, okay?

Well, that concludes my presentation. If you have no other questions, I would like to introduce Atambir Rao, who is the project manager for General Electric.

MR. RAO: Good afternoon. We wanted to make things absolutely clear so we brought our own projector. Some of the questions on why the presentation on the design. The approval of the code is based on an application to a design, and so the

design forms the background for the basis for the approval.

And also one of the key aspects of the approval process is that we are relying on the fact that this plant has a lot of margin in the responses. So we believe that should make it easier for the staff to find --

MEMBER WALLIS: Well, that's true, but that should not influence our assessment about whether or not TRACG is applicable, and the fact that it predicts a big margin should not influence our evaluation of TRACG.

MR. RAO: That's true.

MEMBER WALLIS: If we like the plan or not is irrelevant.

MR. RAO: Well, that is -- yes. What I will be covering a little bit about what we are doing in the overall program, and give you a design overview. As far as the overall program is concerned, our approach has been to follow a step-wise program, where technology closure or preapplication of PRA as it is called is the first step towards certification of the plant.

I believe the pre-application review is more specific than this plant's application compared

to some of the others, where we are asking for a safety evaluation report on the technology issues.

The overall design, I will assure you that we have a lot of margin, and the margin is there by design, and that we have also done a comprehensive testing and analysis program.

The bulk of the presentation will focus on the technology program, where we develop a comprehensive plan and we have completed the implementation of that plan, which includes both testing and qualification, and the use of a single integrated computer code for analysis with a well-defined application methodology.

And what we are looking for from the staff in the technology closure program is a safety evaluation report for TRACG. And this is all part of our overall plan to basically try to minimize the regulatory risks.

When we started the SBWR program we submitted the safety analysis report, and the design certification application, and the computer codes, and testing, were all being reviewed in parable. So it was a little bit messy in that sense, and it was not a productive use of resources.

So this time we felt that it was better to

follow a step-wise approach to both the design development and the regulatory approval. In terms of the design development, we over the last 15 years have developed passive safety systems, which were then integrated into a plant design for the SBWR.

And where we completed a detailed system designs, PRAs, and looked to the building design. We also as part of that effort did an extensive testing and analysis program.

First we started the testing program, and then we went back and defined it. A new program, which was starting from scratch, which was a rigorous process that we followed for defining what would be the best needed to quality the TRACG computer code.

Then we went back and completed that test program, and at that stage we concluded that the SBWR was not economic at the 670 megawatts it was at. We marked on this program for the ESBWR, which where the E has now been defined as economic SBWR, and the program started off about 10 years ago.

It was a one person operation, and it was to improve the plant economics, and the design, and we focused on optimizing the design, and we relied on the economies of scale. We incorporated utility requirements.

We had a utility steering committee that has been and are still providing guidance ont he design of the plant. And the overall program was a market oriented program, and so we used the ABWR experience basically using the same components.

It was our overall plan for commercialization of this plan has been based on building one plant at a time. We are not looking for a six-pack. We will take one if it comes, but it is based on the first plant has to be economical, and has to meet all the commercial requirements.

So we are utilizing a lot of the ABWR components in the design. So that is what we did on the design, and we realized last year that it was now time to come back to the NRC and start the regulatory improvement process.

And again on this one, we focused on a step-wise approach, and because the most fundamental thing here is the design margin, and that is the most important thing. That is what we made sure of, that the design had plenty of margin and was simple.

And also to make sure that we had a solid technology program, and I will describe what we did in the technology program. What we are looking for a safety evaluation report for TRACG, and we are using

a simple activity report, and I will show you a lot of the details and some of the testing.

In fact, I will give you an overview of the typical details and what they will be. It is too hard to go over in a meeting like this. After that, after we get closure on the technology, and a good feel that there is no additional testing needed and that the big part of the effort, the big uncertainty regarding the computer codes is over, we will then submit the safety analysis report for design certification.

GE is committed to develop a license for the ESBWR. The goals for the technology closure as Amy had mentioned is basically approval of the use of TRACG for analysis, and for vessel response to a pipe break, and the containment response to a pipe break.

And the vessel response to anticipated operational occurrences, and the submittals have covered those areas. The AOO has been slightly delayed because there is some additional information required by the staff, and it will take us a little more time to fill in that information.

The ATWS and stability area was also deferred in the original sets of submittals just because of timing. We wanted to make sure that the

first two especially, since those are the areas where there is a significant change in the technology, that we get those off the table, and that is why we focused on those two.

Even though I use the words significant change in the technology, I will also end up by saying it is the same as standard BWR technology by the end of the presentation. So that was something that was significantly new and different, at least in terms of what people had seen in the past.

And of course one of the elements of the approval of TRACG is the confirmation that the qualification base of TRACG is adequate. Just to put it in perspective, it is a 15-plus year comprehensive technology program, and the question is whether that is enough.

MEMBER WALLIS: This is on TRACG or on BWRs?

MR. RAO: On all the passive systems. And 10 years ago, the ESBWR started and the SBWR started more than 5 plus years before that.

MEMBER ROSEN: Can I ask for a clarification of your question? Is that enough for licensing, or enough forever, or what is the intent of that question?

MR. RAO: The intent of the question is more rhetorical, and that they have been at this for 15-plus years. We would like to have some closure on that. That is more of a rhetorical question.

MEMBER POWERS: Were Professor Apostolakis here, he would say that you could have been wrong for 15 years.

MR. RAO: Could have been doing what?

MEMBER POWERS: You could have been doing it wrong for 15 years.

MR. RAO: Yes.

MEMBER ROSEN: And also what I was going at was that it is never enough. I mean, there will be technology questions that come up once the plant is in service, and you will be back to doing -- you know, it is an ongoing thing.

MEMBER KRESS: I think that this is not for certification.

MEMBER ROSEN: That's what I thought you meant.

MR. RAO: Well, right now we have the first step of certification to get approval of the TRACG, and we need to close out the testing program. It is a practical thing, you know, a countless researching effort that --

MEMBER WALLIS: This is sort of like the cry from Job is what it really is, isn't it?

MEMBER SHACK: He is in the wrong business.

MR. RAO: I would like to finish it before I have to retire. I am still young enough and still have the energy. This just gives you an overall of what has happened in the evolution of the BWRs. On the top you will see that on the earlier BWR designs, BWR-4 and BWR-6, and BWR-3, et cetera.

And on the top part, you will see some of the key parameters of the design, and in the lower part, you will see some safety related issues. And on the last line, it will also give you a feel for the overall economics.

What you see is that some of the parameters are pretty much -- they have stayed in the range where we have got experience. One of the things that we wanted to make sure of was that he last 50 years worth of experience that we got from the BWR technology when it comes to transients.

And as we have learned over the years is that it is not the physics, and it is not the thermal hydraulics. It is the materials that are the things that are the biggest challenges.

In fact the chairman of our utilities steering committee refers to those people who work in the thermal hydraulics area as that we need to get rid of the thermal-hydraulic mafia. These are not my words. It is the chairman of the steering committee's words.

MEMBER POWERS: Could we invite him for a talk to assist the ACRS in its complaints.

MR. RAO: So the essence of --

MEMBER WALLIS: He has been trying to do it, too.

MR. RAO: Yes. So what we have done in the overall design out here is to make sure that we use, and we do minimum extrapolations from operating plants, because what you learn from the operating plants, you want to make sure that you use it.

What you will see out here is, for example, some of the big components, like the vessel. The vessel diameter is the same as the ABWR. We did not want to use the same factories that we have for the reactor vessel for the ABWR. We wanted to build a new factor, because you have got to get a plant order one at a time.

So the vessel height is about 6 meters taller than the ABWR, and it is just an extra ring in

fact. The number of bundles is one row extra over the ABWR, and the fuel height is 3 meters, a little shorter than the standard BWR fuel.

The power density is in the range of the power density where we have got experience without the power uprates. The power uprate have gone up even higher than this, and some of the power uprates I think for BWR-6, I think the highest one is about 62 kilowatts per liter.

So this thing is still well within the range of where we have got experience. But what we have done int his plant is to reduce the number of components. We have gotten into the recirculation pumps, and we have simplified the safety systems and got rid of the pumps, the safety diesel generators, heat exchanges that you have in safety systems.

And that shows up in the last two lines. This is an interesting thing that has happened. The evolution of BWRs over a period of time, and when you go from left to right, you will see that the core damage frequency as we evolved the designs basically kept coming down, and the ABWR is down to about the level to as low as you are going to get to practically.

And that is a modest, best creditable,

core damage frequency that you are going to calculate. Anything lower than that starts ending up in the range of it being not credible.

The ESBWR is in the same range as the ABWR, even though it has got a passive system. But the reason to going to passive systems is shown on the last line, which is that you have done it with a lot less.

As we went from left to right, you can see some of the earlier plants, the safety buildings were much smaller than those for the BWR-6s and the ABWRs. Now the reason for that is we added redundancy, more divisions, more pumps, heat exchanges, to get an improvement in the core damage frequencies.

But you pay a price for that, for the complexities. What we have done in this plant is that you get the same core damage frequency, but with less stuff. So it is basically like I said a simplified design , and the place to start is in the normal operation.

The wa that we did that is to get rid of the recirculation pumps. It is hard to imagine anything simpler than that. The feedwater comes in out here and flows up through the core, and it goes up through the chimney, to the separators, and to the

dryers.

All that you do is pull the rods, and the thing reduces 1,400 megawatts without any moving parts. No balls bouncing around, and things like that. The only thing that moves is bubbles.

MEMBER WALLIS: What is the flow regime in the chimney? What is the lowest void fraction?

MR. RAO: It is about 80 percent.

MEMBER WALLIS: So it is a pretty high void fraction.

MEMBER KRESS: That is dispersed droplet regime, I think?

MR. RAO: Yes. Okay. So the drive and separator, and the standard BWR drives and separators. Again, the biggest challenge for BWRs is the materials, and so we made sure that the pressure, and temperature, and other conditions were either or the same as that for any of the operating plants.

We didn't go and increase the operating temperature or any other conditions. We were just keeping it within the range of what we got experience with. In fact, the fact that we are relying on natural circulation, and the flow rates are a little less, or the stresses would be a little less in most of the components down in the core region.

There is one new compliment, which is called the chimney out here, and there were some questions in the subcommittee, and we will provide answers later on at the next meetings.

Basically what we have done out here is that we have got a much bigger vessel, 6 meters taller than what the ABWR is. There are some advantages to that. What it does is that it puts more water in the vessel, which makes the operation of the passive safety systems much better.

You will see that plant performance is very benign, but we also need a bigger vessel to enhance the flow during normal operation and natural circulation.

So if you get rid of one or the other, you still need a larger vessel, and the vessel does not get much smaller. The passive safety and natural circulation in a boiling water reactor is sort of a natural combination.

You see a significant reduction in the components, and this is an actual reactor system for the ABWR, and we have eliminated all of that. We are doing (inaudible) with controlled lower drives.

MEMBER LEITCH: Atam, I can't quite make out what is going on in that power flow map down at

the bottom. How do you vary the power in this? In other words --

MR. RAO: The power is controlled by controlled lower drives, and there is no flow control. This power flow map is plotted this way, but it is a little confusing in the sense that in this plant the power is what is controlled, and so that is what should be on the X-axis.

MEMBER WALLIS: Well, those lines are control rod settings aren't they?

MR. RAO: Okay. Those are ABWR. The green is ABWR, and the red is BWR-5, and that is MELA Plus.

MEMBER LEITCH: Okay.

MR. RAO: And the blue is the ESBWR. So what we do in this, and you have to remember that the power is the variable that you control, and you get water flow coming from that.

MEMBER WALLIS: So you really control your control rods setting, which is at that angle, and the constant control rod setting is an angle line about 60 degrees or something, or 30 degrees.

MR. RAO: Right. Now, this one, what you will do is that when you pull the parts out, you will basically get a certain flow, and it is a fixed flow

that you will get.

MEMBER LEITCH: And you do that all the way up to a hundred percent, right? You just keeping pulling the rods out.

MR. RAO: Yes.

MEMBER ROSEN: The feed water system is just making things level.

MR. RAO: Right. It is a very simple machine. No moving parts, and people are worried about stability in a boiling water reactor, and there is matching circulation, and the reason for that is that this is what the natural circulation flow line is for. The BWR-4 is this and this is what it is for the ABWR.

And this is where you get the instability region. You can see that there is about 3 to 4 times as much natural circulation flow in this plant compared to those for the operating plant. And very simply what we did was that when you get -- it is not really hi-tech. It is single phase flow.

You get rid of the restriction out here and the downcomer, and that in itself enhances the natural circulation flow for a standard BWR by a factor of two.

MEMBER WALLIS: Are you going to argue

that you cannot get into the instability region with this?

MR. RAO: Right.

MEMBER WALLIS: That would be very reassuring.

MR. RAO: There is no way to get out here, you know.

MEMBER WALLIS: And you are going to show us that in the future?

MR. RAO: In the future, yes.

MEMBER LEITCH: So the line -- I'm sorry, but I can't quite make it out, but the blue line there is the ESBWR?

MR. RAO: Yes.

MEMBER LEITCH: And at that point that is a hundred percent?

MR. RAO: Yes. This plot is the average power per bundle, and average flow per bundle. This is not the standard power flow map, and we tried to put it on to something that made sense.

MEMBER LEITCH: It looks like that line bends back a little bit on itself there?

MR. RAO: Yes.

MEMBER LEITCH: So what is the significance of that?

MR. RAO: This is what I am saying. This gives people concern over questions that you have an unstable situation here, and you have got to remember that the thing that it is controlling is the power, and not the flow.

So this should be the X-axis for the ESBWR, the power. So you keep pulling the rods out and you will get some flow, and that is what this is showing.

MEMBER LEITCH: And what are you plotting along the bottom there? I can't quite see it.

MR. RAO: This is the average flow per bundle.

MEMBER LEITCH: Average flow per bundle? Okay. I've got you.

MR. RAO: Just to put it in perspective, the power flow ration is sort of a simple measure of whether you get stable or unstable. It is just one measure, and it is not the total measure. It depends on the power shape and all the other things, okay?

So the power flow ratio, when you draw a line from here up through that for the BWR-5 there, you can see the power flow ratio is about the same at the hundred percent power per bundle. This is the power flow ratio per bundle.

MEMBER WALLIS: But of course the chimney affects the stability of the circulation, too, and so you are going to have to tie all of this together.

MR. RAO: Right.

MEMBER WALLIS: You can't just translate the stability area from one rack to the other. But that is not today's discussion.

MR. RAO: Right. I was just trying to give a simplistic description of that.

MEMBER ROSEN: Atam, you said one thing that puzzled me. You said that the only new component is the chimney, but the chimney is not a component. It is just a great big open hole. What do you mean by component?

MR. RAO: Well, it is a big piece of blueprint out there. It is just a channel.

MEMBER ROSEN: Is it one big open --

MR. RAO: No, it is .6 by .6 meters, the partitions in there.

MEMBER ROSEN: So there are partitions?

MR. RAO: Yes, partitions in there.

MEMBER WALLIS: You have to lift the thing out to refuel.

MR. RAO: No, you don't have to move it out.

MEMBER WALLIS: You don't? You just sneak around?

MR. RAO: You just go in and out through that.

MEMBER SHACK: How much of the internals could I remove in case I had a materials problem?

MR. RAO: All of them. They are designed to be removable.

MEMBER FORD: So they are bolted?

MR. RAO: Yes, they are bolted. So what we tried to do is that we have been learning over the last 15 or 20 years, and one of the advantages of having the 10 years to design it is that you pick up all of the things that have happened in the last few years.

MEMBER LEITCH: Could you get back to that for just a second? Does the dryer go up into the head as shown on that cartoon?

MR. RAO: I don't know whether there was an actual vessel -- this is a cartoon, okay?

MEMBER LEITCH: Yes.

MR. RAO: I did not draw to scale on some of the charts.

MEMBER LEITCH: I mean, I think that if one should take the head of the dryer, the dryer is

still down below you is it?

MR. RAO: I don't know the exact location. We might be able to see it in some of the later ones.

MEMBER LEITCH: Okay. There are some actual drawings, and those that are drawn to scale, and all the others are not to scale.

MEMBER LEITCH: You know, just one problem. I had -- and this is a housekeeping thing, but I had a problem opening that CD, and I could not get the drawings. I don't know if the other committee members had that same problem or not.

MEMBER WALLIS: I had some problem with it.

MEMBER LEITCH: A proprietary CD from General Electric, and I couldn't open it.

MEMBER WALLIS: It was mysterious. There is no pdf, but some of them open and some of them don't. I guess we can sort that out somehow.

MR. RAO: We can make some more different ones, or we can make this one available, too. This is not proprietary. The other thing that is kind of interesting in this design is that we have combined to reduce systems, and this is my personal favorite, because what we did is that we got rid of the RHR system.

There is no RHR system, and the major innovation of this was that we took the standard reactor water cleanup, which is the red line, and we have given it a dual function now. It can perform normal shutdown cooling.

Basically, a reactor water cleanup system is pumps and heat exchanges, and that is what a water shutdown cooling system is. So it takes it from the vessel and puts it back into the vessel.

So what we did is for (inaudible) is that we bypassed the regenerative heat exchanges and removed the heat from these heat exchangers, and we used the same pumps to bypass the defamilizers, and put it back into the vessel.

So that reduces and makes it a lot simpler. And it makes the operation also simple. It is not just a complex system. What we have got now is a full pressure shutdown cooling system.

When you shut down a normal BWR, the RHR only kicks in at 400 psi. So this is a little innovation.

MEMBER WALLIS: So the nozzle sizes are small, and so that the break is not a great disaster.

MR. RAO: Right. The nozzle sizes here on the bottom are 2 inch nozzles. So it is a very small

nozzle there.

MEMBER LEITCH: And those pumps, aren't they much larger than the present design?

MR. RAO: Yes. You have two pumps there, one for the high flow an done for the low flow.

MEMBER LEITCH: Oh, i see. Okay.

MR. RAO: So what we did on the design was basically make the heat exchanger is bigger by a factor of four. And the heat exchanger bigger by a factor of four is not a big deal. So that heat exchanger got bigger and we added a paddle and pump.

MEMBER ROSEN: And you also designed the system for full pressure?

MR. RAO: Yes.

MEMBER ROSEN: But the shutdown system was not.

MR. RAO: Yes. Well, the shutdown system was not. So now you have got a full pressure shutdown cooling system.

MEMBER LEITCH: But you got it essentially free because you had the reactor water cleanup system as a full pressure system anyway?

MR. RAO: That's right. That was the innovation here. I mean, it is not rocket science.

MEMBER LEITCH: You have to make reactor

water cleanup have more pumping capacity, because it is only like a 10 percent success rate.

MR. RAO: You can't do it on the operating plants because it didn't make sense, because the operating plants, the RHR system needed a safety grade for decayed heat removal following an accident.

Now, this one, the safety grade decayed heat removal system is a passive system. So now the question is what do you do for normal shutdown. That's why it works out here than on the standard active plant.

MEMBER WALLIS: This could be a safety system, too.

MR. RAO: But it adds to the costs.

MEMBER WALLIS: I mean, it could be used in an emergency.

MR. RAO: It could be used in an emergency and we use it in the PRA. It is identified in the PRA. This is what passive safety systems are. Basically everything is right here in the containment. And it is very simple. What you have is the standard BWR pressure suppression system.

MS. CUBBAGE: Adam, you need to use the microphone.

MR. RAO: Sorry. So what you have got

here is that the reactor vessel, and then we went up front he ESBWR in power, and the ESBWR had two steamlines and they are both steamlines in this, and we increased the number of steam lines.

We don't have to add a steam generator. Just increase the number of steamlines. These are the two feed water lines, and water comes in, and goes up through the core, and comes out through the steamlines.

These are the safety release valves, which perform the same depressurization function that we have on the standard BWRs for ADS function, automatic depressurization system. They blowdown into the depressurization system, and these are the quenchers for that standard.

The only difference is that this pool of water is down and raised off the base mat, and you could provide water in the vessel back to the vessel by gravity.

We added these pools up here, about a thousand cubic meters, and the ones that you would call the ECCS systems for this plant. It is a pool of water with a thousand cubic meters in total. It is not a big pool, and it provides water make up following a s loss of pool density.

So this replaces all the ECCS systems makeup,and the only other thing left is the decayed heat removal, and that is removed through heat exchanges mounted on the top of the drywell.

I show you another picture what is there. So the containment is about the same size as an ABWR, and all the safety systems are right in there. So that is an overall simplification of the design.

And all we have is a low pressure water makeup system, and no accumulators like in other high pressure systems that could give your system interactions. This is not to scale, and --

MEMBER LEITCH: Could you go back to that previous one for just a moment?

MR. RAO: Yes.

MEMBER LEITCH: So in a loss of coolant accident the drywell pressurizes and is there pipes like the Mark-II blown down into the suppression pool, or what is the flow pattern there?

MR. RAO: Right there. If you have a pipe break here, it flows down through here like the ABWR.

MEMBER LEITCH: That is an annulus is it?

MR. RAO: Yes, that is an annulus, and there are 10 or 12 of these off the top of my head. There are 10 or 12 of these very large pipes, and they

go down into the suppression pool, and the horizontal lines, like the Mark III and it is covered like a Mark II.

So the initial blowdown was in the vector suppression system. The only thing that is different is after that the water make-up after that pressurizes, and the water flows by gravity from these pools in the vessel.

And after the water flows into the vessel, and this is not to scale, and please note that this is just in order to show how all the systems fit together. These are the pools that I was talking about and this is the vector suppression pool.

There is an isolation condenser which takes care of removing the energy following a reactor isolation and in this plant the release valves are not open following the reactor isolation.

So it is a much milder transient than those in other operating plants. So not only have we made the accident response better, we have made the plant transient response a lot better.

This line out here is the major innovation of the old design, which is that this is the heat exchanger for removing the decayed heat that goes into the containment following a pipe break. The steam

goes up here and it is condensed in that heat exchanger similar to an isolation condenser.

But since there is non-condensables in the containment, they have to be removed from that condensing heat exchanger. And those get removed through this pipe that is here, which blows into the wetwell, and that is all done by the pressure difference between the drywell and the wetwell. No moving parts, no valves, nothing.

It is always open, and so the decay heat removal for this plant is --

MEMBER ROSEN: No vacuum breakers?

MR. RAO: No, there are no vacuum breakers between the drywell and the wetwell.

MEMBER LEITCH: Now, how do you get high pressure injection? Now, let's say you have a small break LOCA.

MR. RAO: We don't have a safety grade high pressure engagement system anymore. If you have a small break LOCA, some of the energy initially will be removed from the isolation condenser system.

We have a non-safety grade system that controls our drive system, which provides water makeup. We have actually increased the capacity of that compared to that for operating plants.

So they are non-ECCS systems which can handle small break LOCA from a realistic point of view.

MEMBER LEITCH: So the drive system pumps become safety grade then?

MR. RAO: No, no. I said they are non-safety. We just made them bigger actually. What we did was that we added a line which injects through the feedwater alignment and it is hard to show that in all of this.

MEMBER WALLIS: But if you don't depressurize, none of this other water helps you.

MEMBER KRESS: That's right.

MR. RAO: Yes, you have to depressurize for this other water. It does --

MEMBER LEITCH: The only method of depressurizing is through the safety release valves then?

MR. RAO: Normally because depressurization is a very important factor in this design, we went through a diverse depressurization system. This is the standard ADS system for the SREs, and we added another system on the depressurization valves, and so there are different kinds of valves, and they are very different than the standard ADS

valves.

MEMBER ROSEN: How big are they?

MR. RAO: The DPVs, I think it is about a 12 inch line.

MEMBER ROSEN: And they are squib actuated? Have you ever tested one?

MR. RAO: We have tested a lot of them, and I can show you an actual test of those.

MEMBER ROSEN: Wow.

MR. RAO: We have done a lot of testing.

MEMBER KRESS: Isn't that novel.

MEMBER SHACK: When you say you can make a small break LOCA with either your control rod drive, how big a LOCA are we talking about here?

MR. RAO: A 2-inch line.

MEMBER SHACK: A 2-inch line. The CRD system is designed to handle a 2-inch line. We increase the capacity over that for the operating BWRs. We did a lot of things to improve the core cooling, and that is shown up here.

But the biggest thing is we have got a bigger vessel, and there is more water in the vessel, and so you start off with more water, and so the loss of coolant accident response is a lot better. You don't have to rely on other systems.

And we keep the core covered following a loss of coolant accident. I already mentioned some of these things out here. So basically we improved the plant response by design features, and very simple design features, and nothing really fancy, you know.

It is just like of level of safety, you know, and you put it together right and you end up with a design which is a lot simpler. The same thing with the decay heat removal area. Like I mentioned, we added the full pressure normal shutdown cooling system regarding the isolation condensers.

The major new system is a passive containment cooling system.

CHAIRMAN BONACA: Could I ask you to go back to number nine. I have a question.

MR. RAO: Sure.

CHAIRMAN BONACA: You have that bottom line there which says increase security. I mean, did you mean security or safety?

MR. RAO: I really do mean security, because everything is inside the containment which is (inaudible), and anyone who wants to get in there is not going to last too long.

It is all inside the containment. I mean, that is really a neat feature of this thing.

MEMBER RANSOM: How thick are the containment walls?

MR. RAO: Two meters, 1-1/2 to 2 meters thick.

MEMBER RANSOM: And I don't know if you mentioned it, but you can show shore up the lower containment and still keep the coolant covered.

MR. RAO: Yes. That is an interesting feature and it does not show up out here, but the lower containment is about 700 cubic meters, and I mentioned that these pools are a thousand cubic meters.

So it is a closed system now, and water does not leave anywhere, and so we looked at all of the different scenarios and combinations, failures, and all the rest of it. So what you do is you can easily plug the lower driver.

Now, when you end up with a closed system, everything is finely tuned, because you are dealing with -- you know, you have to make sure that you have got the right amount of volumes everywhere, and we looked at all the different combinations and different failures.

So it is a finely tuned system in that sense, and that is what it prepares for.

MEMBER KRESS: Does it --

MR. RAO: Yes, it is not as expensive.

MEMBER LEITCH: Those larger reactor water cleanup pumps, how are they sealed? We used to have all kinds of trouble with backing on reactor water cleanup pumps. Are they can pumps or --

MR. RAO: Yes, I think they are the can pumps. I don't know offhand, but I think they are the can pumps.

MEMBER LEITCH: And that could be a real maintenance problem.

MR. RAO: This is what the system looks like. We got rid of a lot of the water systems in this plant, but we still have enough of the water systems that there is a number of non-safety water makeup systems, okay?

So we have simplified them, and what is shown here is the reactor water cleanup system that fits in. This is the reactor vessel, and this is the suppression pool, almost to scale.

This is the pool of water up on the top where the heat exchanger is and the isolation condenser, and the decay heat removal sit. This is the containment boundary up here.

And you can see the core compared to the

suppression pool, and water can flow regularly down in there. The only water systems (inaudible) is we have reduced them substantially, because the reactor water cleanup nozzles is in this part of the building, and you have got the hydraulic control units there.

And you have the field pool and an auxiliary cooling system which is out here. It will cool all the pools and also clean up all the pools that are existing in the plant. And the rest of it is all gone. We have six floors of ECCS system in all of that.

MEMBER KRESS: These heat exchangers that are in the pools, are they completely separate in the sense that each of them has its own line coming? There is not a header?

MR. RAO: Each has its own line, and each has its own separate compartment. The pools are not connected.

MEMBER KRESS: The pools are not connected. Of course.

MEMBER RANSOM: Are there any problems with isolation with the reactor water cleanup system and the feedwater systems? How are those isolated?

MR. RAO: They are just like standard plants. One of the things that we have done now as

far as the reactor water cleanup system is concerned, we put it in this part of the building, which is actually structurally better than the standard reactor building, because structurally this lower part out here is going to be part of that structure, and it part of the containment boundary. So in a sense it is a pressure bearing.

MEMBER RANSOM: I am wondering if those are squib closed valves, or redundant values, or --

MR. RAO: They are redundant valves, but not squib valves for the reactor water valves.

MEMBER SHACK: Since I don't have pumps any more how do I heat up the vessel before I start to go critical?

MR. RAO: You just pull the rods and you get heat i[after ==

MEMBER SHACK: Did you get the staff to agree to that?

MR. RAO: After the first one, and we also have -- we have both.

MEMBER ROSEN: What do you mean after the first one? You mean after you got some decay heat on the coil?

MR. RAO: Yes.

MEMBER ROSEN: After the first neutron you

mean?

MR. RAO: After that, you can just do (inaudible).

MEMBER SIEBER: Now, it seems to me that since you don't have any pumps for ECCS that the importance of accuracy in TRACG is pretty high, because everything is driven by a thermal head, and so the demand on the code would be more than it would be for a pump system. Is that correct?

MR. RAO: No, the answer to that is please wait and I will answer that question. But the answer to that question is most of this stuff can be done on the back of an envelope. So hear me out and --

MEMBER WALLIS: Which is why you want to approve a very complicated code, right?

MEMBER SIEBER: Yes, I have some envelopes here.

MR. RAO: You have to keep the thermal-hydraulics guys.

MEMBER KRESS: That is the reason for keeping us though.

MR. RAO: The evolution of the containment in the reactor building is shown out here, and you can see that all the BWRs have suppression pools, and all of them were on the base mats, BWRs raised off the

base mats.

This hash mark is the bar code for the Mark I and Mark II, and the spent fuel pool. You can see on the Mark III that we moved it down to grade elevation. One of the advantages of having delayed this program post-911 was the high spent fuel was an issue that came up I believe in Connecticut and other places. So one of the advantages --

MEMBER ROSEN: To put it down lower.

MR. RAO: Down lower, and in fact it was actually a trade-off, in terms of costs and we don't think that high pools are a problem, but in terms of costs, ending up in those separate fuel buildings like Mark III, it was sort of the thing to do.

MEMBER KRESS: Is it below grade?

MR. RAO: You will see some actual sketches of grade. It is two-thirds below grade.

MEMBER KRESS: Two-thirds?

MEMBER ROSEN: You mean the whole plant is two-thirds below grade or just the pool?

MR. RAO: The elevation of the spent fuel pool.

MEMBER WALLIS: But it could be lower.

MR. RAO: It could be lower, but it is just that this is the optimum design. I mean, you

have got to remember that you have got two meter thick walls. I mean, there is nothing that can really do any damage to any of these plants, and all the studies have shown that. That is not a real issue. It is just more feels good.

MEMBER LEITCH: So there is really no -- what we might have called reactor building in previous BWRs. In other words, everything is inside containment here.

MR. RAO: Well, no, if you want to use the terminology reactor building and reactor water cleanup system, this part out here is the reactor building.

MEMBER LEITCH: But it is in containment though, right?

MEMBER WALLIS: No, it is not a containment.

MEMBER LEITCH: It's not in containment.

MR. RAO: The different boundaries go up like this.

MEMBER LEITCH: Okay.

MR. RAO: So that is the outside containment there, and hydraulic control units and the reactor water cleanup system outside.

MEMBER KRESS: That's so you don't have to work that region?

MR. RAO: Pardon?

MEMBER KRESS: Is that so that you don't have to inert that region?

MR. RAO: Well, we kept it outside -- yes, that region is not inerted. You do maintenance on the hydraulic control units and reactor water cleanup and that;s it.

A couple of other things is that we have added an entire fuel transfer system, which should make the utilities life a lot easier, because you can move fuel up and down with a spent fuel pool, and during operation it takes it off the critical path.

The reason that you can do that in this plant compared to the Mark III is the top of this thing is outside the containment now. In the Mark IIIs that is part of the containment. So you have got to move during an outage.

In this one, you can move it and what we have done is we have reduced the safe buildings. You can see that we got rid of 6 floors of safety grade ECCS, and heat exchangers, and heat controls, and all of that.

We have on this plant shown something on the outside called an external event shield. We have not defined what requirements are there. We can make

it probably a revolving requirement on what is required for us to do in that area.

So the design is flexible in that sense. This is actually to scale and Graham has left, and he claimed that the drawings are not according to scale, but this is an actual section of the plant.

And you can see that it is actually a fairly simple plant. The reactor vessel, and fuel pipes, and reactor water cleanup system, and hydraulic control units, and pools of water.

MEMBER ROSEN: And grade is again -- show me.

MR. RAO: Grade is right here.

MEMBER ROSEN: Right there? Okay.

MR. RAO: This is the spent fuel pool, and this is the inclined fuel transfer system, and this is the fueling machine, and this is the fuel cooling system. So that is all of the systems, and the accumulators for the standby liquid control are somewhere out there, and you can see them in a different section.

MEMBER ROSEN: And this external event shield that you talked about, is it talking about how big or how thick the walls are on the rectangular cross-section part of the vessel or part of the

plant?

MR. RAO: This one, we have not defined the thickness, no.

MEMBER ROSEN: Of the external event shield. Oh, it is that piece?

MR. RAO: It goes over --

MEMBER ROSEN: But it doesn't go over the other piece?

MR. RAO: No, it doesn't go over this piece.

MEMBER ROSEN: Because all the fuel is way down low?

MR. RAO: Yes, the fuel is way down low.

CHAIRMAN BONACA: One thing that I noticed in this design is that you have a lot of bundles, a thousand bundles. How long will it take you before you have to begin to off-load spent fuel from that pool?

It seems to me like you have almost a permanent operation to dry storage.

MR. RAO: The size of the spent fuel pool right now is good for 8 years. One of the advantages of having a separate fuel building is you can increase the size and make it part of the initial investment cost.

Standard fuel, you can move about 5 or 6 years, and if you go to MOX fuel, it is a little longer. Ten years is what the Europeans require. So if this were built in Europe, and they had MOX fuel, they could end up with a slightly bigger fuel building, but it would not affect the rest of the design of the rest of the plant. So it is kind of flexible in that sense.

MEMBER ROSEN: And Graham, you are going to tell them that it is to scale?

MEMBER KRESS: You might let him know.

MR. RAO: To scale.

MEMBER WALLIS: Do I get to applaud?

MEMBER SIEBER: Let me ask a question that will demonstrate my failure to fully understand. When you have an accident or a transient in the plant, ultimately the decay heat from the reactor is up in the PCC pool, right, through the heat exchangers that ar up there?

MR. RAO: That's right.

MEMBER SIEBER: How do you remove the heat load from the PCC pool outside the building?

MR. RAO: Okay. If you get a normal vector isolation, you can remove it with the active fuel pool cooling system.

MEMBER SIEBER: Okay.

MR. RAO: You can do that. That is an active, non-safety fuel pool cooling system. So the pool doesn't really have to boil. It takes about 3 hours or 4 hours before --

MEMBER SIEBER: And if that fails, then you are relying on the boil over?

MR. RAO: Then it just boils off.

MEMBER SIEBER: It boils off. Okay. And how long does that last?

MR. RAO: For 72 hours.

MEMBER SIEBER: So you have got to put more water in there.

MR. RAO: All you have to do is provide --

MEMBER SIEBER: Call the fire truck, right.

MR. RAO: -- 200 or 300 gallons per minute, and that's all you have to provide. It is not big, and it is low pressure, and it is outside containment, and we have got a connection to that, and that's all you do.

MEMBER SIEBER: Okay. Thank you.

MR. RAO: This is the spent fuel refueling floor, and it controls the building size, and you can see that this is a pool for storage of either spent or

new fuel, and there is not enough time to cover all of these issues. This is the reason that we are here. TRACG.

Now that was just an overview of the design. I am notorious for exceeding my time, and I will keep watching my watch out here.

MEMBER WALLIS: Well, it is a matter of doing it full-scale and not distorting it are you? You distort the dimensions of time as well.

MR. RAO: What we have done in this plant, and what this shows is these are the codes that we used for the operating BWRs, and for doing the different analyses.

For the ESBWR, we are using some of the same, but we are switching using TRACG for most of the application. This is a proven code, and for those of you who have worked with codes know that it takes 15 or 20 years before people start feeling comfortable with some of these codes, you know, and to take all the bugs out.

So this one has been around for 25 years. I remember going to Los Alamos for the first time almost 20 years ago, or 17 years ago, and talked to the people there who are using such codes.

MEMBER WALLIS: That is one of the

problems with these codes, of course. They all have the same roots.

MR. RAO: They all came from Los Alamos?

MEMBER WALLIS: That's part of the problem, yes.

MR. RAO: But we are taking the bugs out. That is why G is our last initial up here. The overall technology program is shown up here. It is a very comprehensive program. What we did was that we started with a program, and we looked at the PIRTS and looked at what the important phenomena were, and developed what the board called the test and analysis plan.

Then we ran some tests were used to qualify the computer code. We did model bias and uncertainties, and we did a scaling report, and to make sure to test for scale drive, and on the side out here we first developed the TRACG code, and learned all the creations and made sure that it could do the analysis for both the reactor vessel and the containment, and that was in your application.

And after that, you get a validated code, and then you define an application methodology for using that code, and the code can't be used just generally.

I mean, you can use it, but it has to make sense. So we have defined an application methodology. Now that is what we are asking the staff for an SER on, on the approval of the code, along with the application methodology of that code.

Then we will do the safety analysis report up here. So these are all the different elements of the technology program, and I will give you a feel for some of these so that you get a feel for how complex and comprehensive this has been. There is not enough time to go into detail, but --

MEMBER WALLIS: So part of this application is this model bias and uncertainty part, where you show how you take care of that?

MR. RAO: Right.

MEMBER KRESS: Didn't we hear that tone before?

MEMBER WALLIS: In association with something like the AOO transients or something for different reactors?

MEMBER KRESS: Yes, for the AOO transients we heard about.

MR. RAO: Yes, that is for the AOO transients, but we went beyond that. Now, this is a LOCA applications and for the containment analysis

also.

MEMBER RANSOM: It is interesting that you mentioned bugs, and one bug that we found in TRACB and TRACG came from TRACB, was when they attached a line to the vessel at somewhere other than the center of the node, they had not accounted for the hydrostatic pressure difference between the center of that node and the line attachment.

And I am wondering was that corrected in TRACG?

MR. RAO: I am not knowledgeable enough to answer that.

MEMBER RANSOM: Is Bharat here?

MR. RAO: Bharat had to take an earlier fight and he is gone for the day.

MEMBER RANSOM: I am wondering if -- well, you didn't bring Bharat?

MR. RAO: We did bring him, but he was on an earlier flight. The meeting was in the morning, and he had planned to be at the morning meeting. In fact, one of the reasons that I am looking at my watch is not only that I have to not exceed my time, but I have a flight to catch. I will finish on time.

MEMBER KRESS: Could you tell us just a little more about the application methodology.

MR. LANDRY: From what we have seen, yes, our understanding that has been corrected. But we will look just to be further just to be sure. Our understanding of it right now is that it has been corrected.

MEMBER KRESS: Just a few words by what you mean by the application method on it.

MR. RAO: Okay. I have a few more charts to describe, but basically you take a computer code, and how do you account for the uncertainties.

MEMBER KRESS: Oh, that sort of thing?

MR. RAO: Yes, that sort of thing. This is a realistic code. How do you account for the plant parameters, for example.

CHAIRMAN BONACA: And the nodalization and sensitivities, and all of that.

MR. RAO: The nodalization, yes, and what we did -- and so what I am going to do is just go over some of these boxes, and give you a feel for what we have done. It will just give you a feel.

If you want me to cover all of these charts in detail, they are in your handouts. First, we developed an overall test and analysis plan, which consisted of going over the governing phenomena, and doing PIRT, to bottom-up, and top-down processes. We

looked at the highly ranked phenomena, and --

MEMBER KRESS: Where did you get your experts for the PIRT?

MR. RAO: The PIRT experts came from BWR experts who have been working with us over the years on --

MEMBER KRESS: They are GE employees?

MR. RAO: It was GE employees, but we had other people also.

MEMBER WALLIS: You even had a professor.

MR. RAO: We even had a professor.

MEMBER ROSEN: Which just shows that they are not excluded.

MR. RAO: He used to teach at Berkeley.

MEMBER KRESS: That makes it a academic exercise, I guess.

MR. RAO: So we followed a rigorous process to define the technology plan. It is very extensive, and I have taken out all the tables that we had prepared for that.

That was initially done for the ESBWR, and then when we came to applying it to the ESBWR, we said let's look at the differences between the ESBWR and SBWR. This is a summary of the differences between the ESBWR and SBWR.

We basically increased the power, which has affected several things, and we did change the plant systems and the buildings. Like I mentioned, we increased the number of steam lines from 2 to 4, and we increased the number of bundles.

We changed the height also. The SBWR was 2.7 meters, and we have gone to 3 meters on this one. We have added more isolation condensers. As you were told before, we did not just go up in power. We added more decay heat removal systems to the plant, and it was not just a power uprate.

We increased the -- the fashionable thing is to get another 5 or 10 percent, or 20 percent more, out of the same system. We added capacity. We increased the isolation condenser capacity by 50 percent.

We increased the decay heat removal capacity by 80 percent. We basically now have four units, and we previously had three units, and we increased the size of the units.

So one of the good things about this design is it is fairly easy for us to add more decay heat removal capacity, because we are not removing it from the containment boundary, or from the vessel boundary like some of the liquid metal or gas

reactors. We are removing it through heat exchanges.

And those heat exchangers are -- they are not cheap, but we increased the size of the units.

MEMBER KRESS: Let me ask you a question. In your test and analysis program that you did for SBWRs to qualify the TRACG, you developed a scaling process using PI groups.

Was your PI group acceptance criteria the same for SPWR as it is for the ESPWR?

MR. RAO: We have the scaling expert here.

MR. GAMBLE: Hi, Bob Gamble from GE. There was actually a very subjective criteria used on the SPWR. There was no quantified value.

MEMBER KRESS: You didn't use from 5 to 2?

MR. GAMBLE: No, that kind of developed I think through the AP-600 program. Prior to that, no one had really come up with the idea of a quantified criteria.

So seeing that, we adopted it, and ours is slightly different than theirs. So now we have --

MEMBER KRESS: Now you have on-third to three.

MR. GAMBLE: Correct.

MEMBER KRESS: But my question is whether that is different than what you used for SPWR?

MR. GAMBLE: In SPWR, we just looked at the PI groups and subjectively argued whether they were close enough or not. There was no criteria.

MEMBER KRESS: So you had no criteria?

MR. GAMBLE: Correct.

MR. RAO: What we did on the plant systems and buildings was we did increase the system sizes and capacities, but we did not increase the numbers. For example, the reactor water cleanup system was a two-train system, and it is still a two-train system, and the fuel cooling system was a two-train system. It is still the same, except that it is bigger pumps, and bigger pipes.

We did utilize a little innovation, and again not hi-tech stuff, but innovation. We used the pools when they empty out, it opens up air space, and that can help us reduce the containment pressure following an accident.

So we basically are taking credit for that, which gave us an additional 15 percent increase in retro volume, which then translates into 15 percent lower containment pressure following an accident, which then allows us to reduce our design pressure by about 15 percent, and make it the same as the ABWR now.

So we are now in the same range, and there is a whole trust out here to make us the same as ABWR, because we use everything the same. And that was one of the advantages of what we did out here.

We did do a major building optimization, including transferring non-safety systems out of the safety grade buildings. So that is one of the reasons that we reduced the size of the safety grade building, and we also ended up in a different building for the spent fuel storage.

But the bottom line of all of this is that the differences do not affect the governing phenomena for normal operation transients and accidents. It is pretty much the same as the SBWR when you look at it from a hydraulics point of view.

So that program that I mentioned earlier which defined what was needed to qualify the code for all the different phenomena, resulted in a test program. This shows you the results of the test program, and there is not enough time to cover all of them.

You can see that they were best done at different scales and at different facilities, and by different organizations, and a very extensive test program all over the world.

MEMBER WALLIS: Well, a thousand scale doesn't mean that it is something like using a little matchbox car model and a model Cadillac. It means that it was pretty well full height isn't it?

MR. RAO: Exactly. When you see the last one, the PAMDA is the biggest test facility that we have got. It is a full high test facility, and it is 1/50th --

MEMBER WALLIS: It is a thousandth in cross-sectional -- well, what is the one-thousandth part? Is it the thousandth in cross-sectional area? Because the thousandth in linear dimension is sort of absurd.

MR. RAO: That is the full height, and power also. It is power and you can look at it at one-thousandth power. This facility is a huge facility. I think it is the biggest test facility for testing safety systems, and it is full height, which is about 27 meters I think from top to bottom.

CHAIRMAN BONACA: Is it a GE facility?

MR. RAO: No, it is owned by Paul Sheridan Steel in Switzerland.

CHAIRMAN BONACA: Oh, I see.

MR. RAO: This is the depressurization valve.

MEMBER WALLIS: Which one is it, that big one?

MR. RAO: This one.

MEMBER SHACK: Oh, this is the promise that you made before.

MR. RAO: This is the squib valve. This is the actual valve, and in a sense it is a rupture disk. Well, rupture disk gives the wrong impression. It is sheared off.

MEMBER ROSEN: Do you in some place use the reliability of that in the PRA?

MR. RAO: Of course. We have done a test program.

MEMBER ROSEN: And have you got the data for how reliable this valve is from that?

MR. RAO: Yes.

MEMBER LEITCH: How many did you do, one tests, two tests, 10 tests, a thousand tests?

MR. RAO: Ten.

MEMBER LEITCH: And they all passed, I assume? Then you extrapolated from that.

MR. RAO: Yes, there is a whole test report on that, a 500 page report that has been done, and we can share that with you. I know that you asked the other guys the same questions.

MEMBER LEITCH: It seems like a pretty good question to me. If you are going to build a big break LOCA into your system, you ought to make sure that when you want it, you get it; and when you don't, you don't.

MEMBER LEITCH: And how many of those are there?

MR. RAO: Six.

MEMBER LEITCH: Six conventional relief valves?

MR. RAO: Well, 12. So this is the full scale DPV, and that was done somewhere in Southern California, I believe. This is the facility in California which was tested and it shows that water flows down in California by gravity also.

This was the vacuum breaker full-scale test, and this is the test facility in Switzerland for the integral testing of the DPV systems. This is a full-scale decay heat removal condenser.

MEMBER ROSEN: When you did the reactor to the depressurization test, you gave out ear plugs to everyone?

MR. RAO: Yes, I think it was out there somewhere.

MEMBER WALLIS: Now, Atam, this is nice to

know that these exist. Now the real question is whether or not this program is adequate enough to support the future licensing of the plant like this, and the only way we can determine that is to go into details, which you are not going to present today.

MR. RAO: Right.

MEMBER WALLIS: So this is very much an overview.

MR. RAO: It is an overview. The details, like you said, the reports are, oh, 5,000 pages.

MEMBER WALLIS: But the justification of why this is adequate would take us some time to evaluate, I think.

MR. RAO: That is definitely the case, and that is why the staff is reading them and they are doing a yeoman's job of going through them. I mean, the number of pages of the reports, it is extensive.

I am just trying to give you an overview. But it is a lot of pages. These days it now fits on CDs, and so it a lot of CDs.

MEMBER WALLIS: But is there some sort of executive summary that says why these number of tests is adequate, and these facilities are adequate? Is there some sort of concise argument that would satisfy us, or do we have to read through all these reports?

MR. RAO: You will probably have to read the TAPD, which is the --

MEMBER WALLIS: Which is the central thing to go to?

MR. RAO: Yes. That is the one that gives the overall plant and lays out the road map. That is a fairly comprehensive document. It is not that long, 300 or 400 pages.

There were additional tests done that we have qualified the TRACG computer code against, and in fact some were performed after the SPWR program was terminated, and we recall the PAMDA P-Series test, and there was some done also in Japan at a test facility run by CRIEPI.

MEMBER WALLIS: But this is an Ontario hydro test isn't it, which is rather important for the chimney? Or is that the CRIEPI?

MR. RAO: Well, we list all of them there.

MEMBER WALLIS: Okay. You did not list them on that previous slide.

MR. RAO: So this shows some of the tests that were done showing the same test program. The previous chart listed all the tests, and the qualification report is about a thousand pages. It is two volumes.

So it is a huge report. And it covers a lot of tests. You can see the circulation of the vessel, and we looked at separate performers, and chimney wide fraction, and this was the testing done in Canada.

And the start-up flow oscillation, and mixing, and it is an extensive test program, and we went about it systematically trying to fill in the holes that we had found.

I can tell you the history about the chimney design also. Initially, we started off with an open chimney, and no partitions, and all that we had at that time was some published Russian data.

We had to read it off a little report paper,a nd we said, gee, that is not enough, and so that is when we went with partitions, and that's when we initiated the testing in those many items.

So we went about it systematically. Whether it was natural circulation, or the containment and safety system technology, you can see that we did a lot of testing. Individual fuel condensation, and look at all the test facilities that were involved.

Some were at MIT, U.C. at Berkeley, and GIRAFFE was in Japan, and PANTHER was in Italy;a nd PAMDA was in Switzerland. We looked at the

performance of the heat exchangers, and looked at system interaction, and we looked at suppression pool stratification, and stratification of the drywell and looked at quenching.

We supplemented these. No, there were tests that were done in other organizations which extended the database that was done for the SPWR, which covered even more severe conditions than had been tested before.

MEMBER WALLIS: So you had systems that actually simulated entire transients?

MR. RAO: We covered -- there was no one test that covered it all from zero to the end, but we had a level that has given us confidence, and we covered all the bases.

MEMBER RANSOM: Atam, did you find that the chimneys were really necessary, the partitions in the chimney to overcome geysering or slugging in the open arrangement?

MR. RAO: No, we didn't add the chimneys for the geysering concerns. We added them just because of the uncertainties associated with an open chimney during --

MEMBER RANSOM: So you don't really know whether you need them or not then?

MR. RAO: Right. In fact, there was a long debate when we were deciding to put in the partitions, and we said that we would put them in and be conservative with that, and if you don't need them after some time, then we can take them out.

MEMBER WALLIS: I would think that you would need them.

MR. RAO: We put them in because that area is --

MEMBER RANSOM: Well, you mentioned the Russian data. What did that concern? I mean, did it concern the need for them, or --

MR. RAO: No, no, that was just a void fraction in general. It was very small. It was much smaller than the interior hydro channels.

MEMBER WALLIS: Now, were these short big vessels where the steam tends to go up one side and get a non-uniform flow?

MR. RAO: Well, we put the channels in there.

MEMBER WALLIS: We don't need to discuss it.

MR. RAO: Then what we did was we ran these tests, and then we compared the TRACG computer code, and this shows the next couple of plots. It is

hard to read all of this, but I just wanted to give you a feel for it.

What we did was that we compared the TRACG against several test data and this was a component data, and Patsy did a dam good job. You can see how here different tests out here, and this high condensables, and this is only with steam.

Again, not enough time to go into all of these, but what you can see is that TRAC does a dam good job. It helped us define the bias of the uncertainties and the predictions using TRAC as a realistic code.

MEMBER WALLIS: There is no tuning of TRAC?

MR. RAO: No tuning of TRAC. These were TRACG predictions of integral tests, and a prediction of the drywell and the wetwell pressure, and the dashed line is TRACG. It is hard to see that in the actual pictures.

It does a dam good job of that. Another figure of merit is this calculation of the amount of energy removed in this integral test, and that is measured by the pool level in the PCCs, and you can see that it does a dam good job of that.

It misses a few details shown out here.

This is the flow into each of the three PCCs. In this particular test facility, there were three PCCs, and two of them removed more energy than the other one, and one actually sort of went to sleep is what we call it.

But the integral performance is pretty good. So in summary we had a comprehensive, well efficient program, and like you said, it is a thousand page report, and what we call the base qualification of the capacity systems.

We did another qualification report, which is about another 400 or 500 page report. So this is about 1,500 or 2,000 pages worth of qualification that the staff is reading.

They are fast readers and they are on a tight schedule, and they have done a great job on that.

MEMBER WALLIS: But you have not replied to the RAIs?

MR. RAO: We are doing it. We are working together.

MEMBER WALLIS: Since you are saying all the good things that you have done, I had to remind you of that.

MR. RAO: No, we will reply to the RAIs.

We provided draft responses to some of those questions, and we provided draft responses to about a hundred I think out of those 300, and so it is now just a question of formalizing the responses. So it is doing well, believe me. Trust me.

MEMBER WALLIS: Fatal words.

MR. RAO: We want the staff SER on October 15th,a nd so we will do whatever it takes to make that happen. We want closure, okay? This shows the effective scale of different test facilities, and again it is hard to see. These are different test facilities, and they are at very, very different scales.

They are 1-by-1,000, and 1-by-50, and some with helium and some without helium. This was -- you can't see any of the details out here, but what you can see is that they all follow along this line out here, which shows that they are pretty close to what we expected them to show. This was the components for the --

MEMBER WALLIS: Now, what we said at the subcommittee was that it would really be nice since TRACG is what is in question here, if you had TRACG predictions with all of these results, and that comparison is going to be very well made in your

application, right?

MR. RAO: We are focusing right now on answering the RAIs, and after that we will put that on the things to do. So these are tests at different scales. You know, very different scales.

These components, you know, these were the heat exchangers, and some of these were full-scale, and some of them were a slice, some of them were just three cubes. So you can see that the performance is --

MEMBER WALLIS: Scaling works is what you are saying.

MR. RAO: Yes, scaling does work. In summary, for the technology program, what you see is that we have improved the performance by design features, and we have used qualified methods basically. What we are doing -- and this is where I describe what we are doing in the application methodology.

It is basically used for calculations and this is something that we have already reviewed. We are using realistic calculations and with simplified accounting of uncertainties.

Until 2 days ago, we were using bounding -- no conservative calculations for the containment and

the LOCA. So what we have done is that we are accounting for the uncertainties.

And we can use a simplified accounting of the uncertainties of this design, because we have got lots of margin. Remember that the core, the minimum water level is about 9 feet above the top of the active fuel. The core is not even uncovered in a loss of coolant accident. There is a lot of margin in this plant.

And that is what I was talking about. Why does the core remain covered? As is shown on this chart, this is the ESBWR vessel and this is ABWR vessel, and in the core, you can see that it is lower in the vessel of this plant.

And when you have a bigger vessel, you have got actually more water. What you want to do is have a lot of water above the top of the active fuel. So one of the reasons that you have got water by the top is that it is going to be less.

MEMBER LEITCH: One of the features of the present design, the present fleet with the jet pumps is that you have two-thirds core coverage even with a LOCA.

Now in this situation, you don't really have any ensuring of core coverage with a LOCA, just

depending on the fact that you have few and smaller lines below the core?

MR. RAO: No, this one is a lot better than any other plant, period, because you can fill up -- let me go back to a question from before. Well, that one is a new one. This is as good as any, and it shows the answer.

What happens is that you can fill up the lower drywell in the vessel to the top of the active fuel, about two-thirds correct, to the top of the active fuel. It is a closed system, and so you will always keep that core covered.

It doesn't take any fancy calculation. You just take all the breaks and the water flows from there, and what has happened in this plant is this lower drywell volume is only 700 cubic meters, okay?

The lower drywell volume in all these plants is huge. You can't flood the outside, okay? So you can talk about filling it up to two-thirds of core height, but the outside is empty.

On this one, not only is the inside full, but the outside is all full of water. So you are assured of core coverage on this one.

MEMBER WALLIS: As long as you remove the heat?

MR. RAO: Yes, decay heat removal goes out through those passive heat exchangers. I mean, there is no moving parts there. I know that I am not giving you a convincing answer.

MEMBER LEITCH: I have to think about it for a little bit. Go ahead.

MR. RAO: You know, if you just look at this, this is drawn to scale. This is only 700 cubic meters down here to the top of that. And that is a thousand cubic meters over there and that pool is not showing up there.

MEMBER LEITCH: Yes, but you are relying on a safety system to fill it up?

MR. RAO: Well, that is how you keep two-thirds core in the operating plants, too. You have a safety system. The safety system is the gravity driven pool. That's all it is. It is not anything more complex than that.

So what you see in this plant is the water volume that is a true measure of how well this plant behaves, you have got about 2=to-2-1/2 times as much water as any of the operating plants.

MEMBER LEITCH: In the vessel.

MR. RAO: In the vessel, yes. And the other thing is that not only do you have more water,

but you have got a larger steam volume. Remember that I mentioned this, that you have and 80 percent void in the chimney.

So when you get a reactor isolation, the transient response is a lot better. You have got twice as much steam volume, and so you have got about half the pressure rate in the standard operating plant.

This shows what happens to the water. Initially, the water -- this is from a TRACG nodalization, and initially the water is on the outside of the stand pipes, and the downcomer, and in the core region.

The chimney is voided, and when you get to reactor isolation, this water basically comes down and fills out the downcomer, and fills up the chimney region. And that fills up the water level to about 8 meters.

So that's how much water there is in the vessel. There is a lot of water. This shows the plant response, comparing different plants. You can see that the ESPWR has a lot more margin than past plants.

This is the water level above the top of the active fuel following a pipe break. The jet pump

plants, I was more generous to them, and showed them recovering from the top of the active fuel, rather than two-third core height.

And the ABWR doesn't uncover, because it does not have any large pipes, and recovers because you inject water. And these have to be done in the 100 or 120, or 200 seconds. Very fast. Some of the earlier plants were a lot faster than that.

In this plant, the water level initiative drops because the water comes from outside the shroud and into the core region, and so that is why you see a drop in the water level.

Then you get flashing and depressurization, and then the water level slowly -- it takes about 600 seconds before you get to the minimum water level, and that is when the water starts flowing in by gravity. The pressure is lower enough in the vessel and it starts running water makeup, and it does not recover as fast. These ones come back really fast.

This one, because the gravity flow is not as fast, it doesn't need to come up any faster, but the core is still covered. So what it shows is that this plant is a lot more forgiving, and the other thing to notice is that when we went out from SBWR to

ESPWR, we actually improved the response.

So it is not just a power uprate where you lead into the margins. We have actually retained them the margins that we had, and maybe got a little better.

So this is a picture of some of the hundreds of pages that I keep mentioning that we submitted to the staff to basically give us approval that we know how we calculate the plant response out here. It is reasonable, and some of this stuff can be done in the back of an automobile.

But this does give us confidence that what we are getting out the code is good. Where we are on the overall status, and I am down to my last two charts, is we had made extensive submittals to the NRC in 2002, and we had several meetings and conference calls interactions, and in fact we met yesterday and we met this morning.

The NRC staff has done an extensive and thorough review of about 300 plus RAIs, and a few more that are coming fairly shortly. According to the plan, final responses by GE are due by August 15th, and we will meet those dates.

The draft DSER is due mid-October, and I believe it will come back to the ACRS and the thermal

hydraulics committee before we get the final safety evaluation report.

And we are trying to work out a schedule for additional application submittals governing ATWS stability, and the AOO is sort of in between this submittal and additional RAIs.

MEMBER WALLIS: So the big date for you is sometime in October is it? When is the big date for you when we are going to see you again?

MEMBER WALLIS: Sometime after October 15th, after the draft SER. I think they are trying for sometime in November.

MS. CUBBAGE: We are planning for the subcommittee.

MEMBER WALLIS: So we have got plenty of time to do our homework haven't we?

MR. RAO: It is good summer reading. After that, we will do the preparation of the SAR, and the certification, and we are expecting FDA approval in 24 months after the submittal.

And Dana challenged me when I came to the ACRS a few years ago, he says make your submittals and see what the new NRC will do. And by the time that we make the submittal they become 12 months.

The charges for the coming month is to

make sure that GE responses are timely and complete, and that we get -- they are looking for complete technology closure with no open items.

We believe that we have done an extensive program, and we have been responsive to the RAIs, and we believe it is a good complete program. With a 50 plus year technology and design program, and this is a BWR with less components that you need to analyze.

It is easy to understand the safety response. The analysis is simplified and basically our goal is that this is a program that is made and run by industry and it is not funded by the government or any other organizations.

It is an industry-run program, and minimizing the regulatory risks is one of the key factors in going forward with this. And both the company is committed to this, and interested parties are really interested in this design. So, thank you.

MEMBER LEITCH: You have not discussed any ventilation systems here. Is that on GE's scope of supply?

MR. RAO: No, we didn't discuss the ventilation system. I focused primarily on the stuff that is related to the TRACG approval, and things that were on the table. There is a whole lot of stuff that

we did not discuss, such as structures, and materials, and others.

MEMBER LEITCH: But when you say there is no diesel, some of those ventilation systems are safety grade systems that need diesels?

MR. RAO: No. Remember that the ECCS systems are all inside and they need no cooling. Nothing is needed for those.

MEMBER ROSEN: No stand-by gas treatments?

MR. RAO: No stand-by gas treatments, and so none of those -- that is the advantage of greater passive systems. You get rid of the whole HVAC, and you get rid of all the water systems. It really does simplify the plant.

It is hard to imagine getting something simpler than this. When we did our cost estimate, you will see -- well, we won't share that obviously, but if you order a plant, we could provide you one. But you can see, and I would like to say that we have essentially got the safety systems for free, because what it is, is a few tanks of water, and a few valves connecting them to the vessel.

And when you look at the design of the containment, and in fact we were actually planning to reduce the design threshold to even lower than that

for the ABWR.

But our structure people told us that you don't save anything by reducing the design pressure any further. So we kept it the same as the ABWR, because there are other considerations, like shielding, and just holding up the equipment of the building.

MEMBER ROSEN: It would be good to hold it up.

MR. RAO: Yes, you have got to hold it up, and so in a sense we have got the containment, and the safety systems for free.

MEMBER RANSOM: What is the regulatory risk that you refer to? I mean, just getting it through the process?

MR. RAO: Getting it through the process. You can see how long --

MEMBER RANSOM: Is there any reason why you think that would be unusual?

MR. RAO: Well, we got burned in the earlier days on the SPWR, and I am not trying to find fault with anyone. Like you said, there is enough fault for us, and there is enough fault on the NRC side, or even our sponsor's side, okay?

So there we did things in parallel. We

have adopted a step-wise approach, which has minimized what we are doing out here. We don't go to the next step until we have a draft SER, and that is what we are trying to do.

We won't go to the SAR and certification until we know that we have got testing and the core is approved. We won't go to the COL stage until we have got the draft SER, and the SAR, or the certifications. So that is what we are talking about when we say we want to make sure that we can get closure.

MEMBER ROSEN: What about the fuel? Is it the same?

MR. RAO: It is the standard fuel. It will be standard. It will keep changing, and the way it works is that basically you use the latest fuel design that is developed. And it has a much shorter cycle life than the vessel in the plant.

CHAIRMAN BONACA: Shorter bound.

MR. RAO: Yes.

MEMBER ROSEN: What do you foresee in terms of plant orders? I mean, or the possibility of plant orders.

MR. RAO: We can't get into plant orders, but what we want to do is to be sure that we are ready when the issue comes up, and that is the reason that

we started this process obviously, because our feeling was that we need to start getting ready because thee is a lot of stirring and people are showing interest, and we want to make sure that this is the plant of choice.

But again you might have heard some presentations at the ANS meeting, where a utility person stood up and plotted a chart of costs versus this. The cost of the X-axis is this, and Y-axis, and made a 9-by-9 block thing, and he put different plants on that.

And the ESBWR was on the low cost block, but he had the risk high because we didn't have some of the regulatory approvals. And so that is one that is easy to do. Costs sometimes cannot be fixed, and to come down and you can reduce the risk.

So the way the utilities make a decision is cost and risk.

MEMBER KRESS: We are talking about economic risk.

MR. RAO: Yes, commercial risk. You start on the process --

MEMBER KRESS: And you may not every get over it.

MR. RAO: But definitely not a safety

risk.

MEMBER KRESS: I knew that couldn't be right.

MR. RAO: An economic risk, a commercial risk.

MEMBER KRESS: Yes, commercial.

CHAIRMAN BONACA: Okay.

MEMBER WALLIS: And this is no letter or anything like that involved?

MEMBER KRESS: I can't see any point for a letter at this point, at this time. I think we are just getting our feet wet on this certification process, and it is a good start.

I think we know a lot now and know what the process is, and I don't know when the right time for a letter from us is, unless you guys have heard something that you think is pathological about this.

MEMBER WALLIS: Well, the thing is, this is a very optimistic and impressive presentation, and it is also that the time scale has not been distorted, and you stayed within your time.

And the thing that I just don't know yet is if there are technical issues. If there are some sort of major things that we are going to have to think about. We just don't know yet.

MEMBER KRESS: Well, clearly if there are, they would lie in the realm of has there been enough testing to qualify TRACG, and does TRACG do the job.

MEMBER WALLIS: That's right.

MEMBER KRESS: And I don't think we know enough about the test results. We know a lot about the program now to make a judgment.

MEMBER WALLIS: We don't know the quality of the documentation yet.

MEMBER KRESS: We have not looked at it very closely.

MEMBER WALLIS: And if the quality is too bad, we just won't read beyond page 2 or something.

MEMBER SIEBER: Well, the road map is going to be the SER.

MEMBER KRESS: I think the SER is it.

MEMBER SIEBER: So whatever we do, we are going to do after we see a draft SER.

MEMBER WALLIS: Well, we are going to have to look at some documentation before we see the SER.

MEMBER SIEBER: That's right.

MEMBER KRESS: Oh, yeah, we will have to read some of this, but at this point I see nothing pathological that requires us --

MEMBER WALLIS: It is conceivable that

some of us in reading the documentation may come up with significant points.

MEMBER KRESS: Yes.

MEMBER WALLIS: I mean, we don't want to just wait until November.

MEMBER KRESS: No, the sooner they know this, the better, if there is such a thing.

MEMBER WALLIS: But if we did have points that we need to delve into, can we communicate with the staff?

MEMBER KRESS: Yes, definitely. I think it is incumbent on us to get started reviewing the TRACG documentation.

MEMBER ROSEN: And how about the test documentation?

MEMBER KRESS: And the test documentation.

MEMBER ROSEN: How do we get this stuff? Do you make it available to the staff?

MEMBER KRESS: We have a CD of it.

MEMBER ROSEN: Does it contain all the test reports?

MEMBER KRESS: Well, I don't know if all of them are there, but there were a lot of them there.

MR. CARUSO: Steve, this is Ralph Caruso. I believe that includes everything. Everything that

the staff has, all the members have. It is all on that CD.

MEMBER ROSEN: Okay.

MR. CARUSO: I understand that there are some members that have a problem opening some files, and we will talk to you about that. We will figure out how to deal with that.

MR. RAO: And that is a 400 page report on that valve.

MEMBER ROSEN: And it is on the CD, Ralph tells me?

MR. RAO: Yes.

MEMBER ROSEN: I have not opened the CD or even tried yet. But I will.

MEMBER SIEBER: I did.

MEMBER KRESS: Unless you guys have got more to say, I guess I will turn it back to you.

CHAIRMAN BONACA: Thank you. All right. Thank you very much for the presentation. It was very informative. With that, we will now take a break until 3:00 p.m.

(Whereupon, at 2:41 p.m., the meeting was recessed and resumed at 3:05 p.m.)

CHAIRMAN BONACA: The meeting is called back to order. The next item on the agenda is the

Expert Elicitation in Support of Risk-Informing 10 CFR 50.46, and that is -- I see here Dr. Shack.

MEMBER SHACK: Well, as most of you are aware, there was certainly an effort to develop a risk informed alternative to the present maximum LOCA break size, and the staff is looking at ways to characterize LOCA frequencies.

I think eventually we will have an SRM that directs you to a reconciliation of LOCA frequency distributions based on service data, probablistic fraction mechanics.

And since one has a very, very -- fortunately one has a very weak database for large break LOCA events, expert elicitation to somehow converge the results and get some handle on it. And they are in the midst now of their expert elicitation, and Robert Tregoning is going to give us an update of how they are going about the expert elicitation.

And we have a number of very elicit members who are highly experienced in this arcane art.

MR. TREGONING: That is what I am banking on.

MR. NEWBERRY: Before Rob gets going, I am Scott Newberry from the Office of Research, Risk Assessment staff, and Rob's presentation, like Dr.

Shack said, is focused on the expert elicitation of a much larger activity to risk-informing 10 CFR 50.46.

And as was indicated, there is a recent March SRMs which many of you may have read. It is quite an SRM, and I think I just wanted to put some context on the briefing here.

There is considerable activity wrapping up now as a result of the SRM. Eileen McKenna is here in case you have questions or thoughts on the rule making, which is beginning to pick up as I said.

So there are staff on the NRR working on all aspects of the rule, as is my staff in research. And all three divisions are thinking about what a rule would look like.

The industry is working as well. There was a meeting just here this last month with licensees and NEI, where they are thinking of submitting material that would relate to other aspects of the rule, and considerations of the loss of off-site power requirement in the rule.

And these interactions will proceed. So I just wanted to comment that there is a lot of aspects going into 50.46. Eileen and Hossein are here in case the committee wants to ask a question that might be outside of Rob's area. He is focusing on the

expert elicitation and I am sure that we are going to be here quite a few times talking about all of these aspects. So we are glad to be here.

MR. TREGONING: Thanks, Scott. As both Scott and Bill mentioned, it is a very broad and challenging effort that the Office of Research and NRR are undertaking, and today we are really looking at a piece of that effort.

It is a piece that we have been looking at for quite some time, and so technically we have been thinking about it for a while, and we have been planning and developing issues and frameworks, and things like that, to deal with the specific issues.

So this seemed like a really opportune time given where we were in the schedule, and given people's interest, to come in and discuss at least one very important technical phase in the project.

Certainly not the only, but one of the necessary technical phases in the process, and this is an expert elicitation that we are conducting in support of this broader effort to look at redevelopment of a full spectrum of LOCA frequencies that we would use to support this risk-informed reevaluation effort.

So I don't want to forget Lee, who is also

here. So any messy statistical or elicitation questions, I am just going to cede the floor at that point, and maybe duck into the hallway get Lee up here to answer those.

So I will be fielding any easy and general questions and any specific questions, Lee is back here to handle the really tough ones. Just an update of what you all have heard just to refresh everyone's memories, and what's happened since the last briefing?

The last time we came in to talk about this was a little over a year ago, May of 2002. This was a combined subcommittee meeting, Materials Thermal hydraulics and the PRA folks, and we told you about the interim LOCA frequency elicitation effort that we had recently finished.

This first effort was in support of the ECCS reliability-feasibility study that was really one of the initial components that kicked off the 10 CFR 50.46 effort. So we focused primarily on this interim solicitation, and how we conducted it, and what the results were.

But we also gave you some of the broader plans that we had at the time for redefining the LOCA break size. We discussed conceptually at least the elicitation, and I got some good feedback from ACRS at

the time.

We certainly tried to incorporate and implement as much of that feedback as had been possible. So this was really a good fundamental building meeting that we had last year.

But really even prior to last year, we have been talking about and thinking about this all the way back, a couple of years back, back in March of 2001, when I think we were first here talking about the technical reasons of why we needed to go about doing this LOCA reevaluation.

So what has happened since May 2002, and I am just going to highlight a couple of the milestones right now, and we will certainly go into much more detail about all of these milestones throughout the presentation.

But some of the more significant things. We have actually selected our expert panel and facilitation team that are going to be conducting and participating in the elicitation.

We have had the kick-off meeting for the elicitation effort. This was February 2 through 4 of this year. Again, these are roughly chronological order. So this was done in about November, and this was in February.

As Scott mentioned, in March, we had the SRM issued on the Option 3 plan for risk informing 10 CFR 50.46, Appendix K and GDC-35, of which the LOCA redefinition was one of four pieces of that.

And certainly a focus of the SRM, if you look at the SRM, as many of you have, even though LOCA redefinition is only again 1 of 4 of the areas that is being evaluated in this risk-informed reevaluation, it occupied about 80 to 90 percent of the SRM, with a lot of very specific direction from the Commission.

So the Commission has obviously some very strong view points and very detailed view points on how we needed to proceed in this area. So this was an important milestone, and it focused to reevaluate the plans that we have up until now, and to make sure that we have incorporated the Commission's direction within those plans.

After that, we have had a second meeting with the expert panel and the facilitation team, where we reviewed some interim results that we had, and this was really a final meeting before we go into the elicitations themselves.

We had this meeting -- this was a two day meeting that was held last month, the first week in June, and then finally since then, and this is again

a broader meeting, and we had a broader public meeting to discuss the 10 CFR 50.46 effort.

This was a little bit -- a couple of weeks after this meeting, and the elicitation was also discussed there. So a lot has happened since the last time that we were here.

MEMBER WALLIS: This public meeting, did you have many representatives other than industrial people?

MR. TREGONING: We had one didn't we? Anybody other than industry at the public meeting; didn't we have one? It was primarily NEI and the owners groups.

MEMBER WALLIS: Because I would think that any revision of the LOCA definition would be of interest to certain sectors of the public.

MR. TREGONING: That public meeting was broader than that. It was the 50.46 effort in general. So with that meeting, we only briefly touched on the elicitation effort. Maybe a couple of minutes in the meeting.

It dealt more with the SRM in general, and what the framework of --

MEMBER WALLIS: So the timing isn't right for the public to get involved?

MR. TREGONING: Well, once we get a little bit further on the elicitation, there will certainly be some more public meetings dealing specifically with that.

So let me summarize where we are at, and again we will get into more detail on all of these, but I just wanted to pick some of the big picture bullets here of where we are at in the elicitation, and we will get into a lot of these in much more detail as we go.

But at least -- and this one is my opinion, and I hope that it is management's opinion, and hopefully ACRS opinions at the end of the day, but I really feel like the elicitation objective and the approach that we are following is consistent with the guidance that we got in the SRM for the development of LOCA frequencies.

And I use the term near-term here, because if you look at the SRM, and I will put some of the salient features up from the SRM in a minute, they talk about looking only for the next 10 years or so. So that is what I mean when I say in the near term, sort of now and into the near future for these LOCA frequencies.

The elicitation effort is structured in

such a way that we will get LOCA frequencies as a function of leak rate and operating time. Leak rate is important. We are looking at the full range of LOCAs, and now just LBLOCAs.

We think that it is important from a risk base not to look at just absolute values, but relatively how these different break sizes compare. So we think we would be remiss if we looked at a reevaluation of just the LBLOCA frequency, or LBLOCA regime, and then neglected the small break and medium break, because we would not have a consistent comparison at that point.

So we are looking at the full range, and we are looking at it as the function of an operating time, and we are considering both piping and non-piping contributions to these LOCA frequencies.

And both implicitly and explicitly looking at considerations or contributions from all modes of plant operations.

MEMBER WALLIS: And the wrong piping would be something like the Davis-Bessie event?

MR. TREGONING: Yes.

MEMBER WALLIS: I think you won't have difficulty if you come up with a conclusion that that was a very unlikely event.

MR. TREGONING: Well, if you look -- one of the big challenges in LOCA estimation in general is that it is always the -- that the surprises are the one-time events and are the things that make provide the biggest challenge at the end of the day.

And we have had a lot of discussion among the panel about that, and that it is not always the things that you know about. It is the things that you don't know about that are really the significant contributors.

MEMBER KRESS: I think it was an unlikely LOCA.

MEMBER WALLIS: Well, there was a leak. You know what I am getting at.

MEMBER KRESS: You are referring to the large break LOCA.

MR. TREGONING: I know what you are getting at, and we have done some work and had some discussion among the panel at going back over the operating experience and looking at similar one-time surprise mechanisms, things that have happened once that we don't expect, and we have good reason to expect won't happen again.

And to try to provide some rational assessment of their frequency and potential severity.

It is not an easy thing to do. I don't want to say that it is. And it is certainly a big challenge in this project. But we have certainly talked about it.

MEMBER POWERS: Maybe you will get into this later, but I am puzzled. If you have something actually that occurs that is unexpected, and suppose we put that in a class of unexpected things, stuff that happens.

And we ask a Baysian how likely is it that unexpected stuff will occur that has a high potential of leading to a large break LOCA, and you come up with a pretty high number don't you?

And you can argue perhaps to me that TMI will never occur again, but you can't argue to me that small break LOCAs never occurs again. You can argue to me that erosion of a hole in the head by boric acid will not occur, but it is difficult to argue to me that something of similar surprising character will never occur again.

And you will be glad to provide us with lists of things that degrade materials.

MR. TREGONING: Of course, and what we have tried to do in this exercise, at least again very explicitly, is to look at the -- and I will get into this in more detail, but to look at the areas within

the plant that are LOCA sensitive.

Think about the systems, and think about the degradation mechanisms that could occur. Think about the loading that could occur, both typical and surprise,a nd try to consolidate all that information and make an assessment as to how likely you think that those specific sets of conditions are.

And given the likelihood that they occur how severe they will be after the fact.

MEMBER POWERS: Well, doesn't the Baysian estimate give you a floor under your frequency?

MR. TREGONING: The thing with the Baysian estimate, what you can do easily I would grant you, is that you can add all of the surprise mechanisms that you have had in your PI and get a frequency of surprise mechanisms.

What is harder is finding the conditional LOCA severity for those given surprise mechanisms. I can say that with pretty good certitude because we are trying to analyze Davis-Bessie now for almost a year, and we have put a lot of time and resource into it, and I think we are finally coming closer now to understanding or having an assessment which is somewhat realistic.

But I don't know that every event has

received that same scrutiny or it is even possible.

MEMBER WALLIS: Well, to go on now, both TMI and David-Bessie had human behavior aspects, and I am not quite sure how you are going to take account of that in your studies.

MR. TREGONING: Hopefully that will come out later. I do talk about that, and we get into that in another slide. So I am sure that we will have some more discussion when we get to that point.

The other thing that we are looking at is -- and I am calling them emergency faulting, but those one-time loads that are unlikely over the operating history of a plant. Things like earthquake loadings, and very large transients, and very large water hammer transients.

We are not trying to analyze their frequencies in the elicitation, but we are trying to say that given this loading what is the conditional LOCA probability.

We are specifically avoiding analyzing the frequencies in this effort because there has been again over the history of the nuclear power industry a lot of work looking at analyzing frequencies, and we don't want to supersede that.

MEMBER WALLIS: And you are avoiding this

one?

MR. TREGONING: We are not avoiding it. We are trying to -- what we are trying to do is to provide information or tools that can be combined with that past work to determine the final LOCA probability.

MEMBER WALLIS: Does this include sabotage, terrorism, and that kind of thing?

MR. TREGONING: What we are doing at this point is again we are defining loadings at a certain magnitude on the pipe. Now how you get that loading could --

MEMBER WALLIS: Could be caused by a terrorist?

MR. TREGONING: -- be a variety of reasons, okay?

MEMBER WALLIS: And that is being included?

MR. TREGONING: Again, we are defining the loadings because we are trying to make sure that we have a scope that we can deal with.

We have 12 experts, and most of the experts that we have are experts in materials, and they are experts in plant operation, and they are experts in piping, and they are experts in structural

mechanics. They are experts in materials.

So we need to make sure that we have a consistent framework that the information that we get out also matches their expertise. They are not necessarily experts in terrorist activities, or the likelihood of terrorist activities.

So all we are trying to do is to give people a framework that they care comfortable, and that the experts are comfortable with. And this was one thing that we touched on for touching some of these, and again, very unlikely events that could be due to something like an earthquake, like a terrorist event.

And one way that the group decided would be the easiest to deal with, and the most consistent with our expertise.

MR. NEWBERY: Bob, let me clarify in response to one question. The question was asked are we considering terrorism events here. I think that the staff and the Commission is still looking at the guidance that we need to give on all rule making activities with respect to terrorism.

So I think that the answer is -- I would answer it no at this point.

MR. TREGONING: Not specifically.

MR. NEWBERY: Not specifically, but the SRM certainly has guidance in it relative to that, and how you would implement this rule.

MR. TREGONING: The other thing that I would add certainly is that there are other efforts within the agency that are specifically addressing that question, and that is not to say that we would certainly not to leverage against some of that work as we go on here.

CHAIRMAN BONACA: But coming back to Professor Wallis' question, the failure of relevant programs to control age mechanisms, for example, is not included in your evaluation. It is strictly engineering.

MR. TREGONING: By relevant programs what do you mean?

CHAIRMAN BONACA: Well, nothing from preventing the boric acid control program weld at Davis-Bessie.

MR. TREGONING: Well, again we look at all of these and you will see when we get into the details that we talk about for each of the degradation mechanisms that we have identified, we talk about mitigation and maintenance procedures that you would use to combat that particular degradation mechanism.

CHAIRMAN BONACA: Or preventive.

MR. TREGONING: Or preventive. Well, yes, to combat or prevent, and there is certainly an aspect of all these degradation mechanisms where there is a likelihood that they won't be carried out correctly.

That they will be carried out incorrectly and the incorrect actions will actually exercebate the problem. So, yes, we will be definitely considering that.

And again if you look back over the operating experience like you all had mentioned, and specifically those types of events that are most prominent in terms of the challenges that they give to the system.

The elicitation itself, and I will talk a little bit about the philosophy and the way that the elicitation is structured. We are combining aspects of those groups in individual elicitation as we felt it appropriate again to maximize the information that we get out of the experts, and also tailor the elicitation to their strengths.

I will talk a little bit about this. It is separate from the elicitation, and I have got this as sort of an aside if we get to it, but we also have plans in place to provide confirmatory analysis for

the solicitation, as well as develop a methodology that we can use to continually assess LOCA challenges more rigorously and more robustly as they come up in the future.

MEMBER APOSTOLAKIS: What does confirmatory analysis for the elicitation mean?

MR. TREGONING: It means that the elicitation will -- that the end result of the elicitation will be essentially LOCA frequencies as a function of break size.

MEMBER APOSTOLAKIS: And are you going to confirm that?

MR. TREGONING: We would like to confirm that by using some actual modeling, probablistic modeling. And if we get to that -- and the problem is that the probablistic modeling is going to take obviously a while to develop.

MEMBER APOSTOLAKIS: But the experts may have already used that model?

MR. TREGONING: Many of the experts have used models. There is no such model that is as comprehensive as what we are in the process of developing.

We have been working on developing predictive tools in this area for 30 or more years.

Bill Shack can give a much better history than me. But they tend to be focused on a few different systems, a few different mechanisms. We have never really tried to combine things.

MEMBER APOSTOLAKIS: Why have you guys dropped the word opinion? When you say expert elicitation now, is the elicitation expert, or are you eliciting experts? Shouldn't it be expert opinion on your elicitation, or is it too much --

MR. TREGONING: I knew that I was never going to make you happy.

MEMBER SHACK: We are on Viewgraph Number 4 of 29.

MR. TREGONING: Yes. And I will apologize up front if the terminology that I use is confusing.

MEMBER APOSTOLAKIS: Shouldn't it be an expert opinion on this thing?

MR. TREGONING: Expert opinion? We are trying to get the opinions out of the expert, and me being a non-expert in elicitation terminology, I might offend you with some of the terminology that I have used.

MEMBER APOSTOLAKIS: I just make a quick comment.

MR. TREGONING: Okay. I hesitated putting

this up there, but I figured that I had to do it, and the purpose is not to parse the SRM language, which we could spend the rest of the time that we have doing. But to just put this up there. I pulled out about the five salient points of the SRM that are related to LOCA frequency evaluation.

And what I want to do is to use this as a framework for how we think we are meeting this guidance, and I am going to spend most of the talk talking about this, and conducting this practical reconciliation of LOCA frequency distributions by expert use of service data, the SRM, and expert elicitation.

This is what Bill used in his opening remarks. As I am talking about this, I want to --

MEMBER FORD: Excuse me, but who gave you that first bullet? Was that the instructions that you got from the SRM?

MR. TREGONING: Yes, these are from the SRM.

MEMBER FORD: Well, who is the technical person who gave you that guidance?

MR. TREGONING: Again, it is the Commission.

MEMBER FORD: Well, the reason that I am

asking the question is that if you take the use of service data from all of the various environment systems that we have in light water reactors, you will have just a random scatter of data. And I fail to see how you will ever make any expert draw any conclusion from that.

MEMBER KRESS: That is making sense.

CHAIRMAN BONACA: Let's give him a chance.

MEMBER FORD: Well, I see nothing there in that 1, 2, and 3. I see nothing at all about the prediction of the time dependent creation of the amount of degradation. There used to be spot checks, and I got a crack of such and such a length after a certain time in some random -- no?

And that is how I expect service data. That at a certain time I found a crack in the steam generator.

MEMBER SHACK: Well, that is certainly important to know, but it is not to say that between 1, 2, and 3 you don't cover that all, Peter.

MEMBER FORD: Probablistic fracture mechanics is just mechanics,a nd it does not tell you anything about the creation of the damage.

MEMBER SHACK: Sure it does.

MEMBER FORD: Sure it doesn't.

MEMBER SHACK: It depends on how you do it. If you build it into it, it does.

MEMBER FORD: Okay. Carry on.

MR. TREGONING: I don't know if I can carry on after that. For most of what we will be doing it will be addressing this point that Peter found so distasteful.

MEMBER APOSTOLAKIS: I have a question, too.

MR. TREGONING: Sure.

MEMBER APOSTOLAKIS: Why do you need to reconcile it? I mean, somebody gives you high numbers, and somebody else low numbers?

MR. TREGONING: Of course.

MEMBER APOSTOLAKIS: And who does what?

MR. TREGONING: It depends. This has been one of the historical problems. You see people coming in and usually using either service data or what they claim to be service data, or probablistic fracture mechanics, where they model something.

It is technically the same system. You could get results that are easily -- and I am not making this up, but 10 orders of magnitude different. People laugh, but that is not uncommon. And Peter is shaking his head. That is a common occurrence.

MEMBER APOSTOLAKIS: I understand that for materials that is an increase of two orders in PRA?

MR. TREGONING: So getting these guys in the same room without killing each other is also a good objective of this expert elicitation.

MEMBER APOSTOLAKIS: So the experts then are giving more reasonable results or we don't know?

MR. TREGONING: Well, we don't know because they have not given us their results yet. But that is one of the prime reasons that we are doing the elicitation, because of this guidance.

MEMBER ROSEN: Can we get off of this slide?

CHAIRMAN BONACA: We are on page four and we have quite a ways to go.

MR. TREGONING: I will go to 29, and I am happy with that. So we are ready to move on then? Okay, good. This is the general approach that we are using to address the Commission guidance, and we have got essentially a four-prong approach.

Again, I am going to focus mainly on the expert elicitation, although I have got a couple of slides at the end that talk specifically about this. I have touched on these already.

Again, we are making sure that we have a

fundamental and consistent assessment of the operating experience. We have constructed expert elicitation to reevaluate these LOCA frequencies and to develop a relationship between leak rates and break size, and frequency, for all LOCA events.

And we are using this not just to give us this relationship, but also to provide some fundamental input that we can use in this computer code development.

Why are we doing this? This is our confirmatory analysis. We want to develop I think, and I am not trying to be egotistical, but I think if we are successful, one of the first codes to hopefully combine operating experience and PFM insights together.

That is a challenge. It is not easy to do obviously, but that is the goal. That is what we are shooting for. We also within this code, we want to explicitly consider again LOCA contributions to piping, and pmn-piping components, and most importantly look at how merging degradation mechanisms could evolve and what challenges they give to the system.

Theoretically if a code was mature enough, something like Davis-Bessie, you would get a hint of

it, and if you have got good enough models built into the code, you can assess the challenges much more quickly than we have been able to do with Davis-Bessie.

And then the fourth piece is as important as the code development, but making sure that we have tools that we can do a continual assessment, and one of the things that we are doing here is we are developing LOCA precursor databases, and building on existing pipe failure databases to incorporate also non-piping failure statistics.

And of course the other thing that we always try to do in research is identify merging degradation mechanisms and conduct the appropriate anticipatory research to assess the LOCA significance.

So the rest of this is going to be focused on that first point that Peter brought up. How are we going to combine these three areas of operating experience, probablistic fracture mechanics, through the detailed solicitation, to give us what we are looking for with this spectrum frequency for both piping and non-piping contributions.

MEMBER FORD: And you are going to give us an example of what a formal solicitation will be provided? It will be data, or will it be opinions, or

whatever it will be.

MR. TREGONING: It will be both, and there will be data and there will be opinion.

MEMBER FORD: And there will be algorithms, prediction algorithms.

MR. TREGONING: No, not so much. Not the elicitation. WE will assess for each expert how they arrived at their opinions, okay? So they will be describing their predicted algorithms, but an output will not be a predictive algorithm from this exercise.

MEMBER FORD: Okay.

MR. TREGONING: It is important to understand how people are arriving at their opinions.

MEMBER FORD: I agree.

MR. TREGONING: I think that we have caught a lot of this --

MEMBER SHACK: Why don't you just skip ahead to nine so just we know what you are doing on your elicitation.

MR. TREGONING: Okay. That's fine. The formal approach to the elicitation, and these are the 6 or 7 steps that we are following, and I am going to go into detail on each of these.

We have selected the panel and the facilitation team, and we have developed technical

issues that we want to address, and that includes defining the scope and objectives, and constructing the approach, and determining significant issues.

We have put a lot of work into quantifying these base-case estimates, and I have a lot of discussion on what these are and why they are important within the framework of the elicitation.

Essentially, they are going to be quantitative estimates for well-defined piping conditions. And we will have four sets of estimates, two using primarily PFMM modeling and two using analysis of service history.

But they will be benchmarked to the same service history data.

CHAIRMAN BONACA: You mean, two estimates, and you will have two separate teams providing estimates regarding the same set, or --

MR. TREGONING: We have four different people from the expert panel.

CHAIRMAN BONACA: All right. Okay.

MR. TREGONING: We have developed the conditions from the whole group. The whole group defined how the analysis or what the analysis should try to -- what the objectives should be and the results should be.

The four people went off and they collaborated, and so in a sense they acted as a group so that they knew that they were using the same set of operating experience data.

And then what you will see at the end of the day is that they will come back, and that is that follow-up meeting that they had and presented their results to the expert panel.

MEMBER POWERS: When you speak of operating data, are you speaking only of nuclear powered systems, or are you also considering other systems?

MR. TREGONING: Nuclear. We are only looking at the nuclear experience.

MEMBER APOSTOLAKIS: Worldwide?

MR. TREGONING: Worldwide, but obviously we are heavily focused on the U.S. But obviously the databases that we look at and the insight that we have is also pulling in the worldwide experience, and three of the panel members that we have are from overseas. So we also get worldwide experience in that regard.

MEMBER POWERS: Is there a reason that you have excluded fuel plant experience?

MR. TREGONING: There is many reasons. The materials are quite a bit different, and the

operating experiences are different. I would just personally say that they are not consistent enough to try to combine those together.

If we did, fossil plants have had LBLOCAs. So I don't know that we would want to do that.

MEMBER SHACK: You mean the failure mechanisms are quite different.

MR. TREGONING: Yes.

MEMBER SHACK: And if you have grade failure of an axial weld seam in a cold fire plant, that has absolutely no relevance to it.

MR. TREGONING: And that has been a degradation mechanism that has led to LBLOCAs in --

MEMBER WALLIS: Now, pipes have failed in nuclear plants from thermal fatigue.

MR. TREGONING: Yes.

MEMBER WALLIS: And I don't see anything here about thermal. It seems to be all probablistic mechanics people. Yet the cores could well be something that is quite different.

MR. TREGONING: Well, again, we have a number of piping system and plant experts on this panel that know about thermal fatigue loading and have experience dealing with thermal heat cracking in surge line primarily, and feed water nozzle and things like

that.

But I am purposely not talking about specific degradation mechanisms, but if you look at the mechanisms that we have talked about, thermal fatigue is quite prominent and quite an important one.

MEMBER WALLIS: Yes.

CHAIRMAN BONACA: Now here you must have also used the definition of a LOCA.

MR. TREGONING: Yes, and I am going to get to that, too.

MEMBER FORD: But you are identifying specific code regulation notes?

MR. TREGONING: Of course. We would be remiss if we didn't.

MR. GILLESPIE: I thought you just said now that you weren't.

MR. TREGONING: I was not going to identify them in this talk. You won't see them in this talk unless you all ask about them.

MEMBER FORD: Could I ask?

MR. TREGONING: Of course. Yes.

MEMBER FORD: Well, could you just quickly tell us what the degradations are that you are considering?

MR. TREGONING: Well, essentially anything

that we think is relevant. We have gone through every LOCA sensitive piping and identified the materials and degradation mechanisms which are relevant.

And they include the whole ball of wax, from fatigue, corrosion, corrosion of any vain, IGSCC, PWSCC, trans-granule or external stress, and chloride cracking and corrosion.

We have looked at boric acid corrosion, and we have talked about thermal fatigue, and mechanical fatigue, more high cycle vibratory fatigue. A whole host of things. Any fact, of course, is important.

All the things that people classically think about.

MEMBER FORD: Well, this is a fairly high level approach then, because from those that you mentioned, there is no way of predicting it.

MR. TREGONING: I am going to show you the approach and I think you will have a really good sense of where we are going once you see the approach. The other thing we do is formulate the questions.

If you look at where are at on the schedule, we are up to about here. We are still doing some little tidying up work in this area, and we formulated our questions, and we are getting ready to start conducting the individual elicitations.

MEMBER APOSTOLAKIS: There was an important bullet on the previous slide that we skipped.

MR. TREGONING: Which slide is that?

MEMBER APOSTOLAKIS: You are educating the experts as a group, but you are eliciting individually.

MR. TREGONING: That's correct.

MEMBER APOSTOLAKIS: That is a key element here.

MR. TREGONING: Yes.

MEMBER APOSTOLAKIS: So that everybody comes to the same understanding of the issues, but then you have individual --

MR. TREGONING: Yes.

MEMBER APOSTOLAKIS: Are you going to show us the names of the experts?

MR. TREGONING: I was not going to show you the names, but I will tell you the names.

MEMBER APOSTOLAKIS: Okay. When?

MR. TREGONING: Are you asking for them now?

MEMBER APOSTOLAKIS: Are we? Yes.

MR. TREGONING: Would you like their affiliations, too? Bruce Bishop of Westinghouse; Vic

Chapman, formerly of Rolls Royce; Gary Wilkowski, of EMC Squared, formerly of Bechtel; Guy Deboo, who is with Exelon; Sam Ranganath, formerly of GE; Pete Riccardella, from Structural Integrity Associates.

Let me think. Karen Gott from SKI; Helman Schulz of GRS; David Harris, and Bengt Lydell of Aaron Engineering; and Bill Galyean of INEEEL. I think that is it. And Fred Simmon of INEEL. We have Exelon and Westinghouse.

MEMBER SHACK: But Westinghouse was not a utility person the last time I checked.

MR. TREGONING: Well, industry participation.

MEMBER SHACK: Well, Guy Deboo is industry. He is a utility.

MR. TREGONING: Exelon, yes.

MEMBER APOSTOLAKIS: Graham, do you recognize any names that would be an expert on the thermal fatigue --

MEMBER WALLIS: You have no academics?

MR. TREGONING: We have no academics.

MEMBER WALLIS: No one to keep you honest? These are all people wrapped up in the nuclear business?

MR. TREGONING: Yes.

MEMBER WALLIS: Seriously.

MR. TREGONING: Yes.

MEMBER SHACK: But only one of them an owner, with any kind of owner perspective. Like owner of these assets.

MR. TREGONING: I would argue that Westinghouse, and Exelon, and GE, have similar perspectives.

MEMBER WALLIS: Now I think that this could be a contentious list for a public forum eventually. You are going to have to defend the --

MEMBER SHACK: Why don't you go to your next slide which discusses the panel selection.

MR. TREGONING: Yes, we spent a lot of time on the panel. It is not easy to do obviously.

MEMBER APOSTOLAKIS: So the academics were not selected is what it says.

MR. TREGONING: We looked at people from across the board, there is no doubt, including academia. The difficulty with this panel is because of the range of technical specialties that are required, we were really looking for broad-based people, because we wanted the most well-founded panel we thought we could get. These are not all the specialties that we looked for, but these are some of

the primary ones.

We eliminated a lot of very good people who we thought were too narrow, because we were looking for people that were, again, who had broad experience in a lot of relevant technical areas.

Because again what we were trying to do was in general boost the overall knowledge of the panel itself and keep it very broad so that the discussions could be fruitful.

If we had a bunch of specialists, and we had one specialist in each area, we never would have gotten anywhere I don't believe.

MEMBER APOSTOLAKIS: Who is your facilitation panel?

MR. TREGONING: The facilitation panel is myself, Lee Abramson, Alan Kuritzky, Bennett Brady and Paul Scott of Bechtel; and Ken Jaquoy of -- he is formerly an industry consultant, and now independent consultant.

MEMBER APOSTOLAKIS: Except for Lee, has anybody else been involved in a elicitation?

MR. TREGONING: I don't think so.

MEMBER APOSTOLAKIS: This agency has sponsored major efforts in the past, especially in the seismic area, and couldn't you get one of those guys

to participate as a facilitator?

MR. TREGONING: Well, when we picked the facilitation team, we wanted to make sure that we had substantive experts that matched these fields also.

MEMBER APOSTOLAKIS: And normative.

MR. TREGONING: Right, and Lee is our normative expert.

MEMBER APOSTOLAKIS: And so he is the only one?

MR. TREGONING: Right. So, yes, we could have, but we did focus on making sure that we had appropriate substantive experts. Do you disagree?

MEMBER WALLIS: Well, I am just baffled by the whole idea that there are normative and substantive experts. but go on.

MEMBER APOSTOLAKIS: Normative is a guy who is familiar with the process, and the issues related to the process of what you should be, and what the pitfalls are. You look at Lee. This is a guy.

MR. TREGONING: But you don't have to define it. Just look at Lee.

MEMBER APOSTOLAKIS: And substantive guys, these are stress analysts.

MEMBER WALLIS: People who know something, right?

MEMBER APOSTOLAKIS: And know something about the subject itself, but not the process necessarily.

MEMBER ROSEN: I am astounded and entirely dismayed by the idea that you have so few of the asset owners on this, and you said that industry includes them. And let me give you an analogy.

If you were about to constitute an expert panel on some issue of great significance to the airline industry, and had no one representing the airlines, or one person representing the airlines, I think that a priority would be to discount the answer.

What is your response to that? How could you have possibly put this together this way?

MR. TREGONING: The expert panel, and the panel was known to people in the industry, and we also solicited names from the industry.

MEMBER WALLIS: That's the problem.

CHAIRMAN BONACA: No, I don't think it is a problem. Wait a minute now.

MR. TREGONING: Do you have a suggestion of either a person or an entity?

MEMBER ROSEN: Give me 30 seconds and I would, sure.

MEMBER KRESS: Are you implying that these

experts are biased in their opinion?

MEMBER ROSEN: Of course, I am. It is not only implying, but I am suggesting that they should. That is exactly what experts do. They come to the question with their biases from their experience and points of view.

CHAIRMAN BONACA: Well, I would expect that people from Westinghouse or GE, which really relate all their work to a real class of plants, et cetera, would in fact have more insight of plant specific individual companies.

MEMBER ROSEN: I disagree.

CHAIRMAN BONACA: And who deal with pipe systems for a full generation of plants, and they deal with all the utilities and all the problems that they have. So I personally think that there is sufficient representation there for the industry, insofar as expertise to have this kind of elicitation.

MEMBER ROSEN: I disagree respectfully of course, Mr. Chairman.

CHAIRMAN BONACA: Yes, I understand. And I respectfully disagree with your point of view. I think that --

MEMBER SHACK: And you basically have the consultants that the industry typically hires to

handle a problem like this. I mean, the first guy you call is Riccardella.

MEMBER ROSEN: Of course, but that has nothing to do with the constitution of this panel. And I have already said my point of view, is that if you were an airline that you would have some people at the end of the operating chain, the food chain, who would be part of this process and who could later on say, yes, I was part of it and I agree, or this makes sense overall. They have not done that.

MEMBER APOSTOLAKIS: Well, when it says operating mitigation practices, do you think that the current panel members are very familiar with those? Is that the expertise of the utility person would have?

MEMBER ROSEN: Well, yes, that is one thing for sure.

MEMBER SIEBER: Those would be things like chemical treatment and those are developed by the vendors.

MEMBER ROSEN: Off normal circumstances that occur.

MEMBER SIEBER: I don't find that offensive.

MEMBER APOSTOLAKIS: Defensive.

MEMBER ROSEN: Offensive.

MEMBER APOSTOLAKIS: Oh, offensive.

MEMBER SIEBER: I am not offended.

MEMBER APOSTOLAKIS: Because the way you were speaking and sitting down --

MEMBER SHACK: Well, we are on Slide 10 of 29, and we are heading towards four o'clock. So maybe we will just register that note and move on.

MEMBER KRESS: That would be unusual wouldn't it?

MEMBER SHACK: I think we can have mixed opinions int he panel as to whether it is a problem.

MR. TREGONING: As we move through the process, we certainly will be getting feedback, and the feedback will be welcome, as it always is, from all sources. So if we get some feedback that causes us to go back and revise some of these things for very good reasons, we are certainly open.

This is not a closed process and it is not a process necessarily that when we are finished and the panel comes in with the final result that it is a done deal.

MEMBER ROSEN: I understand that you are not offended if I don't like your process.

MEMBER FORD: Bill, I don't know how you

feel about this, but it seems to me though that this topic is of such importance that it should be done correctly. I am ont saying that it is not being done incorrectly, but there is obviously a lot of --

MEMBER SHACK: Can I disagree with that, Peter?

MEMBER FORD: Well, there is a lot of opinions around the table. I think that before too long there should be another try committee, M&M thermal hydraulics subcommittee meeting for a day and discuss this.

Once you have got some more or have moved off the starting block, then --

MEMBER SHACK: Well, they are off the starting block.

CHAIRMAN BONACA: They are already down to the 5th or 6th bullet.

MEMBER SHACK: But perhaps we should think about a subcommittee meeting here, but we are moving or they are moving right along. They have a schedule to meet.

MR. TREGONING: SEM is aggressive and so we have no choice.

MEMBER SIEBER: I suggest that we do that here, too, and move right along.

MR. TREGONING: Okay. We covered the first bullet and the next thing I am going to look at is how we develop the technical issues. We have talked a little bit about this already. The first thing we looked at was developing the scope and objectives for the panel.

Again, I have brought this up many times, but again we are developing piping and non-piping passive system LOCA frequencies as a function of creating an operating time, and we are looking up until the end of the license extension period.

MEMBER WALLIS: That seems to be to be absurd. LOCA frequency is not a function of leak rate.

MR. TREGONING: Why not?

MEMBER SHACK: Break size.

MR. TREGONING: Break size. But break size has been built on leak rate historically if you go back to 11-50. The leak rate determines the plant responses.

CHAIRMAN BONACA: And I asked the question before the definition, and I am sure that you will give it to me, but really what I had in my mind before was like an event at VCsummer, where you had a leak, and would it be part of your database that you have to

look at?

MR. TREGONING: Yes.

CHAIRMAN BONACA: And I imagine it would be, right?

MR. TREGONING: Of course.

CHAIRMAN BONACA: I would like to know how it gets to be into that given that the definition of LOCA is one that --

MEMBER SHACK: Any precursor that could lead to a LOCA is obviously --

MR. TREGONING: That is a precursor event.

MEMBER SHACK: His LOCA database is very sparse.

CHAIRMAN BONACA: I can wait on the question.

MEMBER SHACK: One or two, and we would not need to be here anymore.

MR. TREGONING: That's right. That's exactly right.

CHAIRMAN BONACA: Thank you.

MR. TREGONING: It is a good thing that it is sparse. We are looking at determining these distributions for the topical plant operating cycle and history,and again like I mentioned, we are estimating conditional probability distributions for

these rare events, including seismic and other large unexpected --

MEMBER APOSTOLAKIS: Wait a minute. You estimate conditional LOCA probabilities?

MR. TREGONING: Yes. I had a bullet on this earlier.

MEMBER APOSTOLAKIS: And the experts do that?

MR. TREGONING: Yes. The experts would do that.

MEMBER SHACK: This is a conditional probability. If you wham it this hard, this is the chance that it is going to bust.

MR. TREGONING: They are not experts in the frequencies of these events. But they are experts on if you were given that event what would happen. So it is well beyond the capabilities of the panel to give the full LOCA probability distributions for these rare things.

But it can be combined with other work that has been done in the past to give you that. So you have been trying to get the definition and I finally made it there to the definition.

CHAIRMAN BONACA: No, I already had the answer anyway.

MR. TREGONING: Can I move on?

CHAIRMAN BONACA: Go ahead.

MR. TREGONING: We have six categories of LOCAs that we are looking at. Initially, we have tired them to the leak rate threshold, and why do we do that? Well, there is historical reasons for that. That is how we have always done it.

MEMBER SHACK: I don't call a hundred-thousand gallons a leak rate.

MR. TREGONING: A LOCA rate.

MEMBER KRESS: That is a fire hose and a hearse anyway.

MR. TREGONING: We have six categories of LOCA, the first three of which are consistent with the historical definitions of a small break, medium break, and large break LOCA.

And all we have done here is we have further partitioned the large break LOCA size, and this is the problem that we have had all along.

MEMBER WALLIS: Why do you use this absurd unit of gpm when you have got steam coming out of this hole?

MR. TREGONING: Well, you can measure that. When I say a leak rate, this is really the rate of the makeup system essentially.

CHAIRMAN BONACA: In the beginning.

MR. TREGONING: Right.

MEMBER WALLIS: There are very many different gallons at that temperature than you do at the leak.

MR. TREGONING: Right. But we tried to be consistent and that is why this is the makeup rate. So we partitioned the large break size and again, to examine trends that happen when we get up to larger break size.

Of course, when you get to this big guy, that is essentially that you are only talking about failures of the largest pipes in the largest pipes in the plants. So this gets at our design basis right here, and it gives us a narrow focus on just those design basis type accidents.

The other thing that we have done, which I have not shown, but we have gone back and looked at some of the earlier correlations between leak rate and break size, and we have reevaluated --

MEMBER WALLIS: I thought leak was a dribble, and you try to figure out what is the frequency of a LOCA as it is related to leaks. You are not saying that at all. You are saying that LOCA frequency is a function of slow rate out the break.

MEMBER SIEBER: Right.

MR. TREGONING: Right.

MEMBER WALLIS: I thought what you meant was that you detect a leak and it is dripping. What is the chance now that the pipe is going to break.

MEMBER SHACK: That's not what he meant.

MR. TREGONING: That is not what I meant at all.

CHAIRMAN BONACA: They extended the definition.

MR. TREGONING: This has been typically what has been called a LOCA. The leak has not been called a LOCA because it is within the makeup capacity of the plant. Some people have called them very small LOCAs over time, but we have never really analyzed it.

MEMBER WALLIS: This is absurd. LOCA size based on, and what do you mean by that? The size of the hole based on the flow rate?

MR. TREGONING: Yes, the size of the hole based on the flow rate, yes.

MEMBER WALLIS: Then it has nothing at this point to do with frequency?

MR. TREGONING: It has nothing at this point to do with frequency.

MEMBER APOSTOLAKIS: The PRA definition of

the large LOCA is which one?

MR. TREGONING: This one.

MEMBER APOSTOLAKIS: Greater than 5000?

MR. TREGONING: Yes.

MEMBER APOSTOLAKIS: So that is what, 8 inches?

MR. TREGONING: It depends on the system, but you are looking at 6 to 8 inches. It depends on the plant, and it depends on where the break is located, but it has always historically been about 6 inches.

MEMBER SHACK: Close enough for a PRA.

MEMBER APOSTOLAKIS: And we have confidence that the experts can make a distinction between something that is 4, 5, 6, categories 4, 5, and 6? I mean, something that they can distinguish?

MR. TREGONING: What happens here is that when you go up in leak rate, you effectively eliminate systems that you have to consider.

MEMBER APOSTOLAKIS: So they are not really thinking in terms of 25,00 gpm or 100,000. They are thinking in terms of what does it really have to break to get there.

MR. TREGONING: Yes. We have developed a correlation between leak rate and break size that the

experts are using. So I didn't show this, because this is how the panel developed it.

MEMBER APOSTOLAKIS: Call it LOCA rate. Leak is really --

MEMBER WALLIS: You only need to call it frequency prediction. Nobody cares about this --

MEMBER SHACK: No, frequency is a function of size.

MR. TREGONING: You have to care about that.

MEMBER SHACK: It makes a big difference.

MEMBER APOSTOLAKIS: Size does matter here.

CHAIRMAN BONACA: That is the end point, right?

MEMBER WALLIS: Well, let's move on.

MR. TREGONING: And we are looking at three time periods. The current time period, which we are at about an average of 25 years of operating experience, and the design life, and then the design life and extension.

So this is how the experts -- this is how we generally classified the issues which affect LOCAs, and this is inaccurate in a sense, because I don't show safety culture in this, but you will see later

how we roll in safety culture.

MEMBER APOSTOLAKIS: Safety culture.

MR. TREGONING: How we try to roll it in.

MEMBER APOSTOLAKIS: What is your name again? Actually, Abramson.

(Laughter.)

MR. TREGONING: You know Lee, and I can't get away with that. I didn't say safety culture. This is how we are dealing with the total LOCA contribution. We split them as a group into passive and active system LOCAs.

This is of course where we really have service history data. Now, the elicitation is only focusing on the passive system LOCA, but obviously in the final numbers that we develop, we have to go back and add up the relevant active system LOCA contributions in.

And for some sizes these are probably going to be probably dominant.

MEMBER APOSTOLAKIS: So where there at the bottom do you have the time element in the sense that something can be arrested before it becomes very bad?

MR. TREGONING: The time element is really in all of this. It is in all of this.

MEMBER APOSTOLAKIS: But let's say that I

am looking at aging mechanisms there at the bottom, and so I may have lots of accelerated corrosion, and it is a mechanism on a certain time scale, but they may catch it.

So all that stuff is there or are the experts thinking exclusively in terms of the aging mechanism.

MR. TREGONING: Time is in here and time is also in materials, and that if you --

MEMBER APOSTOLAKIS: But what do the experts know about all of this?

MEMBER SHACK: The experts think about how long it takes to fail a thing by a given mechanism, and how many changes you have to find it. What are your chances of finding it, and all of that is sort of rolled into the process.

MEMBER APOSTOLAKIS: And they are experts at all that stuff?

MEMBER SHACK: That's why you have a range of experts, but yes, they are all sort of framed to think that way. That is how piping stress analysts and fracture mechanics guys think.

MEMBER APOSTOLAKIS: Are these people happy?

MR. TREGONING: Happy in the PRA world, I

think.

MEMBER APOSTOLAKIS: No, they can't be.

MEMBER FORD: Now just to come back to my original outburst. I think I can understand now how you are dealing with it, because you said -- I was thinking of trying to do this continuously, and you are saying no. I am asking Karen Gott, for instance, do you think that that piping system, a 28 inch scheduled piping in a BWR will last under the current operating conditions of normal water chemistries, and being quite specific, will it last 25 years.

And you are just asking her that question, and she says yes, no, and you say, well, why. And so is that the way it is working?

MR. TREGONING: Similar to that. Lee, do you want to jump in here or do you want me to do it? He was getting ready to come out of the chair. So I figured I would call on him anyway.

MR. ABRAMSON: Lee Abramson, Research. Essentially what we are going to be asking the experts in their quantitative judgment is to make relative, relative comparisons.

No one is going to be asked to make any absolute number, and everything is going to be based relative to base cases, and particular things which

they have some experience with, small break LOCAs, and things int he base case.

That is why we spent a great deal of effort in developing base cases which would be presumably understood in the same way by all of the experts. And then each of the experts are going to be asked to make comparisons to the base case.

And in particular, we are going to go through the range, and we are going to say, okay, consider a medium break LOCA, however you define it, and say how do you expert the frequency of this to compare with, say, a small break LOCA, and same material, same degradation mechanisms, and so on and so forth.

So we are asking them to make relative comparisons in the LOCA frequency under specific conditions, and we are going to try to compare as much as we possibly can, apples with apples.

So that experts in their own minds are only going to have to say make a comparison juggling maybe one thing at a time, rather than all things together. That is the general philosophy of this whole expert elicitation, is for the quantitative estimates, and to make relative numbers compared to things which they feel are pretty well established and

pretty well understood, namely the base cases.

MR. TREGONING: And in which we have attempted to quantify. So that links back to the quantifying.

MEMBER FORD: So of the 12 members that you have, not all of them know a lot about stress corrosion cracking?

MR. TREGONING: Correct.

MR. ABRAMSON: Correct.

MEMBER FORD: Or not a lot of them know about the (inaudible).

MR. TREGONING: Correct.

MEMBER FORD: And so the experts who are experts in those particular areas, will their answers have a specific weighting compared with the others?

MR. ABRAMSON: Well, we are certainly giving each expert the option of opting out of a process that they feel that they don't really know very much about it. That is another reason, of course, for having a relatively large panel, because then hopefully we will be able to get enough useful answers from enough people on the panel so that we will have some estimate of the uncertainly.

And we are explicitly asking each expert for uncertainties on each of their answers. So if

somebody is particularly uncertain about it, it will show up in his responses.

MEMBER APOSTOLAKIS: But, Lee, if the evaluation of these bottom boxes there requires more than one kind of expertise, why are you eliciting the experts individually? Wouldn't it be better to do it in subgroups?

You just mentioned that you will have a guy who understands the degradation mechanisms, and somebody else who understands the intervention, or preventive measures and so on. So it would seem to me that putting it in subgroups would make more sense.

So you have a group of people who -- a subgroup who understands everything that is going on with respect to this particular issue.

MR. ABRAMSON: Well, our basic idea is to use the individual elicitation, because that is a way to try to minimize the particular group dynamics that you might get from a group.

And also I think it is very important here to try to have the results reflect as much as possible the real scientific uncertainty therein in these answers.

MEMBER APOSTOLAKIS: Well, the biases, Lee, that we are talking about that are in group

dynamics refer to groups of experts who are more or less experts of the same things. In other words, if I am looking only at flow accelerated corrosion, and I have five experts for that subject, and then one of them may dominate.

But the value of having a group, that value comes to the surface if you are in a situation where the expertise now, the experts compliment each other. So nobody will dominate really in that case, because I will respect your opinion, and you will respect mine.

So this is something that is really important I think to the elicitation process.

MR. ABRAMSON: I am not quite sure how to answer that. Part of the answer may be, first of all, as Rob suggested, we are trying to get people with a broad range of experience, so that they are not just narrowly expert in one particular aspect.

So that could be part of a response to yours. How well this will work out, I can't say. And another thing is that we are trying to break down -- I don't think that Rob is going to have the time to do this, but if you look at the question, there are literally probably hundreds of questions that we are going to be asking, and the reason that there are so

many is because we try to ask them about extremely specific situations.

And presumably in doing this, we will be able to tap on their expertise as it applies to the situations and to the degradation mechanisms, for example, and something that they are familiar with.

I think how successful we are going to be in this will probably -- I would expect that we would probably have a pretty good sense of this after we get through the elicitations.

MEMBER APOSTOLAKIS: Try it both ways. Nobody is stopping you from doing that.

MR. ABRAMSON: Pardon me?

MR. TREGONING: Well, when we analyze it, we will certainly analyze it both ways.

MEMBER APOSTOLAKIS: Anyway, I have a point here, a different one. What is the purpose of the presentation today? We are not writing a letter are we?

MEMBER SHACK: We had not planned on writing a letter. If the committee feels that there is something that we need to address, then that is something, but a letter was not planned.

MEMBER APOSTOLAKIS: Okay.

MEMBER SHACK: This was to inform the

committee how the process was going, and to get some input from it. So when the answer comes back to us, we --

MEMBER APOSTOLAKIS: Well, I propose the following. It is obvious that there is great interest in this by most of us, and this is of course one of the most important issues that the agency is looking at these days, right, 50-46 eventually.

I am not sure that we are going to get very far today. We are going to have a hell of a lot of questions. We have important letters to write. I propose that we schedule a subcommittee meeting soon, because you really have to see the details here to appreciate what is going on to be convinced, and you can't do that in a full committee meeting, and terminate this as soon as we can.

MR. SNODDERLY: George, the purpose of this meeting now was because it is such an aggressive schedule, and the elicitation is scheduled to be done by September, and when we looked at our schedule about when we could schedule meetings.

So what we would like to try to do today is to make you aware -- we have made you aware of who is on the panel, and now to make you aware generally of what elicitation questions are.

But I think it is going to be very difficult for us to have much interaction before the elicitation has been completed, and compiling the results.

MEMBER APOSTOLAKIS: I think we are achieving today something that is really unfair to the NRC staff. You are creating negative attitudes on the part of the members because they don't see the details to appreciate what is going on.

MEMBER FORD: Well, I would not call them negative, George, but they are inquiries, aggressive inquiries.

MEMBER APOSTOLAKIS: Well, I mean are concerned.

MEMBER SHACK: As a practical matter though, George, if we have the subcommittee meeting, we won't be able to have a committee response to the subcommittee meeting.

We can have the subcommittee meeting for information, but --

MEMBER APOSTOLAKIS: But this is an extremely important topic. I mean, we can't say that the committee cannot get involved in the excruciating details because they have to do it by September 5th.

MEMBER SHACK: Well, can we continue with

this presentation and we will --

MEMBER APOSTOLAKIS: I would hate to go beyond the allotted time.

MEMBER SHACK: Well, we're not.

MEMBER APOSTOLAKIS: Because there are very important things to deal with.

MEMBER WALLIS: Are we going to be asked to approve the results?

MEMBER APOSTOLAKIS: Eventually you will be asked to do that, and to write a letter, yes. And then at that time we will be told that we have already done it. What do you want us to do, select new experts? And I say that is unfair to the staff as well.

MEMBER WALLIS: Well, we can say that our role comes after the experts have done their work.

MEMBER FORD: But it is unfair to come in at the end.

MEMBER SHACK: It is 4:09.

MEMBER APOSTOLAKIS: Yes, but this is an important issue.

MR. TREGONING: And let me say that we are planning to have the elicitations done by the end of September and then we are looking to have a feedback meeting from the experts where they get to see the

results, and they get to see how we analyzed it and at least get the experts themselves to say if they agree in the process and in the final results.

MEMBER WALLIS: So it is not finished?

MR. TREGONING: No, it is not finished, and we are either telling people when they come in to do their elicitation that if there is more information that comes out later, and they want to change their answers, they can certainly do that.

MEMBER WALLIS: I don't think we have to be managing this process. We can look at the final results.

MEMBER APOSTOLAKIS: No.

MR. TREGONING: And the way that we have tried to structure the elicitation is we have tried to decompose things; issues, topics, important contributing factors. And at the end of the day, we roll them all up.

If there is issues or contributing factors that we have missed, and that you all point out, if there is a flaw that we have missed, I would hope that we could go back and it would be non-fatalistic at that point, and we could essentially address it, and see if it makes a difference or not, and then come back and present the results.

Now the thing that would be harder to do is if we wanted to reconstitute the panel in some way, and if wanted to change who is on the panel.

MEMBER ROSEN: Which by the way is what I suggest.

MEMBER APOSTOLAKIS: But the process may be difficult to change, too. I mean, this idea of providing individual elicitations, after a certain point things are pretty costly. So I don't know what to say, but it seems to me that this is one of the biggest issues that the agency is working on.n

CHAIRMAN BONACA: I agree with that.

MEMBER APOSTOLAKIS: And I don't think that schedule should be the determining factor here.

CHAIRMAN BONACA: Schedule what? The whole program?

MEMBER APOSTOLAKIS: Yes.

MR. TREGONING: One of the things that I will say to try to answer it and to follow up what Lee said, we have combined the group and the individual. The group is providing a lot of combined or background information that the rest of the panel has access to.

So if there is a specific area that a panel member does not have expertise in, we have been trying to develop information so that they will have

that knowledge.

MEMBER APOSTOLAKIS: All I am saying is that we really need to go deeply into this. Now when we are going to do that, I don't know.

CHAIRMAN BONACA: Anyway, why don't we let Robert go through.

MEMBER SHACK: I would really like you to get to Slide 19.

MEMBER SIEBER: Before you leave that one, what is the difference between passive and active systems?

MEMBER ROSEN: Yes it would be nice to know what is on this slide.

MR. TREGONING: Passive systems are pipes and nozzles, and reactor pressure vessels, and things like that. And active system LOCAs are things like valves, and pump seals.

MEMBER SIEBER: You mean actual components?

MR. TREGONING: Right. Active components.

MEMBER SIEBER: As opposed to passive components?

MR. TREGONING: Right.

MEMBER SIEBER: Thank you.

MEMBER WALLIS: Somebody opens a valve and

leaves it open. That is an active --

MEMBER SIEBER: That is not a LOCA then.

MR. TREGONING: That is an active.

MEMBER ROSEN: It could be if it is a relief valve.

MEMBER SHACK: That is one of the most common LOCAs around.

CHAIRMAN BONACA: Exactly.

MR. TREGONING: That is an active component. A passive would be a valve body failure, let's say. That would be a passive component.

MEMBER WALLIS: I would think active where somebody does something, like opening a letdown system, and letting it run.

MR. TREGONING: No, that's active. Active can contribute to a passive component failure.

MEMBER APOSTOLAKIS: Change of state.

MR. TREGONING: So we have talked about the piping base cases, and so what are they exactly. Well, these have been developed iteratively between or among the facilitation team and the expert panel members.

And what the people are doing is that they are -- you sure you don't want to go to 18 for this?

MEMBER SHACK: Well, you already told us

18.

MR. TREGONING: Not really. I think we need to go back to 18. The base cases we are using to provide anchor. These base cases are very specific variables for piping systems, size, material, loading degradation, and mitigation. We have a very specific set of conditions. We have defined five of them.

And for piping now. These are all for piping at this point; 2 for BWR, and 3 for PWR. We tried to hit some of the most important LOCA sensitive systems and then also mechanisms and loading histories.

So each of these are being -- we are calculating the LOCA frequencies for each set of base case conditions as a function of leak rate and operating time. As I mentioned, we have four panel members individually doing calculations; two using operating experience, and two using PFM.

MEMBER RANSOM: How is historical data factored into this?

MR. TREGONING: Yes, I am going to get to that. In fact, you see it right here. But let me get down there first. We developed these things iteratively like I said. We are evaluating these at three different time periods.

And to get down to how we are using the operating experience, and where we have the most operating experience is in terms of leaking cracks. So we have told each of the four members that are doing their analysis that they have to benchmark their analysis so that you essentially get agreement to the leaking crack frequency that you would get at an average of 25 years, which is essentially where we are now.

MEMBER RANSOM: I was thinking more of the chemical industry, and even some of the nuclear industry, where you have accelerated corrosion, and you have pipe ruptures, and so there is a little bit known about their frequency.

MR. TREGONING: There are, but again like I mentioned earlier, we have really tried to limit to nuclear experience only because of the uniqueness of the materials degradation mechanisms, and then also the quality of the materials, and the robustness of the mitigation and maintenance procedures.

So that makes our industry unique enough to I think only look at that specific subsection of results. LOCAs were done in 1400, and in fact they did go -- in fact, a lot of the early LOCA numbers were based on oil and gas transmission piping, simply

because they did not have anything else, and not because they thought it was relevant.

In fact, if you go back to WASH-1400, there is a big disclaimer that says we don't think that this is relevant. However, we have only got a hundred or so years of operating experience, and we don't feel that is enough basis to make a judgment at this point.

So we think we have got enough operating experience now, especially with precursors. We do have pretty good precursor databases, and that is what we have been looking at for the piping.

Another stipulation is we are trying to make sure that all the base case calculations capture the conditions that were established by the panel. The panel determines what these conditions were, and by conditions I mean again the degradation mechanism, the geometry of the material, and the loading conditions.

And along with these base case calculations, we have also done sensitivity analyses using PFM to look at the effect of seismic loading and in-service inspections. So this gets at your question what happens if you miss it, and what happens if you don't. So how the probability of detection and the

resolution of the ISI affects it.

And look at variability and the loading history. Of course, with PFM, this is a prime driver.

MEMBER SHACK: Well, let me just mention for Vice, too, that Mr. Lydell is sort of the industry custodian of the biggest and most complete, and most detailed database on piping cracks. George knows it because it is sort of a PRA.

When they need a frequency on something, they go to that.

MEMBER APOSTOLAKIS: He also published in my journals.

MR. TREGONING: He is okay.

MEMBER SHACK: In a sense, you know, service experience is strongly plugged in here.

MR. TREGONING: So that is how we do the piping. How do we do the non-piping. Well, we could have done the same thing. We could have chosen several presentative systems and then examined and extrapolated the operating experience through modeling.

We did not decide to do that because with non-piping there is a whole or a much bigger range of failure mechanisms that are in play just because you are dealing with things that are not just piping. You

are dealing with bolts, and thermal sleeves, and things that are totally different components.

So it didn't make sense to pursue this approach any more. So what we are doing here, and what we don't have for non-piping is we don't have the same robust precursor database.

We are essentially trying to develop that for leaking and cracking frequencies, and that is something that we are working on quite feverishly as we speak.

MEMBER FORD: Would that include cracks L-grade or core shrouds?

MR. TREGONING: Core shrouds would not lead to a LOCA.

MEMBER FORD: You are absolutely correct.

MR. TREGONING: CRDM nozzles.

MEMBER ROSEN: Reactor coolant pump casing bolts.

MR. TREGONING: Yes. Yes. We talked about a number of bolt failures.

MEMBER WALLIS: And the seals on the pumps?

MR. TREGONING: Seals we are considering as part of it, and because there is a maintenance plan for seals, we are incorporating those into the active

component regime. And there is a lot of data on seals, seal failures, and we are not looking at seal failures.

MEMBER WALLIS: Well, thinking about seals, it is not just the seal. It is the cooling system for the seal, and there is a whole chain of events which can fail a seal, and not just the seal itself. Do you have to write a PRA for the seal?

MR. TREGONING: Again, we are not explicitly considering the seal, because -- we will roll it in after the fact.

MEMBER WALLIS: But you have to do it some day.

MR. TREGONING: Yes, and we will deal with the seal, I think, --

MEMBER WALLIS: But the thing itself, it is a series of events which leads to the failure, and that is what you have to somehow capture for some of these things.

MR. TREGONING: Well, that is all of these things.

MEMBER WALLIS: But some of them are simpler than others.

MR. TREGONING: I have not found that one yet unfortunately. Okay. So we are going to use

these leaking and crack component frequencies as our anchor for our non-piping responses. And then each expert is going to have to determine how to translate that information into meaningful LOCA estimates.

So certainly not a trivial exercise, but this is what the experts for the most part, this is what they do for a living.

MEMBER APOSTOLAKIS: So in your training session, you train them to think in terms of frequency, or these are experts who have actually used frequency?

MR. TREGONING: Like Lee said, we are going to be asking only relative questions.

MEMBER APOSTOLAKIS: The training.

MR. ABRAMSON: Using relative quantitative judgment.

MR. TREGONING: Right.

MEMBER APOSTOLAKIS: So all of these guys have worked with probabilities in the past and they understand what it means?

MR. ABRAMSON: They understand frequencies, and we are not talking about probabilities. We are talking about frequencies.

MEMBER WALLIS: You are not talking about frequencies at all.

MR. ABRAMSON: The whole idea here was to try to ask them questions --

MEMBER WALLIS: It is all probability isn't it?

MR. ABRAMSON: The idea was to try to phrase the questions in terms of the experts' expertise, in terms of the systems that they have been working with their whole career.

So we tried to frame the questions in terms of extremely specific physical situations, degradation mechanisms, and materials, and so on and so forth, and so that sets the stage.

And then we say, all right, you have this situation and compare it to what happened with a small break LOCA or whatever. And the base case is what do you think about the relative frequency, just relative frequency difference. We don't ask them explicitly about probabilities.

MEMBER APOSTOLAKIS: You are talking about the base case development here now. So for the base case the experts are asked to come up with frequencies.

MR. ABRAMSON: No, the base case --

MEMBER APOSTOLAKIS: Then they do what you say here.

MR. ABRAMSON: -- was done by specific people, these four people on the panel, who are base case -- they have experience in developing base cases, and they develop the specific absolute numbers based on their service experience and based on data for the most part isn't it?

MR. TREGONING: Well, again, that's what we had the four of them do. They each ran models and predictions, extrapolating the service history experience to give them LOCA estimates.

So not surprisingly, you have a range of estimates among the four of them, which in some sense gives us a measure of uncertainty, too.

MR. ABRAMSON: Right. And each expert on the panel in the elicitation will be asked to choose which base case they prefer to anchor towards, to compare with.

MR. TREGONING: Or they can anchor just with the conditions.

MR. ABRAMSON: Right.

MR. TREGONING: And then we will propagate the uncertainty throughout their answers.

MEMBER APOSTOLAKIS: Now when you say frequency information into meaningful LOCA estimates, does that include uncertainty, the base case?

MR. ABRAMSON: The base case I don't think explicitly includes uncertainties.

MR. TREGONING: Again, the base case for non-piping is just going to be leaking and crack component frequency data. So these are accounting for things that have happened.

MEMBER APOSTOLAKIS: But you need a base case for a large LOCA don't you?

MR. TREGONING: You need to go from this leak and crack --

MEMBER APOSTOLAKIS: I am telling you we really need a subcommittee meeting.

MR. ABRAMSON: I think we are doing this. We have a base case for small LOCAs, and then we are saying, all right, consider the comparable materials, and degradation mechanisms, and what do you think are the chances of a large one.

MEMBER APOSTOLAKIS: So the base case is based on data as much as you can.

MR. ABRAMSON: Right.

MEMBER APOSTOLAKIS: And then you are going to larger --

MR. TREGONING: Right, using a relative comparison.

MEMBER APOSTOLAKIS: That is actually very

good.

MR. ABRAMSON: What we are doing is we are extrapolating as much as we possibly can from the observed data.

MEMBER APOSTOLAKIS: I like that.

MEMBER SHACK: But, for example, on the hot- leg, you will have somebody compute a frequency for the break of the hot-leg?

MR. TREGONING: For the break of the hot-leg under, and we looked at the hot-leg specifically for PWSCC cracking, but not the hot-leg under every set of conditions, but the hot-leg for PWSCC.

MEMBER SHACK: For the PWSCC.

MR. TREGONING: Exactly. We will have a set of frequencies.

MEMBER ROSEN: A complete break, or a small break?

MR. TREGONING: They are looking at the range of breaks.

MEMBER ROSEN: You will have them compute a set of these things?

MR. TREGONING: Yes, for each leak pattern.

MEMBER ROSEN: How likely is it to have a double-ended rupture and presumably you could plot

that?

MR. TREGONING: They have done all the six LOCA categories that I listed, and for the hot-leg, they could fill in also those numbers. We have had them do it for smaller piping systems, too, where you can only get up to a Category 1, 2, 3, or maybe 4, LOCA.

You can't get the bigger ones, but you can get a range of smaller ones. So, yes, that is exactly right. They look at the frequency of small breaks and then all the way up to the largest break possible.

MEMBER WALLIS: You have about a half-a-,minute per slide and a minute to wrap up.

MR. TREGONING: Bill, tell me where to jump to.

MEMBER SIEBER: Tell me about the second bullet.

MR. TREGONING: I will be happy to.

MEMBER APOSTOLAKIS: You are actually serious.

MR. TREGONING: Let me go to this one, because --

MEMBER SHACK: Hit 22 and 28, and we will call it quits there. This one and then 28.

MR. TREGONING: I figured you would want

to see 28. These are the areas that we are asking them questions about. We are asking the experts to validate or evaluate the base case and how that evaluation went. Do they agree with the numbers and do they not agree with the numbers. Do they have different numbers that they would like to use.

What anchoring set of conditions do they want to use. Then we are asking generic questions about regulatory and utility safety culture. And we had a kick-off meeting and we identified a whole host of issues within here that could affect LOCAs. We decided --

MEMBER ROSEN: How would this team know anything about utility safety culture? There is only one guy on the team that can have any background.

MR. TREGONING: Again, we had --

MEMBER SIEBER: That is my question.

MR. TREGONING: Again, between Westinghouse, and Exelon, and GE --

MEMBER ROSEN: I'm sorry to laugh, but does Westinghouse know about utility safety culture?

MR. TREGONING: Industry safety culture.

MEMBER ROSEN: I'm an adult.

MEMBER APOSTOLAKIS: Okay. So you got the comment. Let's move on.

MR. TREGONING: So we are asking them generally about these issues, and then we are also asking about again LOCA frequencies for piping and non-piping, and then these conditional probabilities under emergency faulted loads.

MEMBER APOSTOLAKIS: Okay.

MR. TREGONING: This is 28, and this talks about the passive code development, and so we will be using this to provide confirmatory analysis. The objective of this is to determine again the same relationship, but to do it computationally as much as possible, and it is a pool that we will be using for continual --

MEMBER APOSTOLAKIS: Excuse me, but why does it have to be confirmatory? Why isn't this an additional piece of information that some super being will combine and blend with the results of the expert opinion in your elicitation exercise?

MR. TREGONING: Theoretically, it would.

MEMBER APOSTOLAKIS: But that is what you will do in fact. I don't think that you are trying -- your objective here is not to tell the world the experts are good. Your objective is to -- you say, look, I really don't know what the frequency of large breaks is, but I have a body of knowledge here which

is represented by experts.

I have a body of knowledge here that is represented by calculational models. I will do both, and then I will sit back and see how I can put them together. If they happen to agree, then great. But if they don't agree, I will have to do something. But when --

MR. TREGONING: When I used confirmatory, I didn't mean validate, per se.

MEMBER APOSTOLAKIS: Don't do it again.

MR. TREGONING: I meant exactly what you said.

MEMBER APOSTOLAKIS: I know you did.

MR. TREGONING: A somewhat independent assessment, although we are using some of the results with the elicitation to feed into our codes, and so they won't be entirely independent.

MEMBER APOSTOLAKIS: Fine.

MR. TREGONING: But it will be another tool or another approach to evaluate or to get to the same question.

MEMBER APOSTOLAKIS: Right. And ultimately perhaps you may want to have another group of experts taking all this information and just saying this is it, the technical facilitator integrator.

MR. TREGONING: Yes. Hopefully I won't be involved in that aspect.

MEMBER WALLIS: So this is all written up at the end so that someone can understand it?

CHAIRMAN BONACA: Of course.

MR. TREGONING: Yes, of course it is written up at the end, and hopefully people will understand that. That has been our goal. In fact, we have been heavily documenting the process as we go.

MEMBER WALLIS: I think it is very important for this particular issue that you have a very understandable rationale at the end.

MEMBER APOSTOLAKIS: I would like to see actually an example with numbers walking through the whole exercise.

MR. TREGONING: Yes. I would have been happy to present that, but given the time --

MEMBER APOSTOLAKIS: There is no way today, but we should do that well before we have to write a letter.

MEMBER SHACK: Let me talk to you about this again, George. We will be discussing this matter again in the future.

MEMBER APOSTOLAKIS: But not at the full committee meeting.

MEMBER KRESS: No, the subcommittee.

MR. TREGONING: I am sure at the full committee we will be discussing it, too.

MEMBER SHACK: At the full committee, we will be discussing it, too.

MEMBER ROSEN: I think we need a letter.

MEMBER APOSTOLAKIS: Now?

MEMBER ROSEN: Yes.

MEMBER SHACK: Why don't you just finish the slide and we will discuss that.

MR. TREGONING: Well, again the approach, we are constructing separate modules for piping and non-piping, and then again these surprise mechanisms that we have talked about.

We are trying to couple again through the code PFM modeling with an understanding of operating experience. We want to make sure that the modeling frequencies are scaled based on this operating experience. Again, we will be using insights from the elicitation to focus on the most important systems and mechanisms.

And there is a European program called NURBIM that has similar objectives that we will be working with on this effort. And also in terms of our LOCA precursor development, too, there is also

international efforts for the development of piping databases that we are part of, and I think we will also look at starting up one for non-piping LOCA precursor events, too.

So we are looking at starting up an international effort there, too. So that is it.

MEMBER KRESS: I would like to ask you a provocative question. I think this is good stuff, and stuff that needs to be done, and will help us in risk analysis and other places. The question that I would ask is how are you going to use this to help risk informed 10 CFR 50.46?

How will it be put to use in risk-informing 10 CFR 50.46, which is the title of this.

MR. TREGONING: Do you want me to tackle it? Do you guys want to tackle it?

MS. MCKENNA: This is Eileen McKenna, NRR. We have a working group that has been tasked to work on the rule making that would take advantage of the information --

MEMBER KRESS: This is a question for NRR, you're right.

MS. MCKENNA: Yes, and our schedules are running in parallel, and so we are kind of having to figure out what we are going to do with it before we

know what we are going to get.

But we are trying to deal with the issues that you are also seeing in the SRM about what kind of risk cut-off metrics we should be considering, and some of the other considerations that we need to bring to bear in making decisions with respect to what kinds of changes might occur as a result of redefining the maximum break size and what kinds wouldn't occur.

And those kinds of issues that we are actively working on, and we will be discussing it at a future meeting with the committee, but we just are not ready to have that kind of dialogue.

MEMBER KRESS: Well, expressly, I was hoping you would say that you will not say that given your frequency as a function of leak size that you will determine the contribution of these different sizes to risk, and cut off at a given risk.

I am hoping that is not what you want to do with it.

MS. MCKENNA: We hear you, and that is not our current plan.

MR. TREGONING: But realizing that this is just one technical piece,a nd that research is ongoing and will be ongoing in looking at integrating this, with probablistic risk assessment and thermal

hydraulic analysis to come up with hopefully a technical basis behind whatever change is envisioned for the ECCS rule.

MEMBER FORD: I have got a question along somewhat other similar lines. It is my understanding that the rule making, once it is made, is somewhat cast in concrete. And yet this particular technology is forever being developed further.

So in 2 years time when we may have a different perspective of how you predict the future behavior of leak rates and the effect on risk, it might be different in 2 years time. Do we have the wherewithal to change the rule?

MEMBER KRESS: Hopefully you will write the rule so that is accounted for.

MS. MCKENNA: This is Eileen McKenna again. I think if you read the SRM, you will see that some of that concept was already built into that. It talks about doing kind of doing a relook of the frequencies and potentials for changes, and things having to be undone, and obviously this poses a great challenge for us in regulatory space of how to deal with that kind of a process, which is very different than what we have done in the past. But that is part of the SRM also.

MEMBER FORD: The reg guides can be changed.

MS. MCKENNA: yes.

MEMBER ROSEN: I would like to say why I think we need a letter.

MEMBER SHACK: Is there anything else before I turn it back over to the chairman?

CHAIRMAN BONACA: Okay. Thank you for the presentation, and I think at this stage we can go off the record now.

(Whereupon, at 4:34 p.m., the meeting was recessed.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Reactor Safeguards 504th Meeting

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Debra Wilensky
Official Reporter
Neal R. Gross & Co., Inc.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
504th MEETING
MIXED OXIDE (MOX) FUEL FABRICATION FACILITY
ROOM T-2B3, 11545 ROCKVILLE PIKE
ROCKVILLE, MARYLAND

JULY 10, 2003

-PROPOSED SCHEDULE-

SUBJECT	**PRESENTER**	**TIME**
I. Introductory Remarks Subcommittee Chair	D. A. Powers, ACRS	8:35 - 8:40 a.m.
II. Industry and NRC Presentations		8:40 - 10:15 a.m.
Introduction	A. Persinko, NMSS	
General facility mission and layout	P. Hastings, DCS	
Safety Philosophy - Prevention features (redundancy, reliability limits) - Mitigation features (confinement zones, HEPAs) - Safe facility configuration	P. Hastings, DCS	
Estimated Risk to the Public	P. Hastings, DCS	
Criticality Safety	M. Chatterton/C. Tripp, NMSS	
Fire Safety	R. Wescott, NMSS	
Red Oil	A. Murray/W. Troskoski, NMSS	
Seismic	TBA, NMSS	
Estimated Risk to the Public /Five Factor Formula	R. Wescott, NMSS	
Remaining Open Items	A. Persinko, NMSS	
III. Committee Discussion		10:15 - 10:30 a.m.

MIXED OXIDE FUEL FABRICATION FACILITY

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

July 10, 2003

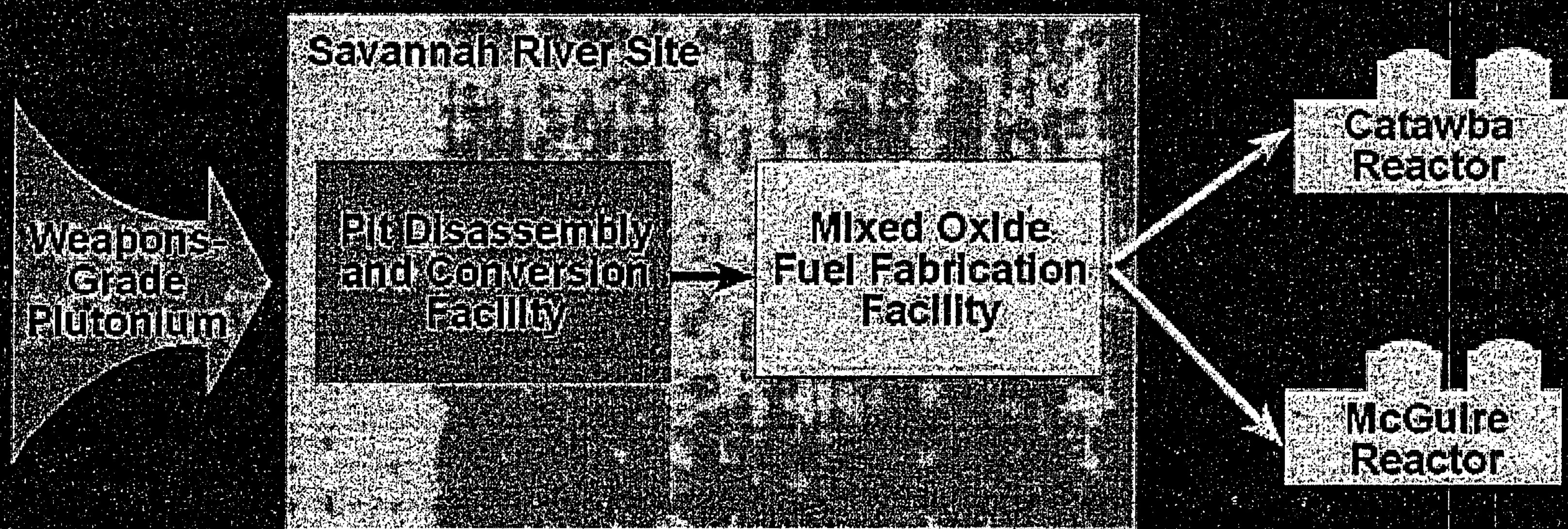
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Review of the Mixed Oxide Fuel Fabrication Facility
Construction Authorization Request

Introduction

Andrew Persinko, Sr. Project Manager
NMSS/FCSS/SPIB

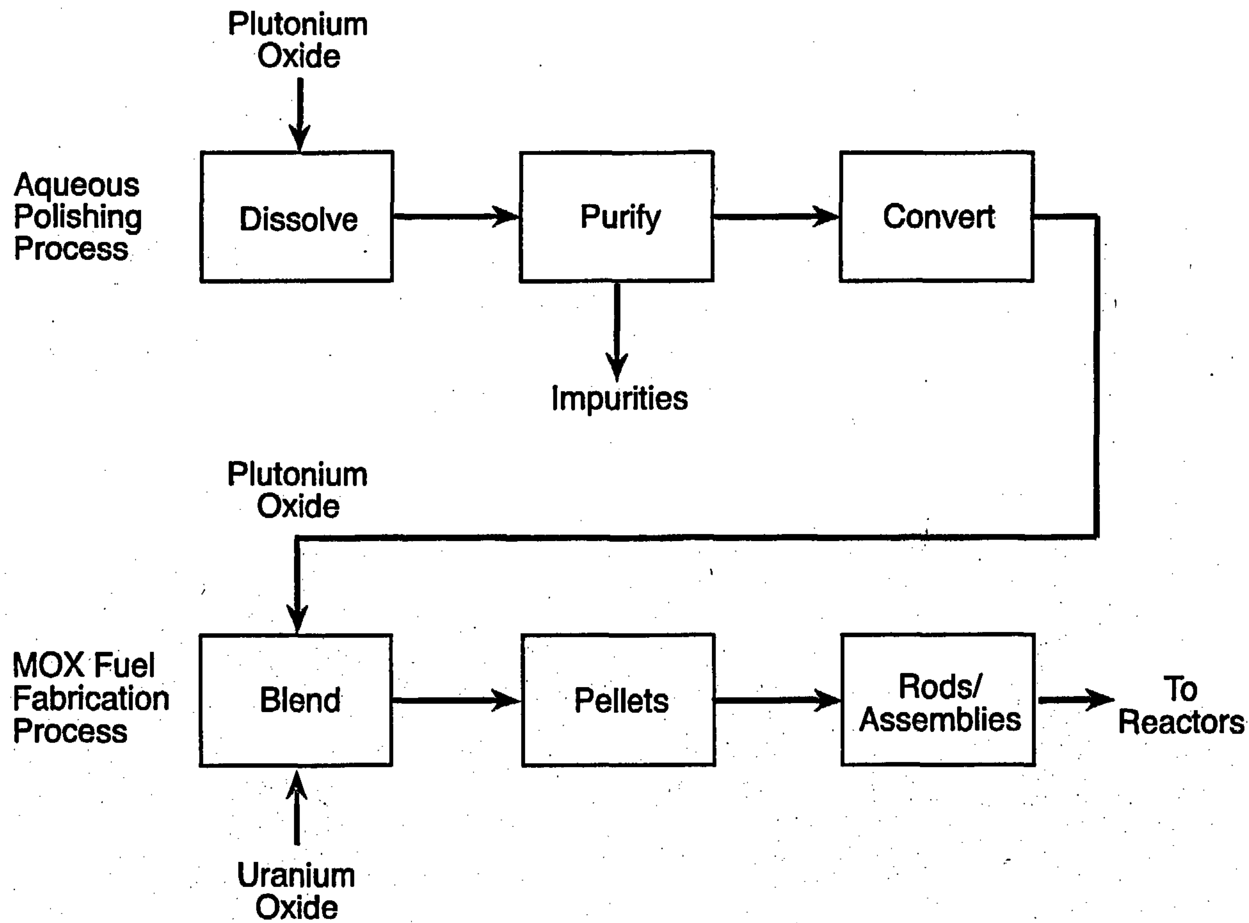
NRC Role in Regulating Mixed Oxide Fuel



Yellow = NRC regulated

Blue = DOE regulated

Mixed Oxide Fuel Fabrication Facility Process



Mixed Oxide Fuel Fabrication Facility

Licensing (10 CFR Part 70)

- 2-step approval:
  - Construction
  - Operation/possession of special nuclear material
- Approvals to start construction plutonium facility
  - Design bases of principal structures, systems, and components (PSSCs)
  - Quality assurance program
  - Environmental impact statement
- Principal structures, systems, and components / Items relied on for safety

Construction

Design Bases

- 10 CFR 50.2 Definition:

"Design Bases means that information which identifies the specific functions to be performed by a structure, system, or component of a facility and the specific values or ranges of values chosen for controlling parameters as reference bounds for design..."

10 CFR 70.61 Performance Requirements

	Highly Unlikely	Unlikely	Not unlikely
High Consequence Publ Dose > 25 rem Worker Dose > 100 rem	Acceptable	Not Acceptable	Not Acceptable
Medium Consequence Publ Dose 5 - 25 rem Worker Dose 25 -100 rem Env releases > 5000 Tbl 2	Acceptable	Acceptable	Not Acceptable
Low Consequence Publ Dose < 5 rem Worker Dose < 25 rem	Acceptable	Acceptable	Acceptable

Schedule

Major Milestones

- Received Environmental Report 12/19/00
- Received Construction Authorization Request (CAR) 2/28/01
- Issued draft Safety Evaluation Report (SER) for construction 4/30/02
- Received revised Environmental Report 7/11/02
- Received revised CAR 10/31/02

Schedule

Major Milestones

- Issued draft Environmental Impact Statement (EIS) for public comment 2/28/03
- Issued revised draft SER for construction 4/30/03
- Issue final EIS and final SER 9/03
- Issue EIS Record of Decision (ROD) and construction licensing decision 10/03

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Nuclear Criticality Safety Review for the Mixed Oxide Fuel Fabrication Facility Construction Authorization Request

Christopher S. Tripp, Sr. Nuclear Process Engineer (Criticality)
NMSS/FCSS/SPIB

NCS Design Bases

- Double Contingency Principle (DCP)
- Maximum k-effective for criticality calculations
- Subcritical under normal and abnormal conditions
- Dominant parameters for major processes
- Preference for engineered over administrative control
- Criticality accident alarm system
- Management measures
- Organization and administration
- Technical practices (including ANSI standards)
- Balance of fire protection and criticality risk

Controlled Parameters (Waste Storage)

- Waste to be stored at MFFF
- Waste to be processed under DOE jurisdiction
- Control strategy:
  - Dual controls on concentration/mass
  - Adherence to DCP
  - May consist of active and passive engineered means, dual sampling
- Consistent with usual industry practice for auxiliary systems (e.g., ventilation, acid/solvent recovery)

NCS Open Issue (NCS-4)

- K-effective limits for 5 different AOAs:
  - Pu nitrate solutions
  - MOX pellets, rods, assemblies
  - PuO_2 powder
  - MOX powder
  - Pu compounds

- Methodology for normal condition minimum subcritical margin (abnormal = 0.05)

NCS Open Issue (NCS-4)

Criticality Code Validation

- Few critical benchmarks with required absorbers, range of parameters
- Use of sensitivity/uncertainty methods (SCALE 5) for powder systems
- Lumping all benchmarks into same AOA
- Rigor of methods used to demonstrate benchmark applicability

NCS Open Issue (NCS-4)

Criticality Code Validation

- Received Validation Report January 2003
- Meeting on major issues March 2003
- Received SCALE 5 (sensitivity/uncertainty code) May 2003
- Issued RAI June 2003
- Performing independent sensitivity/uncertainty analysis for solution, powder, and compounds

Conclusions

- Design bases acceptable except k-effective limits
  - Validation of AOAs
  - Normal case subcritical margin
- Identified early as main technical challenge for NCS
- Staff reviewing validation report
- SCALE-5 code being used

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Fire Protection Review of the Mixed Oxide Fuel Fabrication Facility Construction Authorization Request

Rex Wescott, Integrated Safety Analysis Specialist
NMSS/FCSS/SPIB

Fire Protection

OVERALL DESIGN BASES: Assure that the 10 CFR 70.61 Performance Requirements are complied with under all credible fire scenarios

- Prevention
  - AP process cells
  - Inerted gloveboxes
- Suppression and/or combustible loading controls
  - Truck bays
  - Secured warehouse
  - Glovebox areas (clean agent suppression)
  - Fuel rod and canister storage areas
- Fire barriers
  - Confinement of internal fires to one fire area
  - Protection against external fires

Fire Design Basis Values

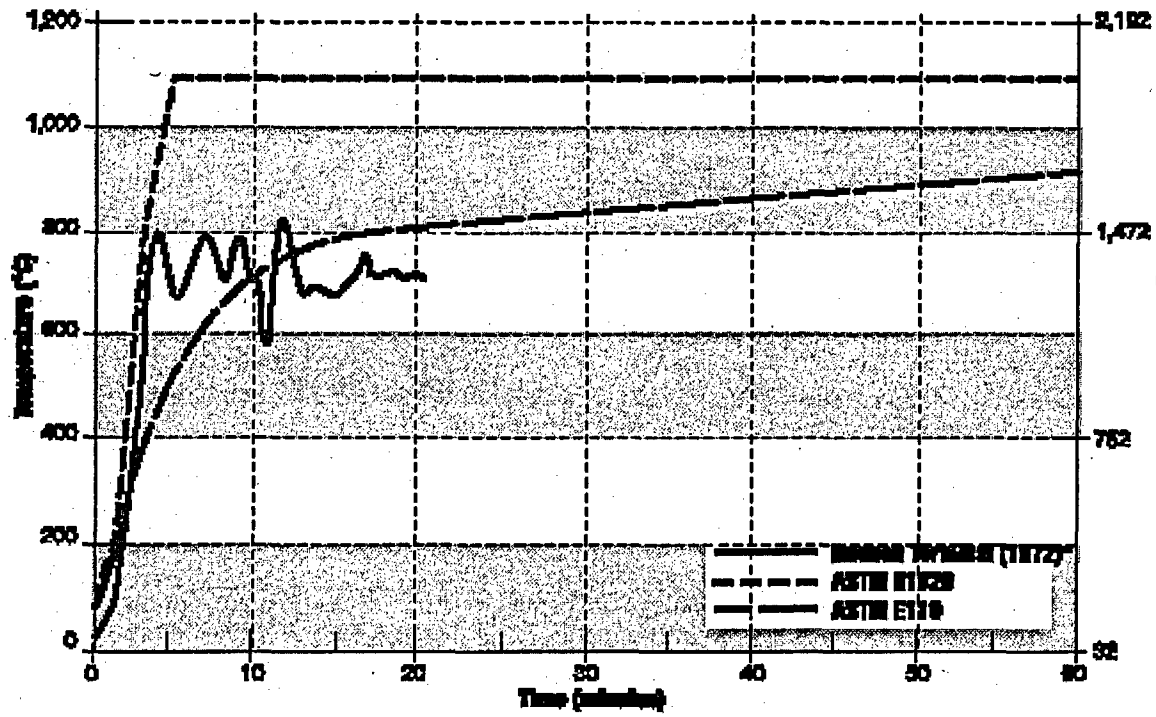
- Compartment or fire area boundaries -- 2 hour fire as per ASTM E-119
- Compartment air temperature into ventilation system -- 2000°F to protect final HEPA filters
- Material confinement barriers --
  - 3013 transport cask -- 1472°F for 30 minutes
  - MOX fuel transport cask -- 1472°F for 30 minutes

Open Issue: Fire barriers

- Applicant has evaluated fire scenarios where temperatures could exceed the ASTM E-119 curve (reagent storage area)

- It must be demonstrated that fire barriers can withstand the rapid fire development without loss of integrity

Comparison of standard fire test curves with office fire experiment



*Hudson Terminal experiment conducted with normal office fuel load (5 psf) (DeCicco, et al. 1972)

Figure A-3 Comparison of exposure temperatures in standard tests.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Tributyl-Phosphate (TBP) -Nitrate
(Red-Oil) Review for the Mixed Oxide Fuel Fabrication
Facility Construction Authorization Request

Alexander Murray, Sr. Chemical Process Engineer
NMSS/FCSS/SPIB

Description of Tributyl-Phosphate (TBP) -Nitrate (Red Oil)

- Chemical reaction of TBP/organics and nitric acid/nitrates
- Reaction can runaway - generate thermal energy and non-condensable gases
- Reaction rate is a function of chemical species, concentrations, temperature, and pressure; radiolysis can contribute to the phenomena
- Impurities and intermediates exacerbate the phenomena
- Red oil reactions are explosive under certain conditions

Background

- There are 4 reported accidents with equipment damage and facility release
- There is 1 accident with offsite release (Tomsk)
- Literature implies several "incidents" have occurred
- DCS has recognized red oil as an explosion event and has proposed a prevention strategy

Applicant's Approach

- 3 PSSCs, 5 safety functions, and distinction of open versus closed systems
  - Offgas: vent path (open) or evaporative cooling (closed)
  - Process Safety Control Subsystem: Steam temperature and residence time
  - Chemical Safety Control (Administrative): diluent selection and degraded organic compound quantity limit

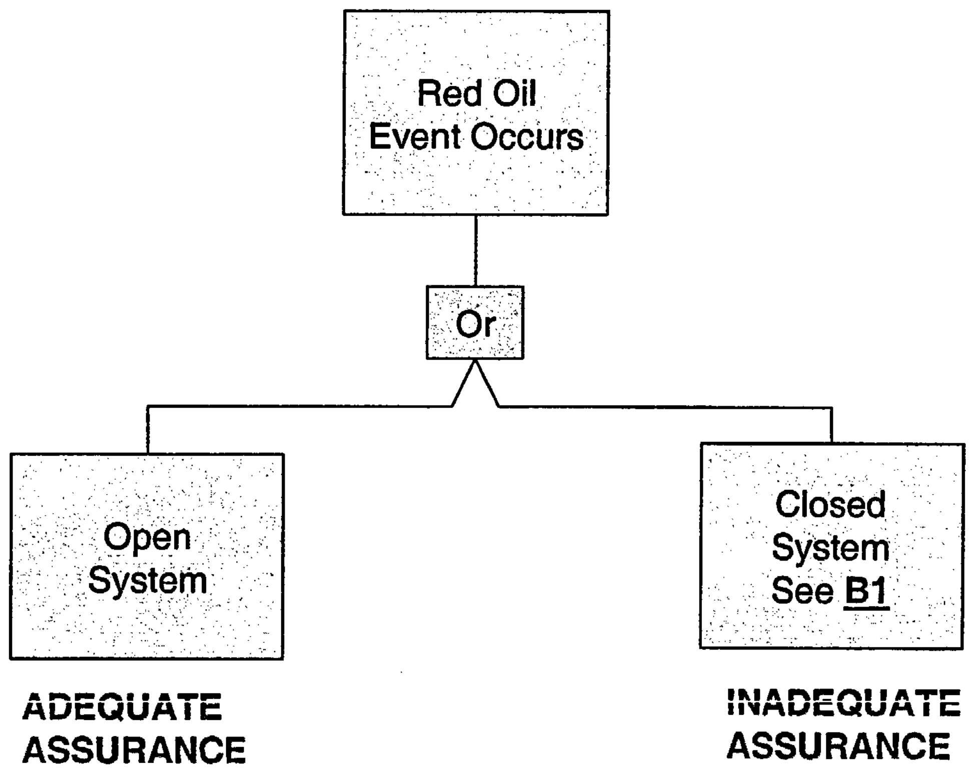
Open and Closed Systems

- Open system: capable of venting the full runaway reaction based upon experimental results (SRS), safety factor of 2.5, and assumption of 100% organics in system

- Closed system: Mass transfer to assure evaporative cooling at nitric acid/water azeotrope
  - vessel can have significant organics but not 100%
  - Safety factor 1.2 x [energy input + energy generation] with steam limited to 133°C
  - incapable of venting full runaway reaction (system would pressurize)

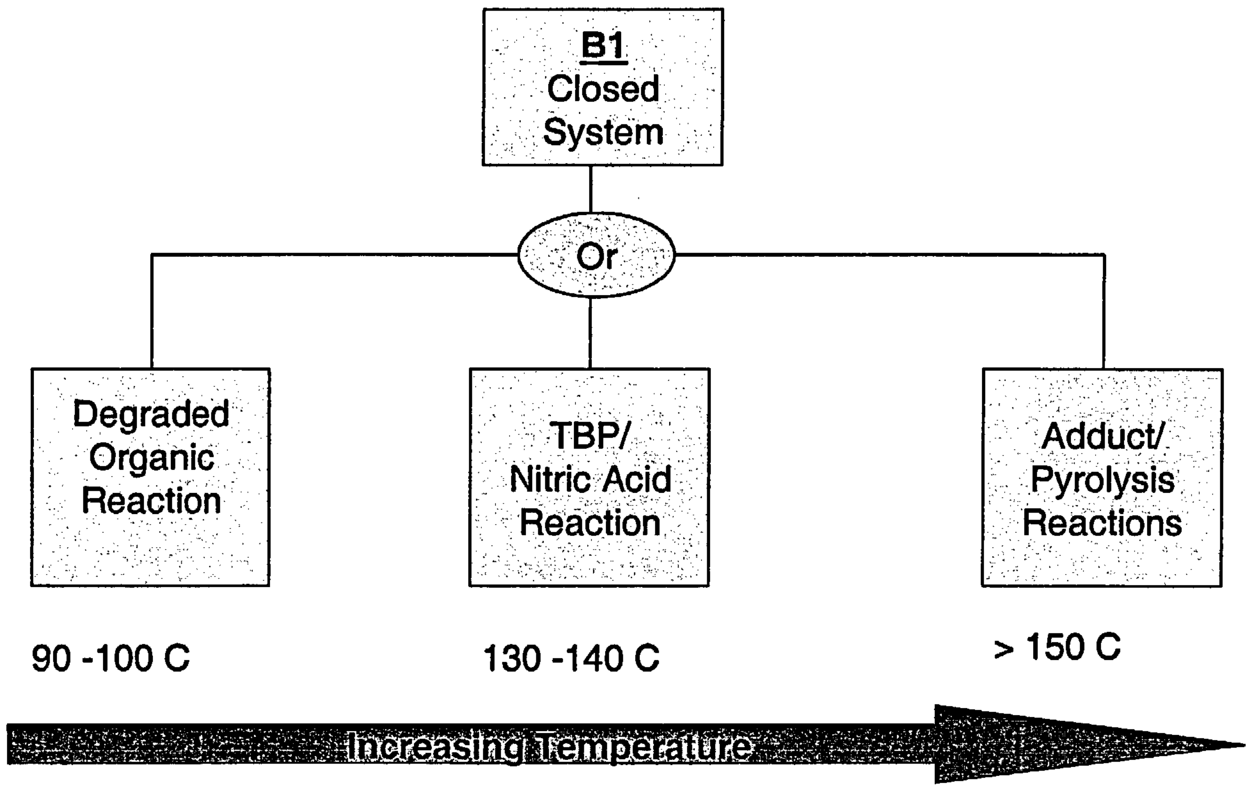
Top Level Fault Tree: Open Systems vs. Closed Systems

Initial Tree



Closed System Fault Tree - Top

FTA – Second Level



Conclusions

- Open system: approach capable of meeting "highly unlikely" and is acceptable
  - applies to most vessels (unheated)
- Closed system: approach not currently accepted by staff
  - likelihood of potential event not "highly unlikely"
  - some differences with approaches at existing facilities
  - limit solution temperature susceptibility to increases (steam pressure/temperature fluctuations, degraded/loss of venting capability)
- DCS to provide additional information to the NRC

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Seismic Review of the Mixed Oxide Fuel Fabrication Facility Construction Authorization Request

John Stamatakos
Rex Wescott
Herman Graves, III

DCS Approach to Seismic Design

- Seismic Design Based on Four-Part Seismic Hazard Assessment
  - Generic probabilistic seismic hazard assessment (PSHA) for the Savannah River Site.
    - Based on Lawrence Livermore National Laboratory (LLNL) and Electric Power Research Institute (EPRI) sesimic hazard studies for Central and Eastern United States.
    - DCS established design basis earthquake by implemented DOE Standard 1023 (parallels methodology in NRC Regulatory Guide 1.165).
    - Design basis earthquake based on DOE performance categories defined in DOE Standard 1020 with PC-3 and PC-4 (mean hazards at 5×10^{-4} and 1×10^{-4} annual exceedence probabilities).

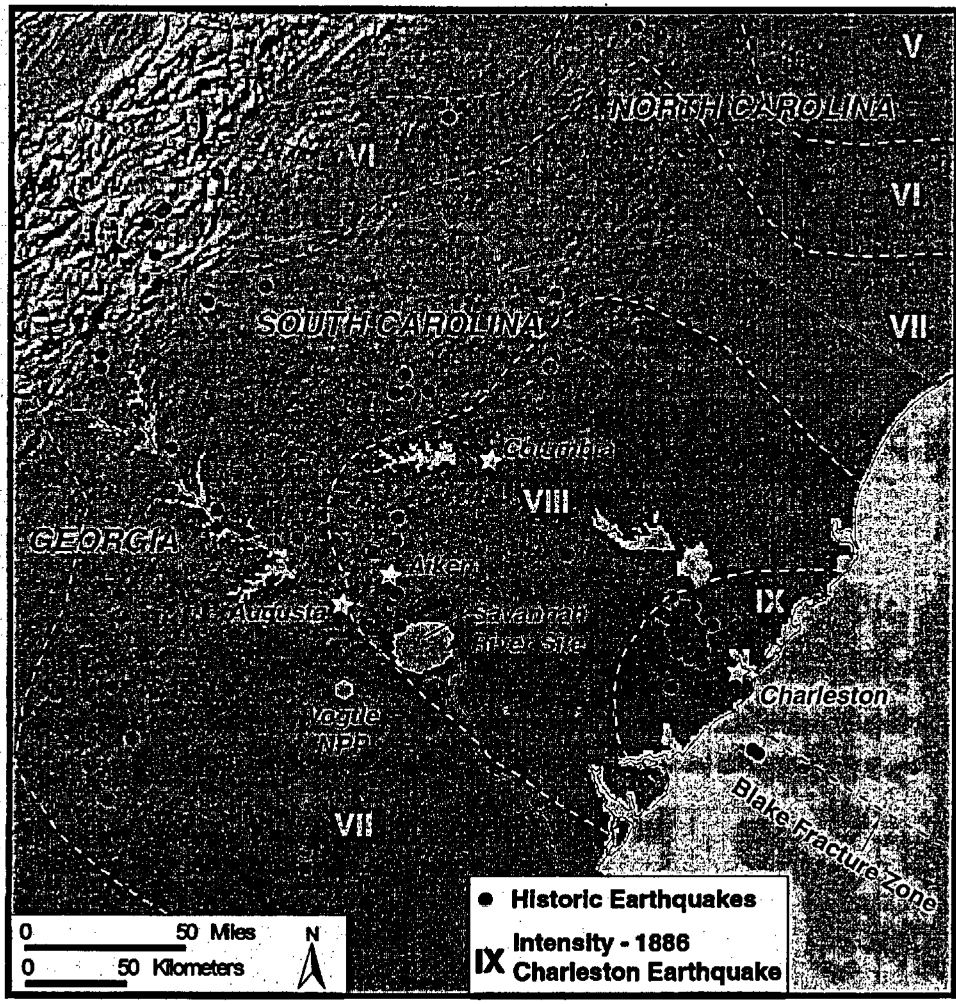
DCS Approach to Seismic Design (Continued)

- Facility design based on Regulatory Guide 1.60 spectra scaled to 0.20 g peak ground acceleration (Plant Vogtle NPP).
  - Target 1×10^{-4} mean annual exceedence probability for ground motions at frequencies of interest.
  - Design uses Regulatory Guide 1.60 horizontal soil surface spectrum scaled to 0.20 peak ground acceleration to meet this goal.
  - Vertical spectrum is also based on NRC Regulatory Guide 1.60 scaled to 0.20g peak ground acceleration.

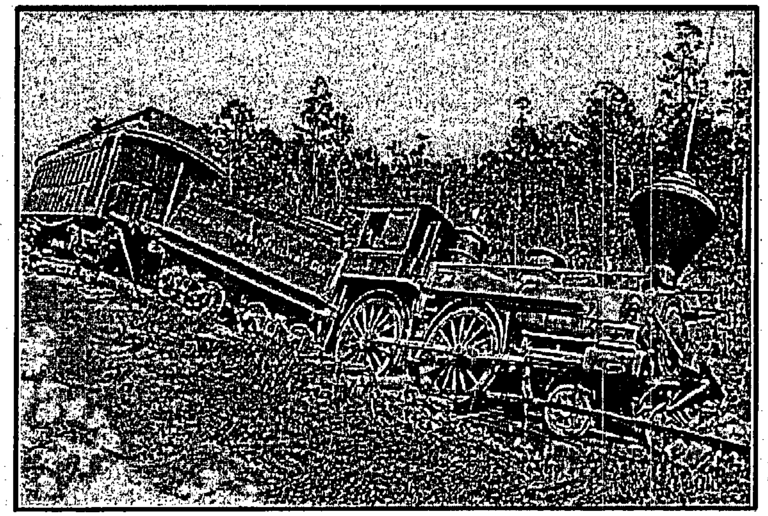
DCS Approach to Seismic Design (Continued)

- Soil stability analyses based on LLNL and EPRI seismic hazard results adjusted for site response.
  - Mean soil amplification factors were developed from site response model to scale the bedrock uniform hazard spectra to the soil surface.
  - DCS also developed alternative site-specific amplification functions (bedrock to soil surface) to validate response model.
  - For soil stability analyses, DCS used the bedrock PC-3 ground motions scaled so that when amplified throught the soil they produce surface ground motions with 0.20 peak ground acceleration.

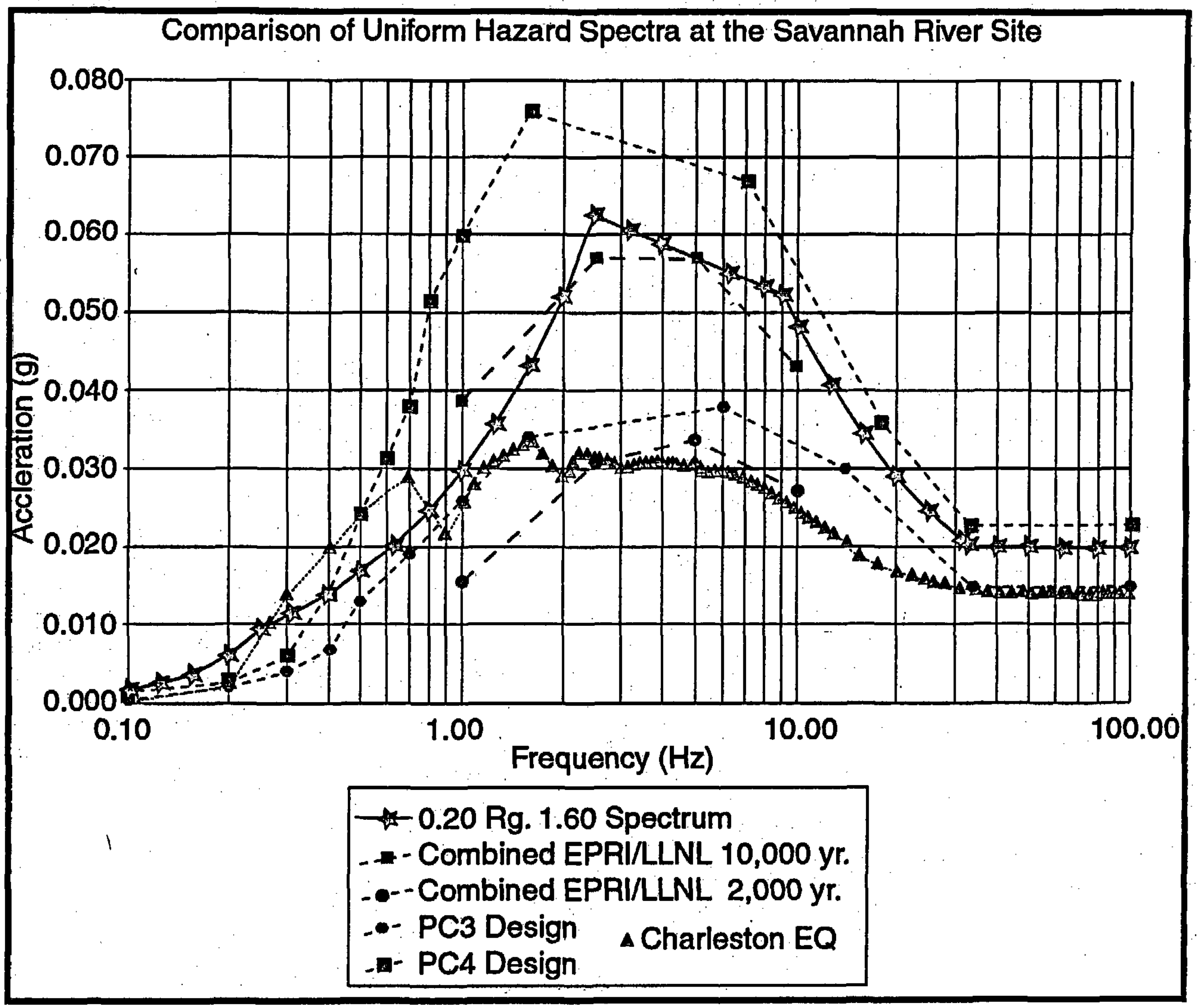
DCS Approach to Seismic Design (Continued)



- "Historic Check" using repeat of the 1886 Charleston Earthquake.
  - Magnitude =7.3 at Distance of 120 km from the site.



Summary of MOX Seismic Hazard and Design Spectra



Confirmatory Risk Assessment

- DCS performed limited probabilistic risk assessment on representative systems, structures, and components (e.g., offsite power, glove box, building structure).

- DCS showed seismic performance of these systems, structures, and components is 1×10^{-5}/yr or better, consistent with guidance in NUREG 1718.

Staff Evalaution

- Bedrock Seismic Hazard
  - Application of LLBL and EPRI hazard results is appropriate.
- Site reposnse
  - Site response models, based on site-specific soil data, are adequate.
- Sesimic Design
  - Regulatory Guide 1.60 spectra scaled to 0.20 g peak ground acceleration envlopes uniform hazard spectrum and Charleston Earthquake "historic check" at frequencies of interest.
  - Probabilistic risk assessment shows that critical systems, structures, and components consistent with performnce objectives in NUREG-1718.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Safety Assessment:
Radiological Consequences

Rex Wescott, Integrated Safety Analysis Specialist
NMSS/FCSS/SPIB

Overview

Safety Assessment: Radiological Consequences

- The staff's review of the applicant's radiological consequence calculations included review of:
  - Source term calculations
  - Facility worker dose estimates
  - Downwind consequence calculations
  - How the applicant's safety strategy reduces the risk to each receptor.

Safety Assessment: Radiological Consequences

Source Term using Five Factor Formula

- The staff reviewed:
  - material-at-risk (MAR)
  - damage ratio (DR)
  - atmospheric release fractions (ARFs)
  - respirable fractions (RFs)
  - leak path factors (LPFs) (i.e., HEPA filters)

Safety Assessment: Radiological Consequences

Source Terms: Applicant's proposed methodology

- ARFs and RFs were assigned for each type of material and each event.
- Material release forms
  - Solution
  - Powder
  - Pellet
  - Rod
  - Unencased filter
- Events
  - Explosive detonation
  - Explosive overpressurization
  - Fire/boil
  - Drop
  - Entrainment

Safety Assessment: Radiological Consequences

Source Terms: Applicant's proposed methodology (cont.)

- For example:
  - Powder, fire: ARF x RF = $6 \times 10^{-3} \times 0.1 = 6 \times 10^{-4}$
  - Solution, explosion = $1.0 \times 0.01 = 10^{-2}$
  - Rods, dropped = $3 \times 10^{-5} \times 1.0 = 3 \times 10^{-5}$
    - Source: Table 9.1-5 of the April 30, 2003 DSER

Safety Assessment: Radiological Consequences

Source Terms: Staff's Evaluation

- DSER, Section 9.1.1.4.2:
  - Staff finds the values chosen by the applicant to be consistent with recommendations in NUREG/CR-6410, and find them acceptable for construction authorization.
- Staff will review all 5 factors again during review of the Integrated Safety Analysis

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Review of the Mixed Oxide Fuel Fabrication Facility
Construction Authorization Request

Remaining Open Items

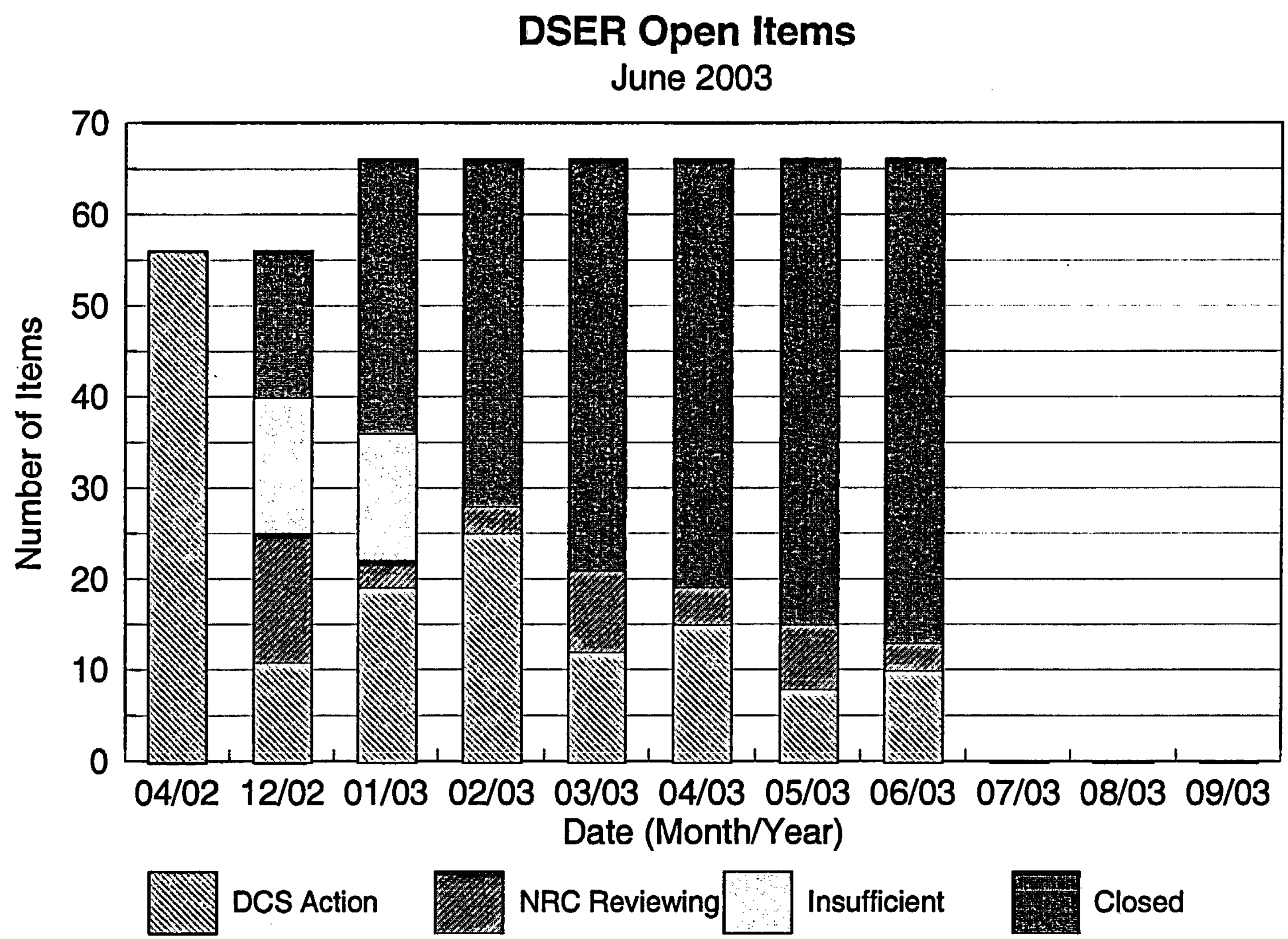
Andrew Persinko, Sr. Project Manager
NMSS/FCSS/SPIB

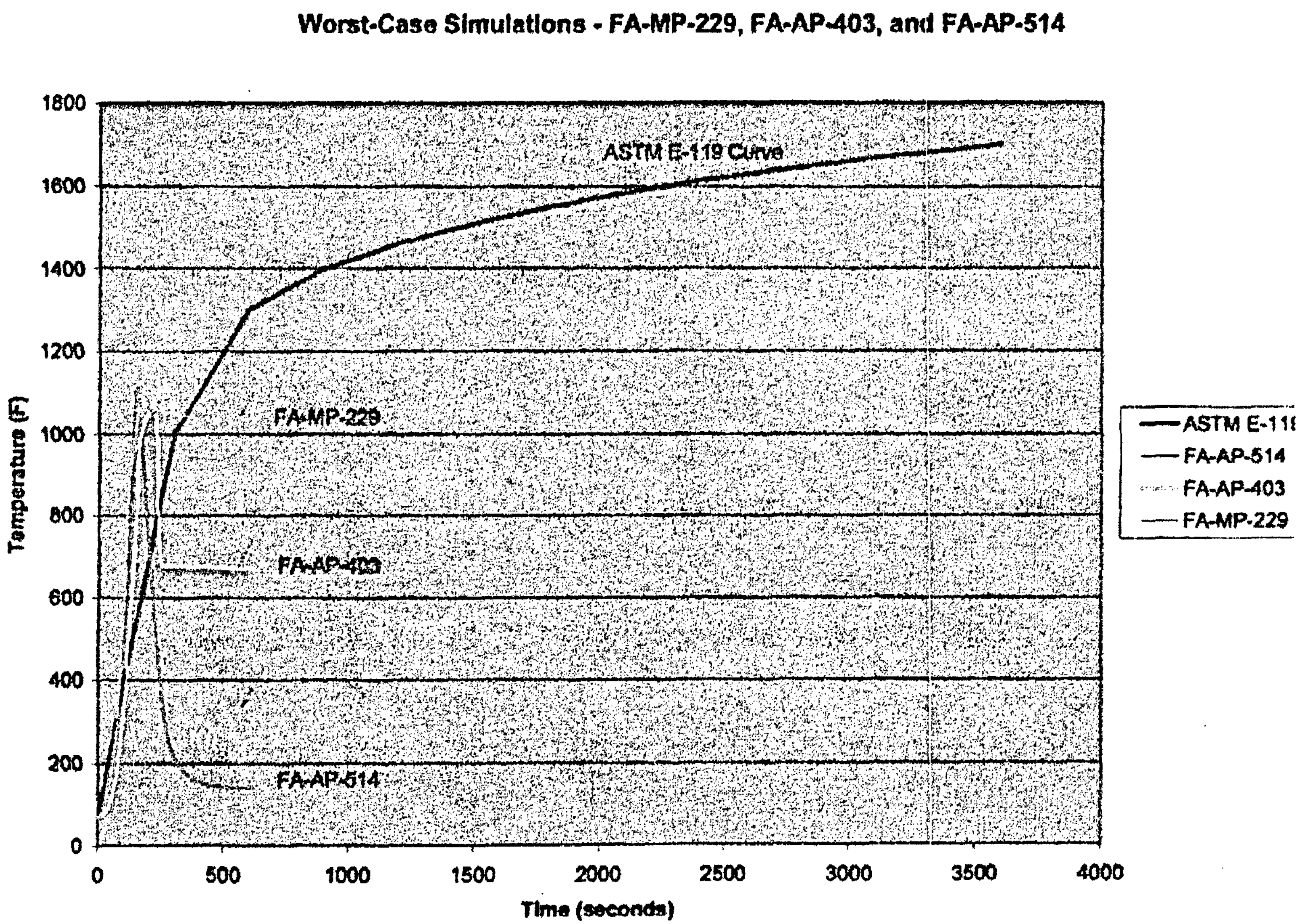
Remaining Open Items

- Titanium fires (AP-3)
- UO_2 burnback (MP-1) Hydroxylamine nitrate (HAN)/hydrazine (CS-2)
- Design basis for flammable gases: lower flammabilty limit values 25% vs 50%
  - Solvent temperatures (CS-9, AP-9)
  - Electrolyzer (AP-2)
  - Offgas unit (AP-8)

Remaining Open Items

- Emergency control room habitability limits (CS-10)
- Use of Temporary Emergency Exposure Limits (TEELs) (CS-5b)


DSER Open Items
June 2003
Number of Items
70
60
50
40
30
20
10
0
04/02
12/02
01/03
02/03
03/03
04/03
05/03
06/03
07/03
08/03
09/03
Date (Month/Year)
DCS Action
NRC Reviewing
Insufficient
Closed



Worst-Case Simulations - FA-MP-229, FA-AP-403, and FA-AP-514
ASTM E-119 Curve
FA-MP-229
FA-AP-403
FA-AP-514
Temperature (F)
Time (seconds)
0
200
400
600
800
1000
1200
1400
1600
1800
0
500
1000
1500
2000
2500
3000
3500
4000
FA-AP-514
FA-AP-403
FA-MP-229

DUKE COGEMA
STONE & WEBSTER

MFFF
General Facility Mission and Layout

Presentation to the

504th Advisory Committee on Reactor Safeguards

10 July 2003

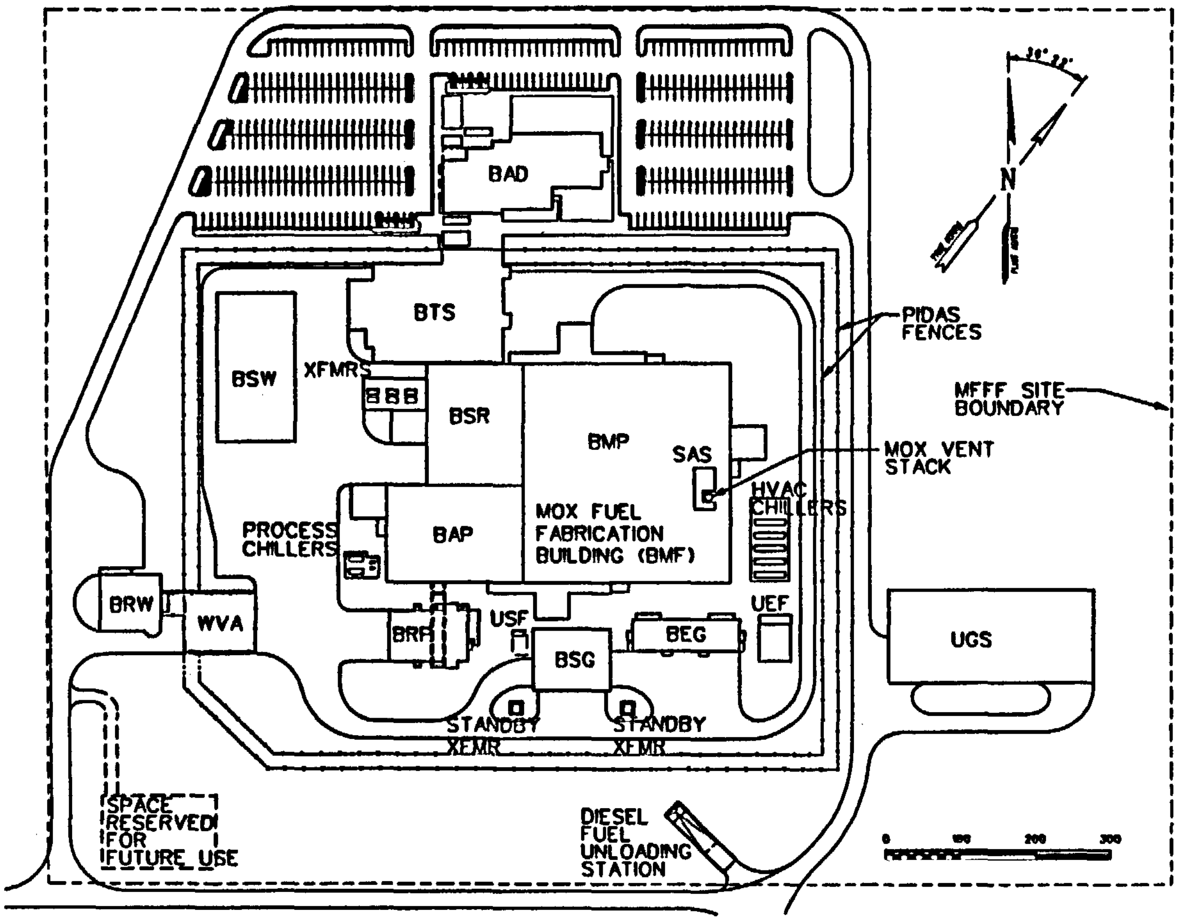
DUKE COGEMA
STONE & WEBSTER

MFFF Mission

- **To irreversibly transform 34 metric tons of excess weapons plutonium into a form unusable for weapons**
  - **MOX Fuel Fabrication Facility - Fabricate plutonium oxide powder into mixed oxide fuel assemblies**

DUKE COGEMA
STONE & WEBSTER

MOX Facility Layout

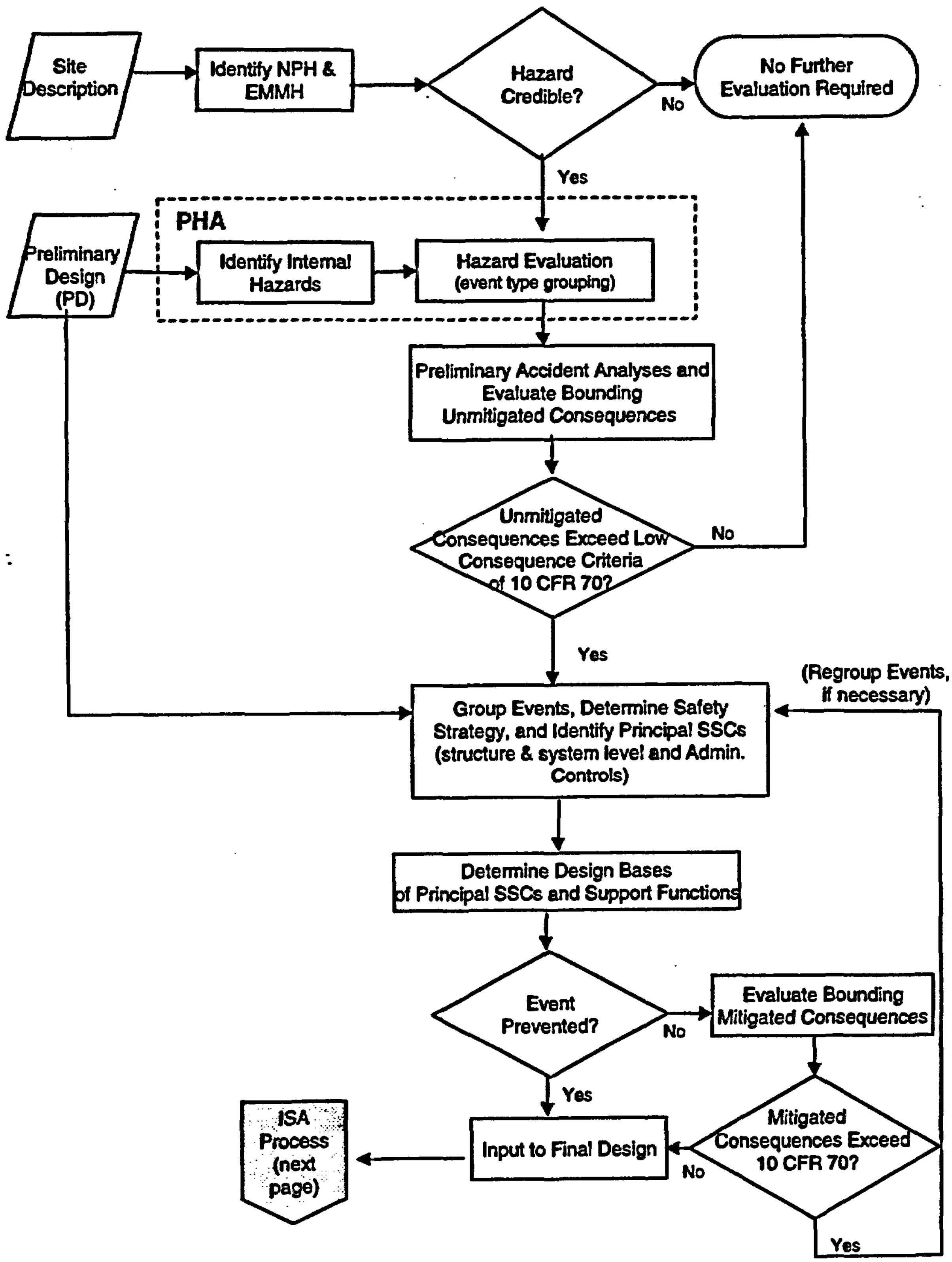


- **BUILDING LEGEND**
  - **MOX FUEL FABRICATION BUILDING (BMF)**
    - **BMP- MOX Processing Area**
    - **BAP- Aqueous Polishing Area**
    - **BSR- Shipping and Receiving Area**
  - **SUPPORT BUILDINGS**
    - **BTS- Technical Support Building**
    - **BRP- Reagents Processing Building**
    - **BAD- Administration Building**
    - **UGS- Gas Storage Area**
    - **BSW- Secured Warehouse Building**
    - **BEG-Emergency Generator Building**
    - **BRW- Receiving Warehouse Building**
    - **BSG- Standby Generator Building**
    - **WVA- Vehicle Access Portal**
    - **BRW- Receiving Warehouse Building**
    - **UEF- Emergency Fuel Storage Vault**

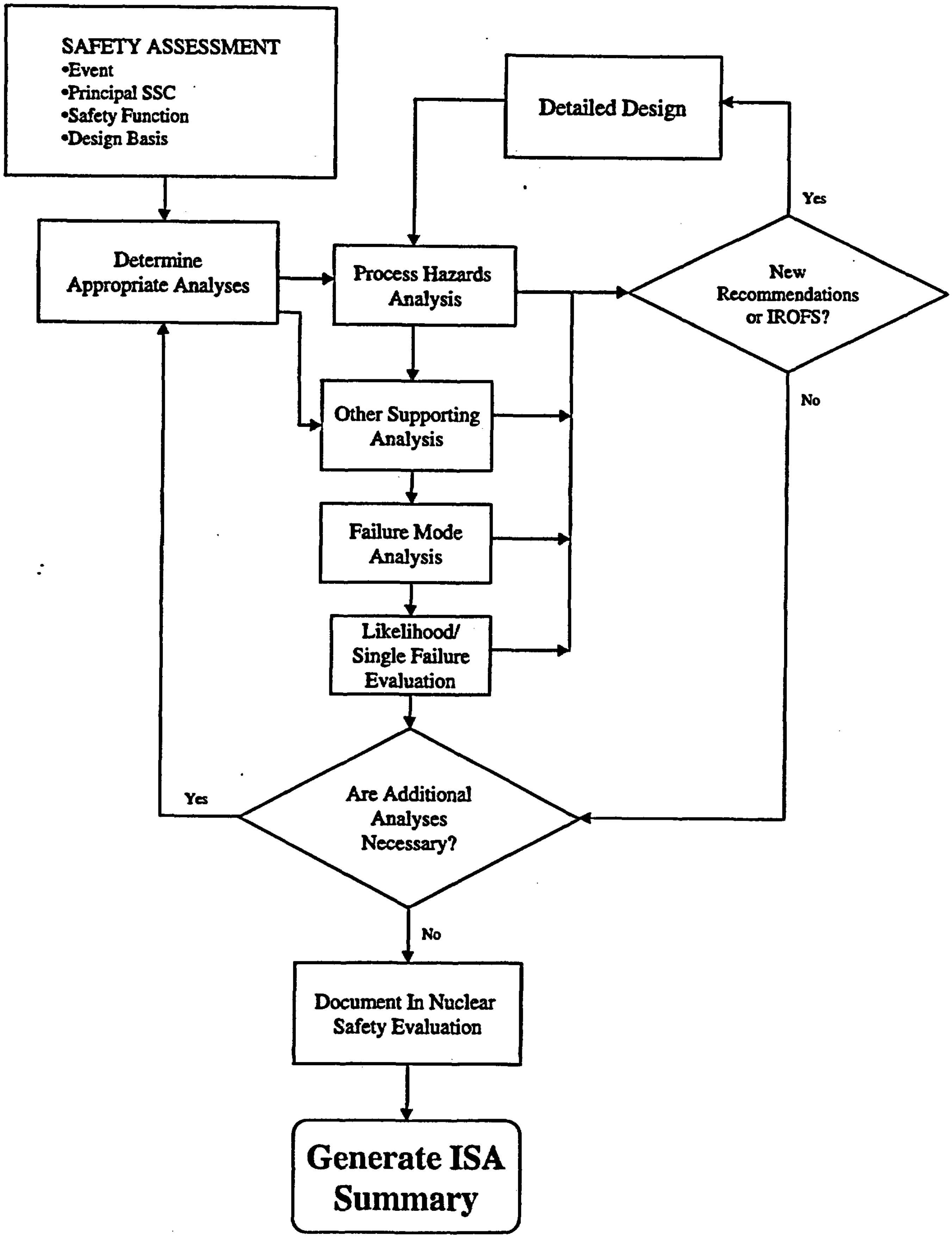
DUKE COGEMA
STONE & WEBSTER

Safety Philosophy

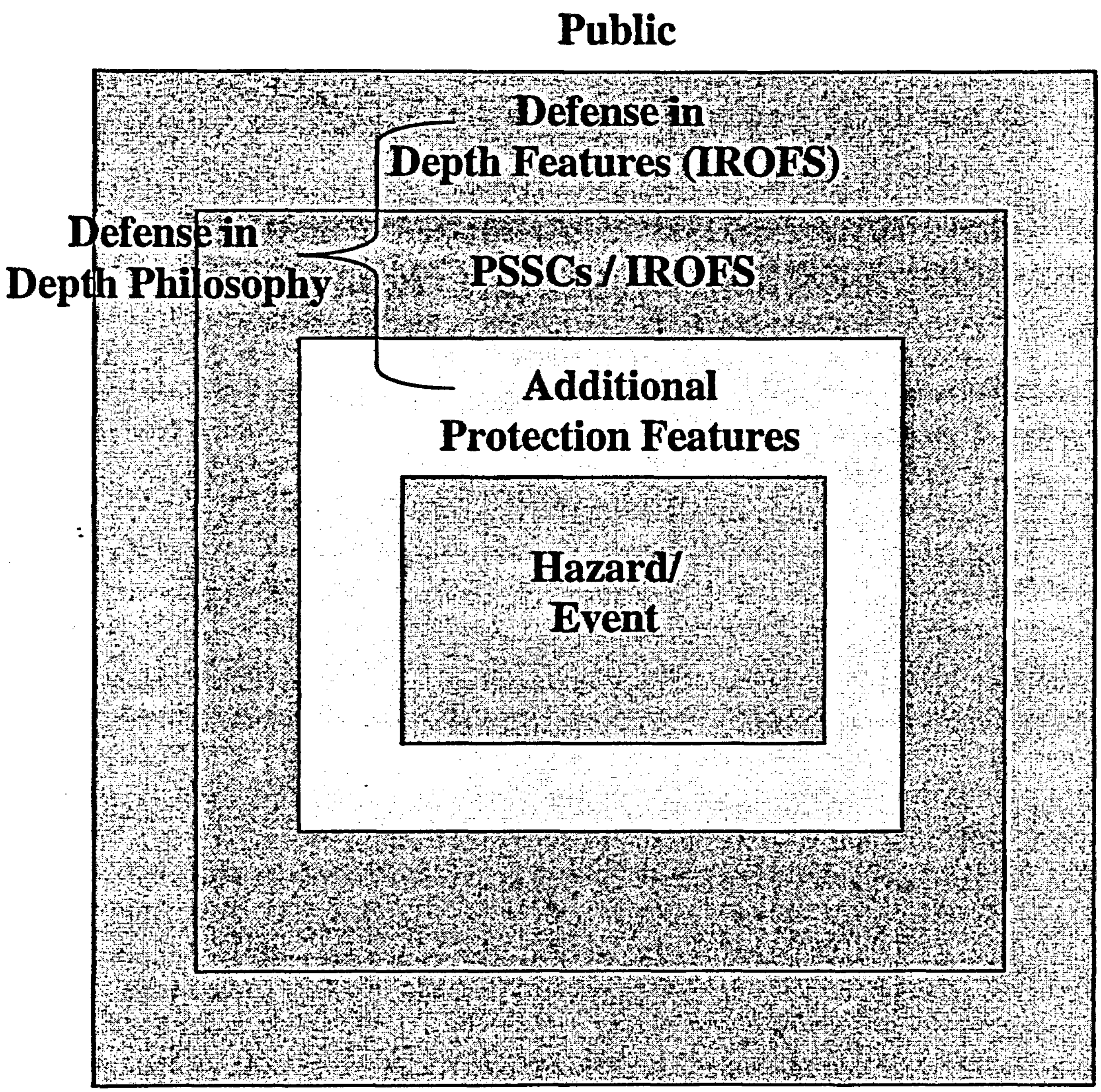
ISA Flow Chart (Safety Assessment of the Design Basis)



Continuation of ISA Process



ISA Terminology and Defense in Depth Philosophy



Proposed Criteria for the Treatment of Individual Requirements in a Regulatory Analysis

Briefing to the ACRS

Brian J. Richter
Reactor Policy & Rulemaking Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
July 10, 2003

Objective of Presentation

- Obtain ACRS consent on the staff's approach to the treatment of the "bundling" issue.
  - Given the proposed approach is improved over existing guidance, obtaining ACRS consent would allow implementation, via the issuance of the Regulatory Analysis Guidelines, Revision 4, to occur in a timely fashion.
- Obtain comments from ACRS to improve the proposed approach and, if needed, adapt additional input for a new revision (5) to the Guidelines.

Issue

- The Commission and others have raised the issue of the "bundling" of individual requirements into a single regulatory analysis.
- The concern is that the net benefit from one regulatory requirement could potentially support other requirements that are not cost-justified.

Background

- SECY-00-0198, "Status Report on Study of Risk-informed Changes to the Technical Requirements of 10 CFR Part 50 (Option 3) and Recommendations on Risk-Informed Changes to 10 CFR 50.44 (Combustible Gas Control)"
  - Staff recommended that the Commission not allow selective implementation of voluntary rules, as was suggested by some licensees.
  - Commission agreed, but challenged staff to establish a process solution.

Background (cont.)

- SECY-01-0134, "Final Rule Amending the Fitness-for-Duty Rule"
  - Stakeholders raised concerns with the NRC approach that "bundles" individual requirements into a single analysis.
  - SRM directed the staff to ensure that individual rule changes are integral to the purpose of the rule, cost-justified, or qualify as backfit exceptions.

Background (cont.)

- SECY-01-0162, "Staff Plans for Proceeding with the Risk-Informed Alternative to the Standards for Combustible Gas Control Systems in Light-Water-Cooled Power Reactors in 10 CFR 50.44"
  - Staff proposed to develop guidance to address how to assess new risk-informed requirements.
  - Commission agreed and directed the staff to ". . . [I]mplement a disciplined, meaningful, and scrutable methodology for evaluating the value-impact of any new requirements that could be added by a risk-informed alternative rule."

Staff Activity

- Working Group formed containing members from NRR, NMSS, RES, and OGC.
- Proposed revision to Regulatory Analysis Guidelines, NUREG/BR-0058, Rev. 3 to address the treatment of individual requirements.
- Published FRN February 13, 2002, which presented preliminary proposed criteria for the treatment of individual requirements in a regulatory analysis, and announced public meeting.
- Held public meeting on March 21, 2002, to discuss preliminary proposed criteria.
- Extensive comments were received at the meeting..
- Developed proposed guidance considering comments received.

Staff Activity (cont.)

- Obtained CRGR endorsement of proposed guidance.
- Staff obtained approval from the Commission to publish these proposed revisions to NUREG/BR-0058 for public comment in the *Federal Register*.
- SRM said staff should provide the final criteria to the Commission for review not only if the comments result in significant changes to the criteria, but also if there are significant adverse comments regarding the criteria.
- A request for comment on the proposed criteria was published in the *Federal Register* on April 18, 2003.

Published Proposed Criteria

- The proposed criteria were:
  - If an individual requirement is "necessary" (i.e., it is needed in order to meet the objectives of the rule or maintain consistency with Commission policies), it does not need to be analyzed separately.
  - If an individual requirement is supportive but not necessary, it should be included only if it makes the bundled initiative more cost-beneficial.

Published Proposed Criteria (cont.)

- If an individual requirement is unrelated to the overall regulatory action, it should be included only if it makes the bundled requirements more cost-beneficial *and* it passes the backfit test, if applicable.
- Disaggregation is only appropriate if it produces substantively different alternatives with potentially meaningful implications on the cost-benefit results.
- If an individual requirement in a voluntary rule is justifiable under backfit criteria, NRC should consider imposing this as a mandatory backfit.

Comments Received

- NEI made the only submittal of comments
  - Criteria necessary to evaluate the bundling of individual requirements into a single regulatory analysis.
    - Risk-informed voluntary alternatives should be cost-justified and integral, not cost-justified or integral.
    - Lack of scrutable guidance by the NRC.
  - Use of subjective judgment in making bundling decisions.
  - Request another public meeting on the issue.

Future Actions

- Working group to meet to resolve NEI comments and requests.
- Management is considering whether to hold another public meeting.
- Draft revised Guidelines input and submit to the Commission.
- Issue NUREG/BR-0058, Rev. 4.

GE Nuclear Energy

ESBWR Design Overview and Technology Closure

Atam Rao
Project Manager ESBWR
GE Nuclear Energy, USA

ACRS Meeting
July 10, 2003,
Rockville, Maryland

Outline

- ESBWR Program Overview
  - stepwise program with Technology Closure as first step
- ESBWR Design Overview
  - simpler with more margin – by design
  - comprehensive testing and analysis program
- Technology program
  - comprehensive plan with complete implementation
  - testing and qualification
  - single integrated computer code for analysis with well defined application methodology
- Technology Closure Program – pre-application review
  - safety evaluation report for TRACG
- Summary and Conclusions

A simple design, extensive testing and analysis – Implementing an action plan to minimize regulatory risk

ESBWR Program overview

- Stepwise program for design development
  - Developed passive systems
  - Developed integrated plant design – SBWR
    - Completed extensive system and building design
    - Defined extensive test and analysis program
    - Completed extensive test and analysis program
  - Improved plant economics and design
    - Plant optimization and economies of scale
    - Incorporated utility requirements
    - Utilize ABWR experience – components, construction
- Stepwise program for regulatory approval
  - Simpler with more margin – by design
  - Technology Closure Program – pre-application review
    - safety evaluation report for TRACG
    - focus on safety systems & containment
    - use of single integrated computer code for analysis
    - comprehensive testing and analysis basis
  - Safety analysis report & design certification – after technology closure

GE is committed to develop and license the ESBWR

Goals for the technology closure

- Approval of the use of TRACG for analysis
  - vessel response to pipe break – loss of coolant accident (called ECCS/LOCA)
  - containment response to pipe break (called Containment/LOCA)
  - vessel response to anticipated operational occurrences (called AOO) - delayed
  - plant response to anticipated transients without scram (ATWS) and normal operation stability (ODYSY) – LATER
- Confirmation of the adequacy of TRACG
  - adequacy of the qualification base and approach

Is a 15+ year comprehensive technology program enough?

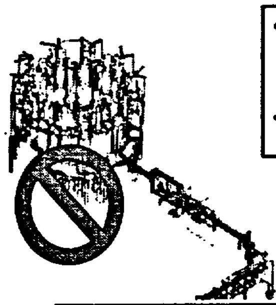
Comparison of Key ESBWR Parameters to Operating BWRs

Parameter	BWR/4-Mk I (Browns Ferry 3)	BWR/6-Mk III (Grand Gulf)	ABWR	ESBWR
Power (MWt/MWe)	3293/1098	3900/1360	3926/1350	4000/1390
Vessel height/dia. (m)	21.9/6.4	21.8/6.4	21.1/7.1	27.7/7.1
Fuel Bundles (number)	764	800	872	1020
Active Fuel Height (m)	3.7	3.7	3.7	3.0
Power density (kw/l)	50	54.2	51	54
Recirculation pumps	2(large)	2(large)	10	zero
Number of CRDs/type	185/LP	193/LP	205/FM	121/FM
Safety system pumps	9	9	18	zero
Safety diesel generator	2	3	3	zero
Core damage freq./yr	1E-5	1E-6	1E-7	1E-7
Safety Bldg Vol (m^3/MWe)	115	150	160	70

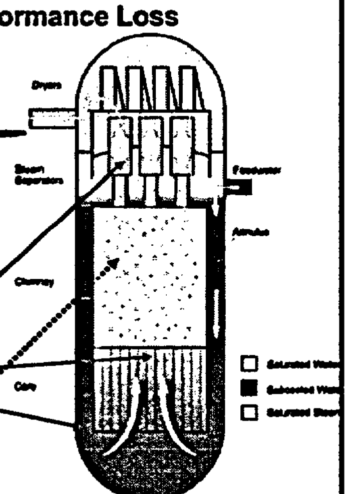
Evolution Within a Small Range Minimizes Operational Risks

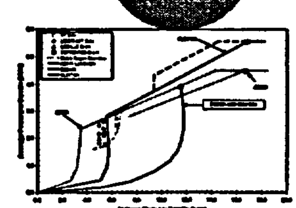
Natural Circulation – Simplification Without Performance Loss

- **Passive safety/natural circulation**
  - Put the water in the vessel – larger vessel
  - Increase driving head – larger vessel
- **Significant reduction in components**
  - Pumps, motors, controls, HXers
- **Load following with Control Rod Drives**
  - Minimal impact on maintenance



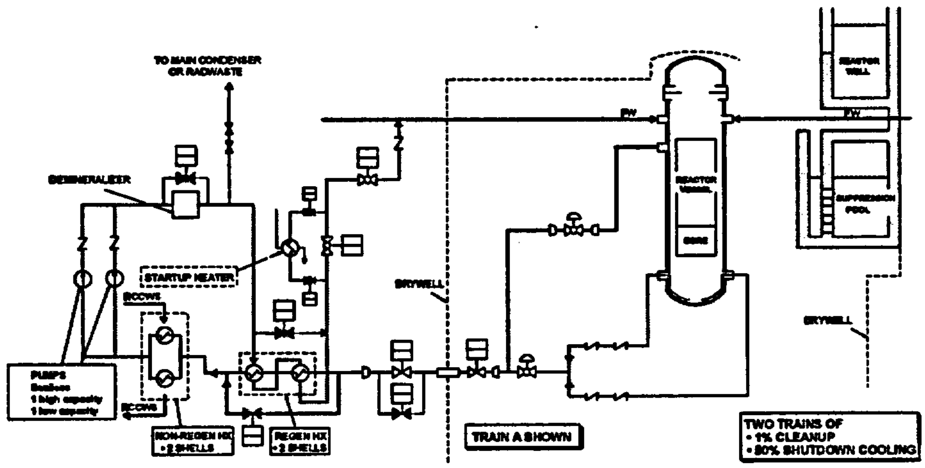
- Reduced flow restrictions
  - Improved separators
  - Shorter core
  - Increase downcomer area
- Higher driving head
  - Chimney/taller vessel





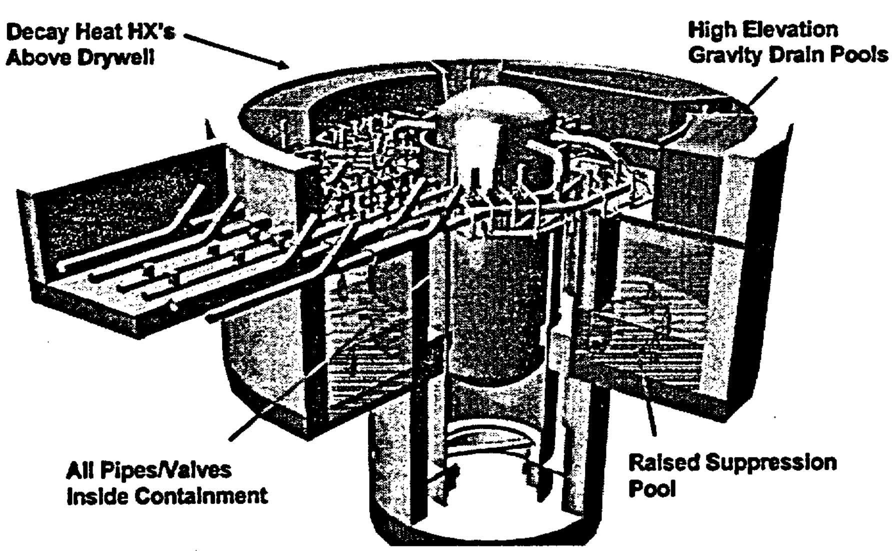
Enhanced Natural Circulation Compared to Standard BWR's

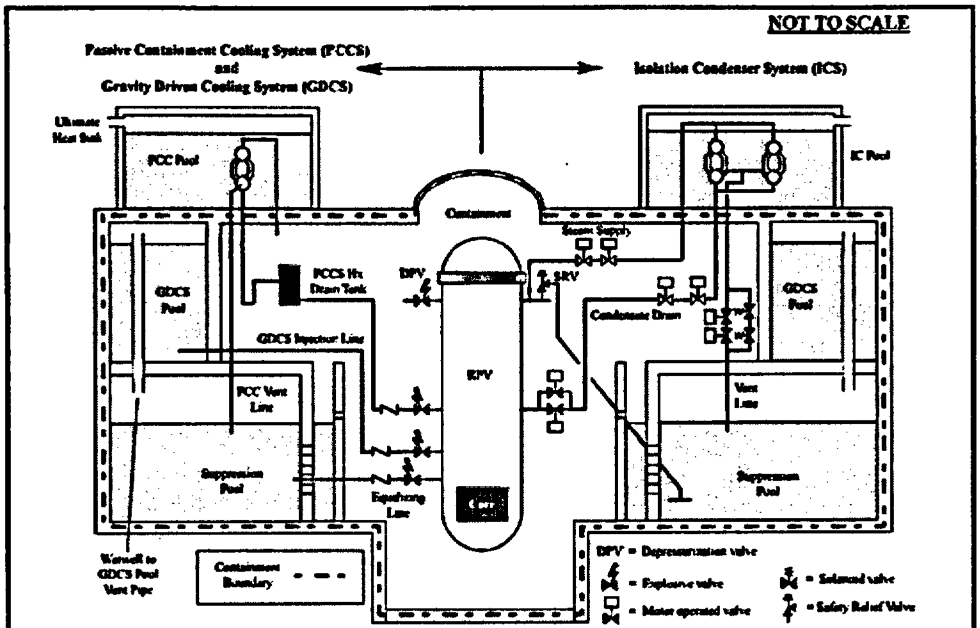
Reactor Water Cleanup / Shutdown Cooling System
(both systems combined for ESBWR)



Standard 2 x1% reactor water cleanup system with Unique full pressure shutdown cooling system

Passive Safety Systems Within Containment Envelope





Passive systems simplify the plant, reduce maintenance & increase security

AR-9

Design philosophy for core cooling

- **Increase inventory in the vessel**
  - Use taller vessel - NEW
  - Increase amount of subcooled water - NEW
- **Minimize inventory loss from the vessel**
  - Eliminate large pipes below the core and minimize other pipes - NEW
- **Keep core covered after initial blowdown**
  - Shorter core lower in the vessel - - NEW
- **Provide inventory makeup – low head using gravity**
  - Provide diverse depressurization system for high reliability - NEW
  - Required makeup rate is very low
    - Multiple pools rely on gravity to fill vessel - NEW
  - No high capacity systems needed
  - Fewer systems interactions
- **Utilize integrated BWR analyses tools**

Design features improved the plant response

AR-10

Design Philosophy for decay heat removal

- **Remove Decay Heat From Vessel**
  - Main Condenser
  - Full pressure normal shutdown cooling system - NEW
  - Isolation condensers - NEW
  - Remove vessel heat through relief valve opening
- **If Needed, Remove Heat From Containment**
  - Passive containment cooling (PCC) Hx (safety-grade) - NEW
    - Always available and drywell/wetwell pressure difference removes the non-condensables from the heat exchangers
    - Condensed steam returns to drywell/vessel, non-condensables collect in the wetwell airspace
    - No operator action needed for 72 hours
  - Suppression pool cooling (non-safety)

Several Diverse Means of Decay Heat Removal

AR-11

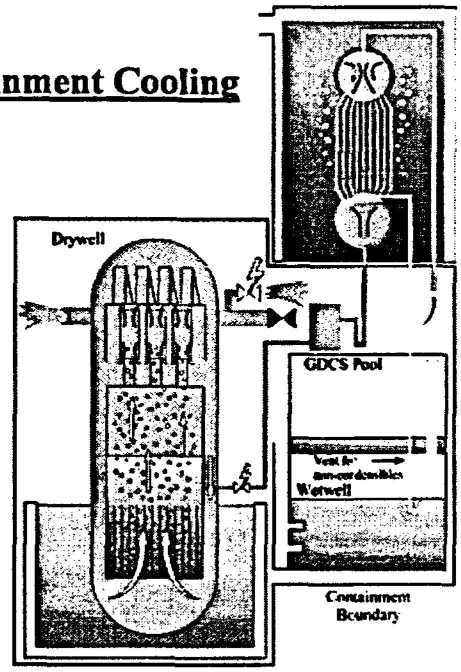
Decay Heat Removal from Containment - How it works

- **Initially steam (blowdown energy) flows to large heat sink in containment (suppression pool) and through heat exchangers**
- **Longer term (decay heat) steam flows to heat exchanger (similar to an isolation condenser) and heat is transferred outside containment**
  - vertical tube heat exchangers in a pool of water
  - non condensables removed by pressure difference between drywell and wetwell
- **Containment pressure determined by non-condensables in wetwell airspace and vapor pressure**

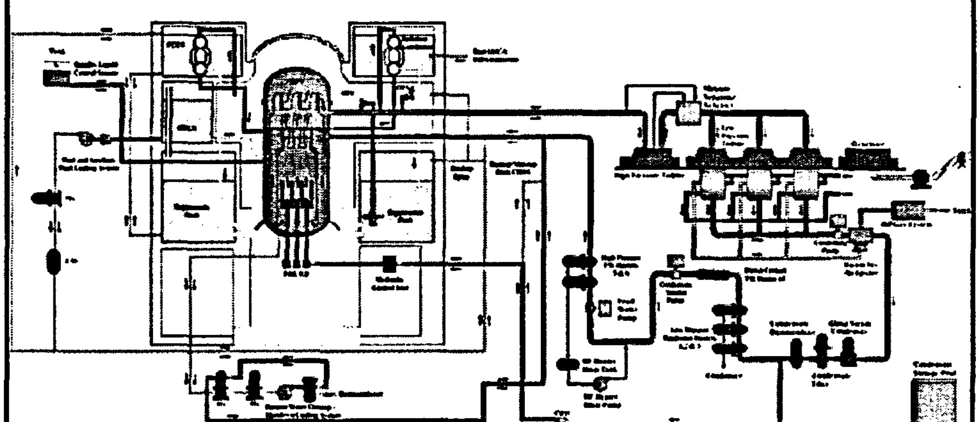
Concept is simple, reliable - extensive testing and analysis provide high confidence in the design margin

AR-12

Passive Containment Cooling

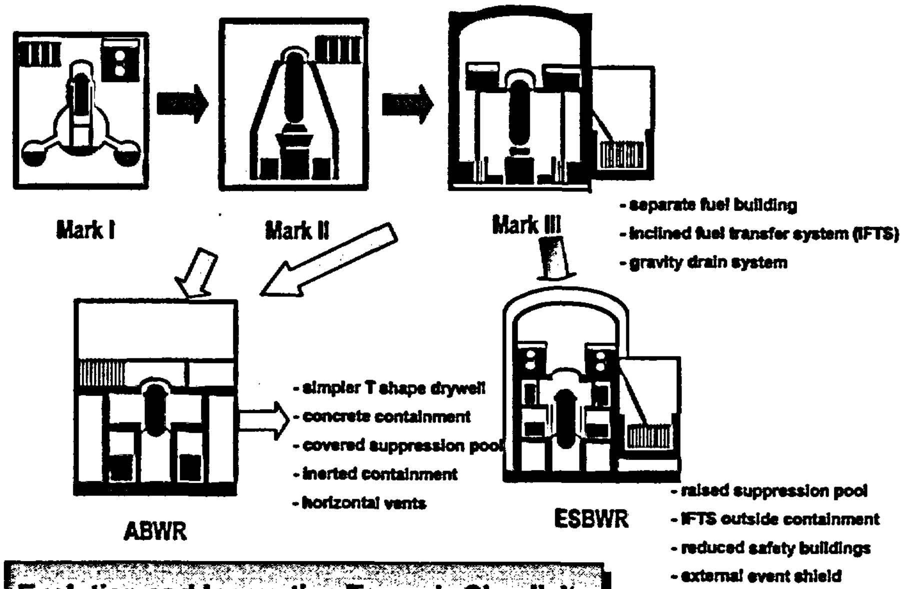


ESBWR Plant Schematic

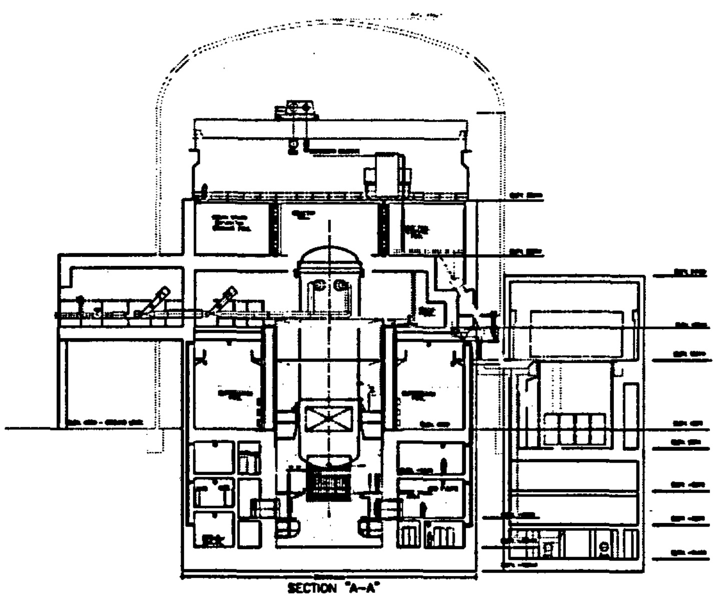


A Typical but Simpler Direct Cycle Plant

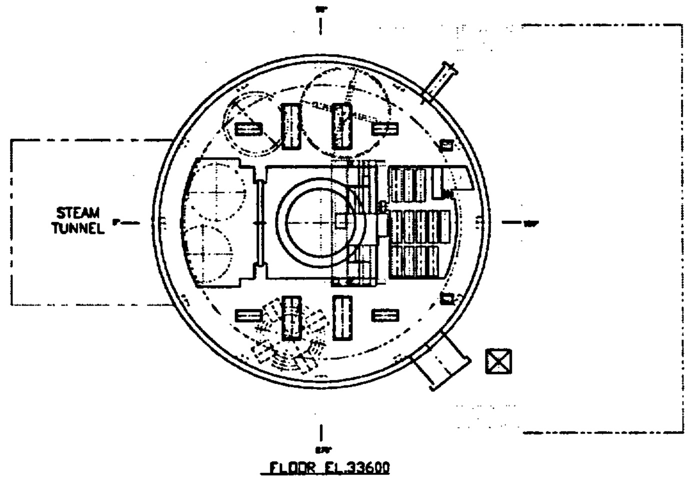
Evolution of BWR Containments and Reactor Buildings



Evolution and Innovation Towards Simplicity



Smaller structures – less equipment with good access
Separate fuel building and improved security



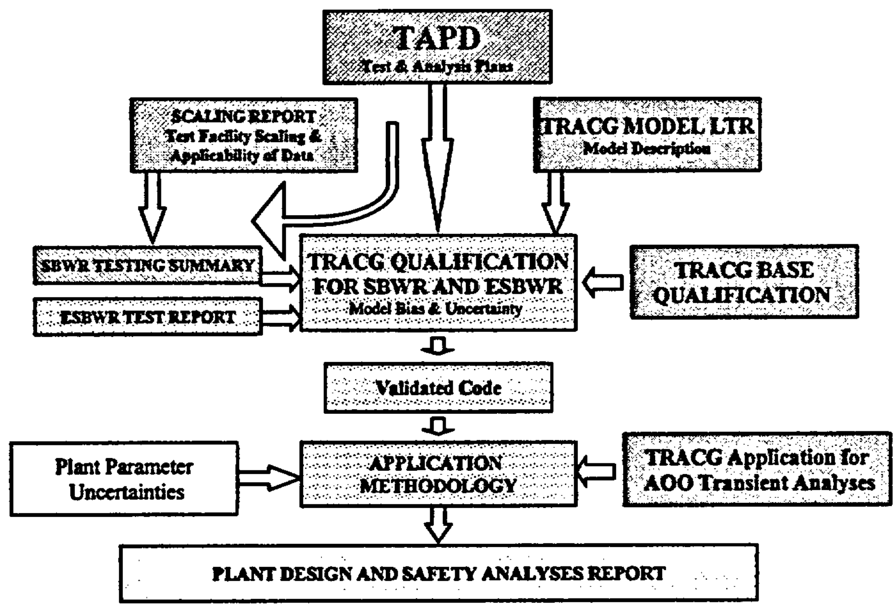
Refueling floor arrangement controls building size.
Improved fuel storage and transfer system

ESBWR and BWR Analysis Methods

Analysis Type	Analysis Method	
	BWR	*ESBWR*
Steady state	ISCOR	ISCOR
Transients		
· Pressurization	TRACG	TRACG
· Loss of feedwater heating	PANACEA	PANACEA
ATWS	ODYN/TASC	TRACG
Stability	ODYSY/TRACG	ODYSY/TRACG
LOCA/ECCS	SAFER	TRACG
LOCA/containment		
· Pressure/temperature response	M3CPT/SUPERHEX	TRACG
· Loads	Approved Methodology	Approved Methodology

TRACG – an integrated proven code - used for most analysis for ESBWR

ESBWR Technology Program Elements



Strategy for Determination of Test & Analysis Needs

- Develop list of governing phenomena and system interactions
- Top-Down Process based on plant accident/transient scenarios
  - Determine key phases of transients
  - List potentially important phenomena
  - Expert group ranking phenomena (PIRT)
- Bottom-Up process based on all unique ESBWR design features
  - Determine associated phenomena/system interactions
  - Evaluate and rank issues by importance
  - Supplements PIRT ranking approach to fill any gaps by focusing on ESBWR-unique features
- Consolidate highly ranked phenomena and system interactions
- Evaluate capability of analysis models & testing plans
  - Implement any needed models or bounding modeling procedures
  - Fill in testing gaps
  - Evaluate uncertainties to establish appropriate design margins

Rigorous process followed to define technology plan

Differences between ESBWR and SBWR

- Power Increased
  - Steamlines increased to 4 vs 2
  - 1020 bundles of 3 m height
    - F-lattice core design with wide span control blades
  - Isolation condensers (IC) capacity increased by 50%
  - Passive condenser (PCCS) capacity increased by 80%
    - 4 vs 3 units of 13.5MW/unit vs 10MW/per unit
- Plants systems and buildings
  - System sizes and capacities increased but not numbers
  - Utilize gravity drain system (GDCS) pool draindown space to provide increased wetwell volume (~15%)
  - Major building optimization incl. transfer of non safety systems and spent fuel storage

Differences do not affect governing phenomena (PIRT) for normal operation, transients and accidents

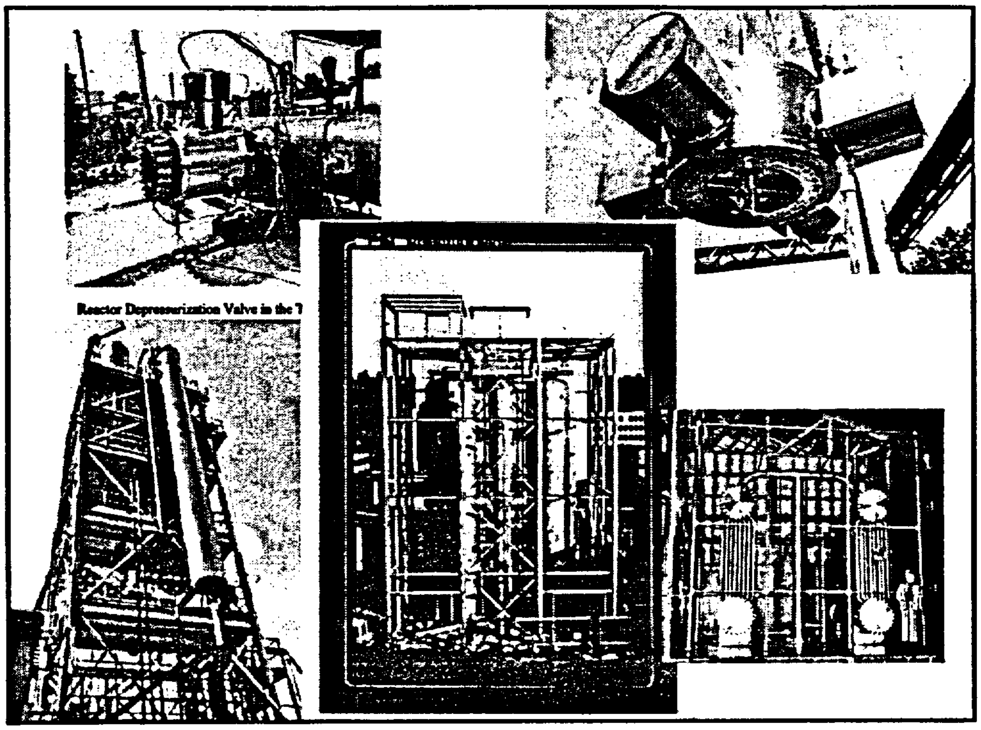
AR-21

Overview of Passive Plant Test Programs

- **Component Tests**
  - PANTHERS/PCC (FULL SCALE)
    - Full-scale prototype performance tests
    - Steady state and transient tests with heavy (air) and light (helium) noncondensibles
  - PANTHERS/IC
    - One of two modules of a full scale unit
    - Steady state, startup and transient tests
  - PANDA PCC Tests (S Series) (1/50scale)
    - 10 steady state tests
  - DPV Tests (FULL SCALE)
    - Performance tests of prototype valve
  - Vacuum Breaker Tests
    - Performance tests of prototype valve
- **Integral System Tests**
  - GIST (1/1000 scale)
    - 26 ECCS/LOCA integral tests with GDCS from wetwell pool
  - GIRAFFE Step 3 (1/800 scale)
    - Long term containment response
  - GIRAFFE/Helium (1/800 scale)
    - Long term containment response with light noncondensible gas
  - GIRAFFE/SIT (1/800 scale)
    - ECCS/LOCA and containment integral tests with SBWR configuration (GDCS pool in drywell)
  - PANDA (1/50 scale) M Series
    - Long term containment response

Extensive tests at different scales in different facilities

AR-22



Other Applicable Test Programs

- CRIEPI Natural Circulation Stability Tests
  - Thermal-hydraulic stability tests of natural circulation loop
- Dodewaard Plant Startup
  - Natural circulation plant startup
- PSTF Mark III
  - Containment Early Blowdown Response
  - Suppression Pool Stratification
- Mark II 4T
  - Containment Early Blowdown Response
- 1/6 Scale Boron Mixing Test
  - Measurements of "boron" concentration in scaled regions of a BWR
- PANDA P-Series Program (performed after SBWR program was terminated)
  - Integral System LOCA Test with ESBWR configuration (~1/50 scale)
  - Tests of Long Term Containment Response and late GDCS period
  - Tests include release of lighter-than-steam gas (Helium)
- CRIEPI High Pressure Stability Tests (performed after SBWR program was terminated)
  - Thermal hydraulic stability tests with natural circulation loop

Natural Circulation Technology Program

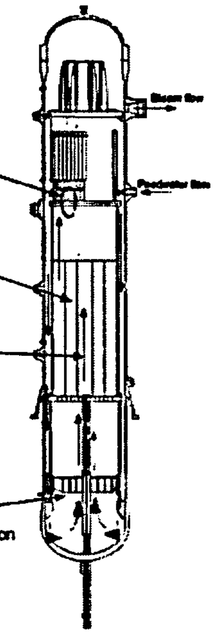
Separator Performance
ATLAS Tests - AS2B
- smooth inlet geometry
- reduced pitch
  (305 mm -> 292 mm)

Chimney Void Fraction
Ontario Hydro Tests
- transient test (pump induced)
- round pipe (0.618 m ID)
- relatively flat void distribution

Startup Flow Oscillation
CRIEPI Tests
- single chimney
- SBWR conditions
- large margin to oscillation regime

Dodewaard Plant Start-up

Mixing
1/6 Scale Boron Injection
- low pressure
- salt simulant



Containment and Safety Systems Technology

SBWR

Condensation with N/C
MIT - external condensation
UCB - single tube tests
GIRAFFE - component tests
PANTHERS - component tests
PANDA - steady state tests

PCCS Performance
Steady-state: PANDA, GIRAFFE, PANTHERS
Start-up: PANDA, GIRAFFE
Secondary Side ht: PANDA, PANTHERS, GIRAFFE
N/C Buildup: PANDA, PANTHERS, GIRAFFE
Interactions: PANDA
Unit interactions PANDA

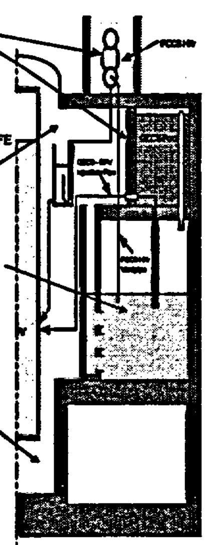
System Interactions
PANDA
GIRAFFE

SP Stratification
PANDA
SP Stratification

DW Stratification and Hideout
PANDA
GIRAFFE

Steam Quenching
Main Vent:
-Horiz. Vent Test/MK III tests (PSTF)
-Mark II 4T
PCC Vent:
- PANDA

Heat/Mass Leakage DW to WW
VB Testing



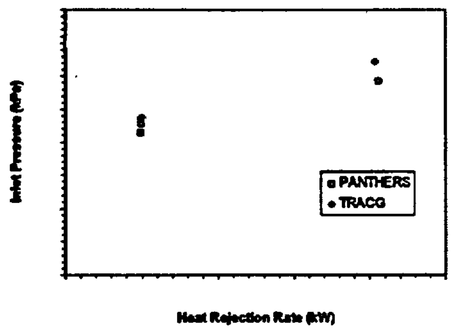
Confirmatory Tests

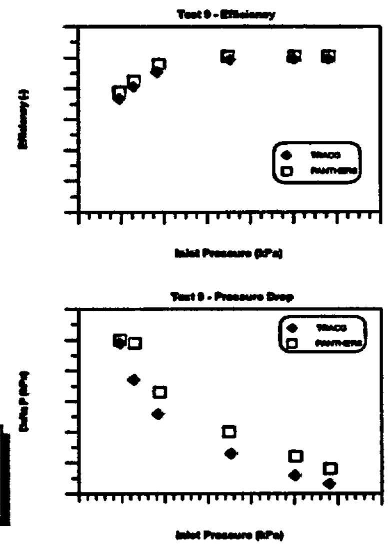
PCCS Performance
PANDA-P series
- startup
- interactions
- secondary side ht
- N/C Buildup
- Unit interactions

ESBWR Configuration
PANDA -P series
- reduced cont. volume
- GDCS in WW
- PCCS Condensate to RPV

DW Stratification and Hideout
PANDA-P series
- Asymmetric loading
- hydrogen

TRACG comparisons for PANTHERS PCC Tests - with & w/o non-condensibles

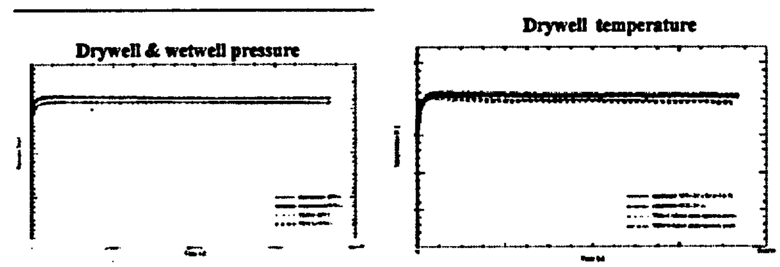


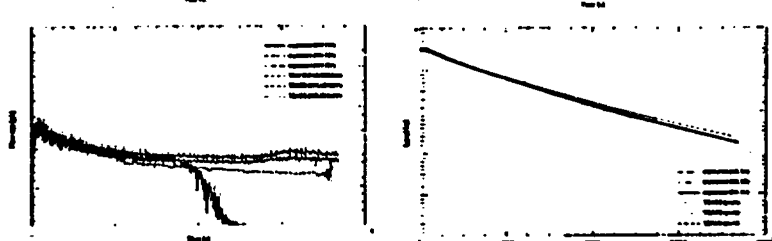


TRACG predicts component tests accurately for different test conditions

AR- 27

TRACG comparison to PANDA Test M3





TRACG predicts figure of merit and details accurately

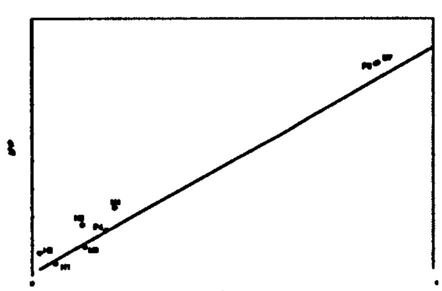
AR-28

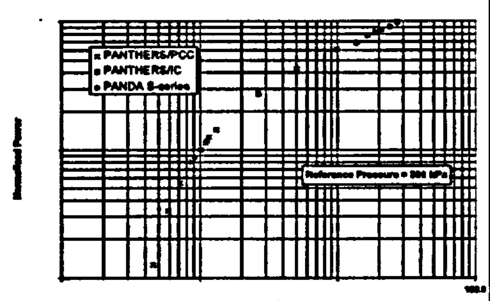
TRACG Qualification Summary

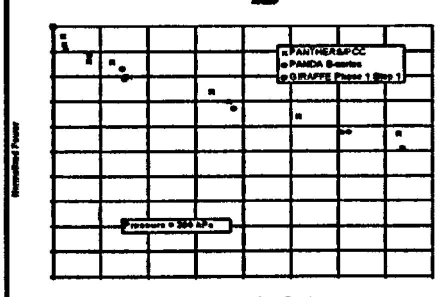
- All qualification activities identified in test and analysis plan have been satisfactorily completed
  - "generic qualification" studies have been reviewed and accepted by NRC for AOOs for operating plants
  - Significant additional qualification has been performed, particularly for long term containment response
  - Accuracy of models has been quantified for prediction of key parameters
- Model limitations have been identified and bounding approaches developed to treat these limitations
- TRACG is qualified for passive BWR (SBWR/ESBWR) analysis with appropriate application procedures

A comprehensive qualification program has been completed

Effect of Scale on test results







- PCC/IC's are Readily Scalable
  - PANDA IC/PCC is a section of PANTHERS IC/PCC
  - PANTHERS PCC is a slice of ESBWR PCC
  - GIRAFFE PCC has different header configuration
- Containment pressure varies with non-condensable gas quantity in wetwell for different scales and different gases

Tests at different scale show similar results

ESBWR Technology Program Summary

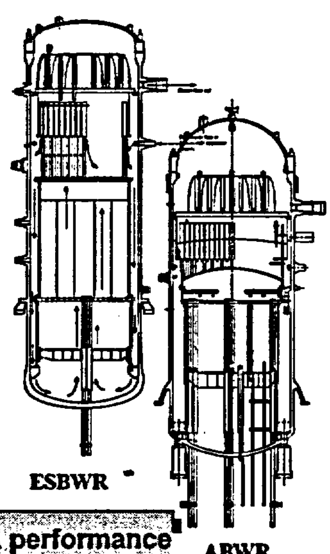
- Passive safety systems have simplified the plant design
- Plant evaluations are simpler
  - Less complex analyses
    - Realistic calc. with uncertainties defined as for operating plants - AOO
    - Realistic calc. with simplified accounting of uncertainties – ECCS/LOCA
    - Conservative calculation for containment/LOCA
  - Low parameter uncertainty
  - Substantial margins exist in the design
  - Improved integrated code shows better performance
  - Defense in depth systems provide additional back-up
- Extensive qualification of TRACG
- Technology issues extensively studied

Performance Improved by design features
Improved performance measured by qualified methods

AR-31

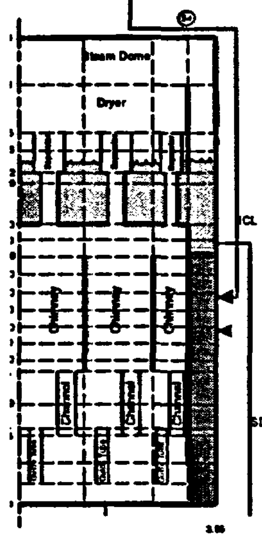
Design Features Affecting Plant Response

	ESBWR	ABWR	BWR5	BWR4
Large pipes below core	No	No	Yes	Yes
Core height, m	3.05	3.66	~3.66	~3.66
TAF above RPV bottom	~ 1/4	~ 1/2	~1/2	~1/2
Separator standpipes	Long	Short	Short	Short
Vessel height, m	27.7	21.1	~21.9	~21.8
Water volume outside shroud (above TAF), m^3	222	88	94	92

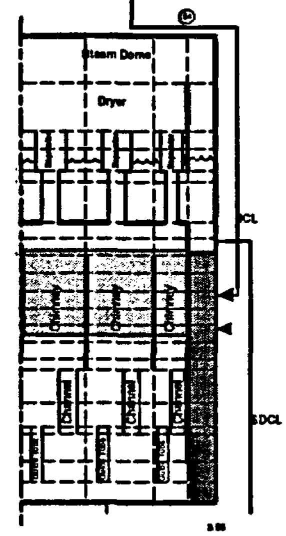


Greater water Inventory - Improved plant LOCA performance
Larger steam volume – improved transient performance

Substantial Initial Water Inventory inside RPV



Collasped Levels at time = 0.0 sec

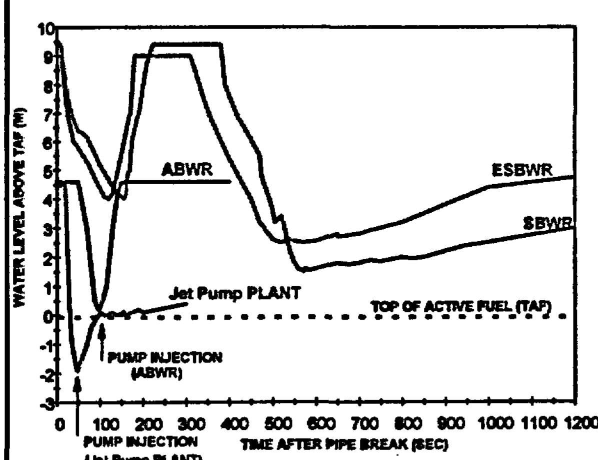


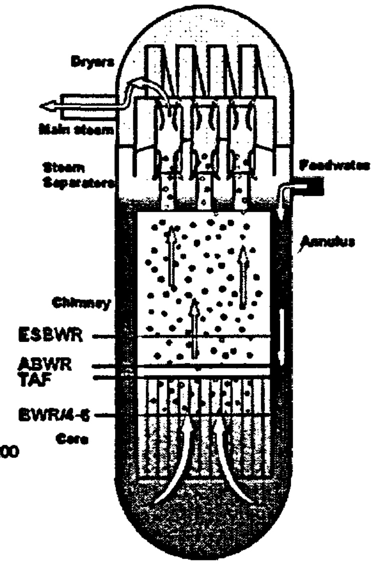
Collasped Levels at time ~20.0 sec

RPV Inventory Distribution Immediately following a LOCA

Water Level in Shroud Following a Typical Pipe Break

(values are intended to show typical trends for limiting breaks)

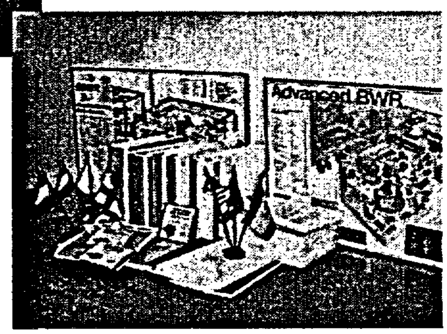




ESBWR Margins are Increased Over Past Plants

ESBWR Design/Technology based on SBWR and ABWR

Extensive new submittals



Extensive SBWR submittals and reviews, new test data and reports, coupled with design changes to add margin

Current status and near term deadlines

- **Extensive submittals made to NRC in 2002**
  - several meetings, conference calls and interactions
  - Extensive and thorough review by staff w 300+ RAI's
  - Final GE responses due by August 15, 2003
  - DSER for TRACG application due mid October
  - Additional application submittals covering AOO, ATWS and stability due over the next 6+ months
- **Preparation of SAR and certification**
  - Complete plant design optimization and SAR
  - Expected FDA 24 months after submittal
- **Challenges for the coming months**
  - Ensure GE responses are timely and complete
  - Complete technology closure (TRACG SER) with no open items

ESBWR Program Summary and Conclusion

- **15+ year technology and design program**
  - a BWR with less components
- **Simplification and margins by design**
  - large vessel results in benign response
  - analysis is simplified
- **Challenges for the coming months**
  - need closure and confirmation that regulatory risk is manageable

Expert Elicitation in Support of Risk-Informing 10 CFR 50.46

Robert L. Tregoning
Lee Abramson
US Nuclear Regulatory Commission

504th Advisory Committee on Reactor Safeguards Meeting
July 10, 2003

Previous ACRS Briefings and Program Milestones Since Last Briefing

- Previous ACRS briefings
  - May, 2002: Combined M&M, THP, R&PRA Subcommittee briefing on interim LOCA frequency elicitation and LOCA break size redefinition plans.
  - June, July, November, 2001: Overviews of LOCA frequency and break size redefinition effort provided to outline its importance within 10 CFR 50.46 revision framework.
  - March, 2001: Technical issues necessitating LOCA reevaluation.
- Program milestones Since May 2002
  - Selected expert panel and facilitation team.
  - Conducted kick-off meeting.
  - SRM Issued on SECY-02-0057 (Option III plan for risk-informing 10 CFR 50.46, Appendix K and GDC-35).
  - Conducted base case review meeting.
  - Held Public Meeting to discuss 10 CFR 50.46 effort: June 2003.

Expert Elicitation: Executive Summary

- Elicitation objective and approach are consistent with SRM guidance for development of near-term LOCA frequencies.
- Elicitation will develop LOCA frequencies as a function of leak rate and operating time considering both piping and non-piping contributions for all modes of plant operation.
- The conditional LOCA probabilities of larger, "emergency faulted" loadings are being estimated.
- Elicitation to combine aspects of group and individual elicitation approaches as appropriate to achieve objectives.
- Plans are in place to provide confirmatory analysis for the elicitation as well as develop a methodology for continually assessing LOCA challenges.

SRM Guidance

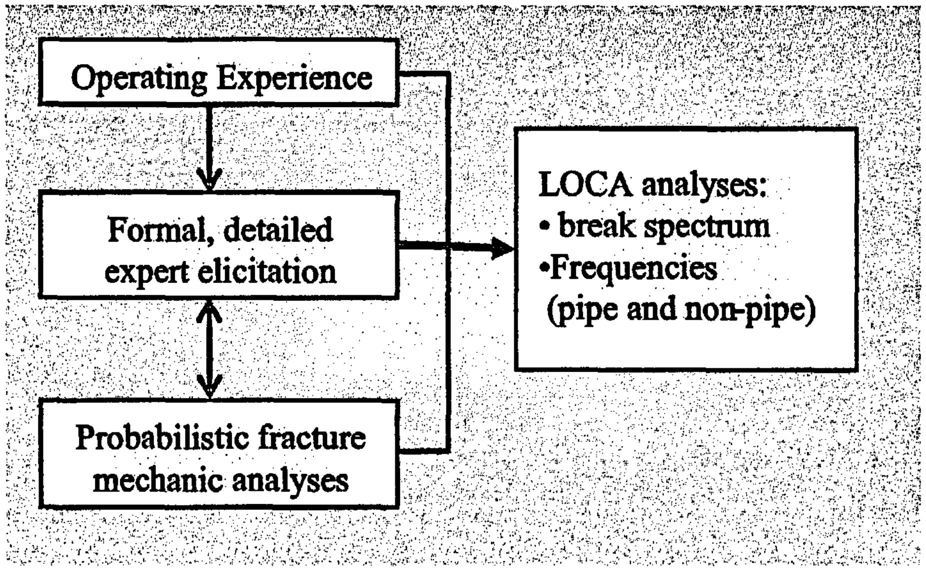
- The staff should conduct a practical reconciliation of LOCA frequency distributions by the 1) expert use of service-data, 2) Probabilistic Fracture Mechanics (PFM) and 3) expert elicitation to converge the results.
- Provide a comprehensive LOCA failure analysis and frequency estimation.
- Develop realistically conservative estimates, with appropriate margin for uncertainty.
- The staff should credit leak-before-break considerations only in conjunction with the establishment by a licensee of reliable and comprehensive means to detect primary system leaks of the relevant size.
- Use a 10-year period for the estimation of LOCA frequency distributions, with re-estimation every 10 years and review of new type of failures every 5 years.

General NRC Approach

1. **Operating Experience Assessment**
2. **Expert Elicitation.**
   - Re-evaluate LOCA frequencies.
   - Develop relationship between leak rate/break size and expected frequency for LOCA events.
   - Provide input to probabilistic LOCA computer code development.
3. **Probabilistic LOCA Code Development**
   - More rigorously combine operating experience and PFM insights.
   - Explicitly consider contributions from piping and non-piping components, and the evolution of new degradation mechanisms.
4. **Continual LOCA Assessment.**
   - Develop and maintain LOCA precursor database through expansion of existing pipe failure database.
   - Identify emerging degradation mechanisms and conduct anticipatory research to assess LOCA significance.

LB-LOCA Frequency Reevaluation

"The staff should conduct ... expert elicitation to converge the results"



Value of Expert Elicitation

- Limitations of traditional approaches for LOCA frequency assessment.
  - Operating experience alone not sufficient to make future projections.
  - Probabilistic fracture mechanics (PFM) not sufficiently mature to model all system variables.
- Expert opinion (elicitation) is a formal process for providing quantitative estimates for the frequency of physical phenomena when the required data is sparse or when the subject is too complex to adequately model.
  - Data sparseness: no LOCAs have occurred.
  - Complexity is evident.
    - Many non-piping failure mechanisms.
    - Tremendous piping system variability.
- Elicitation has been used for similar problems.
  - Development of seismic hazard curves.
  - Performance assessments for high-level radioactive waste repository.
  - Determination of reactor pressure vessel flaw distributions.

General Elicitation Philosophy

- Use group assessment to develop base case conditions and frequencies. Conduct individual elicitations with respect to base case conditions and frequencies.
  - Assure common understanding of the base case.
  - Preserve independence and diversity of opinion.
- Conduct elicitation training.
  - Identify sources of motivational and cognitive biases.
  - Demonstrate value of elicitation process.
- Delay quantitative assessment until after panel discussion and issue analysis.
  - Ensure common understanding and clarity of issues.
  - Allow experts time to analyze issues.
- Require quantitative answers and rationale for mid, high, and low estimates.
  - Assess uncertainty
  - Ensure consistency among quantitative estimates.
  - Enhance understanding of LOCA frequencies contributing issues.
- Use facilitation team to guide elicitations.
  - Minimize motivational and cognitive biases.
  - Probe deeper into important issues.
  - Ensure comparable results among panel members.

Formal Elicitation Approach

- Select panel and facilitation team.
- Develop technical issues.
  - Define scope and objectives of elicitation.
  - Construct approach for determining LOCA frequencies.
  - Determine significant issues affecting LOCA frequencies.
- Quantify base case estimates.
  - Develop quantitative estimates for well-defined piping conditions.
  - Two estimates using PFM and two estimates from service history analysis.
- Formulate elicitation questions.
- Conduct individual elicitations.
- Analyze quantitative results and qualitative rationale.
- Summarize and document results.

Panel Selection Process

- Expert Panel.
  - Panel solicited from industry, academia, national laboratories, contracting agencies, other government agencies, and international agencies.
  - Panel members chosen to represent a range of relevant technical specialties: PFM, piping design, piping fabrication, operating experience, materials, degradation mechanisms, thermo hydraulics, operating mitigation practices, stress analysis, nondestructive evaluation, etc.
  - Initially started with a pool of 55 nominally qualified people supplied by a number of knowledgeable sources (incl. future panel members).
  - Solicited resumes from 25 people and asked them to judge their relevant technical areas of expertise.
  - Final panel of 12 chosen based on broad relevant expertise, and to ensure a diversity of opinion, expertise, and backgrounds.
- Facilitation Panel.
  - Comprised of normative and substantive experts.
  - Substantive experts chosen to provide relevant background knowledge.

Formal Elicitation Approach

- Select panel and facilitation team.
- **Develop technical issues.**
  - **Define scope and objectives of elicitation.**
  - **Construct approach for determining LOCA frequencies.**
  - **Determine significant issues affecting LOCA frequencies.**
- Quantify base case estimates.
  - Develop quantitative estimates for well-defined piping conditions.
  - Two estimates using PFM and two estimates from service history analysis.
- Formulate elicitation questions.
- Conduct individual elicitations.
- Analyze quantitative results and qualitative rationale.
- Summarize and document results.

Elicitation Scope and Objectives

- Develop piping and non-piping passive system LOCA frequencies as a function of leak rate and operating time up to the end of the license extension period.
- Determine LOCA frequency distributions for typical plant operational cycle and history including all modes of operation.
- Estimate condition LOCA probability distributions for rarer, emergency faulted load conditions.
  - Seismic loading.
  - Other large, unexpected internal and external loads.

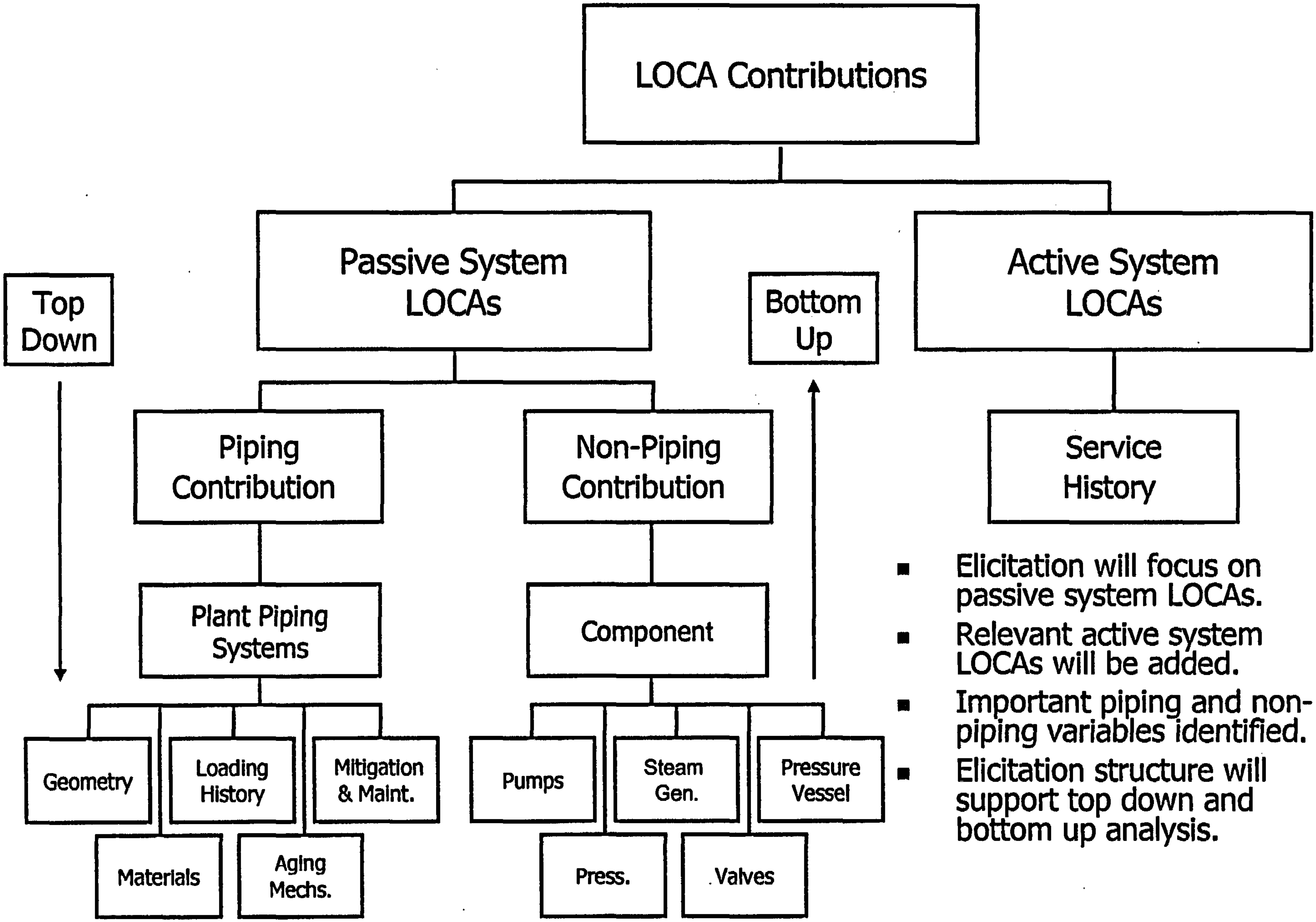
LOCA Sizes and Operating Time Periods Evaluated

- LOCA sizes based on leak rate to group plant system response characteristics.
- First three categories encompassed traditional definitions utilized in NUREG-1150 and NUREG/CR-5750.
- Three more LBLOCA categories added to examine trends with larger break sizes.
- Correlation between leak rate and break size developed for relevant BWR and PWR systems.

Category	Leak Rate Threshold (gpm)	LOCA Size
1	> 100	SB
2	> 1500	MB
3	> 5000	LB
4	> 25,000	LB a
5	> 100,000	LB b
6	> 500,000	LB c

- Three time periods evaluated.
  - Current (average 25 years of operating experience.
  - End of design life (40 years of operation).
  - End of life extension (60 years of operation).

General Issue Classification



- Elicitation will focus on passive system LOCAs.
- Relevant active system LOCAs will be added.
- Important piping and non-piping variables identified.
- Elicitation structure will support top down and bottom up analysis.

Piping Issue Classification

- Brainstormed variables in all relevant categories which influence the LOCA frequencies: materials, geometry, loading, mitigation & maintenance, degradation mechanisms.
- Agreed that variables and their effects are a function of the piping system.
- Individual categories developed for experts to summarize pool of applicable variables for a given piping system.
- Determined LOCA sensitive piping systems for BWR and PWR plants.
- Determined which of the individual variables in each of the five categories were relevant for each piping system considering individual plant variability.
- Developed master tables for BWR and PWR plants for the expert elicitation panel.

Non-Piping Issue Classification

- Identified approximately 25 different sections of primary components (i.e. pressurizer, reactor, steam generator, pumps, valves) where passive system failures could lead to a LOCA.
- Discussed failure mechanisms which could lead to LOCAs in these components.
- Identified components that may have existing failure data.
- Determined which of the individual variables in each of the five categories were relevant for each non-piping system.
- Developed master tables for non-piping LOCA contributors for the expert elicitation panel.

Formal Elicitation Approach

- Select panel and facilitation team.
- Develop technical issues.
  - Define scope and objectives of elicitation.
  - Construct approach for determining LOCA frequencies.
  - Determine significant issues affecting LOCA frequencies.
- **Quantify base case estimates.**
  - **Develop quantitative estimates for well-defined piping conditions.**
  - **Two estimates using PFM and two estimates from service history analysis.**
- Formulate elicitation questions.
- Conduct individual elicitations.
- Analyze quantitative results and qualitative rationale.
- Summarize and document results.

Piping Base Case Development

- The base cases will be used to anchor the elicitation responses.
- Base case conditions specify the piping system, piping size, material, loading, degradation mechanism(s), and mitigation procedures.
- Five Base Cases Defined.
  - BWR
    - Recirculation System
    - Feedwater System
  - PWR
    - Hot Leg
    - Surge Line
    - High Pressure Injection makeup.
- The LOCA frequency contribution (per year) of each set of base case conditions will be calculated as a function of leak rate and operating time.
- Four panel members chosen to perform calculations: two using operating experience and two using probabilistic fracture mechanics.

Piping Base Case Approach

- Iterative process involving facilitation team and expert panel.
- Evaluate LOCA frequencies at 25 (current), 40 (end-of-license), and 60 years (end-of-license extension) after plant startup.
- Each base case member should benchmark results using service experience for leaking cracks.
- All base case calculations should capture as closely as possible the conditions established by the expert panel.
- Sensitivity analyses of PFM results conducted to evaluate:
  - Seismic loading
  - Effect of ISI
  - Loading history variability
  - Effectiveness of mitigation

Non-Piping Base Case Development

- The non-piping base cases could have been developed in a similar manner to the piping base cases.
  - Choose several representative systems.
  - Examine and extrapolate operating experience through modeling
- However, the variety and complexity of the non-piping failure mechanisms makes this assessment intractable and of limited value.
- Philosophy here is to conduct database searches for each non-piping failure mechanism listed to develop leaking and cracked component frequencies.
- These frequencies will be used to anchor the non-piping responses for each expert.
- Each expert must determine how to translate the leaking and crack frequency information into meaningful LOCA estimates.

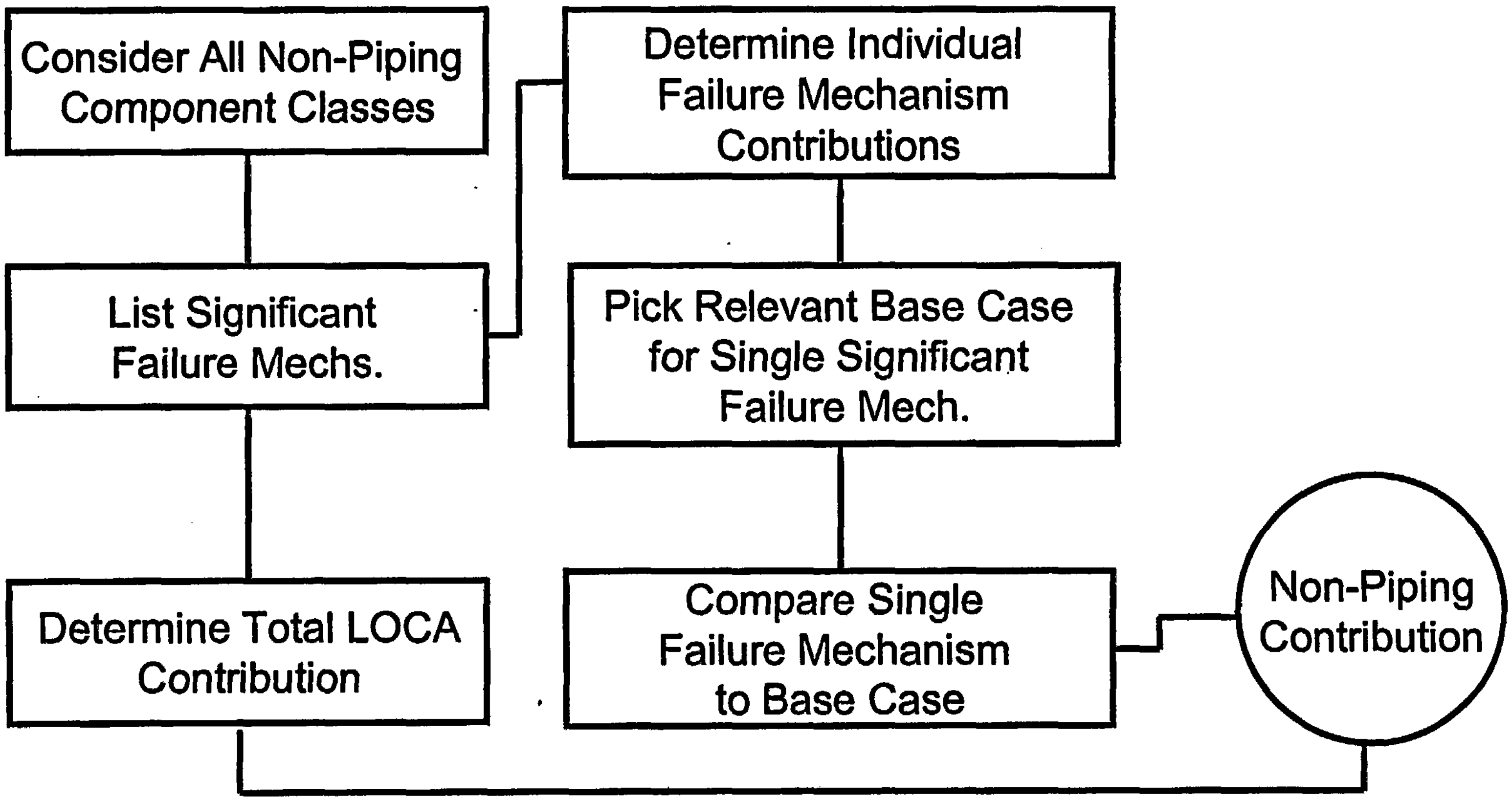
Formal Elicitation Approach

- Select panel and facilitation team.
- Develop technical issues.
  - Define scope and objectives of elicitation.
  - Construct approach for determining LOCA frequencies.
  - Determine significant issues affecting LOCA frequencies.
- Quantify base case estimates.
  - Develop quantitative estimates for well-defined piping conditions.
  - Two estimates using PFM and two estimates from service history analysis.
- **Formulate elicitation questions.**
- Conduct individual elicitations.
- Analyze quantitative results and qualitative rationale.
- Summarize and document results.

Elicitation Question Development

- Questions will be focused on the following topic areas.
  - Base Case Evaluation.
  - Regulatory and Utility Safety Culture.
  - LOCA frequencies of Piping Components.
  - LOCA frequencies of Non-Piping Components.
  - LOCA Frequencies of Piping Components under Emergency Faulted Loading Conditions.
  - LOCA Frequencies of Non-Piping Components under Emergency Faulted Loading Conditions.
- Questions will be asked relevant to a set of conditions and quantitatively linked to the base case results.
- Each question will ask for mid, low, and high values for each question as well as appropriate rationale or comments.
- Questions can be answered using a top-down or bottom-up approach.
- Rationale will be discussed for important and some unimportant issues for each expert.

Non-Piping Components: Top-Down Approach



Ongoing and Future Elicitation Work

- **Conduct individual elicitations.**
  - Provide answers to questions and rationale for answers.
  - Discuss significant issues which impact LOCA frequency estimation.
  - First two scheduled for July 15^{th} and 16^{th}. Remaining ten to be completed between mid-August and end of September.
- **Analyze quantitative results and qualitative rationale.**
  - Calculate results for each expert if appropriate.
  - Combine answers for individual questions and calculate results.
  - Propagate uncertainties.
- **Conduct wrap-up meeting.**
  - Summarize quantitative and qualitative results.
  - Summarize analysis methodology and LOCA results.
  - Obtain feedback from the expert panel.
- **Summarize and document results.**

SRM Guidance

- The staff should conduct a practical reconciliation of LOCA frequency distributions by the 1) expert use of service-data, 2) Probabilistic Fracture Mechanics (PFM) and 3) expert elicitation to converge the results.
- **Provide a comprehensive LOCA failure analysis and frequency estimation.**
- **Develop realistically conservative estimates, with appropriate margin for uncertainty.**
- **The staff should credit leak-before-break considerations only in conjunction with the establishment by a licensee of reliable and comprehensive means to detect primary system leaks of the relevant size.**
- Use a 10-year period for the estimation of LOCA frequency distributions, with re-estimation every 10 years and review of new type of failures every 5 years.

Addressing Specific SRM Guidance

- **"Provide a comprehensive LOCA failure analysis and frequency estimation."**
  - Include piping and non-piping LOCA contributions.
  - Consider LOCA contributions from all modes of operation.
  - Examine conditional LOCA probabilities under extreme loading conditions.
- **"Develop realistically conservative estimates, with appropriate margin for uncertainty."**
  - Develop best estimate values for all LOCA distributions.
  - Evaluate uncertainty among all experts as well as for each expert's responses. Combine answers for individual questions and calculate results.
  - Propagate uncertainties to understand impact and appropriateness of subsequent regulatory action.
- **"The staff should credit leak-before-break considerations ...".**
  - Credit leak detection based on technical specification limits when evaluating both the service history and in making future projections of operating performance
  - Identify and quantify LOCA contributions of non-leaking cracks.

SRM Guidance

- The staff should conduct a practical reconciliation of LOCA frequency distributions by the 1) expert use of service-data, 2) Probabilistic Fracture Mechanics (PFM) and 3) expert elicitation to converge the results.
- Provide a comprehensive LOCA failure analysis and frequency estimation.
- Develop realistically conservative estimates, with appropriate margin for uncertainty.
- The staff should credit leak-before-break considerations only in conjunction with the establishment by a licensee of reliable and comprehensive means to detect primary system leaks of the relevant size.
- **Use a 10-year period for the estimation of LOCA frequency distributions, with re-estimation every 10 years and review of new type of failures every 5 years.**

LOCA Frequency Reevaluation: Passive LOCA Code Development

- **Objectives:**
  - Determine the relationship between break size and expected event frequency for large primary system pipes (>150 mm diameter).
  - Provide confirmatory analysis of elicitation results.
  - Develop tool which can be used for subsequent frequency re-evaluation.
- **Approach**
  - Construct separate modules to consider piping, non-piping contributions, and future surprise mechanisms.
  - Modules will couple state-of-the-art PFM modeling with understanding of operating experience historical, recent, and potential degradation mechanisms to determine frequency partitioning.
  - Scale modeling frequencies using expert judgment to determine the LBLOCA frequency.
  - Use insights from elicitation to initially focus on the most important systems and mechanisms.
  - Monitor and interact with the NURBIM program which has similar objectives.

LOCA Frequency Reevaluation: Continuous Assessment of LOCA Challenges

- **Objectives:**
  - Develop framework for evaluating operating experience for LOCA precursor events in piping and non-piping components.
  - Evaluate mechanisms or trends which could be detrimental affect future LOCA frequencies.
- **Approach**
  - **Participate in the CSNI-sponsored OECD Piping Database Exchange (OPDE) project to expand international operating experience.**
    - Twelve participating countries: Belgium, Canada, Czech. Republic, France, Finland, Germany, Japan, Korea, Spain, Sweden, Switzerland, U.S.
    - The SKI-pipe SLAP database serves as the baseline.
    - Year 1 of 3 year effort is focusing on events between 1998 and 2001. Year 2 on events from 1995 – 1998 and 2002.
  - **Continue to evaluate international operating experience and research results to identify trends and mechanisms which warrant further research.**

ESBWR Pre-Application Review

Amy Cubbage, Project Manager
New Reactor Licensing Projects, NRR

ACRS
July 10, 2003

1

ESBWR Pre-Application Scope

- TRACG Application for ESBWR LOCA and Containment Analyses
- TRACG Qualification
- Test and Analysis Program Description (TAPD) and PIRT
- SBWR and ESBWR Testing Reports
- ESBWR Scaling Report

2

ESBWR Pre-Application Scope

- Product – Safety Evaluation Report on TRACG Application and Testing Program

3

ESBWR Design Certification Scope

- Design
- Transients
- ATWS
- Stability
- LOCA Events
- Severe Accidents
- PRA

4

Gilena Monroe - Bio

Miss Gilena Monroe joined the ACRS staff on June 16th as a summer intern. Currently, Gilena is a full-time Graduate student attending North Carolina A&T State University. She has a B.S. degree in Computer Science and is presently majoring in Industrial and Systems Engineering with a concentration in Human-Machine Systems/Human Factors. She is working with the ACRS as a Student Engineer on topics of Human Factors Engineering and Human Reliability.

G:Bio.Jain

Dr. Bhagwat P. Jain

Bio-Data

Dr. Jain will be joining the ACRS staff as a Senior Staff Engineer on July 14, 2003. He has been with the NRC for 5 years. During this period, he has served in NRR (Division of Engineering), NSIR, and RES (Division of Engineering Technology). Currently he is a project manager in RES. Prior to joining the NRC, Dr. Jain worked with Carolina Power & Light Company as a project engineer at the Brunswick nuclear power plant, AES Corporation as a supervising structural/mechanical engineer at the Prairie Island nuclear power plant, and with Sargent & Lundy Engineers, Chicago, as a supervising structural engineering specialist. He is a registered professional engineer with a Ph.D. in structural engineering which he received in 1976 from Illinois Institute of Technology, Chicago. In addition, Dr. Jain has experience in the evaluation of nuclear plant safety issues relating to plant structures, systems, and components of PWR and BWR containments. He is experienced in the structural design and licensing of several nuclear power plants (e.g., Lasalle, Zimmer, Byron, Braidwood). Dr. Jain has a broad range of over 25 years experience in progressively responsible positions in private nuclear power industry with design consultants and power utility companies, and the NRC.