ORIGINAL ACRST-2003

OFFICIAL TRANSCRIPT OF PROCEEDINGS

Agency: Nuclear Regulatory Commission
Advisory Committee on Reactor Safeguards

Title: 408th ACRS Meeting

Docket No.

LOCATION: Bethesda, Maryland

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PAGES: 1 - 69
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UNITED STATES NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

DATE: April 7, 1994

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

408th ACRS MEETING

Nuclear Regulatory Commission

Conference Room P-110

7920 Norfolk Avenue

Bethesda, Maryland

Thursday, April 7, 1994

8:31 a.m.

PARTICIPANTS:

E. WILKINS, JR., Chairman of the ACRS
T. KRESS, Vice Chairman of the ACRS
C. MICHELSON, Member of the ACRS
C. WYLIE, Member of the ACRS
H. LEWIS, Member of the ACRS
I. CATTON, Member of the ACRS
J. CARROLL, Member of the ACRS
W. LINDBLAD, Member of the ACRS
P. DAVIS, Member of the ACRS
R. SEALE, Member of the ACRS
W. SHACK, Member of the ACRS
S. DURAISWAMY, Designated Federal Official
J. LARKINS, Executive Director
S. SCHOFER, Technical Secretary
T. WAMBACH, NRC/NRR
B. BORCHARDT, NRC/NRR
D. CRUTCHFIELD, NRR/NRR
J. WILSON, NRC/NRR
R. CORREIA, NRC/NRR
S. RITTERBUSCH, ABB/CE
T. CROM, ABB/CE
R. DUBE, NRC/NRR
F. CONGEL, NRC/NRR

PARTICIPANTS [Continued]:

P. McKEE, NRC/NRR
E. TENEYCK, NRC/NMSS
A. BUSLIK, NRC/RES
F. YOUNG, NRC/NRR
M. WARREN, NRC/NRR
D. NEBUDA, Corps of Engineers
M. VIRGILIO, NRC/NRR
R. BARRETT, NRC/NRR
R. LOBEL, NRC/NRR
A. SERKIZ, NRC/RES
S. PORTSLINE
D. HORNER
C. POSLUSNY, NRC/NRR
R. GRAMM, NRC/NRR
C. SAWYER, GE
J. POWER, GE
A. BEARD, GE

PROCEEDINGS

[8:31 a.m.]

MR. WILKINS: The meeting will now come to order.

This is the first day of the 408th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the Committee will discuss and/or hear reports on the following:

One, ABB/CE System 80-Plus standard plant design;

Two, proposed final rule on protection against malevolent use of vehicles on nuclear power plants;

Three, recirculation sump strainer clogging;

Four, report of the Planning and Procedures Subcommittee;

Five, preparation of ACRS reports.

A portion of today's meeting will be closed to discuss safeguards and security information; information regarding organizational and personnel matters that relate solely to the internal personnel rules and practices of this Advisory Committee; and matters, the release of which would represent a clearly unwarranted invasion of personal privacy.

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

Mr. Sam Duraiswamy is the designated Federal official for the initial portion of the meeting.

We have received no written statements or request for time to make oral statements from members of the public regarding today's sessions. A transcript of portions of the meeting is being kept, and it is requested that each speaker use one of the microphones, identify himself or herself, and speak with sufficient clarity and volume so that he or she can be readily heard.

I will begin with some items of current interest.

I believe this first item I have on my list has already been taken care of in the agenda. All right. There has been a minor change in the agenda, really a shuffling of a course of items in order to accommodate the desire of representatives of GE Nuclear Energy to catch planes this afternoon to get back to the West Coast.

The Nuclear Engineering Institute -- and I suppose all of you remember that that is NUMARC.

MR. CARROLL: Nuclear Energy.

MR. WILKINS: What did I say -- Engineering? I'm sorry. I'm looking at it. It says "Nuclear Energy Institute," which is the successor of NUMARC. It is holding a fire protection industry meeting on April 20 to 21 at the Stouffer Harbor Place Hotel in Baltimore. Those of you who have an interest in this particular subject may wish to attend that meeting.

I have the very great pleasure to inform the

Committee that one of our staff engineers, Mr. Doug Coe, has been awarded the Meritorious Award for Engineering Excellence by the Agency. That is an Agency-wide award.

It is more than just a well deserved pat on the back, Doug. We all share our respect and admiration for your work. But I also understand that Mrs. Coe might even benefit from this, that is to say, there is some cash that goes along with this award. So it is a very significant award. We wish you well.

MR. COE: Thank you.

[Applause.]

MR. WILKINS: It is perhaps a little awkward for me to make this next announcement. But there is supposed to be a dinner tonight.

MR. MICHELSON: What for?

MR. WILKINS: Well, just to eat, you know. That is good enough. We don't need a reason. Just to eat. The dinner is at 6:30. We will try to adjourn early enough to enable people to pick up their wives -- pick up their own wives --

[Laughter.]

MR. WILKINS: You see, since I have been on this Committee, I have been very meticulous in how I word my statements. No ambiguity. You pick up your own wife, please.

MR. LEWIS: You only have trouble with hyphens.

MR. WILKINS: I only have trouble with hyphens and commas.

MR. CARROLL: Oh, no; not that again.

MR. CATTON: We don't have problems with that.

[Laughter.]

MR. CARROLL: I don't know why what you said reminded me of it, but some creative head writer in the sports section of the San Francisco Chronicle Monday had a headline that said, "President Clinton to Throw Out the First Ball in Cleveland, His Wife in Chicago."

[Laughter.]

MR. WILKINS: That will be at Mr. Tea's Restaurant at 6:30 tonight.

There is some possibility we could complete our business by Friday night. I must tell you that we have three -- well, I will get to the letters in just a minute. But the ABWR letter has the highest priority. I would very much like to get it finished unless Carl reports that there are some show-stoppers or some real obstacles to getting that out. I would very much like to get that letter out at this meeting.

We also have a couple of other letters, one of which is optional. The Committee may or may not decide to write that letter. It deals with an issue that has come up quite recently. That will be discussed in connection with the report of the Planning and Procedures Committee.

I suggest that we not try to decide this morning whether we can adjourn tomorrow night. But we will have a much better fix on that by the close of business today.

I don't want to rush the ABWR letter. I don't want to rush any of these letters. We need to give them all the attention they deserve. But in the course of your deliberations, you may wish to modify your loquaciousness by consideration of Saturday morning.

That is all I have for right now. Does anyone else have any other general comments he would care to make?

[No response.]

MR. WILKINS: Okay. The first agenda item is a discussion of the ABB/CE System 80-Plus Standard Plant Design. J. Carroll is the cognizant Subcommittee Chairman. I will turn the meeting over to him.

MR. DURAISWAMY: Mr. Chairman --

MR. WILKINS: I have many, many regrets about leaving the Committee, but this is not one of them.

[Laughter.]

MR. WILKINS: This is the last time Sam will be able to remind me that I have forgotten to talk about the list of reports and letters. And I even got close to it because I referred to it.

I suppose you all have this in front of you, this chart. You will notice that the ABWR has been given a Priority A-Plus. Actually, it is our Planning and Procedure Subcommittee will discuss the possibility of it being A-Plus-Plus. But anyway, it is a top priority item. We have made considerable progress on this letter already. So it is not as though we have to start from scratch in reviewing it.

We will try to get out a letter on the proposed final rule on protection against malevolent use of vehicles. There is no draft of that, yet. This topic is on our agenda for later this morning.

You know that there is considerable Commission interest in this. So, if we expect to have any impact on the Commission's ultimate decisions, we really should issue our opinion at this meeting.

Then there -- what is this. This is a long title. Issues Stemming from the Review of Evolutionary Plant Design and their Potential Applicability to Operating Plants.

This is a letter that you will recall that we agreed that we would write and with that agreement, we deleted that material from the ABWR letter. There was a lot of material in the ABWR letter which the Committee, as a whole, felt we didn't need to say in that letter in order to keep the message in that letter crisp and clear.

I know there was some disagreement. This letter was not a unanimous decision. But the Committee decided the last time that they would write a separate letter not linked to the certification process for the ABWR, which called the Commission's attention to a number of issues that have stemmed from our review, not only of the ABWR, but also the CE System 80-Plus design. We will get to that one, if we can.

The fourth letter is the one on the ABB-CE System 80 Plus design itself. Our schedule calls for us to complete that report during next month's meeting and I don't believe that we will be in any position to complete it at this meeting. But there is a first draft and I think Jay would like to discuss that first draft and get some reactions to it and to put on the table his view of what the letter should look like overall, get some feedback from members of the Committee between now and the next meeting so that at the next meeting that letter can be finished.

Then there is a letter that is not on this list and I won't attempt to put any priority on it. It's a letter that deals with the subject that I have hinted at. I might as well mention the title of the subject which is selection of members -- new members for Advisory Committees of the Nuclear Regulatory Commission. I will simply say that the Commission is in the process of issuing an SRM which will, if placed in effect, give the Commission and its

Staff a very much more active role in the selection of new members.

John tells me that there is -- well, I have seen a package of material that he has put together on this and he is planning to distribute it to all of you. Some of you have already seen portions of it or maybe all of it because you were here yesterday. The discussion will occur during the Planning and Procedures Committee, during the report of the Planning and Procedures Subcommittee this afternoon.

MR. LEWIS: I note, Earnest, that the SRM is dated April 1, 1994. Are we sure this isn't a joke?

MR. WILKINS: Yes. I think you can safely assume that it's dead serious. Dead serious.

In fact, the original date that the SRM was supposed to have been put out last -- day before yesterday on Tuesday. I called the Chairman's office yesterday and asked him to hold up on it until this Committee should have had a chance to react. That was the way I put the request. I didn't say that the Committee was going to react negatively or positively, just hold up until this Committee would have an opportunity to react.

The Chairman's assistant -- one of the Chairman's assistants notified John late yesterday afternoon that the Chairman had agreed to do that. I don't want to claim that he did it because he got my request. It turns out that one of the commissioners is also having some problems with it. That fact may have had more impact than requests of the Committee but no matter. We will have an opportunity to talk about it.

Now am I all set, Sam? All right, thank you.

We will proceed then to the next item on the agenda, which is a discussion of the ABB-CE System 80 Plus standard plant design. Jay Carroll is the cognizant subcommittee chairman. I turn the meeting over to you, Jay.

MR. CARROLL: Okay.

Tuesday and Wednesday of this week we had our final major meeting on System 80 Plus and completed our review of all chapters of the CESSAR and the Staff's FSER or draft FSER or whatever it is. We agreed last month following the precedent that we had set with the ABWR to have a full committee briefing from the Staff and from Combustion on this design certification activity. Although most of the members have attended at least some of the subcommittee meetings, I guess procedurally we need to have a full committee consideration in some form or another, so that's what we are doing this morning.

As I understand it, we are going to start with the Staff. Then, following that, we will have a presentation by Combustion Engineering.

I guess I should say that when we closed yesterday afternoon there were still a few remaining issues and questions that Combustion has agreed to provide some additional information on and during future activities we can decide how to deal with that, whether we want to have a short subcommittee meeting the day before or full committee next month or if it's a sufficiently short agenda maybe we can fold it into the full committee agenda and not use up a day for some other potential subcommittee meeting.

MR. WILKINS: I guess the only question I would ask Jay is, are those issues of such magnitude that they may have a significant impact on our ability to meet the May letter?

MR. CARROLL: Not in my judgment. Most of them are issues Carl still needs some information on.

Would you say that that's fair, it's just really --

MR. MICHELSON: My main problem is I am trying to play catch-up and I am still trying to play catch-up because we just had too many things going concurrently. I may not have any more questions; I don't know.

MR. CARROLL: There were still a couple they were going to provide some more information on. But certainly those didn't fall into the category of show stoppers.

Bill?

[Slide.]

MR. BORCHARDT: Good morning.

My first two slides just give a brief overview of some of the major milestones in the past and in the future.

MR. WILKINS: Excuse me. We all know who you are, but just for the record --

MR. BORCHARDT: Sure. Bill Borchardt. I am the branch chief, NRR Projects, Advanced Reactors.

One thing I would like to point out is in February we issued FSER which the committee, Commission and CE are now reviewing. It had no open items, eight confirmatory items. We show five exemptions and 15 applicable regulations.

I have a slide on each of these topics following.

One thing I would like to point out now is that the exemptions and applicable regulations, the exact wording for these are being worked out now. It is still undergoing activity between CE, the Staff and the Office of General Counsel.

In April, we are expecting Amendment V from CE. This will address all of the confirmatory items and all the technical staff agreements reached by the Staff and CE during the January-February time frame. It will also include a discussion of PRA insights.

Also in April, you will see some of the activities we have planned. The consistency reviews and independent

ITAAC and tech spec reviews. One point I will make is that these are the same things that we did on the ABWR. These are things to make sure that the SSAR is consistent with the SER and that the tier one design descriptions and ITAAC are consistent with what is in CESSAR-DC.

The tech spec audit is in progress now. It started earlier this week and is expected to conclude by the end of the month.

[Slide.]

MR. BORCHARDT: In May, Amendment W will be issued by CE, ABB-CE, and this will address any remaining confirmatory items. The ITAAC review group comment resolutions, tech spec audit findings, any issues that still need to be addressed from ACRS concerns or your letter. We would also expect there to be some minor editorial kind of housekeeping changes in Amendment W.

In June, we are expecting to issue the SER in final form as NUREG 1462. You see that this will incorporate all of the technical editor comments and OGC review.

Now, between August and December, essentially after the final design approval is issued, we expect to complete our design control document development, review and any refinement activities and prepare the notice of proposed rulemaking.

MR. DAVIS: Excuse me. When did you say the PRA insights would be revised?

MR. BORCHARDT: In the next amendment, which is the end of this month. This is really a discussion more of a preparation of the PRA insights that we expect will be incorporated into the design control document.

MR. CARROLL: Is it your understanding, Bill, that Combustion plans to go ahead with design certification rulemaking?

MR. BORCHARDT: Absolutely.

MR. CARROLL: Good.

[Slide.]

MR. BORCHARDT: This list shows the confirmatory items that we identified in the SER. You'll see about half of them read as Staff actions, the other half are ABB-CE actions. In reality, all of them are a little bit of both. In some cases, we are waiting for some information from ABB, then we'll review it. A number of them have to do with the consistency checks that I alluded to earlier.

The numbers on the left refer to the SER section where you can find a further discussion of these individual items.

MR. CARROLL: The tech spec item we did get an update on the diesel generator issue. Did you --

MR. BORCHARDT: About all I can say is I actually learned something yesterday afternoon too, because these discussions are ongoing up at Windsor as part of the tech spec audit activity. So there are things being discussed and information being provided by ABB in Windsor this week to provide a basis on which to allow credit for the CTG during power operations. It looks now that there will be some credit given so there will be a longer LCL tech spec time provided after demonstrating operability of the CTG with one diesel inoperable.

MR. CARROLL: But no recognition of whether there is a tornado in the area or not.

MR. BORCHARDT: I think they took your point yesterday and they're going to look at that.

There are other mechanisms that a facility has to consider adverse weather conditions. It's usually in their emergency procedure guidelines that would cause them to put the plant in a stable condition if a hurricane or tornado were imminent.

MR. DAVIS: On that issue, it seemed to me like there was not a well-established definition of what verification really means.

MR. CARROLL: Verifying operability?

MR. DAVIS: Yes. Whether you -- you know, it said if there is a potential for common cause failure of the second diesel, then there is a different kind of verification apparently required. But I couldn't get a real good answer for how tight that was going to be and whether the rules will really be well established so that the applicant knows exactly what he needs to do.

MR. BORCHARDT: I tend to agree with you. I don't think it's very well laid out in any particular document. In reality, there is a lot of judgment that the plant, that the utility management has to make in those circumstances in cooperation with their engineering department and the NRC, because inevitably you run into the tech spec action time and NRC and the utility have to come to some judgment whether or not there has been adequate review of any possible common mode failure.

[Slide.]

MR. BORCHARDT: This slide again shows the exemptions. The SER number is listed on the left-hand side so that you can have -- you can read what the specific details are.

These exemptions are consistent with current operating and design review practices, also consistent with the ABWR exemptions with the one exception. I don't think -- I am not positive, but I don't think we had the source term exemption on ABWR and this is because of the new source term for ABBCE.

MR. CARROLL: You didn't have the 19.2 exemption either. That's a PWR item, I think.

MR. BORCHARDT: They are asking about 19.2 on ABWR.

I think there was also an exemption to that. That's a TMI action plan item which ABWR was also exempted from the specific requirement, although there is a design provision for it in ABWR. To be honest, I have to get back to you on the specifics of it unless Jerry can --

MR. CARROLL: I always had the impression that was a PWR issue.

MR. WILSON: Jerry Wilson, NRR.

That particular TMI requirement called for provisions of a certain size vent and containment in the event that -- excuse me, a penetration containment in the event that a vent was required later on. In the case of ABWR, there is a vent in the design and so there was no need for the additional penetration.

MR. DAVIS: Excuse me. What's the Appendix J exemption?

MR. CARROLL: You don't want to know, Pete.

MR. BORCHARDT: It has to do with mass point calculation methodology. It is really, to my understanding, a case of where the common practice that the NRC and the utility is using, the regulations haven't caught up to that yet and it is really related to a pending rule change on

Appendix J.

MR. DAVIS: I knew there was a rule change coming up but the source term calculations assume a specific leak rate. We'll be looking into that, I guess.

[Slide.]

MR. BORCHARDT: The next two slides show the applicable regulations the staff has designated that are applicable to ABB-CE design. I just need to make the point that the specific wording, like I said earlier, has not been worked out yet. The idea being that we would prepare some GDC-type language that addressed these topics that are unique to the review of the ABB-CE design, and include these in part of the rulemaking activities. The Commission has not decided on this general approach yet, and we expect them to do that through the proposed rulemaking process.

MR. WILKINS: Let me interrupt just for a second because I think I misunderstood what you said earlier about applicable regulations. When you use that language, I expected to see on this slide opposite say, 3.9.6 section, I expected to see 10 CFR XYZ PDQ. But what you are saying is, these are regulations that you have yet to write?

MR. BORCHARDT: There is no question that Part 50 and Part 52 apply to these designs, and they have to meet all of those requirements. Part 52 is very clear about that.

There are policy matters that were identified and discussed in a number of Commission papers, 90-016 and 93-087 are two of the larger ones, that go beyond the current regulations or provide an alternative way of meeting the regulations which we specifically ask the Commission to pass judgment on and approve. They have done that for these items. They are not regulations per se, so the staff approach to meeting these policy issues that have been approved by the Commission we are calling applicable regulations.

MR. WILKINS: Thank you, that's fine.

MR. BORCHARDT: I will skip the next slide because that just lists a few more applicable regulations.

[Slide.]

MR. BORCHARDT: The last slide in the package really is just put there to give you a feel for the wide breadth of staff review activity that went into this design. These list not all of the reviewer but some of the key reviewers and people involved in preparation of the SER. I would just like to say that this review has been characterized by a commitment on both ABB-CE's part and the staff's part, I think, to reach technical resolution of some very difficult issues from the very beginning.

I think you have seen yourself in the presentations in the subcommittee meetings that we have had that the interaction between ABB and the staff has been professional throughout and really focused on resolving the technical issues without trying to do a lot of needless handwringing and bargaining.

On that behalf, I would like to thank the ABB team for their commitment to respond to staff concerns in a meaningful way.

MR. DAVIS: Do you know how many man years of effort are represented by all these people?

MR. BORCHARDT: Yes. We are in excess of 50 FTE since the beginning of the design. I don't have the exact number, but --

MR. WILKINS: You are still counting, too, aren't you? This is 50 and counting.

MR. BORCHARDT: They are still adding up and they will for another couple months.

MR. WILKINS: Just to give me some basis for understanding this, you list 14 NRR section chiefs. How many NRR section chiefs are there altogether?

MR. CRUTCHFIELD: This is Denny Crutchfield with NRR. There are roughly 64 section chiefs in NRR altogether.

MR. WILKINS: So this is what, 20 percent or so?

MR. CRUTCHFIELD: Yes, 20 to 25 percent.

MR. BORCHARDT: Just to give you an idea of the level of activity between the DSER and the FSER, we had estimate over 100 meeting days with ABB, about 12 senior management meetings, and around ten ACRS meetings, subcommittee meetings.

The last point on the SER that I would like to make is that ABB-CE has been exempted by the Commission from the metrification policy statements. So when you read the SAR, you will see that it is in single units, English units. The SER, however, is still in dual units, metric and then followed by English in parentheses.

That concludes my presentation.

MR. CARROLL: Any questions of Bill, or further questions?

[No response.]

MR. CARROLL: We are now going to hear from combustion engineering, Stan Ritterbusch.

[Slide.]

MR. RITTERBUSCH: I have now figured out how to work the microphone.

MR. CARROLL: Could you spell your name right, Stan?

MR. RITTERBUSCH: Yes.

MR. CARROLL: That is how you spell Stanley?

MR. RITTERBUSCH: No. I was looking at the last name.

MR. WILKINS: I decided not to ask the question, but when you answered it yes, I said well.

MR. RITTERBUSCH: Most people guess wrong at the end of my last name, so that is where I looked. I guess you all know my name now. For the record, I will say it, my name is Stan Ritterbusch. I have been, as you know, at ABB for some time, and I have been on this program since its beginning in the mid-1980s.

I have to say that most of the time it has been a great pleasure. It truly has been an industry effort. We worked with EPRI. We have had the strong support of the Department of Energy throughout the program, and most recently we have had some very heavy interactions with NRC staff. I would like to thank Mr. Borchardt for his kind comments on interactions with ABB. We feel the same way.

I wouldn't take that to mean it has been a picnic getting through this past year, and you will see why in the next slide.

[Slide.]

MR. RITTERBUSCH: I can put this slide up because I don't see any spelling mistakes. I am going to cover for you briefly this morning an overview of the licensing process and what we view as some of the major efforts and issues that we address.

Of course, you are welcome and I encourage you to ask any questions you might have at any time, and we will answer those.

[Slide.]

MR. RITTERBUSCH: To give an indication of what we have been through, I would like to point out that through the first three years of the program we answered approximately 1,500 questions. Of course, this meant that there had to be someone on the other side of the table to make the questions and to look at the answers, but that is 1,500 over a two or three-year period.

In contrast, in the 1993 timeframe, when we were responding to the draft SER, and into early 1994, we responded to almost 3,000 questions. So more questions over a shorter period of time.

We were especially pleased that we were able to achieve the advanced copy of the FSER without any open items. I think you heard yesterday and today about the additional work that needs to be done. There are some confirmatory items. We are working hard with NRC staff to close those out, and we will be doing so shortly.

If there is one area which I would say is the granddaddy of all issues and subjects, the one that was both the most interesting and the most challenging, I would say it was the addressing of severe accident issues and, of course, the Probabilistic Risk Assessment that goes along with it. That was a challenge to both the staff and ourselves, primarily because there wasn't a regulatory history and, therefore, we had to work on the criteria for acceptability and the groundrules for doing the analysis. But it all came to a good end, and I will be giving a bit more of a summary on that.

[Slide.]

MR. RITTERBUSCH: My next slide shows the confirmatory issues. I won't go through those. I will just summarize by saying I do not believe there are any significant technical issues in them.

[Slide.]

MR. RITTERBUSCH: Bill indicated we expected two amendments, and he was correct. This slide shows the dates. I would like to say we are going to do our very, very best to get all matters of interest to the committee, that is all of the responses to your questions over the previous meetings and any technical issues that we are working out with the staff, we are going to try our very hardest to get those into Amendment V. Knowing how things have worked over the last five or six amendments, I would expect that there would be a few spill overs, especially as we go to resolve some late questions from the ACRS and as we resolve last minute issues on ITAAC with the staff.

But, again, right now we know of no issue that would cause us to be worried about the conclusions that have been reached already.

[Slide.]

MR. RITTERBUSCH: We have made plenty of indications over the course of the review that we have established a significantly safer design relative to the previous generation of plants, and we made specific comparisons to System-80 demonstrating to you.

That wasn't an accident. We started from the beginning to make that happen, and we used what we call our defense in-depth approach and, of course, there may be different definitions. This slide summarizes our approach to defense in-depth. Basically what we are looking at here is, starting from the beginning and just building some very good engineering features into the plant, and I will call it just good solid engineering judgment, and we had a lot of input from the EPRI requirements document on that. We also had help from the EPRI requirements document in addressing features for the safeguard systems that would, even if we had an accident, that would help us prevent core damage.

Finally, the next level of protection is to add some features to the plant and do some special analyses to address all of the severe accident issues. When we build in these features to the plant, we then ask ourselves, how did we do the job, and we looked at it two different ways.

We first used the historic design basis safety analysis methods that have been well established in the SRP and Reg. Guides and, of course, those methods got supplemented because the NRC Staff was a little more stringent. They have learned as well, so there were some additional issues we had to address there. Things became a little more conservative. But all in all, it was the same type of safety analysis we had been doing.

In addition, we did special analyses, as I mentioned to address severe accident issues, and in addressing severe accident issues we looked at the events from a probabilistic sense as well as from a deterministic sense and, of course, those two were related, and I will be summarizing those in a moment.

[Slide.]

MR. RITTERBUSCH: This slide points out or identifies some of the very basic improvements to the safety injection system. We increase the size of the steam generators and the pressurizer simply to make the system bigger, have larger heat capacity, slower response to accidents. We used Inconel 690, or we changed our tube specification to Inconel 690, better resistance to corrosion and strength. Then, as we mentioned yesterday, we have the ring forged method of constructing the reactor vessel, and we tightened up our specifications there.

[Slide.]

MR. RITTERBUSCH: We also improved the safeguards systems, and this is a complicated slide. So what I would like to do is, I would like to cover over half of it. What we are looking at here is one-half of the safety injection system. In the plant we have four mechanically independent trains. Of course, two independent electrical divisions. The main features here are those individual trains, but also we have a full float test capability, so the pumps can be tested at power.

For the shutdown cooling and containment spray systems, again, this is half of what we have in the plant. The major features here are, again, the feedback loop for full flow testing, and also the containment spray pumps and the shutdown cooling pumps are identical. So they can be interchanged, and that gives us additional liability for shutdown cooling.

[Slide.]

MR. RITTERBUSCH: In the emergency feedwater system, we made several changes. First of all, this is a dedicated system. It is not used for a plant startup.

The major improvements are we have two storage tanks, each of them 350,000 gallons. I think what we saw yesterday was that for our design basis natural circulation cooldown calculations, we use something like 35 percent of the liquid so there is plenty of inventory there.

Previous designs had three pumps, one pump for each steam generator and a swing pump. In this design, we have a turbine and a motor-driven pump for each steam generator.

The last item or major addition is the addition of the cavitating venturis. What this did was allowed us to eliminate the need to isolate the auxiliary feedwater or emergency feedwater to the ruptured steam generator. Previously we had some complicated electronics to figure out which steam generator was ruptured and shut off the emergency feedwater to that steam generator. With these cavitating venturis, we do not have to do that anymore.

[Slide.]

MR. RITTERBUSCH: We added a safety depressurization system to the plant to address severe accident concerns. We want to rapidly depressurize the system if we sense that we are approaching a damaged core situation. This also helps us to keep the core covered in a feed-and-bleed mode if we lose all feedwater to the steam generators.

I want to emphasize that our primary method of removing decay heat from this plant is through the steam generator using the feedwater systems. We added the rapid depressurization system as yet an additional method of removing decay heat using the feed-and-bleed process on the primary side.

[Slide.]

MR. RITTERBUSCH: I would now like to get into some of the major licensing issues that we addressed in getting this through the NRC Staff. As I go through this, I will be indicating some of the corresponding design features.

It was a tight race. A year ago I would have said that the most challenging subject we dealt with was the issue of human factors, engineering the control room and the I&C design. However, we got to the finish line in that area before we got to the finish line on severe accident prevehtion and mitigation features.

I would say all of them were pretty significant challenges, severe accident, the one taking the most manpower and effort.

The last two items, development of the seismic design envelope and implementation of the new source term I would have to say were pretty much a pleasure from beginning -- from the beginning to the end. The reason I say that is because we had good support from Electric Power Research Institute, there was a lot of interaction. We also had support from NRC Staff along with lots and lots of questions.

But we weren't really challenged. It was just a matter of grinding out the work and we were able to succeed there and we were pleased to get to the good end.

[Slide.]

MR. RITTERBUSCH: In the human factors engineering area, one of the -- I would say the principal challenge was agreeing with the NRC Staff on how to do human factors engineering review. It took over half of the review period to get agreement as to just how we would do it.

Once we adopted -- I guess I would say we adopted the NRC's model and then we worked with the NRC staff to adopt -- modify that model to allow for our evolutionary approach to control room design. But once we got the model squared away, I would say the progress was very rapid and very successful.

Once we had agreed upon the model, we did design work and we actually exercised a part of that model. If you are familiar with the eight-step model that the NRC Staff uses, these design features exercised the first four or five steps of that model.

This is important to us because this enables us to establish all the major design features of the control room and get some concurrence from the NRC that if everything works out through the ITAAC process and we implement these, that we'll be able to have a design that works.

I would like to point out that we are ready to go to construction. There have been some questions as to what level of design detail we have and whether we are ready to procure equipment. We are, in fact, ready to issue procurement specifications. If we had a contract today, we do know the equipment and we would go to work.

That is not to minimize or say that we don't have additional design work to do, we certainly do. And we certainly have a lot of detailed questions to discuss with Staff as we work through the whole software development process and implementation.

So there is a lot of work to be done in closing out the ITAAC but we have enough right now to proceed.

MR. WILKINS: Before you leave that general area, let me take this opportunity to ask Bill, it is understandable that when you look at a plant like this for the first time, it is really a guinea pig in the NRC's development of its own procedures and processes. I heard Stan say that half the time in this area was spent in just evolving the model that was going to be acceptable to NRC and that the vendor could follow.

Do you believe that you now have a model that is generally applicable in the future? I say "generally." I don't want to pin you down to every detail.

MR. BORCHARDT: Bill Borchardt, NRR Staff.

I believe we have a model under development that will get there. The Human Factors Branch has out for industry review a model for comment that will become the basis for that future reference document. I think that would, in some way, be related to the standard review plan update which will incorporate the new and unique review areas for advanced reactors in addition to updating the standard review plan just because it's grossly out of date.

MR. WILKINS: Thank you.

MR. CARROLL: Ernest, we commented on that model in our DAC letter on ABWR, and our conclusion was that we thought it was a pretty good approach.

MR. WILKINS: I am sure they wanted to say it out loud again.

[Slide.]

MR. RITTERBUSCH: This slide identifies some of the major features of the control room. The first feature is the large overhead display screen. We kept it very simple on purpose, and we kept it readable from all positions in the control room.

We also make extensive use of the touch sensitive CRT screens and the fixed displays.

We use a microprocessor technology, as I indicated earlier. This is an all digital control room. That enables us to make a lot of improvements by way of alarm prioritization and processing of information. So, for example, the software now selects which pressure reading is the appropriate one. We don't have to display 10 or 12 pressure readings and let the operator choose.

MR. LEWIS: You know, microprocessors can't do anything that discrete components can't do more clumsily. What microprocessors did you use?

MR. RITTERBUSCH: I don't know.

MR. LEWIS: Thank you. I love direct and honest answers.

MR. RITTERBUSCH: If you require an answer --

MR. LEWIS: I don't.

MR. RITTERBUSCH: Thank you. I'm sure if Ken Scarola were here he would be at the microphone already, but we let him go home last night. You missed your chance yesterday.

MR. CARROLL: I promised we wouldn't ask any nasty questions, but I forgot about you, Hal.

[Laughter.]

MR. RITTERBUSCH: The other thing I wanted to say while this slide is up is that we made a point of using what we believed to be a very simple and basic approach to designing the computer system. It is what we call a disbursed system. We do not have a central processor. We believe that gives us some resistance to a single fault and some additional reliability.

We use off the shelf components. We are not developing any special hardware to make our system work. Again, that is because we are ready to go commercial now and we have to be able to deliver a product that works in the field.

[Slide.]

MR. RITTERBUSCH: I guess I've already said words that address most of the features with respect to our all digital system. I would like to point out that since we were responsible for designing the whole control room from beginning to end and we have responsibility for all the systems, that we were able to make an integrated approach that made a complete separation between a safety and non-safety system, and also a complete separation between control and monitoring systems.

This was a very major consideration in addressing the issue of common mode failure. I will say more about that later.

[Slide.]

MR. RITTERBUSCH: One of the easier items that we dealt with was development of the seismic design envelope. I am glad our structural people are not in the room because they would probably disagree with me. They have sweated this one for probably three years.

From a project and licensing point of view I would say that we never feared getting to the finish line. We always knew we would be successful.

It was a very special challenge because for the first time we are trying to bracket a series of sites and cover that in the design. Previously, all we were able to do, for example, in our case was come up with an NSSS system that could fit on any site. But to come up with a whole plant was quite a different challenge.

To make a long story short, we had to make a more conservative plant. There is a lot more concrete in this plant. Of course, there is a cost associated with that.

Now that I have mentioned the cost of the plant, I would like to add that there has been a cost factor associated with all of the severe accident improvements we have made as well as the one I just mentioned.

However, we don't believe there has been a significant cost penalty in the marketplace because our construction plan is approximately 49 months. We did a very detailed analysis. We believe we can do construction in that timeframe, and, of course, that brings down the interest cost. So we have a competitive cost.

But by building conservatism into the plant, in order to come up with a seismic envelop and a safe shutdown earthquake of 0.3g, we have determined, using design basis analysis rules, for any specific plant site we could go above the 0.3 safe shutdown earthquake.

So any particular site -- for example, I have on the slide 0.4g -- we believe that at any specific site we can justify 0.4g as well, possibly higher. That simply indicates the conservatism that is inherent in the plant because we envelop the number of sites at 0.3g.

[Slide.]

MR. RITTERBUSCH: The new source term technology issue was exciting at first because we started out with the old source term, and our judgment was it is too much risk; we have to stay on schedule and no-thank-you to the new source term.

However, as we watched NUREG-1465, or shall I say, draft NUREG-1465, proceed through NRC staff, we had meetings with EPRI and the NRC staff. We made a judgment a couple of years ago that it was moving along pretty good and we decided to take a chance and plunge in. We did, and it has worked out very nicely, although there were some tough issues to wrestle with.

Equipment qualification became more difficult. Simply put, the radioactivity is down in the sump water; it is not up in the air leaking out and that makes our equipment qualification job more difficult, and roughly by a factor of 2, it also will give us a little more shielding work to do when we do the detailed plant design.

In addition, we had to address the issue of sump water pH control. I think Mother Nature hasn't changed over the last 10 years, but our understanding has. I think we have come to an understanding that a control of the pH in the sump water is much more important than we have previously understood, and so we had to do some extra work to ensure that we control the pH well above 7.0.

We also found that containment spray effectiveness was very critical for all the complicated phenomena we heard yesterday. After two years of working on the job, I am getting a basic understanding of hygroscopicity, diffusiophoresis, two phenomena which previously were not well understood and credited in the analysis. We are now beginning to understand them.

When it got right down to the finish line, however, we did not take credit for hygroscopicity, and we only took a little bit of credit for diffusiophoresis.

Our recommendation to the staff, which we will be documenting in a near-term forthcoming letter, will be to encourage the staff and, with the support of EPRI, to develop models to handle hygroscopicity because it is so important in cleaning up radioactivity inside the plant.

I have talked about the negative side of the new source term. There have been some very nice benefits. One is that we get a more realistic prediction of the dose at the site boundary. Fortunately, the dose is lower.

All things equivalent, it is very hard to pin it down, but our belief is that there is approximately a factor of 2 reduction in the dose for any given event.

Because of the lower doses and the improved performance of the containment spray system that we have demonstrated, we have, on a best estimate basis, significantly lower doses for the emergency planning scenarios.

We hope that at some point in time this does in fact lead us to either smaller emergency planning zones or, if I had my preference right now I would say no emergency evacuate -- no special emergency evacuation by utilities.

MR. KRESS: I think I know what your answer will be, but I will ask the question anyway. Do you think using the new source terms instead of the TID-14844 has resulted in a better, safer plant?

MR. RITTERBUSCH: I would say that we now have the better basis for demonstrating it and understanding the phenomena involved so long as we have the spray system. So I think we have always had spray systems; we have always had equipment. So I would say that the safety hasn't changed, but now we understand why it is more safe.

In this case, we now understand that as long as we have the spray system we can capture the radioactivity. It is down in the water.

We do not believe that we are going to have to change plant equipment to meet the tighter equipment qualification standards, so we do not believe it has had a serious impact on plant equipment.

So I would say the safety hasn't changed, but our ability to demonstrate safety has improved very significantly.

MR. CARROLL: Is that the answer you expected?

MR. KRESS: It is a good answer, yes.

MR. SEALE: But hasn't the recognition of the criteria for effective pH control, for example, hasn't that sharpened your understanding and perhaps design of the mitigation features that you would put in the plant?

MR. RITTERBUSCH: Yes. I would agree that as a result of our better understanding we have paid closer attention to our control of pH. We did add some additional trysodium phosphate, the dodecahydrate version of it. There was some additional work there.

I am not going to pass judgments on current plants, by my understanding was they all had some form of pH control, so it may be a matter of degrees.

[Slide.]

MR. RITTERBUSCH: The next two slides summarize some of the severe accident prevention and mitigation features in bullet form. Following that I have a few pictures so we can see what they actually look like in the plant.

First, and most importantly, our containment on this plant is much larger. Well over 3 million cubic feet of free volume. What this does for us is it allows us to handle more mass and energy released from the RCS before we get to an overpressurized condition.

It also allows us to handle hydrogen generation without getting to detonable levels. If one can assume because of a phenomena inside the containment that the hydrogen is reasonably well mixed, we have a containment large enough to keep the global concentration less than 13 percent without any mitigation activity by the hydrogen igniters.

Of course, I am not hanging my head on that because Dr. Catton is here and I know if I said that we said we understood hydrogen inside containment, I wouldn't get away with it.

We don't, so in addition to having a large containment, we added the hydrogen igniters to address hydrogen buildup on a local level.

We added the depressurization system that enables us to avoid high pressure core melt threats, or shall I say, decrease the likelihood of high pressure core melt ejection from the reactor vessel.

We also added a cavity flood system whose intent is to cool the debris if it were to spill from the reactor vessel.

I would have to say that we added the system, but when we look at debris coolability -- I am going to save my comment there to the next slide.

We also added additional what has been loosely called hard-wired instrumentation and controls so that we could survive a common mode failure of all the safety grade digital software in the plant. Although I don't know how such a common mode failure would occur; we assumed it nonetheless.

We added some hard-wired controls and instrumentation, and then we were able to demonstrate that we could survive the design basis accidents without violating dose at the site boundary.

[Slide.]

MR. RITTERBUSCH: Because of the large containment, we were able to demonstrate that we did not exceed the service level C stress limits for time periods ranging from 50 to 60 hours.

We also designed our reactor cavity according to the EPRI requirements document, and a couple of the major features there were to have a significantly larger floor area below the reactor vessel to allow spreading out of any debris that might come out.

We also had a couple of other features in our reactor cavity. That is what we call the core debris chamber, which is intended to trap some of the debris if it comes flying out, and also a torturous vent path which I will be showing you when I put the pictures up.

With respect to attack of any core debris on the concrete down below the reactor vessel, we demonstrated that even if -- I am getting ahead of myself here.

This was a steam explosion issue. We demonstrated that if we had the debris falling into a flooded cavity and resulting in a steam explosion, that the walls in reactor vessel support structures would remain functional and therefore not have any consequential impacts on containment integrity.

We also showed that we can support the reactor -- well, we analyzed in detail what happens to the concrete when we have melted fuel in the cavity. We demonstrated two things. One was that even if that concrete eroded walls in the horizontal direction and completed eroded these six and ten foot walls that there is still enough secondary concrete at higher elevations that would support the reactor vessel.

We also demonstrated that there is an awful lot of concrete down below the reactor cavity. I will point that feature out to you in a second.

But shortly put, we have approximately 24 hours before any melted debris would penetrate the pressure boundary.

But even if the pressure boundary is penetrated, there is still concrete around it. It doesn't go into rooms or atmospheres at that time. There is still a lot of concrete down below, and that was the basis for the eight-day calculation.

[Slide.]

MR. RITTERBUSCH: In this slide, I can point out where some of that concrete is.

I guess the scope of the picture, if I wanted to show core concrete interactions, I would show a picture down here. But this shows the scale of it and the large containment.

But the amount of concrete below the reactor vessel is approximately 18 to 19 feet, in that range. And that was the basis for the eight days calculation.

This is a complicated diagram. It requires an awful lot of inspection, but I want to point out one item with respect to the hydrogen igniter system. We have in here a containment crane wall.

Of course, most of the piping and the systems are inside that crane wall. So, most of the sources of hydrogen, if not all of them, are inside the crane wall. As a result, we placed over three-quarters of our hydrogen igniters in the area where the hydrogen is expected to be generated. Then, of course, we have others at the top of the containment and on the outside of the crane wall.

[Slide.]

MR. RITTERBUSCH: This slide shows a little close-up of the area down below the reactor vessel. I am putting it up because there was some questions yesterday about the hold-up volume. This is the IWRST. This is the hold-up volume. Here is the reactor cavity.

The reason we have the hold-up volume, obviously, if we have an inadvertent operation or normal operation of the safety-injection system, we don't want to always be flooding the reactor cavity.

Our trisodium phosphate baskets are here so that if we have safety injections, the water coming back from containment -- I should say safety injection and containment spray -- the water coming back flows past the baskets, dissolves the trisodium phosphate and gets mixed in.

Now I am going to take that slide off.

MR. CARROLL: But that is another date slide because you don't have a vacuum breaker?

MR. RITTERBUSCH: Well, the problem -- I tried getting it off before you spotted that. That slide shows the old vacuum breakers. Our FSAR has now been revised to show the vents that we do have.

[Slide.]

MR. RITTERBUSCH: This slide shows the core debris chamber, the idea being that if the melted core comes and spatters around, it would come over here and hopefully this concrete structure with the floor overhang here would tend to keep some of the debris down in the reactor cavity area.

We also vent the reactor cavity, but the path is a very tortuous path. Again, there are a lot of concrete structures up here, but basically it goes over, up and over, up and something like that. So there is no direct pathway from the reactor cavity to the containment.

That was a requirement to prevent direct containment heating.

[Slide.]

MR. RITTERBUSCH: One of the other basic features of this plant -- and I understand there may be a few questions on how well you will execute our division of systems and so on and so forth -- but we took pains from the very beginning to keep our different trains of our safety systems separated and also to provide flood and fire protection for those trains of safety equipment, and other equipment as well.

What we have here is the divisional wall that we have mentioned many times. For flooding purposes, we have no doors and openings going from one side to another. So, our approach to flood control is assume a flood happens on one side. We assume the whole division is lost. We assume the single failure takes out a quadrant on the other side. We can still get to safe shutdown with the last quadrant.

MR. MICHELSON: What if you are postulating single failures? How about the diesel on the other side? This is assuming that this event is mitigated with loss of off-site power, of course.

MR. RITTERBUSCH: Well, I think the single failures is what cost us one of the quadrants over here.

MR. MICHELSON: Well, a diesel single failure will cost you --

MR. CROM: This is Tom Crom from Duke Engineering. The regulation allows you, in the single failure, to use non-safety equipment. So we can flood a complete division with the diesel generator and combustion turbine make single failure.

MR. MICHELSON: How do you mitigate? You, of course, have to postulate your flood source.

MR. CROM: Yes, the flood source is the -- we have analyzed that every closed water source -- the big ones, the component cooling water, all the fire protection tanks and everything -- emptying into one division. We don't give above elevation 70 where the first opening is.

MR. MICHELSON: Yes, I understand that.

Go ahead.

MR. RITTERBUSCH: The other point I would like to make while this layout slide is here is that we have looked at the plant from a maintenance and operations point of view. We did two general activities. One is to provide ample room and aisleways. This really is true of all elevations above this elevation as well.

We tried to make the plant easier to maintain. We also tried to keep all of the activities involving our radioactive materials on what I believe we call the south end of the plant and the north side where we have the control room and then on to the turbine.

We tried to keep that -- those areas are all clean. Again, this just helps us to keep our ALARA doses down and make it easier to run the plant.

[Slide.]

MR. RITTERBUSCH: I would now like to get back to the PRA discussion.

When we started out, we had three people, or three groups working on PRA. Of course, EPRI was establishing the ground rules. We were trying to implement them. The NRC was trying to approve them.

Of course, you can imagine with three groups working on the same job, there's got to be an iteration and, in fact, there were iterations. I think we did our PRA three times before we got done with all our design improvements and methods changes. However, we did succeed, as we indicated in this bulletin.

In addition, as we did not -- well, we first included seismic in the PRA. We found a seismic contribution of something like 1 times, 10 to the minus 6. But there was substantial disagreement in the industry about the seismic hazards curve, roughly an order of magnitude difference in the impact on seismic.

So we judged that we weren't going to be able to come to agreement very quickly on that seismic curve. So we went to a seismic margins analysis, which uses the PRA models and methods, but really is not in the core damage frequency.

We were able to demonstrate that the plant would survive a severe earthquake with a very little likelihood of core damage. I think we showed that up for an earthquake of something like .7 or .733 g.

For those who are interested in earthquakes, if we would wish a crude approximation to what would have happened to our core damage frequency if we look at seismic and included it in those predictions, it would have added something like 1. or 1.5, 10 to the minus 6 to it.

The bottom line, however, is that we look at internal events, external events. The shut-down risk came up with core damage frequency which is about two orders of magnitude improvement to the design we started with. On that basis we feel we have met the Commission's guidance for a plant which has significantly improved safety.

MR. LINDBLAD: Stan, could I ask clarification on that last slide? You have used the work "earthquake" and "magnitude. Were you really talking about the ground acceleration rather than the Richter magnitude of an earthquake?

MR. RITTERBUSCH: Yes.

MR. LINDBLAD: Thank you.

MR. MICHELSON: Now, you are saying that your PRA shows two orders of magnitude relative to present plants, which, I assume, means what, Palo Verde?

MR. RITTERBUSCH: No. I will explain that in a minute.

MR. MICHELSON: Okay. You are going to explain how you got your two orders of magnitude over your --

MR. RITTERBUSCH: Yes.

MR. MICHELSON: I would like to know over Palo Verde how much did you come.

MR. RITTERBUSCH: I won't say the name "Palo Verde," but I will explain our statement in a second.

MR. MICHELSON: I think we have to -- I mean, why wouldn't you say "Palo Verde"? Average means nothing.

[Slide.]

MR. RITTERBUSCH: Shortly put, we did our PRA valuation using a System 80-Plus, NSSS and a generic balance of plant. It was not modeled after Palo Verde.

MR. MICHELSON: Okay. Not current plants then, as the slide indicates. Generic is not the current design. It is the generic design, which means the average of all of them.

MR. RITTERBUSCH: Let me work on the word.

MR. MICHELSON: All right.

MR. RITTERBUSCH: Shall I say "typical balance of plant"?

We did our -- I indicated two orders magnitude improvement on internal core damage frequency, but we also have an extensive review of shutdown risk.

We did a shutdown risk evaluation and compared our results to studies performed by other groups in the industry. I think there were three well-documented studies.

Depending on which study you look at, our shutdown risk shows a factor of improvement ranging from 20 to 60. The middle one happened to be about just over 40, and hence, the factor of 40. The point was not the exact improvement, but the fact that there was substantial improvement.

I think we have talked about this already. That is the best estimate calculation, and is our basis for hopefully someday having some improvement in the emergency planning criteria.

And then the issue of what happens to the PRA after we complete design certification. It is a complicated discussion and I don't know where it is going to go with respect to living PRA.

But what we have come to an agreement on -- well, I am not sure we are completely there yet. What we have agreed with the staff is that some part of our PRA will live through the design control document and rulemaking proceedings so that there is some basis for the COL applicant and holder to have a plant which is consistent with the PRA that we performed.

MR. KRESS: Your middle bullet there, is the whole body dose?

MR. RITTERBUSCH: Let's see. There was one -- yes, that is correct.

MR. KRESS: And the thyroid for the same sequence was 2.5?

MR. RITTERBUSCH: 2.7.

MR. KRESS: 2.7.

MR. RITTERBUSCH: Right, so it is 0.3 against the 1 rem whole body. The other was 2.7 against the criterion of 5.

[Slide.]

MR. RITTERBUSCH: This is the slide that indicates our two orders of magnitude improvement in safety. We started out with a System 80, NSSS, and Safeguards systems. We built what we thought was a typical balance of plant that would reflect the current generation. We did not pick on any particular plant.

From that base PRA -- and given a set of ground rules -- we evolved the design System 80-Plus. We improved our electrical system, and we added some other features. Then when we redid the PRA using the same methods, models, and ground rules, then we came up with a different set of numbers.

That is where we see the order of magnitude. However, about this time we started getting into a heavy involvement and NRC review. We agreed with the NRC staff that we could make some different assumptions and would be appropriate.

[Slide.]

MR. RITTERBUSCH: It is my understanding that EPRI has participated in these and I believe has adopted them.

So, when we make some new assumptions which had to do with a common cause failure of check values, human reliability methods, and the way we used failure rate for motor operated valves, our numbers went up. So, our final core damage frequency is shown here of 1.7, 10 to the minus 6.

MR. MICHELSON: What did you do on motor operated valve failure rates?

MR. RITTERBUSCH: I have to give the same answer I gave to Mr. Lewis. I don't know. But I do know that they increased.

MR. MICHELSON: Okay.

MR. CARROLL: If I remember reading Chapter 19, Carl, it didn't make much difference.

MR. MICHELSON: It depends on where you start from, and what assumptions you make. That is the question. In other words, the valves that are already out there were good enough. It didn't make much different

MR. RITTERBUSCH: I think it had to do with the way we looked at the data, whether we made assumptions based on demand failure rates or time failure rates.

MR. MICHELSON: Well, I think the big difference makes on whether you are looking at failure rate under similar conditions or not. If you are isolating a break, you only look at failure rates under break isolation conditions, for instance, not under no-load conditions if you want to use PRA approaches.

MR. CARROLL: But I think, Carl, they have also made a commitment to test and demonstrate that the valves will --

MR. MICHELSON: That doesn't give you any statistical information since they are too few in number. I was just curious. They said they did something to the failure rate. I was curious to see if they put in some kind of a finagled factor to give recognition to the insufficiency of their data.

MR. CARROLL: No, I don't believe they did.

MR. RITTERBUSCH: I don't think that was the basis for doing it. I believe we were -- we did not try to change the basis for the data. We simply discussed which data to use.

MR. CARROLL: I think they did a case where they made the MOVs much less reliable and concluded that it didn't have a huge effect on core damage.

MR. DAVIS: Not to my recollection.

MR. MICHELSON: They fortunately don't have too many cases where they really have to worry about it since they don't have much high-energy big piping outside the containment.

MR. DAVIS: But they need to isolate, yes.

MR. MICHELSON: I was just curious to see what approach they were using. I didn't recall being able to ask the question before.

MR. RITTERBUSCH: As we see from the side, all of the items together cause the core damage frequency to increase by a factor of two.

MR. KRESS: Did you also calculate, as part of your PRA, a conditional containment failure probability?

MR. RITTERBUSCH: Yes, we did.

MR. KRESS: Are you are going to mention about that one?

MR. RITTERBUSCH: Well, I was going to try to duck that one because it is a complicated discussion, but I can answer it. It depends on how you define containment failure rate.

MR. KRESS: Of course it would.

MR. RITTERBUSCH: With very conservative definitions of containment failure -- such as failure is any leakage beyond normal leakage for all time -- if that is our definition then our containment reliability would be 88 or 89 percent, given a melted core on the floor. I think that is a CCFP of 11 percent.

If we define containment failure as -- well, I should say "containment success," containment functioning as maintaining normal leakage for the first 24 hours of an event, then we would get a CCFP of only about 4 percent.

The same holds if we defined it to be -- containment failure to be a series of events resulting in a large off-site release greater than 25 rems. Again, for that definition, the CCFP would be about 4 percent.

MR. KRESS: Okay. Thank you. But when you say CCFP, that is a weighted average over all of the core melt events?

MR. RITTERBUSCH: Correct. If one looks in some of the documentation, you may see a CCFP of 2 percent, but one has to look very carefully at what went into that. If you changed some assumptions around, you can get 4 percent for both of those cases, as I mentioned.

I think the point being is that based on the three definitions that we used, they all came up with a highly reliable containment. So, we didn't have to pin any one down.

MR. KRESS: That's a nice feeling, isn't it?

MR. RITTERBUSCH: Yes, it was. When we got to that point, it sure was. Hydrogen igniters helped us get there, by the way.

[Slide.]

MR. RITTERBUSCH: I have just finished all the major issues we dealt with. These are some of the other issues that were not especially long or difficult, but they were interesting for various reasons. I am going to show a quick slide. I guess we have a few minutes left, correct, or would you like me to cut?

MR. CARROLL: No, we are to complete this session at 10:15. So you have 12 more minutes.

MR. WILKINS: Well, of course, unless you want to reserve some time for Committee discussion.

MR. CARROLL: I think we can have that one later in the day. You've got 12 minutes.

[Slide.]

MR. RITTERBUSCH: Okay. I will use 60 seconds.

I think we already talked about I&C diversity. We did add a few controls, I think seven control lines, and 15 instrumentation lines. We changed to hard wires. I should say, monitoring lines. It was a relatively minor impact on the design.

[Slide.]

MR. RITTERBUSCH: We also had to go over the Intersystem LOCA issue. I would like to start out by saying that when we started this review, the best our PRA could predict Intersystem LOCA, core damage frequencies, we were in the range of 10 to the minus 9th.

However, that didn't satisfy the staff that we had done our best job, so we got into a very detailed review. We made basically several system design changes, eliminating some piping connections, increasing the piping rating, adding some isolation valves.

When we redid the same type of PRA model, we put it down by an order of magnitude, not that I believe PRA numbers in the range of 10 to the minus 9 and 10, but the fact was the same model came out with a smaller number, which indicated to us we did the right type of things.

[Slide.]

MR. RITTERBUSCH: This issue has to do with the potential for a main steam safety valve on the secondary side of the steam generator sticking often after a steam generator tube rupture event.

Had we done our best job of making sure that wouldn't happen -- what we did is we analyzed the plant in a best estimate sense. We allowed our control grade systems to function. We did a lot of review. We actually changed some powering arrangements for some of our coolers that allowed our steam dump and bypass system to operate under different conditions.

This is really the main control system that keeps the secondary side pressure intact. It takes the steam from the steam generator and dumps it to the turbine so we don't have to lift the valves.

For those of you who were here yesterday, you saw for a single tube rupture, we made a best estimate prediction of four hours before the safety values would lift. We thought that would be plenty of time for the operator to get control of the plant.

We did, however, pick up some new technology, and that is a N-16 monitor. We don't take automatic plant action based on that. That is simply an operator warning to give them a head start on the four hours.

[Slide.]

MR. RITTERBUSCH: One of the more interesting issues we dealt with, something that we inherited from Europe, I understand, gave us a good test but it all came to a good end and enabled us to do something in the end that probably should have been done or could have been done earlier.

This is a situation where we have a very small break Loss of Coolant Accident, the coolant break diameter in the range of 1 to 3 inches, and for this small range of events, there is a potential of voiding the reactor coolant system and then as it refills the steam boiling off the reactor core goes through the steam generators, condenses and dribbles down into the cold leg and collects there.

Then one further hypothesized that the operator makes a mistake and turns the pump on. Cold water goes into the core and we have some horrible reactivity excursion, at least according to the hypothesized transient.

We didn't really believe that but it was a hard time to say it didn't happen, so we did several things. We really looked and worked hard to calculate how much condensate could collect. We also looked at what would happen with natural circulation because we know there is a time period after we establish natural circulation but before the operator turns the pump on, and during that time period the natural circulation phenomenon is pushing any, shall we say, less borated water from the cold loop into the reactor vessel and that is a slow progression so if one waits about 20 minutes it takes care of the problem.

Well, the operator may jump the gun a bit, so we looked at our emergency procedures and we put in some safeguards to make sure that he would check with the technical support center before restarting the pumps.

Finally, we had to assume what happens, even if he goes and turns the pump on anyway with a loop full of borated water, what would happen? I think this is the real answer and that is that we have a reactor vessel geometry which provides adequate mixing under forced flow. That was an analytical test but it came out okay and as it turned out there is plenty of mixing with the water coming into the downcomer down and around through the upper plenum and up, so that is what we called the three-step approach to resolving that problem.

I am going to skip "Leak before Break Technology" and let it go by simply saying we extended leak before break technology to other piping systems, most importantly the main steam system, and the last slide has to do with --

MR. MICHELSON: Hold off just a moment.

You are applying it to main steam?

MR. RITTERBUSCH: Correct.

MR. MICHELSON: But not feedwater?

MR. RITTERBUSCH: Correct.

MR. MICHELSON: And any other lines outside of containment that you have extended it to?

MR. RITTERBUSCH: We are applying it to lines only inside containment.

MR. MICHELSON: So it's only main steam inside of containment?

MR. RITTERBUSCH: Yes, main stream line inside containment, I'm sorry.

MR. MICHELSON: Okay. None outside of containment.

MR. RITTERBUSCH: Right.

MR. MICHELSON: Of course, I thought it was none but I wouldn't worry much about main steam.

MR. RITTERBUSCH: And of course the reason for that is the leak detection requirement.

[Slide.]

MR. RITTERBUSCH: My last slide had to do with cooling of the reactor coolant pump seals. We ended up adding a third backup method of cooling the seals and I believe everybody is satisfied there.

[Slide.]

MR. RITTERBUSCH: If I had only to show one slide out of the whole presentation I would show this slide, I guess.

MR. CARROLL: That's not the one you spelled your name wrong on, eh?

MR. RITTERBUSCH: No -- maybe the one following that, however. I guess that's what happens when one has assistance in preparing slides and a busy schedule.

One of the very major things we have established here is that we have a more robust plant and as we have looked at it in detail, we feel we have maintained its cost at a reasonable level and yet made it easier to use, so we think we have addressed safety as well as cost, plant maintenance, and operation.

With respect to the regulatory review, I think I indicated my satisfaction, my great satisfaction earlier. I think it is a major milestone for the industry as well as for ourselves commercially.

We needed to show that we could in fact work through this whole design certification and severe accident process and come to a successful conclusion. I see the brochures on the table. Obviously those brochures are intended not for a technical review by a group such as yourself but I wanted to hand it out. It is simply meant to indicate how very important this whole design certification process is to ABB-Combustion Engineering, and we believe the health of the U.S. nuclear industry.

Finally, I think we needed to demonstrate that we can make the design certification process work and that we are not bogged down in this country. That was sort of a negative comment. I would like to end by saying I think we, the industry, DOE, and all working together we achieved a good, successful result.

That is the end of my presentation.

MR. CARROLL: Any questions of Stan?

MR. MICHELSON: I am still trying to come to grips with this question of what is the core damage frequency for Palo Verde versus this plant. Is Palo Verde the System 80 column in your table or is it something better than that but not 80+ or what do I look at to compare?

MR. RITTERBUSCH: Well, I am sure the phone lines from the West Coast to Windsor would be burning up if I said those numbers represented Palo Verde. We made that System 80 set of numbers without any input or review by the people from Palo Verde.

MR. MICHELSON: From your knowledge of Palo Verde, if you know what the PRA says, how does this compare with Palo Verde?

MR. RITTERBUSCH: Well, I don't have knowledge of Palo Verde PRA.

MR. DAVIS: I do. Their IPE submittal originally had a rather high number because they found a DC vulnerability that they subsequently fixed so it depends on which number you are talking about.

MR. MICHELSON: How about the number after they fixed it?

MR. DAVIS: The number after is just slightly below 10 to the minus 4.

MR. MICHELSON: That is where they are now.

MR. DAVIS: That is what the IPE says, yes.

MR. CARROLL: Okay. Any other questions?

MR. DAVIS: I think it is worth noting, Mr. Chairman, for the record, that at least partly, and maybe exclusively, as a result of some concerns expressed by the subcommittee, ABB-CE agreed to upgrade the fire protection piping in the diesel generator room and also agreed to change the pre-action detection method from smoke to heat.

I personally feel that is a worthwhile improvement and I think it was a good thing to do.

Now I just had one quick question.

I thought you said that you have not agreed with the Staff on what the COL's obligation is with respect to use of the PRA after the plant is built. Is that what I heard you say?

MR. RITTERBUSCH: Right. I was trying to reflect the situation that there is a discussion going on within the industry right now as to how to use the PRA after the plant is discussed.

We understand the Staff's concerns. I think they have some very valid considerations. They want to make sure that some of these lessons that we have learned in this review process and some of the assumptions that we have made are reflected in the plant as it is constructed and operated, and to that end we support that consideration.

MR. DAVIS: I agree but I think the COL should be required to maintain, validate and use the PRA.

MR. CARROLL: That is a policy question that has been before the commission for some months.

MR. DAVIS: I know. I am trying to push it along.

MR. CATTON: We have a comment from behind you. Were you going to say something?

MR. BORCHARDT: Bill Borchardt, NRR Staff. We discussed a living PRA idea in a draft Commission paper. I think it was in the spring, middle of last year, I think, that had to do with regulatory treatment of non-safety systems, but the living PRA issue dealt with both evolutionary and passive designs.

We are now finalizing a Commission paper which starts with that discussion from that draft paper and focuses on the living PRA issue. We are hoping to get that to the Commission this month and get that before them for a final decision.

MR. MICHELSON: Pete, on the question of fire protection, I'm not sure if you were in the meeting at the time we discussed that or not, but as you recall there's a couple of potential questions which we will get answers to next time.

One of them is whether heat works well, if at all, when up at 60 feet on the ceiling, and that's where apparently all the force draft comes across. It just isn't a very good way to detect a fire. The PRA won't show that because PRA looks at the heat detector and how good it is, maybe, and what's the probability of functioning and forgets it, but it has good to be looked at in the environment in which it must now function, because under the right circumstances it might not work at all.

In the seismic part, they are only going to qualify the piping as a pressure boundary but not the function of fire protection per se. It's not seismically qualified.

MR. CARROLL: Okay. Well, I'd like to thank Stan and Bill for very good summary presentations and hopefully next month we'll wrap this thing up and get a letter.

MR. RITTERBUSCH: We appreciate the effort on the part of the Committee and Subcommittee.

MR. CARROLL: Back to you, Mr. Chairman.

MR. WILKINS: All right. I want to thank Mr. Borchardt and Mr. Ritterbusch for their presentations, which are their usual excellent presentations and their prompt and full, if sometimes not informative answers.

I better explain what I mean by that. I will never criticize any man for saying "I don't know." Never. But I will rake anybody over the coals if in fact he doesn't know and he tries to tell me in five minutes of obfuscation all kinds of irrelevant and useless information to conceal the fact that he does not know.

MR. LEWIS: You will run out of coals very quickly.

[Laughter.]

MR. WILKINS: For this committee at least, anyway. All right. Well, thank you very much gentlemen.

The first part of the next session will be closed so that the visitors who were planning to come to that discussion should take note of that fact.

We'll take a short break, reconvene at 10:35.

[Brief recess.]

[Whereupon, at 10:35 o'clock a.m., the meeting proceeded in closed session.]

OPEN SESSION

[11:42 a.m.]

MR. WILKINS: Let's open the doors and let people in, and that will take probably 60 seconds or so. Let's reconvene in open session, and Mr. Dube has the floor.

MR. DUBE: Since we're already running late, I will try to make this very brief. Let me first of all state that staff still does not believe that it's able to quantify the likelihood that someone would attack a plant. However, we have done a number of analyses since we received the comments from the ACRS and the public. Based on those analyses which we discussed in the previous session, staff concludes that protecting against a vehicle used as a means of gaining rapid access into a protected area is sufficient justification for going forward with final rulemaking that would require barriers against vehicle intrusions.

Secondly, staff feels that given a requirement to place barriers to protect against vehicle intrusions, that additional benefit can be gained by assuring that those barriers are placed at locations. It would also provide significant protection against a vehicle bomb. Staff is planning to propose to the Commission a final rulemaking that has essentially the same elements in it as the proposed rule. Staff is planning to propose changes in the implementation schedule for that rulemaking, and specifically, to make sure that I don't give you the wrong numbers.

[Slide.]

MR. DUBE: We intend to propose 180 days for licensees to submit descriptions of the barriers that they would put in place and of the analyses that they did. Secondly, we would propose 18 months for implementation of the rule.

Mr. Chairman, that's all I have.

MR. WILKINS: Now, I wonder if there are people in the audience representing organizations that have in the past made presentations to this committee or to the Commission on this issue would care to take advantage of an opportunity to make an extremely brief, extremely brief, because we are way behind schedule -- an extremely brief comment. I'll turn around so that I can see if there's anybody.

Are you coming forward for that purpose? Have a seat at this table where there is a microphone and identify yourself. I don't want to cut you off, but we are running behind schedule.

MR. PORTSLINE: Scott Portsline from Harrisburg, Pennsylvania, private citizen. The Sandia truck bomb analysis was used in '84, and a Naval ordinance team verified the blast size, I imagine. This time around, the

Army Corps of Engineers is being used to look at that type of data. Is there a reason for changing to the Army Corps of Engineers for maybe a more favorable report?

MR. WILKINS: You are certainly not addressing that question to the Advisory Committee on Reactor Safeguards because we had nothing to do with that.

MR. McKEE: Could you repeat the latter part of the question? I missed it.

MR. PORTSLINE: Originally in 1984, the Sandia truck bomb analysis, a Naval Ordinance team verified probably the blast sizes and what the blast is capable of doing, but a Naval Ordinance team was involved. This time, the Army Corps of Engineers is assisting the NRC. Is there a reason for the change? And I made the somewhat accusation for maybe a more favorable report?

MR. LINDBLAD: Mr. Chairman, point of order. I would like to hear the citizen's statement, but I think the members have been asked to limit their questions in the consideration of time, and I'm not particularly interested in spending his statement time and asking questions of the staff. I'm sure that he can write the staff and get an answer from the staff.

MR. WILKINS: And I'm not sure that the answer to that particular question is germane to our deliberations at this time, and I'm going to so rule.

MR. PORTSLINE: All right. I'm sorry.

MR. CARROLL: Did you have other things you wanted to say in the form of a statement, though?

MR. PORTSLINE: No, I've said everything.

MR. WILKINS: Thank you very much, and I'm sorry.

MR. HORNER: I'm Daniel Horner of the Nuclear Control Institute. I generally wanted to say that we support the implementation or the acceptance of the rule and are pleased that the NRC finally is going to be proceeding with it, assuming the Commission accepts the staff recommendations. I also wanted to, if it were possible, to get a clarification on one thing that Mr. Dube said with regard to the implementation schedule. May I pose a question.

MR. WILKINS: Well, pose the question.

MR. HORNER: When he said 188 and he says 18 months. Is that in addition to the 180 days, or does that include the 180 days?

MR. McKEE: The 18 months includes the 180 days. The 18 months is a total time period.

MR. HORNER: Thank you very much.

MR. WILKINS: It was faster to let him answer than to worry about whether it was permissible to answer. Are there any other members of the public or in the audience who would care to make a statement?

[No response.]

MR. WILKINS: Thank you very much, ladies and gentlemen. I believe, then, we ought to close this item out, and ask our next presenters who, for the next agenda item, they're ready.

[Discussion off the record.]

MR. WILKINS: Gentlemen, our next topic deals with the regulation sump or the regulation -- recirculation -- I can't read -- sump strainer clogging problem. We've heard some presentations already, but why don't I let the subcommittee chairman introduce this topic.

MR. CARROLL: In the interest of catching up in terms of our slipped schedule, I'm not going to say anything other than this is an update on the ongoing saga of the sump strainer. I'll turn it over to the staff.

MR. WILKINS: This is an area which is for information only?

MR. MICHELSON: It does have a relationship to ABWR and the system 80 plus, close relationship.

MR. CARROLL: But we're not probably going to write a letter on it.

MR. WILKINS: Except in connection with the other letters. Please proceed.

[Slide.]

MR. LOBEL: Good morning. My name is Richard

Lobel.

COURT REPORTER: You can put that on your tie if you prefer. Is that a clip? That's all right then, I'm sorry.

MR. VIRGILIO: While he's getting clipped up, let me say a few opening remarks. My name is Marty Virgilio. I'm the acting director, Division of Systems Safety and Analysis, and with me today I have Rich Barrett, who is the branch chief in our containment and severe accident branch and Richard Lobel, who will be giving the bulk of the presentation, is a section chief in that containment and severe accident branch. I also have with me Alex Serkiz from the Office of Research, who will help us in responding to some of your questions. Today, as you introduced us, we're going to be talking about strainers used in the ECCS system, and in particular, we're going to be talking about a bulletin we've just recently issued, Bulletin 9302, Supplement number one, which focused on the loss of net positive suction head aue to insulation and other debris being transported through the containment down into the suppression pool. This is a repeat visit on this subject. In January, 1993, we provided you a briefing on the staff response to the Barsebek event. In July, 1993, we provided you a briefing on domestic experience, specifically conditions that were found at Grand Gulf and an event that occurred at Perry that precipitated our issuance of bulletin 9302.

In that bulletin, we asked industry to identify and remove unprotected fibrous material from the containment. We also told you a little bit about our action plans as to where we were going in the future on this issue. Today, we're going to talk about the results of engineering analysis that we have done, specifically research in support of us, and an assessment of foreign test results and plant modifications made overseas that we learned about at an OECD workshop that we participated in.

We're going to talk specifically about Supplement one to Bulletin 9203 which we view as an interim action while we proceed to develop our final resolution on the safety issue. In summary, Rich Barrett will talk a little bit more about the current status and our plans for the future. With that introduction, and now that Rich has got his microphone all set, Rich Lobel.

[Slide.]

MR. LOBEL: Well, good morning again, Rich Lobel. I'm with the containment systems and severe accident branch in NRR. The introduction has been given.

[Slide.]

MR. LOBEL: Let me just go over briefly what I'm prepared to talk about and then we can answer questions.

I'd like to talk about what lead up to this supplement to the bulletin. We've already briefed you before on the bulletin itself, and then go through the bulletin and tell you what it is that the NRC has requested from BWR licensees.

[Slide.]

MR. LOBEL: The issue, just to give us a common starting point, is a potential common cause failure of the ACCS, the containment spray, and containment atmosphere cleanup systems due to a blockage of debris screens that's caused by dislodged thermal insulation and the new ingredient in this, other particulate debris. I'll be talking about that more.

[Slide.]

MR. LOBEL: As part of the introduction, too, let me just give you a common point of what it is that we're talking about. This is a simple diagram of a MARK 1 BWR. The drywell reactor vessel, the vent going to the suppression pool. The ECCS takes suction from headers towards the bottom of the suppression pool, and the strainers that we're talking about are before the pipes to the ECCS pumps and the suction lines.

[Slide.]

MR. LOBEL: The strainer itself, this is a typical type of strainer, if you ignore the exact dimensions. It's basically a truncated cone with holes that serves to keep the larger pieces of debris and particulates from getting into the suction of the ECCS.

MR. MICHELSON: Have all the flat plates been replaced with this type?

MR. LOBEL: I'm sorry?

MR. MICHELSON: Have all the flat plate strainers been replaced with the cone strainers?

MR. LOBEL: There are still a few of that kind around.

MR. MICHELSON: But the flat plate has many fewer holes because it just flattens across the opening?

MR. LOBEL: Yes.

[Slide.]

MR. LOBEL: In 1985, USIA-43 was resolved by issuance of a generic letter, revision to a reg guide, and a NUREG discussing the technical basis. The generic letter talked about is plant specific analyses being necessary and gave general guidance but not details and formulas for how to do these analyses to address the issue of blockage of the strainers and screens and PWR sumps.

In the generic letter, the need for a 50/59 analysis was emphasized. Using the methods that were talked about in the NUREG and the Reg Guide, most BWR strainers would have been undersized, but a decision was made at that time not to backfit. That was based on the fact that most BWRs were using reflective metallic insulation, and the staff felt that the transport assumptions, the transport of the debris from the point where it was dislodged on the piping as a result of the loca, down to the suppression pool, was very conservative. Also, the emphasis at that time was put mostly on the design of PWR sumps.

[Slide.]

MR. LOBEL: On July of 1992, an event occurred at a Swedish reactor, Barsebek, where a stuck open safety valve dislodged insulation. The insulation was transported to their suppression pool, and several containment pumps were blocked. The significance of that was that the clogging occurred in a time that was faster than had been anticipated. They received the first indication to blockage and about 70 minutes after the start of the event, and indications of loss of NPSH to the containment spray pumps about 40 minutes after that.

Also in 1993, an event at Perry resulted in loss of an RHR pump due to debris. I'm going through this kind of fast because this has been briefed to you before. I just want to point out that the significant part of this was that the loss of RHR pump and PSH was attributed to a filtering of corrosion products by fibrous material from insulation that had inadvertently dropped into the suppression pool.

This phenomenon of the fibrous material filtering other particulates hadn't been recognized before. So, this was a significant event from that point of view.

MR. CATTON: I think Rick recognized that at Barsebek, didn't they?

MR. LOBEL: It's my understanding they didn't recognize the filtering of non-fibrous material by the fibers. At Barsebek, it was the insulation itself that caused the blockage.

MR. MICHELSON: Does Barsebek have a carbon steel suppression pool retainer?

MR. LOBEL: I'm not sure.

MR. CATTON: It didn't filter corrosion products, but they did recognize that there was a synergistic effect, that the fibrous materials on the strainer filtered other kinds of things and lead to a more rapid plugging. This was in the paper they gave last summer. Only to keep history correct.

[Slide.]

MR. LOBEL: This is just a simple cartoon of the idea of the filtering by the fibrous material, the fact that the fibrous material is catching and holding other types of particles.

Following Barsebek, and I think this is where we get into new material, following Barsebek, the staff performed calculations. We obtained data from our resident inspectors on each PWR in the country, and did calculations to determine whether there was adequate NPSH. These calculations were very approximate. We assumed thicknesses of insulation. We assumed layout, details of the layout of the piping, but the results of the calculation showed basically that for all the PWRs in this country making the assumptions that we made, there was inadequate NPSH, the ECCS pumps.

MR. MICHELSON: Did these calculations reflect the extensive changing now of the metal metallic insulation to various fibrous insulations?

MR. LOBEL: They assume the fibrous insulation.

MR. MICHELSON: No metallic?

MR. LOBEL: Well, the calculations weren't detailed enough that really was a factor, that fact that some was one and some was the other.

MR. MICHELSON: They have been -- there have been a number of requests to take the metallic off and replace it because it's not so good.

MR. LOBEL: The calculations were based on the actual insulation that was in the plant.

MR. MICHELSON: But was it one where they had replaced the metallic already or not?

MR. BARRETT: It was the current status of the plant.

MR. MICHELSON: No, I realize that, but was it the current status with the metallic replaced with the carbon or manganese oxide, whatever they're using?

MR. BARRETT: In all but a minority of the plants, the current status is that there's fibrous insulation on most of the piping.

MR. MICHELSON: There's always been. That's not just current. There's always been that. The staff didn't recognize it was always there, but it's there in great quantities now in some plants because they took the metallic insulation off.

MR. BARRETT: That's correct.

MR. MICHELSON: Which is one of your earlier slide arguments. It's mostly metallic to begin with. Well, it's not true. At some plants, there's not much metallic left.

MR. LOBEL: These conclusions also agreed with some calculations that were done by the Swiss in a report that we obtained for a reactor named Leibstadt. These rough analyses prompted NRR to request the office of research to perform a more detailed calculation. It wouldn't be necessary to make these types of rough approximations. The goal of the research study was to estimate the loss of NPSH margin due to strainer blockage, given a loca for a specific plant so that we would be able to use the exact dimensions of insulation and piping and layout. The properties of the pumps, all the details of a specific plant would be modeled specifically.

The preliminary findings of this study are that the conditional probability of the loss of NPSH due to blockage is in the order off 60 percent, conditional probability given a loca and assumptions of the transport of the material dislodged by the discharge from the break.

Going to the suppression pool, the conditional probability or loss of NPSH was 60 percent. This is over a range of pipe break sizes. For a large break, the probability is higher. There's a higher probability of loss of NPSH due to blockage. These calculations are preliminary. The office of research is still finishing the work. The bulk of the work has been done. Part of the modeling that hasn't been done yet is this, work with other particulates, material other than the thermal insulation. Corrosion products, paint particles, concrete finds, other materials that might be in the containment.

MR. CATTON: At Barsebek there was two kinds of insulation. One was a powder or something. That was the source of the particles that cause this synergist to defect. In the U.S., what is the case? Do they have two kinds of insulations in the drywall?

MR. LOBEL: I don't know that there's much in that.

MR. BARRETT: Let me respond to that. I'm Rich Barrett with the --

MR. CATTON: You're going to do a presentation, aren't you, Al? Maybe we could wait until you get up here.

MR. LOBEL: No, not today.

MR. SERKIZ: My name is Al Serkiz, office of research, and I can answer questions and I have a flew slides, but I was here principally to answer questions that perhaps did not intend to.

MR. MICHELSON: So, I guess you've got a question.

MR. SERKIZ: I can tell you what I know about it. In the Swedish plants, in Barsebek specifically, the piping had insulation of what is known as a rock wall or mineral wall, which was the fibrous material that got into the pool during the event. The reactor vessel itself is insulated with a calcium cilicate calusil, which is more of a particulate type of insulation.

The survey that we did using our own resident inspectors did not identify any plants in this country that are using calusil still in large amounts. That's the results of our survey.

MR. MICHELSON: But there are a lot of others. that's just a trade name for that material. That material is used in a lot of other trade names. Did you just ask them for the trade name, or did you ask him to give you the composition of the kind of materials you're worried about.

MR. SERKIZ: We just asked him what type of materials that are in use, and we did not identify any of this type of silicate.

MR. MICHELSON: What did you identify?

MR. SERKIZ: We identified that by and large, the piping has fiberglass type of insulation, low density fiberglass, and that the survey seemed to indicate that by and large, the vessels have metallic reflective insulation.

MR. MICHELSON: All right. Now, for the representative plan, what is the percent of metallic insulation? The one you're modeling here? Do you have the numbers?

MR. SERKIZ: I do not have the exact percentages, but the predominance on the piping of question, the recirculation piping, the steam lines, risers, et cetera, is Nukon or fiberglass type of insulation.

MR. MICHELSON: You're going to give me some information on this particular plant that you're doing a detail study on. On that particular plant, don't you know the fraction of this and that or the percentage or something?

MR. SERKIZ: Carl, I don't have the exact percentage, but it's less than 20 percent. The predominance of --

MR. MICHELSON: Less than 20 is what, in metallic?

MR. SERKIZ: Less than 20 would be other than Nukon. They were fiberglass. Other than on the reactor vessel per se, and we have those details. I'm just not prepared --

MR. MICHELSON: The reactor vessel is usually a non-problem because you don't postulate the rupture of the vessel and the blowing out of the insulation.

MR. SERKIZ: However, if the vessel should be targeted in the dry well, it could give you supplemental debris.

MR. MICHELSON: Oh, yeah, the real problem is out on the piping.

MR. SERKIZ: Okay, and we analyzed the piping, and I'll be prepared to answer more questions. I'll add one more item to what Rich has responded. The only mineral well insulation that was in the Barsebek reactor had been there a long time, and they termed it temperature aged or aged. At least the words that have been passed on to us in the workshop and through some of the papers, is that material is very fragile and has virtually none or very low structural capability and does fall apart and form a lot of fines. In their speculation, that is one of the materials that got filtered in quickly.

MR. MICHELSON: On fiberglass, is there any reason to believe there's any aging effect at a high temperature?

MR. SERKIZ: There is an aging effect, and the insulation vendors that have participated in public meetings have discussed it in various terms, but they've not quantified it as a function of time. It does lose some of the structural capability. If I listen to two different insulation vendors, one says their product does not lose that much. The other one talks about it.

MR. MICHELSON: Aren't you pushing the upper limits of fiberglass at 550, 600 Fahrenheit?

MR. CATTON: It depends on the resins that they use.

MR. MICHELSON: I think, though, that you're pushing fiberglass in any case.

MR. SERKIZ: Carl, I can't answer your question. You're getting down to the microscopic level. The vendors that are selling this, okay, are claiming that they can operate it for extended periods of time at this temperature.

MR. MICHELSON: Oh, they can, yes. That doesn't mean -- I'm just trying to understand when I see your answer, understand what the problem is that's creating the source term for this stuff.

MR. SERKIZ: It starts out with the loca, and it starts out with the debris that gets down in there and the filtering.

MR. MICHELSON: The source term I'm interested in is the source of debris that you could potentially have and how much and where it's coming from.

MR. SERKIZ: There are other materials such as the calcium cilicates which do exist in smaller amounts, and getting back to the question of the point you made. When we did the survey, we had the OMB constraint. Eight or 9 plants or less, and Indeed Rich did represent it correctly. We did do a survey on BWRs, and back then, the BWR's were insulating with reflective mettalic. The industry has made change-outs.

MR. MICHELSON: And you looked at the ventilation system as a source of this fibrous material because they get blown apart when the pipe breaks.

MR. SERKIZ: Well, we did, to perhaps a lesser degree than we think we should today, and I remember you and other members at this table, and we had long discussions on fibers.

MR. MICHELSON: Now, this is not new, that's for sure.

MR. SERKIZ: It is not a new subject, that's correct.

MR. MICHELSON: Okay.

MR. CARROLL: Tell me about OMB constraint. What did you mean by that?

MR. SERKIZ: Well, when you asked for to go out on a survey, okay, you can go out and serve a limited number of plants, and it's either 8 or 9. My old memory is getting befuddled. If you keep it down at that level, you do not need special permission and et cetera, et cetera, okay?

MR. MICHELSON: Okay.

MR. SERKIZ: So, at the time we were resolving this issue, at the time Mr. Stello was heading up CRGR, Et Cetera, we needed the information to fit into our schedule and we worked within that number of plants for a survey.

MR. MICHELSON: And that still exists today, does it?

MR. SERKIZ: It's my understanding, it does.

MR. CATTON: But the information may have changed by now.

MR. SERKIZ: Yes, and this is what Mr. Barrett referred to when they did their quick survey going through the residence and so on, responses they got and in some cases were trade numbers and in some cases they were specific.

MR. LOBEL: The last bullet to study is expected to be done this June.

[Slide.]

MR. LOBEL: Since everybody here seems to be so knowledgeable about this, I don't know whether it's necessary to go through this, but this is a figure from the research report that I just wanted to put up to give people an idea of the complexity of the piping and the arrangement inside the containment and the tortuous path that the insulation would have to follow after being dislodged. The research study was done by looking at a possible break of every weld in the containment, over 400 welds, and following, tracking the amount of debris that would have been dislodged by each one of these breaks and making assumptions of the transport of the insulation to the suppression pool, and then doing an NPSH calculation based on that amount of debris, the total conditional probability was then obtained from the sum of all those breaks.

[Slide.]

MR. LOBEL: The other piece that lead up to the issuance of a supplement of the bulletin was the meeting that was held in Sweden this January, a workshop on the Barsebek incident held by the Swedish regulator. The results of this, we had people attend the BWR owners group had people attend, and the results of this, the many discussions of experiments and analyses that were presented reinforced the staff view that the existing guidance may be non-conservative, and that some action should be taken in the interim. Also listed on this viewgraph at the bottom is the fact that there is an international working group planned. There's a meeting later this month, that we will be attending with the goal of obtaining, analyzing and obtaining, sharing what data is available, analyzing the data, reaching conclusions from what is available now.

MR. CATTON: Is anybody going to take a look at the aging characteristics? The Swedes felt that that was a big problem because the fibrous materials aged to rapidly. Now, that my have just been them trying to explain away why they got into difficult, I don't know.

MR. SERKIZ: The answer is yes, and some of that information is included in the experimental data. There are approximately two dozen reports, the majority of which are in Swedish. We've translated three. A fourth one should be coming out of our translation group that's doing it for us. The Swedish authorities have indicated they will assist us in getting the translations done more rapidly. So, some of these things, Ivan, will come out because of the types of materials that they test it under different circumstances. The aging of certain materials such as mineral will definitely be within that grouping of considerations.

MR. CATTON: Okay, thank you. The combination of the study that was done by the office of research. It was done by a contractor, SEA, and the January meeting resulted in the decision to issue the bulletin as an urgent bulletin, as a compliant bulletin, and as an interim measure, until final resolution of the issue.

Just reiterating, there were really three new things that lead to the decision to -- that some more action was necessary. The three areas are debris, transport, head loss, and the filtration phenomenon. The debris transport, like I've said earlier, the Barsebek event showed that the debris, the thermal isolation got to the suppression pool faster than was anticipated. Clogging occurred faster than was anticipated. Of course, that depends on the plant geometry and the break location, and Barsebek is different in several aspects from plants in this country. It showed that perhaps NUREG 897, Revision 1, isn't as conservative as we had assumed. The area of the head loss, experiments down after the Barsebek event, showed that the head loss could be in the range from two to 10 times higher than the NUREG 897 valves for correlations that were used and specified in the reg guide.

[Slide.]

MR. LOBEL: The filtering phenomenon that was recognized after Balsebek, after Perry, showed that the head loss was no longer limited to the effect of insulation alone, and at this time, we don't have any quantitative information on how this other material would increase the pressure drop.

Given the fact that at this time we don't have that kind of information, it was felt that we couldn't bring this issue to a final resolution but that some kind of action was called for, and that lead to the bulletin.

MR. MICHELSON: Is there any attempt to have at least one plant look to see what's laying in the bottom of the suppression pool in terms of corrosion product depths and so forth?

MR. BARRETT: Well, we have had indication from a number of plants that there are less than pristine conditions in the suppression pool.

MR. MICHELSON: I think you could say that.

MR. BARRETT: We're trying to avoid the strategy of going out one plant at a time to try to deal with this cleaning issue. What we want to do is concentrate on our efforts on resolving this in a generic fashion. I think it's clear that one of the key points of the resolution of this issue will be some standards on the cleanliness not only of the pool, but of the dry well since any debris that's in the dry well at the time of a local will be steam cleaned and brought into the pool.

MR. MICHELSON: Now, all the containments have been coded by now, I assume, and the suppression pool. Is that a true statement?

MS. MATZIE: I don't know that to be true. I don't know.

MR. MICHELSON: Most of them have been doing it but I don't know if all have, and of course, now the question gets back to again, what happens to the epoxy coating during a local and all of the blowdown on the codings. Is that going to strip the coatings off? You know, those tests where all done under pristine conditions, too, ideal conditions clearly. After aging of the epoxy and so forth, are those coatings going to rip off, and is that a new contributor to debris in the suppression pool.

MR. BARRETT: One of the issues we want to deal with between now and the fall, and I mention the fall because the fall of this year is when we really want to bring this issue to a head. We want to get a better feel for what are the types of non-fibrous debris we have to deal with, and qualified coatings, unqualified coatings, dust and dirt, you mentioned corrosion products, any kind of concrete finds. We really want to get a handle on what are the characteristics of all of these --

MR. MICHELSON: Those coatings were never qualified for long term degradation due to undermining of the coating by pin holes and whatever and the subsequent coating underneath, and now the stuff comes off in sheets. That wasn't part of the qualification test. They just proved that a new construction would not strip.

MR. CARROLL: Are we approaching this problem correctly? Why are we trying to filter all of this fine stuff out. I know the pump design has a problem because it uses process water, but wouldn't it be simpler just to provide clean water to the pump seals instead of --

MR. MICHELSON: I don't think it's the pump seals alone you're trying to protect here, although that's going to be an issue we'll discuss I'm sure, in a little while. The nozzle sizes and spray nozzle sizes inside of a reactor vessel and so forth become part of the consideration. ECCS has passed back into it.

MR. CARROLL: I want something that will take big chunks out, but you know, we're now fighting --

MR. MICHELSON: Well, I think your basic objective is to make sure you can continue to pump water without plugging the strainers. Now you might argue well, maybe we've got too fine a mesh. That's part of what you have to consider then in terms of that's how they originally were sized, by the throat of those nozzles which at one time was very small. I don't know what they are now.

MR. CARROLL: Spray nozzles?

MR. MICHELSON: Yeah, they were very small throats, and I think the maximum plugging particle is around an eighth or quarter of an inch, something like that. So, we had to go to finer strainers to make sure you didn't plug those nozzles. These other things came up later. It wasn't in there originally to protect the pumps. It was to protect the liability of the nozzle.

MR. CARROLL: When I hear people talking about pristine dry wells and pristine compression chambers, I start worrying.

MR. MICHELSON: One of the things they need to do when they rethink is go back and recognize that boilers perhaps no longer need those spray patterns that were once considered to be sacred. If you got a piece of the material clogged in the nozzle, it lost its spray pattern, and the few assemblies didn't get sprayed right. It was that serious at one time. I think that's all gone away with some of the new thinking and calculation. So, they should be rethought, too. In other words, what is the particle size you're worried about if you weren't worried about the pumps themselves?

MR. CARROLL: And that could be fixed.

MR. MICHELSON: Well, your least shouldn't strain finer than that, and maybe -- there are other ways of fixing the pumps, when we get to those.

MR. LINDBLAD: Are you finished, Mr. Lobel?

MR. LOBEL: I was going to go through what we were going to ask for in the bulletin.

MR. LINDBLAD: I have a question that is similar to what Mr. Michelson and Mr. Carroll have been asking, and it arose out of a consideration of another project yesterday in subcommittee. The question is, does the staff require licensees and applicants to assess the amount of core plugging from debris being injected into the reactor vessel and accumulated in fuel assembly debris traps during the safety injection.

MR. BARRETT: I just wanted to point out that the way in which that is currently handled for all the operating plants is that in Reg. Guide 182, even the original version of it, the strainers were required to be designed as Mr. Michelson said, with hole sizes that were smaller than the smallest aperture in the system, and that includes the pump apertures, the spray nozzle apertures, any other apertures including the core. So that was the design philosophy.

MR. CARROLL: Combustion, of course, is now starting to worry about debris getting into fuel assembles, and threading wear, and all that good stuff. In their latest fuel designs, they told us about debris strainers in the bottom of the fuel assemblies, and that is what Bill's question is about.

MR. LINDBLAD: Yes, and they haven't been asked whether they have a risk of accumulating too much debris during the safety injection.

MR. LOBEL: To my knowledge, we haven't asked. My knowledge goes back a few years.

MR. LINDBLAD: It is also my recollection that debris trap assemblies came after Reg. Guide 1982.

MR. LOBEL: Yes, much after.

MR. LINDBLAD: So 182 really was looking at spray nozzles.

MR. LOBEL: It wasn't looking at what you are addressing now. I don't know, you had a presentation on it yesterday, maybe I ought to let it go, but my understanding, and I did some work on this a while ago is, a long while ago, is that in a PWR with an open lattice, it is not that significant an issue.

MR. CARROLL: Yes, that was their argument.

MR. LOBEL: That there is enough flow to -- you will even get reverse flow if you had that much of a blockage, so that it is not that much of a concern. In BWRs, there are very old analyses that show that the blockage has to be very, very severe before you really start to have an impact on the fuel inside the subchannel, inside of the channel, fuel channel.

MR. MICHELSON: It is subsequent to an accident, and we are talking about quite a bit of time. By then, the power densities are extremely low in the field, and we have to get water to them, but not a lot. Total blockage, of course, would be unacceptable.

MR. LINDBLAD: I am not familiar with the debris traps.

MR. BARRETT: I am not familiar with the size of the holes in these debris traps, but a typical strainer hole size is about a tenth of an inch or less.

MR. LOBEL: Most of the debris I think that they are trying to protect from in the fuel assemblies is much harder material, metallic shavings, and that kind of thing, that come from construction work that was done in-vessel, or material that just wasn't cleaned cut adequately. This material wouldn't be as hard or as sharp as that, although there may be a problem with the particulates that we are talking about now, if we are talking about corrosion products. I think that is more blocking at the stainer rather than a concern in the core itself.

Does that answer your question?

MR. LINDBLAD: Thank you.

[Slide.]

MR. LOBEL: The bulletin is a compliance bulletin, meaning that we didn't attempt to show that there was a substantial increase in overall protection. The issue, as we see it, is an issue of being assured that a design basis system can perform its design basis function. The bulletin was sent out for several reasons. One was just to inform everybody, to make sure that everybody in the industry was aware of this problem, and that they at least knew of the sources, the main sources that we knew about, that the information was available to all licensees.

It was sent to PWR licensees for information. It was sent to BWR licensees requesting actions, and the actions that we requested were to apprise the operators of the vulnerability of the suppression pool, to the strainer clogging, through training and briefings, through training, to ensure that the symptom-based procedures covered this potential.

The procedures do cover loss of ECCS, the existing procedures. The concern really, at least in my view, let me say, is that when an operator sees a decrease in level, sees that he is having a problem, he is going to be trying to figure out, as well as trying to make sure there are other sources of water, he is going to be trying to figure out what the problem is.

One purpose of this bulletin is to make sure that when the operator is thinking through possible problems that are affecting his ability to maintain level flow path problems, instrumentation problems, that this is also something that he has on his mind.

MR. CATTON: U.S. reactors, can they backflush the strainer?

MR. LOBEL: We haven't done a survey of that yet.

There may be some others that can. The Perry plant has, as part of the resolution of the issue at their plant, put in the ability to backflush through a series of valve manipulations, and I believe that is only for one pump or one set of pumps, it is not for all ECCS pumps.

MR. MICHELSON: It is post-accident backflush?

MR. LOBEL: Right.

MR. MICHELSON: I was asking, is it post-accident backflush?

MR. LOBEL: Yes.

MR. MICHELSON: That is the only one that will help you any.

MR. CATTON: The Swedes have the capability.

MR. CARROLL: I don't know how effective it is going to be, though.

MR. CATTON: Well, apparently it was effective.

MR. CARROLL: You knock it off and it comes right back.

MR. LOBEL: Well, the conjecture is that it may and it may not. That if the material accumulates on the screens and gets thick enough that when it is knocked off that it will be heavy enough that it will drop.

MR. MICHELSON: It depends on what the blowdown is doing at that time.

MR. LOBEL: Right.

MR. CATTON: If you backflush with a little too much vigor --

MR. MICHELSON: Or if you are blowing down heavily yet through the chamber, it is going to stir it all up and subdivide it again and send it back to the inlet.

MR. SERKIZ: The Swedes have done at least two things. One is, they very significantly increased the size of their debris strainers. I am going to say roughly speaking by a factor of ten over the old ones. As a result, I am going to the term, they count on some of these strainers now being sacrificial. In other words, they will accumulate the debris. In conjunction with that, they have developed a backflush system that works in conjunction with an excess amount of debris strainers that they can actually be accomplishing backflushing through portion of it while the other strainers are in it. So it is a complicated system, but it is designed to operate in a dual mode.

MR. MICHELSON: I am not acquainted with what kind of strainers they have for the blowdown, because if the blowdown comes first or comes early --

MR. SERKIZ: They are down in the suppression pool, Carl.

MR. MICHELSON: Yes, but how do they protect them from the blowdown?

MR. SERKIZ: The only thing I am suggesting in response to that question, since they are normally submerged in the pool itself, they have designed them structurally so that the blowdown forces that are driven down into the suppression pool have been accounted for in the structural supports.

MR. MICHELSON: Hopefully the factor of ten increase still gave them a protective design.

MR. SERKIZ: It is a very innovative design, and there are some reports that I can share with you.

MR. MICHELSON: The early calculations showed that it was very difficult to protect the strainers, and that is why the early design was a flat plate right against the containment wall, and there was nearly a half-inch thick plate to take most of the blowdown loads.

MR. SERKIZ: That's right.

MR. MICHELSON: Now we are talking about big cones and stuff.

MR. SERKIZ: The Swedes are not talking big cones. They have a spider-like system that has the strainers vertical, and they have had to increase the structural supports to accommodate that.

MR. LOBEL: Finally, there were some specific recommendations that were made, reduced pump flow where possible. Remember, we are talking recirculation, so this is a little later on in the event. We are not talking the initial response, so it may be possible to reduce pump flow. Realignment of systems, if possible, for backflushing. Intermittent operation of the sprays, the sprays contribute greatly to the washdown of material into the suppression pool. Consider alternate water sources other than the suppression pool, and other measures.

MR. MICHELSON: Pipe break may be all you need to wash the debris continuously down there until you finally get to the point where you are not blowing out much out of the break anymore.

MR. CATTON: If you have any crud in the water, the intermittent operation of the sprays, they ensure they plug.

MR. LOBEL: I believe that one of the things they found at Barsebeck was that a lot of the material was washed down by the sprays later, not in the initial blowdown.

[Slide.]

MR. LOBEL: This is my last slide. We have asked for responses -- we have asked for completion of the actions within 90 days, and that BWR licensees inform us in writing 30 days after completion that they have taken the actions. They are to provide us a written response within 60 days of issuance of the bulletin, and that was on February 18th, within 60 days that they intend to implement the interim actions, or that they don't, or that they have other proposals. We expect responses pretty soon. We haven't gotten any as yet that will tell us whether BWR licensees intend to implement the recommendations.

The reason for addressing this to just BWRs first is that the PWRs got more attention during the resolution of A-43. They have some screens with large areas and low approach velocities, and we are taking this one problem at a time.

That is all I have.

MR. MICHELSON: Most of the PWRs, but not all, do not have bearing or seal cooling coming from the process fluid that is being pumped because most of them are Westinghouse. B&W, however, does designs that I am aware of, at least did take processed fluid, so those RHR pumps, for instance, had a problem.

Now when are we going to address the seal and bearing cooling on the pumps? I find it kind of absent in the discussions, but certainly that is one of the plugging potentials, if you plug the seals or the bearings, you are in deep trouble because the pumps will loose their cooling, and they won't pump. It is probably the smallest constriction you have in the entire plant.

MR. BARRETT: Let me just talk about that, and then I would like to give just a quick overview of where we go from here. We have looked at the question of whether there is a real problem for the pumps in the BWRs, and there was some work that was done in the resolution of USIA-43 that looked at what types of concentrations of debris, specifically fibrous debris would constitute a challenge to these pumps, and comparing that with the concentrations that we would expect to see in the pool, especially in the water after it has been, unfortunately, very effectively filtered out by these strainers would be much, much lower than the levels that we would expect to be a problem, specifically for the fibrous material. That was our earlier conclusion.

MR. MICHELSON: When we did this base at the A-43 stage, I don't believe you ever really did the calculations on the recirculation of the water. See, it is a continuous filter, you keep sending in the processed fluid through the seal, and it filters out the fibers and collect.

In time, I think you will find that you do, indeed, can plug them, if you look at the configurations that that water flows through within the seal, it leaves very little doubt. Now it is just a question of how long it takes for it to happen, even in very small concentrations it will happen.

MR. BARRETT: Let me just continue. It turns out that having looked at this now again, and now that we are considering what are, at this point, unknown amounts of particulate, that would exacerbate the problem. So, at this point, we would have to guess that the particulates of unknown quantities from unknown sources, at this point, would probably constitute a bigger threat.

So, from our perspective, the priority from this perspective would be to try to deal with the amounts of particulate that would be able to get through here, because, apparently, there are not only more of them, but they are more abrasive and would have a bigger effect on the pumps.

MR. MICHELSON: Now the threat you are trying to deal with is a loss of NPSH, not the plugging of the spray nozzles or anything like that, but simply the loss of NPSH

MR. BARRETT: As a global problem, yes.

MR. MICHELSON: Once you have that solved by an enormous filter, if that is what it takes, or screen rather, you still have holes in the screen through which fibrous materials come. Now what are you going to do with the material that comes through?

You solved the NPSH, you satisfy yourself that you have so much screen that you aren't going to get it all clogged up, but you are still going to draw the particulates through, unless you are going to put extremely fine mesh sizes on the screen. Now, what are you going to do with the particulates that come through? Now you worry about where would you be concerned that they are lodging?

MR. BARRETT: We are concerned about that problem, and that will be part of the resolution.

MR. MICHELSON: You know, we went through this all on the A-43, and Al is well acquainted with that. The right words got into 143. It says that this was going to be handled, and now I am just asking how it is being handled?

MR. BARRETT: At this point, we don't have specific plans to handle it. Let me just briefly discuss at least the time scale that we wanted to talk about for handling the overall issue, and then wrap up the presentation that way.

As you can see from what we have presented so far, our current assessment is that this issue is a safety significant issue, and that the risk associated with this is higher than we previously perceived, even at the time when we made our previous presentations to you.

We believe that the Bulletin 93-02 and the supplements to the bulletin represent interim actions, but we don't regard them as a final resolution, or even close to a final resolution. We believe, however, that a final resolution really will have to wait until we fully understand the filtering phenomenon because, at this time, we really don't have a quantitative feel for how large of a head loss problem we can expect from the synergistic effect of the fibrous and the nonfibrous debris deposited.

So our current efforts in the research program and in our work with the international community are concentrating on trying to get a resolution of that quantitative problem.

Now a lot of the information that we expect to get from the research program and from the international working group that has been set up under the OACD/CNRA structure, a lot of that information, we believe, will be available in the October 1994 timeframe.

In addition, we expect that we will have published our draft NUREG on the SEA study, and we will have had the benefit of feedback on that from the public, and from the industry, and we are hoping that any information that is available to the industry, to the owners group, will be available to us at that time.

So that is the timeframe in which we are targeting trying to come up with actions that will resolve this issue.

MR. MICHELSON: How are you handling the fact that we have two projects, two evolutionary plants, about to be gleaned to certification, the ABWR and the System 80-Plus, both of which, apparently, although CE hasn't yet given us the details on their pumps, I know the GE pumps have this problem, but I don't know yet for sure what the CE pumps look like. What are we going to do about these two that are sitting here about to have letters written on them?

MR. BARRETT: What we have tried to do on both of those reactors is to envelope the problem by placing an artificial requirement on them that the strainers be sized to three times the value of strainer area that would be calculated based on Reg. Guide 182 Rev. 1.

MR. MICHELSON: What does that do for the debris in the pumps themselves, and strainer and bearings if they are using that water for cooling bearings?

MR. BARRETT: With regard to what we have perceived to be the greater problem, which is the particulates, there are a couple of advantages of the newer plants over at least most of the older plants, and that is that the water bearing vessels in the containment, the IRWST and in the case of the CE-80-Plus, and the suppression pool in the case of the ABWR, are stainless steel. So the loadings from the combustion products would be ameliorated in that way.

But, in addition, there is a commitment from both applicants that is placed on the COL applicant for a high level of attention to the cleanliness of the suppression pool and the cleanliness of the drywell. So that is the way in which the particulate question is being addressed.

MR. MICHELSON: In other words, you think that by keeping the drywell structures clean that you won't blow any debris into the structure? What are you doing, in other words, from the source viewpoint up above in the drywell region, the fibrous insulations? Of course, they are going to use metallic on all of the big stuff, but I haven't heard their commitment on the little stuff.

MR. CARROLL: I notice, Carl, this is an issue at 1:30 when we talk about ABWR.

MR. MICHELSON: These are the people, though, and I was trying to see what their think was on it.

MR. WILKINS: I suspect, Carl, that we had better try to draw this meeting to a close.

MR. MICHELSON: Could we get one other observation, though. What are you going to do in the future in terms of looking at the pumps themselves to see whether or not they really are wonderful?

MR. BARRETT: At the moment, what we had planned to concentrate more -- we felt that the information we have available is sufficient to say that given the concentrations that we are going to have in the suppression pool, and especially the concentrations after the bulk of this material has been filtered out, that we really don't see it as a big threat to filter the fibrous material.

The way that we will try to deal with the nonfibrous material, I believe, is through some sort of a program to deal with trying to limit the amount of nonfibrous material that becomes available to the strainers.

MR. MICHELSON: In other words, your thinking is the same as when you wrote the Reg. Guide?

MR. BARRETT: That's correct.

MR. MICHELSON: It hasn't changed since then, or you haven't gotten any new information or new reason to believe that it is a nonproblem.

MR. BARRETT: That's correct.

MR. CARROLL: Let me turn it back to you, Mr. Chairman.

MR. WILKINS: Thank you very much, gentlemen, for your presentation. We are approximately 19 minutes behind schedule. I suggest we try to pick up some of that by taking a somewhat shorter lunch than we normally would. Why don't we get back here at 20 minutes to 2:00, at 1:40.

[Whereupon, at 12:40 p.m., the meeting recessed to reconvene at 1:40 p.m., the same day.]

AFTERNOON SESSION

[1:40 p.m.]

MR. WILKINS: Let's reconvene the meeting.

The next item on the agenda is a presentation from the representatives of General Electric Nuclear Energy dealing, I presume, with certain items related to the ABWR.

I understand that we rescheduled this to make it possible for you gentlemen to get back to the West Coast. I am very pleased to be able to cooperate with you to that extent.

MR. MICHELSON: I will save some time. I don't have any introductory remarks. It is GE's show, I believe.

MR POSLUSNY: Mr. Chairman, this is Chuck Poslusny of the staff.

What I had planned to do was briefly go through our positions on the two issues and then let GE follow up, and then open the floor to questions.

As a brief introduction, we were here last and indicated that we would try to facilitate the letter-writing process by providing markups of the FSER. We have done that with all 14 issues. All have been closed with the exception of the strainer issue, and we will get into that shortly.

We consider this last issue to be --

MR. MICHELSON: Excuse me. Are you going to tell us how you closed the QA issue?

MR. POSLUSNY: Yes, shortly. As a general introduction, we hope that the status of this last issue will not impact the completion of the letter, and that we feel the staff can resolve this over the next couple of weeks.

It need not be a hold up for the letter.

MR. MICHELSON: The only problem, I guess, is the committee not knowing how you resolve it and is in a little bit more difficult position to write a letter saying they have reviewed the open items and so forth.

MR. CARROLL: With the exception of one item, subject to staff resolution.

MR. MICHELSON: That's the way we will do it.

MR. WILSON: This is Jerry Wilson. Since the staff and GE will be giving their positions on it, if the committee has any views they could put those in the letter and we will address how that got resolved when we respond to the ACRS letter.

MR. WILKINS: Go ahead.

MR. POSLUSNY: Okay. So with that, we will start on the QA item.

[Slide.]

MR. GRAMM: My name is Bob Gramm, Quality Assurance Section Chief at NRR.

I am here today to discuss the open issue in Chapter 17 related to QA and design control provisions for the ABWR project.

I also have with me Rich McIntyre, who was team leader on that particular inspection and Joe Staudenmeier, another team member.

In September of '93 a seven-man review team from NRR went out to examine the implementation of the QA program on the part of GE.

The team examined the implementation of that program as evidenced through the analysis and computer codes associated with Chapter 6 and 15, Accident and Transient Analysis, examined selected design record files, particularly for the residual heat removal and reactor building cooling water systems, examined quality assurance audit reports.

The results of that particular inspection were issued in October of 1993 which led to the creation of an open item in Chapter 17.

The inspection found limited evidence of GE technical review of supporting calculations that were generated by the technical associates.

Just a word of explanation, it was a multi-party design process: General Electric, Hitachi and Toshiba. There were common engineering document at the system design level which were received by GE and received extensive multi-party review, and the inspection confirmed that.

This particular concern had to do with the supporting calculations, though, at a lower tier of design documentation. We did not see extensive evidence that GE was providing technical oversight of those particular products.

In concert with that the team examined the implementation of the audit program and found that GE's QA audits of the technical associates were programmatic in nature, and that contributed to the concern in this particular case.

We have since received two letters from General Electric in November and January of this year which outline their corrective and preventive measures.

These include, among other things, assuring that engineering services provided by Bechtel were in fact conducted under a quality assurance program; signed record files had been supplemented; signed calculations, in some cases, have since been verified; some transient analysis. There have been sensitivity studies performed where some questions were raised during the course of the inspection.

The staff accepted all of those corrective actions with the exception of this one issue on the technical oversight aspect. We had further meetings in March with GE where their positioning was clarified with respect to the fact that GE had had extensive involvement over more than a decade in the ABWR design process, and GE -- documentation to substantiate that was available in San Jose.

That led then to another follow up inspection in March of this year where a six-man team went out and reviewed that particular documentation, confirmed that there were GE analysis to confirm work done by the technical associates.

We again looked at the common engineering, common process, and resolution of GE comments, examined excerpts from the Japanese calculations that were made available to GE, looked at comparisons of the ABWR design versus the BWR 5 and 6.

The bottom line at the conclusion of that inspection, we felt that there was substantive evidence of GE's involvement over a multi-phased design process, and the staff has since closed out this particular item in Chapter 17.

Are there any questions?

MR. MICHELSON: I have one question. I recall reading somewhere and bringing to GE's attention during a subcommittee meeting that information developed by their associates was going to be available to GE only through some date. I don't recall the date now.

MR. EL-ZEFTAWY: October 2001.

MR. MICHELSON: Yes, October 2001. After which, it is not clear that the information is any longer available. It looked to me like there might be a number of fundamental items that would be in that information bank, and I was a little confused as to how we can through COLs later and so forth and not have access to such information.

Did you people look into that at all to draw a warm conclusion on it?

MR. WILSON: Jerry Wilson, NRR. As you know, an applicant who references a certified design is responsible for developing the details of that design, and if they were -- let's assume they were unable to establish an agreement with the foreign associates. They would have to develop that design information on their own in a manner that would conform with the certified design.

MR. MICHELSON: Have to redevelop it, I guess, if it were no longer available to them.

MR. WILSON: That is correct.

MR. MICHELSON: Is that somehow stated somewhere that that is your position?

MR. WILSON: Yes. In fact, as you know GE doesn't necessarily have to be the company that works with the applicant. So in theory, the applicant could contract with anyone as long as they establish that detailed design information in conformance with the certified design that is put in the rule, they could meet our requirements.

It would be much more difficult to convince the staff that they could do, but it could be done.

MR. MICHELSON: Even on items that you have reviewed presently and accepted and so forth, what happens later if somebody comes across and you ask them: you make sure you retain your design basis for your plant, and they can't reconstruct the design basis because they don't have that information. Do they have to redevelop it then to establish it?

MR. WILSON: We are going to have a level of information, both tier one and tier two, that is approved, that is, in effect, that design basis.

MR. MICHELSON: Well, there is a lot behind it that is not in the SSAR. But I guess you are saying that the SSAR will be the design basis, and that is as far back as they have to go?

MR. WILSON: Yes. Basically, all of that is in the DCD with a few exceptions, which we have discussed before.

MR. MICHELSON: SSAR, of course, does not contain design calculational -- it contains results oftentimes, but not design calculational methods or assumptions or a lot of other things that you might need.

MR. WILSON: That's correct.

MR. MICHELSON: I guess everybody understands how this works. I was just kind of surprised by the fact that I am going to develop all this design now, and when I go to use it later I have lost part of the design basis because it is no longer contractually available, or may not be contractually available.

MR. WILSON: I am not sure it is design basis. What may be lost is design detail.

MR. MICHELSON: Awfully important, though, when a question comes up.

MR. WILSON: Yes, it would be difficult.

MR. SAWYER: This is Craig Sawyer from GE. I just want to add a couple of parenthetical remarks. I know you are going through a what-if discussion here. We think it is highly theoretical. It is not a question of whether or not our technical agreement with our associates will be renewed in 2001, only a question of what the terms are going to be in terms of who does what to whom, and on what schedule.

So we have no expectation whatsoever of having that agreement dry up on us. That is the first point I want to make.

MR. MICHELSON: What I read though in the SSAR, you said you had no commitment.

MR. SAWYER: That is true. Legally speaking, that is true, but we have a 30-year track record of renewing this agreement every ten years.

MR. MICHELSON: Yes. I work on the assumption that that is a true statement, and said, well, what happens if you no longer had the information.

MR. SAWYER: Okay. The second point I wanted to make was that under the first of a kind engineering program, we are in fact developing our own version of that detailed information which probably would make the retrieving -- assuming that we are permitted to finish that program -- we will find, probably, our associates' information irrelevant at that point because we would be using stuff we developed on our own.

MR. MICHELSON: Assuming that the first of a kind would go on through because I have no way to know that.

MR. WILSON: Are there any further questions on this issue?

[No response.]

MR. POSLUSNY: Okay. We will continue now with the discussion of the strainer issue. Rich Barrett?

MR. MICHELSON: Do you have a handout for your presentation, Richard?

MR. BARRETT: No. My name is Richard Barrett. I am with the NRC staff.

I would like to briefly recount --

MR. EL-ZEFTAWY: I passed this one out if you want to read it. It is not a handout. It is just some background information.

MR. BARRETT: I would like to recount the sequence of events that has led us to this open issue at this time.

The original application for the ABWR committed to Reg. Guide 182, Revision 1, which is the Reg. Guide that was promulgated in 1985 as part of the resolution of USIA-43.

Meeting the Reg. Guide would put the ABWR way ahead of the operating plants with regard to strainer sizing. If you recall, the resolution of USIA-43 was a forward fit only.

Back in last year as a result of the assessments we were doing following up the Barseback event in Sweden and also the Perry event here in the United States, we began to question whether Reg. Guide 182 Rev. 1 was an adequate resolution.

Specifically, as Rich Lobel pointed out this morning, we had significant questions about the technical resolution, the technical details of the Reg. Guide specifically with regard to our previous views of the transportive debris generated in a LOCA, also the head loss associated with a given amount of debris on the strainers, and, finally, the phenomenon which is still, I believe, unresolved, and that is the question of how much head loss you got as a result of the filtering of non-fibrous particulates.

So we opened up a dialogue with General Electric at that time, this time last year. We were unable to really reach an agreement on how to resolve this issue. So that in December of 1993 when we published the draft final SFER for the ABWR, we documented a staff position regarding the sizing of the strainers.

The staff position was that all the ECCS strainers in the suppression pool should be sized to an area three times the area that would be calculated based on Reg. Guide 182, Rev. 1.

I don't want to go into the details of how we came up with the number three times. I think I've discussed this in the past with the ACRS, but we felt that it was a reasonable number given the uncertainties that were facing us then and that are still facing us now.

We did not ask for any -- at that time, nor at this time were we asking for any capability for backflush in the ABWR, nor did we place any specification on the types of insulation or amounts of insulation that could be used in the ABWR.

General Electric responded to this position of three times. Their basic response was that they would meet the three times criterion for the RHR pumps, the RHR strainers for all breaks except for the main steam line break and for the RCIC supply steam line break.

The rationale there was that in those breaks, because the breaks are so far above the top of the active fuel, it is possible -- and the impression I had was that it was preferred -- that after you have basically recovered from the initial blowdown there RHR would be realigned for RHR cooling directly to the core and therefore would not be taking suction from the suppression pool.

So the threat to the pool, to the strainers, would not be as important for that particular event.

MR. MICHELSON: Could you repeat that one more time? I don't understand the model for this recirculation -- the alignment of the RHR pumps.

MR. SAWYER: I will go into it again.

Basically, it's normal RHR shutdown cooling, suck from the vessel, return to the vessel.

MR. MICHELSON: All right. I didn't know you were going to go into that mode.

MR. BARRETT: The other exception, major exception was that the high pressure core flood and RCIC strainers they proposed not to size into the three times criteria primarily because the recirculation mode is really not part of the design basis for these pumps. These pumps are not needed to meet the design basis LOCAs in the recirculation mode.

The Staff in early March accepted that position and informed the ACRS of our acceptance of that position in a letter dated March 9. Subsequently in March, we were asked to take a second look at this issue, specifically to take a look at the risk associated with this issue, the PRA, the impact on the PRA.

We went back and took a second look at the risk associated with the issue and in the process of doing that we also took a closer look at two other aspects that are basically important to this issue and that is what really is the design basis, did we properly characterize it and, secondly, was there any impact that this might have on the emergency operating procedures. Perhaps beyond the design basis but nonetheless important to safety.

In the process, we also asked ourselves the question if we were to go back to our original position, would that have a major impact on the design and on the cost of the design.

About two weeks ago, we informed General Electric that we wanted to go back to our original position, that we felt that we had good reason from the point of view of the design basis and the emergency operating procedures that there was a marginal benefit in risks base to going back to our original position. Not only that, but it was our perception that there was a minimal cost associated with going back to this position. Our estimate of the cost was based on some information we had from operating reactor plants which had voluntarily gone back and backfit strainers based on the regulatory guide Rev 1 that was published in 1985 and the cost of even a backfit was relatively marginal.

So we informed General Electric of that position and we received General Electric's detailed response deposition yesterday afternoon. We are currently in the process of evaluating that response. At this time I would like to briefly summarize where that evaluation stands at this time.

MR. WILKINS: The response you are talking about is a letter dated April 5, 1994 from -- signed by Quirk addressed to the attention of Borchardt?

MR. BARRETT: That's correct.

Keep in mind as we evaluate this, we are looking at it from those three perspectives. We are asking ourselves what is the design basis for these pumps, what is the importance of these pumps to the emergency operating procedures, either within the design basis or beyond and what is the importance to risk.

First of all, with respect to the main steam line break, we have gone back and we have looked at the standard safety analysis report, our Reactor Systems Branch has done that, and they have gone back and looked at the emergency operating procedures. They have also gone back and looked at their experience with respect to the training of operators in current reactors.

And the conclusion that's been drawn is that it is not at all clear that in a main steam line break, the RHR system will be realigned in the near term, in the relatively near term, to shut down cooling. Our reading of the SSAR is that the design basis is for the RHR pumps to continue to pump from the suppression pool and with water going out the break or steam.

Secondly, that the EOPs are written in that direction. The EOPs do not instruct the operators to expeditiously change to the RHR mode of cooling.

MR. MICHELSON: Assume the break is at the steam -- near the steam nozzle on the vessel. What is the elevation difference between there and the recirc nozzle, how many feet?

MR. SAWYER: We don't have a recirc nozzle on this plant.

MR. MICHELSON: No, the suction point on the RHR.

MR. SAWYER: The suction point for the RHR is about five feet above the core. The main steam lines are about, if I remember, about three feet above normal water level, maybe it's slightly more than that.

The point is that the emergency procedures do tell the operator to try and restore normal water level and that is not possible for any break other than steam line break, of course, or appurtenances attached to the steam line.

MR. MICHELSON: You have to tell them to -- flow on the steam line, I guess is your problem.

MR. SAWYER: That's exactly right. The emergency procedures, once you've restored normal water level then you don't continue to pump water out the steam line break. You can't restore normal water level for other breaks and so you are going to continue to pump water out of the break in an attempt to try and restore normal water level, at least in the short term.

MR. MICHELSON: I will ask the question a little differently. Within what range must you be able to control level at that point in time so that you don't return water out the break? What have you got to play with?

MR. SAWYER: As I recall it's around -- well, the low side doesn't matter; the high side matters. As I remember, the steam line is about three feet above normal water level.

MR. MICHELSON: You don't have much to play with. The low side does matter if it gets too low, of course.

MR. SAWYER: The low side is what the operators are trying to stay away from.

MR. MICHELSON: Right.

MR. SAWYER: What you're asking is, what's the chances that he errs on the high side.

MR. MICHELSON: Yes, and therefore flows out the break. It's another delicate control problem for the operator.

MR. SAWYER: We are looking up the exact dimensions right now if you would just bear with us.

MR. MICHELSON: While they're looking it up, do you have anything else you would like to add?

MR. BARRETT: Our assessment, our preliminary assessment is that the operators are not going to be in a hurry to change from what is a safe and successful mode of operation to one that depends on their certain knowledge that this is indeed a steam line break as opposed to some other break.

MR. MICHELSON: Have you looked at the level indication? We agree, I think the Staff agreed to accept the present level indication mechanism. But have you looked at them from the viewpoint of controlling for this kind of situation, which is the indication you've got to use?

MR. BARRETT: We have not, no. But as I said, it is not our perception that that's -- our reading of the EOPs is not that this is something they are trying to do on a priority basis. It may well be several hours, it may well be the better part of a day or longer before the organization as a whole, including the tech support center and others, make this decision to make this switchover. And by that time, it could very well be that these strainers have plugged up and there's been damage to the pumps.

The pumps will operate upon a LOCA.

MR. MICHELSON: They will start up and suction from the suppression pool as a LOCA signal, I assume.

MR. BARRETT: To summarize for the main steam line break, where we're heading, having gotten General Electric's response based on both design basis and EOP considerations, we're heading in the direction of saying that we would like to go back to the three times criterion, including the main steam line break.

With regard to the high pressure core flooding pumps, we have pretty much come to the conclusion that the high pressure core flooding pumps, that General Electric is correct that this is not -- that recirculation from the pool is not part of the design basis per se. The only kind of argument that can be made regarding that primarily is that it might be important to some scenarios to have those pumps available for the EOPs.

The EOPs are not specific about this; they simply ask you to use whatever sources of injection might be available.

MR. MICHELSON: How about the RHR pumps, which is the ones we're talking about. As long as they were aligned back to the vessel, it wouldn't be a problem. If they were aligned to the suppression pool, it would be a problem.

MR. BARRETT: Our feeling is that there is enough uncertainty about their suction alignment, there is enough indication that they will indeed be aligned for suction from the suppression pool for long periods of time following a large LOCA.

MR. MICHELSON: They will have to be. That's the only way you cool the pool. Those are the only heat exchangers, to my knowledge.

MR. SAWYER: That's correct. That's the safety grade heat removal mechanism.

MR. MICHELSON: So the RHR pumps become important unless you somehow show that the debris is a nonproblem for them and there are various ways you might show that.

MR. BARRETT: We think that is exactly where we are going to come down, is that the RHR pumps have to be sized to three times the reg guide for all LOCAs including the steam line.

MR. MICHELSON: One other question that was raised again this morning but is certainly not new, and that is the seal or bearing cooling that might be acquired -- cooling water that might be acquired from the process fluid. Do these pumps have that arrangement and, if so, have you looked at it?

MR. BARRETT: We discussed that this morning in trying to respond to this letter. In speaking with our mechanical engineering people, the impression I have is that level of detail is not specified in the application at this point.

MR. MICHELSON: The question was asked of GE some time back but they can give us the answer today first hand. They're still tied up.

We did pursue it before with GE, but I would like to pursue it for the record now.

The question has come up which I think we have reviewed previously and that is, on the RHR pumps, do you use process water from the pump discharge to cool the bearings and the seals?

MR. SAWYER: That's correct.

MR. BEARD: Alan Beard, GE.

For the actual cooling of the pump seals, we are using external water supply and that is shown on the P&ID.

MR. MICHELSON: You are injecting clean water into the seals and bearings for the --

MR. BEARD: For the cooling of the seals we are using external water.

MR. MICHELSON: For the seal coolers, you use external water.

MR. BEARD: For the purge, it is likely that we will be using the same arrangement where we have the -- where you are taking water from the discharge of the pump and feeding it back to the seals.

MR. MICHELSON: That is the fluid that is actually being passed through the seals.

MR. BEARD: That would be the purge, correct.

MR. MICHELSON: And that's the one we worry about because that is the fluid that is perhaps laden with the particulates.

MR. CARROLL: Help me out on one point. These are not water-cooled bearings.

MR. MICHELSON: They may or may not be.

MR. BEARD: I am going to listen to what Dr. Wilkins said earlier and say, I don't know for certain.

MR. MICHELSON: Your older plants are but I don't know what you're proposing here.

MR. CARROLL: The bearing jacket is water cooled or the bearing is water cooled.

MR. MICHELSON: The bearing itself. Shoot it right through the bearing. On the old -- on the Browns Ferry version.

MR. CARROLL: All right. It's hard to believe why anybody would do that, but --

MR. MICHELSON: It is extremely effective cooling. You can't do better.

MR. SAWYER: That's a level of design detail that we haven't forced the design to at the SSAR level. We want to make it possible for different pump vendors to come up with whatever they think is the right thing to do to support their pumps.

MR. MICHELSON: You can build an internal circulating system. Unfortunately, though, it has some of the same questions in this case because you are circulating again, though, water from the eye of the impeller backwards through the bearings and it's laden again with the same particulates. You just have to look at what they're proposing.

Westinghouse built an entirely separate system out on the end for their bearings and seals and its clean water. It just recirculates within itself through a heat exchanger. That's another design you can get.

We asked this several meetings ago and I thought I got the impression you were going to use the cycling separator and the straight seal injection, bearing injection. But that's about as far as we got.

But if we do, that's a question for the Staff to deal with. But I think the Staff told us this morning we're just going to deal with NPSH. That's as far as they really dug in detail on.

Is that a correct characterization of what you said this morning?

MR. BARRETT: I think that probably is, yes. We made an assessment of the severity of that problem and we're satisfied with it.

MR. MICHELSON: So now GE and the Staff have agreed that the factor of three on the area will answer the question?

MR. BARRETT: Well, no, we don't have agreement at this point.

MR. MICHELSON: But that's the proposal at this point?

MR. BARRETT: That's where the Staff is right now having seen General Electric's response. General Electric's response is that they do not want to go with the three times the area of Reg Guide 1.82 specifically for the main steam line break.

MR. MICHELSON: Is there some reason technically why it would be preferable not to?

MR. POSLUSNY: Should we let them present their case?

MR. MICHELSON: Are you going to make a speech on it?

MR. SAWYER: I have a presentation to make, if you would like to --

MR. MICHELSON: I wasn't sure that was a part of the speech.

MR. WILKINS: I am just trying to move us along.

Somehow I had the impression this entire thing was going to be finished in half an hour. I don't know where I got that impression.

MR. CARROLL: We are now on minute 31.

MR. MICHELSON: From the agenda, yes.

MR. BARRETT: Let me just quickly summarize where I am.

MR. WILKINS: We do want to hear from the GE people too.

MR. BARRETT: With regard to high pressure core flooder, we feel that the design basis is not challenged by the position that General Electric has taken. We have a disagreement with them on the estimates of the level of risk. We haven't had a chance to discuss it with them. We will be doing that very quickly.

With regard to the RCIC strainers, our preliminary assessment is that it is probably acceptable to go with the GE position that the RCIC strainers can be sized to one time the reg guide instead of three times the reg guide.

So to summarize, we feel that with the main steam line break, we would like to stay with the position we have. With regard to the RCIC, I think we would be amendable to backing off on that position. And within the next day or so, we will know where we stand on high pressure core flooding.

MR. MICHELSON: If I understand your reply, you will not deal beyond the characteristics of the strainer. That was what you are not going to focus on, not questions of the pump and so forth?

MR. BARRETT: That's correct. This issue relates to the sizing of the strainer area.

MR. MICHELSON: Only. Okay.

I guess that finishes the Staff presentation and GE's turn.

[Slide.]

MR. SAWYER: I have a hand-out package which I hope all of you received. Basically what I going to go through very quickly here is the essence of what is contained in our written response so that I can explain how we arrived at that response.

Before I start, though, I thought I would like to at least one more time go through what the ABWR configuration is relative -- not so much relative to the other plants because it is more relevant as to the arguments about the importance of RCIC and HPCF in particular in today's discussion.

But it is here for your reference so when we start talking about what is the break and the most limiting single failure, it will give you an interim set. It is a reference that we can look at.

As a reminder, the ABWR has high pressure injection in three divisions, one of which is steam driven -- that is RCIC, the other two of which is HPCF. It has the RHR function which in ECCS mode is LPCF injection into the vessel in all three divisions which goes beyond what the capability is. The RHR in particular is only two divisional in any of the previous PWRs.

Furthermore, the approach velocities in the existing BWRs is much, much higher. Our RHRs are approximately 4,000 gpm pumps. In the previous BWRs, they are approaching 10,000 gpm, depending upon which BWR you are talking about.

I will skip the next issue because I think Rich succinctly stated the essence of the debate. I wasn't sure whether the NRC was going to have a chance to talk before we did, but I wanted to at least have a chart that carried you down, how we got there.

[Slide.]

MR. SAWYER: On ECCS success requirements, this is more or less deterministic, but also is used as the basis for our probabilistic risk assessments.

For the core cooling function, any single motor driven pump will meet Appendix K. However, in terms of developing success criteria for use particularly in the PRA, we did a whole bunch of extra work and established basically a hierarchy -- small breaks, medium breaks, and large breaks.

I think the issue here for strainer plugging is particularly the large breaks because those are the ones that are going to deposit the much greater volume of insulation material in a suppression pool for the strainers to have to deal with.

Small breaks are characterized in our risk assessments as those breaks which RCIC alone can mitigate. Therefore, of course, they are truly small, less than 5 square centimeters for liquid, or less than 280 square centimeters for steam.

If they are larger than that, that means if RCIC was the only thing you had, you would be losing level in the vessel and you would have to take some further action.

Medium breaks are characterized as between 5 square centimeters and 280 square centimeters of liquid. The basis for the bottom, you can see. The basis for the top is that above 280 square centimeters, you will get sufficient blow down through the break.

Below 280 square centimeters, you are going to lose level but not sufficiently. You are pressurized, so you are going to need additional help in depressurizing from the ADS function. So that is the reason for that break point, particularly when we do risk assessments, whether or not you need to ask yourself if ADS is going to be available. Large breaks, of course, are everything else.

To properly characterize this, and lets you know where things are, the steam line effective break area is about 980 square centimeters. Actually, in diameter, its effective area would be more like 4,000 square centimeters, but we have flow limiters in the nozzle of the vessel. So the effective break area is smaller.

So, in the letter, the numbers that you see in the footnote that talk about the break area for the feedwater and the steam line in particular, are not the actual area, but the effective area accounting for flow restrictions.

For the decay heater removal function within what we call the design basis which we defined as keeping the pool temperature less than 207 degrees in the long-term, that requires two of the three RHR systems to do that.

However, we did a bunch of analyses, both in support of the PRA and in support of the tech specs, which took credit for some testing that has been done in the middle '80s at the Caroso plant that showed that in reality from a condensation oscillation point of view from the quenchers, there is no real limit. In fact, the loads actually go down. The limit that was chosen at the time happened to be about the place where you get your peak loads.

So, within the PRA, we say it is okay as long as the containment stays less than containment design pressure. We did some analyses to support the tech specs that showed that with one RHR system only the pool temperature would peak out somewhere around 225 degrees, which would be very acceptable in realistic performance.

[Slide.]

MR. SAWYER: The staff broke their discussion up, as Rich said, into three areas. One was deterministic, one was probablistic, and one was the effect on EOPs.

With regard to the deterministic evaluation, I can see that we are going to close that one pretty rapidly because we have made the point that RCIC is a very important factor for transients, particularly station blackout where AC power isn't available, and for small breaks, as the deterministic analysis in the previous page showed.

It is virtually irrelevant for medium and large breaks. You end up having to having a blow-down. Once you blow -- it is a low capacity system anyway, but once you blow down, you no longer have a steam supply to run the turbines, so you are not going to have the pump available anyway.

In the PRAs, we never took credit for RCIC at all for medium or large breaks. Even though it is available for a short period of time, we just wrote it off. In the deterministic analysis we, of course, took credit for it if it was part of the single failure set in which RCIC was one of the remaining pumps. However, for medium and large breaks, it plays a very small role in retaining inventory.

The last thirg about RCIC is its primary suction is not from the pool anyway. It is from the condensate storage tank. So at least in the short term it is not even going to be affected by the decision or the deposition of insulation material on potential sucking sources.

MR. CARROLL: It can take suction from the pool?

MR. SAWYER: It will take suction automatically from the pool on an automatic transfer that occurs either because the condensate storage tank level is too low, or because the suppression pool level is high.

But that automatic function can be overruled by the operator. In fact, in the EOPs, there are instructions to, in fact, overrule it under certain conditions, like, particularly in RCIC's case, maintenance of cool water to keep the pump a viable pump in the long-term for station blackouts.

HPCF is also an important factor for transients and small breaks. It does play a more important role than RCIC does for medium and large LOCAs, and, in fact, it is what helps us meet no-core uncovery which we have shown in many analyses for medium and large breaks.

It takes its primary suction from the condensate storage tank, too, and is subject to the same automatic switch-over and operator ability to switch back, if necessary.

In a deterministic analysis in Chapter 6, it turns out that the limiting LOCA is an HPCF line break and the single failure is of the diesel generator in a division which has the other HPCF, leaving you with only low-pressure systems to inject.

That is the LOCA that gives you the minimum water level during the LOCA transient. So HPCF is not available anyway, clogging or no-clogging.

We did one further thing in the SSAR. We extended our analyses basically in Chapter 6 basically to permit more flexibility within the tech specs for allowable outage times to demonstrate what would happen where we would only have low pressure systems available for any break. That is in the SSAR. It is shown in Figure 6.3-76.

[Slide.]

MR. SAWYER: In the written material, I went through a three-step rationale that basically ruled this one out because it is a small break, a bottom drain line break and it wouldn't create a debris problem in the first place. That is a two-inch line.

The HPCF break with only -- this is a case where it only has one RHR, plus five ADS valves to affect the blow-down for the entire break spectrum.

The HPCF case is one in which if you go through the single failure analysis, you will find that you really should be permitted to have two RHRs available as a minimum set available to mitigate that break. This is an analysis, of course, that we did of showing what if only one RHR is available.

The important point here is if we can agree on the commitment for the RHR suction strainers so that that is not -- that both us and the staff agree that the threat of clogging of the RHR suction strainers has gone away. Then, in reality, this should be supported in the deterministic space by two RHRs.

So, therefore, that case happens to have no core uncovery. So that is off the table. That is why I came to the conclusion that the limiting set, of course, is an LPFL line break, a presumed failure of HPCF to inject because it sucks only from the suppression pool.

Those strainers are clogged. In the deterministic space, operators don't get credit for condensate storage tanks since that is not a secured source of water. That leads you to a 1,000 degree PCT which is a reasonable result with a lot of margin to Appendix K.

So, from that perspective, we concluded that tacking on an additional factor of three onto the HPCF and RCIC spargers to cover uncertainties did not make a lot of sense.

[Slide.]

MR. SAWYER: We did a quick reevaluation of our PRA.

MR. MICHELSON: Just one clarification. Your deterministic didn't really look at the pool temperature situation while these other pumps were functioning. To what extent do you need RHR for pool cooling doing these events?

MR. SAWYER: Well, the 207 degree pool temperature, or the peak pool temperature doesn't occur for many hours later. We are talking a 8 to 12 hour time frame.

MR. MICHELSON: Yes.

MR. SAWYER: So by that time --

MR. MICHELSON: Now, is that true if there is no RHR running? It takes 12 hours to heat the pool with no RHR?

MR. SAWYER: If there is no RHR running, the pool temperature will get to the pool temperature limit probably in more like 4 hours.

MR. MICHELSON: My recollection was around 3 to 4 hours, yes.

MR. SAWYER: Yes, that is true.

MR. MICHELSON: So it is important, then to --

MR. SAWYER: We don't deny the importance of the RHR. Okay.

MR. MICHELSON: But the inference was that you didn't -- I thought the inference was that you really just are not looking at RHRs as needed, and it is needed for that cooling function.

MR. SAWYER: It is needed for the -- it does play an important role in core cooling function, particularly in the short-term, but it also plays a very important role in containment heat removal function.

MR. MICHELSON: Right.

MR. SAWYER: Now, we do not deny that. We never -- that is one of the reasons why GE was inclined to agree with the staff on the extra margin on the strainers for RHR even though we don't really know what the data really means at this point in order to close the issue because we believe those are important pumps.

MR. MICHELSON: Are you agreeing that you need the three times area on RHR and just don't need it on the high pressure injection?

MR. SAWYER: The thing that we need to talk about a little bit when I get through my charts is whether or not we should also apply the factor at three for steam line breaks in particular. But we do agree on the factor of three certainly for all the other breaks.

MR. MICHELSON: On the RHR?

MR. SAWYER: On the RHRs, yes. We do agree with that.

MR. MICHELSON: Okay. That is helpful.

MR. SAWYER: PRA evaluation. To put things in perspective, our core damage probability in our PRA is just over 1 times to the minus 7. A medium LOCA core damage probability is about 3 times, 10 to the minus 10, and a large LOCA damage probability is about 1 times, 10 to the minus 10.

I mentioned that in RCIC we never gave RCIC any credit in the PRA space to mitigate medium and large LOCAs anyway. So, its failure to operate due to a clogging mechanism will not change the PRA results at all.

For HPCF we went back through the fault trees and we set the strainer plugging probability to one. That is a little bit non-conservative, but is a lot closer to the truth than the more conservative assumption that one can make which is HPCF fails to operate because it is a alternative water source.

Once you reflood the vessel with water up to the break and the break which would be most relevant here would be -- the lowest break which would be relevant would be a RHR suction line break.

Once you have reflooded if you at that point lose all injection into the vessel, it will take an additional about 35 to 40 minutes for the water to even boil back down to the top of the core, much less get into a heat-up situation.

So there is quite a bit of time for the operators to follow the EOPs and take remedial action to line up alternate pumps and/or alternative water sources for the existing pumps. So that is why we were comfortable.

In other words, we did not originally model the operator effect of switching over to the alternate water source in the PRA. It was a simplification. But in our look at it, we think this is a lot closer to the truth than just writing off the HCPF.

MR. MICHELSON: Now you are talking about some alternative sources?

MR. SAWYER: Going back to the condensate storage tank for the HPCF in particular.

MR. MICHELSON: Okay. An alternative alignment.

MR. SAWYER: An alternative alignment.

MR. MICHELSON: Not alternative pumps?

MR. SAWYER: Well, there are alternative pumps. You are at low pressure now.

MR. MICHELSON: But it is going to clog at the same time, of course.

MR. SAWYER: Well, the alternative pumps that we are talking about in the EOP space, which I haven't gotten to yet, are condensate pumps which can suck from the hot well, and the fire pump which has its own water source.

MR. MICHELSON: Okay.

MR. SAWYER: Both of which are not suppression pool oriented.

Anyway, it turned out that if you do that, if you just set the strainer plugging probability to 1, it didn't have a very large impact on the HPCF system availability, and at the 10 to the minus 7 level, it had no effects on the CDP that we could come up with.

So our re-review of the PRA concluded that we couldn't see a PRA rationale for imposing additional margin due to uncertainty on the Reg Guide, on the HPCF or the RCIC.

[Slide.]

MR. SAWYER: The final thing is the EOPs. Before we get into the issue of the steamline break itself, the EOPs are not the basis for determining design basis requirements. They reflect the design and there are no implications in the EOPs that the operator is to use preferentially safety-grade systems or to base his actions on any assumptions that safety-grade equipment will work if it is selected. He just goes down a list of available systems and he tries them until he finds one.

As I showed you, for core cooling, one motor-driven pump is all you need, so he goes down the list until he finds one that will do the job and then he can achieve success.

There are a large menu of available options, in response to Mr. Michelson's question. I added to the ACCS list already the four feedwater condensate pumps, any one of which has more than enough capacity to make up for boil-off once you have reflooded, and the fire water delivery system which can do the same thing because it can be aligned for core injection as well as containment function.

MR. MICHELSON: How soon is it adequately effective for makeup?

MR. SAWYER: The fire water system?

MR. MICHELSON: Yes.

MR. SAWYER: It has about a 1,000 gpm capability. Once you have accomplished the reflood, the boil-off rate even at that point is more like 200 or 300 gpm.

MR. MICHELSON: That's right.

MR. SAWYER: So it is more than enough.

MR. MICHELSON: They could do it right away.

MR. SAWYER: Right away. There are multiple water sources. Of course every pump doesn't have access to every water source and that gets into a second order of complication but if you are interested I can certainly tell you which pumps can access which water source, but the point is that the operators in executing EOPs have a lot of choices, so their choices we don't think are restricted and given that we didn't feel that that should be a basis for requiring additional margin to cover uncertainties in the HPCF in particular.

That is where we are. Now let's talk a little bit about the steamline break.

I heard some earlier statements from the staff claiming that it might be 24 hours or even longer before the RHR was run in shut-down cooling mode for main steamline breaks.

Point one, the EOPs are not event-based. They are symptom-based so the operator, at least in the short term, for a couple hours, the Staff is right. The operators are not going to do what they need to do to recover water level. That is the highest priority item in the EOPs but the operators also know it is not a good thing to have water spilling out out of a break, particularly a small break if the reactor is still at pressure. We don't want to have high-pressure water going down the steamline, so the operators will try to maintain normal water level and with their complement of systems, once they can get to water level they are going to start shutting things off and keeping water within the normal range.

Mr. Michelson, I was a little bit conservative when I told you it was three feet to play with; it's more like five feet. We looked it up.

MR. MICHELSON: That is the elevation, five feet.

MR. SAWYER: Yes, five feet from high level, at the high end of normal water level range to the bottom of the steamlines.

MR. MICHELSON: That is the lowest point in the steamline?

MR. SAWYER: Lowest point in the steamline.

MR. MICHELSON: Okay.

MR. SAWYER: I can't speak for every operator and I suppose we can get into a debate about goodness of operators but if I was running the plant and I was at low pressure and I could achieve normal water level, and I keep cutting back my excess pumps, and I am being able to obtain normal water level with very little flow capability, I think I would decide to try an RHR in reactor cooling mode rather than containment cooling mode because it immediately shuts off the heat source to the containment right at the beginning, so my personal view is it is not going to be 24 hours or longer before the operator attempts that, once he realizes he can normal water level back. That is the key.

If it's the RHR system pipe breaks, there's nothing the operator, no action the operator can do that would get the water back to normal water level for that case.

MR. MICHELSON: Now you think you can trust his water level indication after the blowdown?

MR. SAWYER: Of course.

We went through that issue on the water level instruments.

MR. MICHELSON: You do avoid the reference legs and so forth for a short time. Do you look and see if everything can recover properly to get back to proper reference leg in the indicator, the reading?

MR. SAWYER: We won't be avoiding the reference legs in the short term in this design.

MR. MICHELSON: Where is it located?

MR. SAWYER: They are located -- you know, they are not Yarways. They are condensate pots. The condensate pots are such that they will not be -- furthermore, as you recall, we committed to --

MR. MICHELSON: Those will still boil down momentarily if you depressurize.

MR. SAWYER: That's correct, yes.

MR. MICHELSON: But they'll take awhile to recover that level. Then they are okay and my question is how long does that take, to get a trustworthy indication?

MR. CARROLL: With the design they have, that isn't of any interest.

MR. MICHELSON: I don't know. I just wanted to get a feel -- five minutes, can I believe, or --

MR. SAWYER: There were several things we did, recognizing the post-TMI situation and the issue that came up over the noncondensible flashing.

To get rid of the noncondensible flashing for sure, we committed to a backflush system so that the starting point won't have noncondensibles in the water. To take care of the flashing error, we run the lines out horizontal or virtually horizontal through the containment to the reactor building so the only portion of the lines which are capable of flashing, the hot portion, won't create a level error.

MR. MICHELSON: So you think it's only a very short period of time before you recover proper indication.

MR. SAWYER: That's correct.

MR. MICHELSON: Because I don't think the operator will try to operate on it until he believes the indication.

MR. SAWYER: That's right, and the way he believes it is he gets the same kind of reading from several instruments.

MR. MICHELSON: From several of them.

MR. SAWYER: That's right, not just one of them.

MR. MICHELSON: Yes.

MR. SAWYER: So, to recap, if it is an RHR line break or an HPFL line break, there is no hope of the operator being able to maintain normal water level, even in the long term. It's not an option.

He could control the recirculation of water within the containment by attempting to maintain a lower level but that is something that the whole crew would deal with much longer term and something fancy like that is something that probably would take 24 hours or more, but it is my feeling that if it is easy to regain normal water level the operators will switch over to normal shutdown mode rather than suppression pool cooling load, so that is why we took the position that we didn't want to use the steamline, which is twice as big in diameter as any of the other lines and has much greater impact on the amount of insulation that could be transported to the pool and therefore would have a significant impact on the sizing of the strainers in the Reg Guide 1.82 calculation.

MR. MICHELSON: You can speculate a lot of course when you start trying to decide how much insulation gets torn loose by the break, wherever the break might be.

MR. SAWYER: I think the way the process works is we are required by the Reg Guide to look at every potential break location and draw what used to be a column and now the Staff is thinking more like a sphere but, anyway, however that turns out you have to take that damage and if it is fibrous insulation there are certain ways you calculate loss coefficients and if it is metallic there's other things you go through in order to figure it out.

MR. MICHELSON: That is a very simplistic approach to the real world, of course, in the containment when you are going to have localized velocities --

MR. SAWYER: As a practical matter --

MR. MICHELSON: That is what tears things loose, of course.

MR. SAWYER: Well, as a practical matter we take comfort from some things that we're not even taking credit for. The vertical vents have vent covers over them. There is a tortuous pathway to the pool. It is not wide open like Mark III's are, for example, and of course we don't have the Mark III potential of inadvertently leaving insulation in the wet-well because it is not part of normal operation like it is in a Mark III.

MR. MICHELSON: Does the vertical vents skim at the floor level or are they elevated a little bit?

MR. SAWYER: They stand about this much above the bottom of the floor and then they have a protective glass plate over them.

MR. MICHELSON: So you have got a separating pool up there on that deck --

MR. SAWYER: For example, in the Barseback case, where they found that continuing to spray actually made the situation worse, in our containment the spray is probably beneficial. It will wash any remaining stuff out and deposit it in the drywell.

That is about all I plan to say on this subject. I think as the Staff outlined, we know this is an important item because it is the only remaining open item at this point for us to close on as soon as possible.

MR. MICHELSON: Have your conclusion slide yet?

MR. SAWYER: Yes.

MR. LINDBLAD: Before you leave that, I'm sorry, Mr. Sawyer, just a point of clarification.

Do you have to run your condensate booster pumps to also have effective main feedwater?

MR. SAWYER: Yes.

MR. LINDBLAD: So it is not just the feedwater pumps. You need the booster pumps.

MR. SAWYER: The reason why I only took credit for those pumps is once you are at low pressure you don't have to have the feedwater pumps.

If you are at high pressure, then you have to have both. You have to have at least one condensate pump and one feed pump to pump at high pressure.

You only have to have one condensate pump once you have blown down, as you will have, for a large LOCA.

MR. MICHELSON: If you have got electric-driven feedwater system, not steam-driven, that helps.

MR. CARROLL: So where does all this leave us, Carl?

MR. MICHELSON: Well, he's got a conclusion slide with that. I hope that is where it leads us.

[Slide.]

MR. SAWYER: We thought that we had accommodated the NRC's uncertainty concerns by applying the factor of three, but as I heard from Rich earlier this afternoon, they still want us to accommodate the steamline and I think we are going to have some heavy duty discussions the next couple days to try and clear that one up.

We have concluded that we don't find any rationale for --

MR. WILKINS: Could you step just a little bit to the right?

MR. SAWYER: I'm sorry, yes.

MR. WILKINS: Thank you.

MR. SAWYER: We don't see any rationale for racheting the RCIC and HPCF beyond our commitment to Reg Guide 182, Rev. 1, in the first place, so that is where we are coming from.

MR. MICHELSON: On the RHR strainers, to get the three times area, are you still using the basic conical configuration?

MR. SAWYER: The configuration in ABWR is basically a standpipe with a "T" on it and then conical shaped standard devices on each "T."

MR. MICHELSON: You are putting more branches or are you putting a bigger cone?

MR. SAWYER: Right now it is just two branches.

MR. MICHELSON: And a bigger cone then?

MR. SAWYER: It's a bigger cone, okay.

MR. CARROLL: A bigger target for --

MR. MICHELSON: Well, you are going to take care of the blowdown loads, of course, on the cone?

MR. SAWYER: Of course.

MR. MICHELSON: But it is more drag on the cone one and of course that means that it is better anchored.

[Slide.]

MR. SAWYER: Here are the vents. Here are the quenchers and here's suction strainers, to give you an idea where they are located, so yes, they are designed for the blowdown loads and also for the quencher loads, too, depending on whether the SRVs are in operation.

MR. MICHELSON: Where does it leave us?

MR. CARROLL: Yes.

MR. MICHELSON: Well, I think if we want to issue a letter at this meeting we just have to indicate that we'll wait for resolution -- in other words, whatever the Staff accepts is fine by us is all we could say, unless we want to wait for the resolution.

MR. CARROLL: Do we?

MR. MICHELSON: I think that is a committee decision.

MR. CARROLL: Okay.

MR. MICHELSON: Did the Staff have something more they wanted to add?

MR. BARRETT: I just do want to clarify one point that wasn't clear in my presentation.

While I did say that it was possible for the time to elapse to be perhaps even as much as 24 hours for switchover to RHR cooling, I did not mean to imply that it would require 24 hours to plug the strainers.

In the case of the Barseback event, it took one hour roughly to plug the strainers and cause the cavitation of the pumps.

The other point I wanted to make was with regard to the high pressure core flutter, and one of the reasons why we view it as much more important than RCIC is because of the versatility of the pump, being able to operate at low pressures and high pressures.

In the case of a very small break in the vicinity of a very large pipe or a very small break in a very large pipe, you can get substantial amounts of insulation dislodged, as was the case in Barseback where a very small relief valve in the vicinity of the steamline caused a substantial amount of insulation to be dislodged so I think that as the gentleman just pointed out, to take a failure of the high pressure core flutter can have a significant impact on risk, as opposed to taking the assumption of the failure of just the strainer.

MR. SAWYER: Well, let me characterize it in our definition of small, medium, and large.

In our definition the sticking open of a relief valve would be a large break. It's about .1 square feet, which would be about 100 square centimeters, so I guess that makes it a medium break, yes.

MR. BARRETT: My point though is that it doesn't require a double-ended guillotine break of the steamline to create all of this debris. In fact, information that was recently provided to us by the BWR owners' group in the resolution of this issue for the operating reactors showed that small breaks in large pipes are more likely than large breaks in large pipes.

MR. MICHELSON: One of the things that GE could tell us, just tell us a little more about these possible sources for the case of ABWR, how you are insulating the main steamline, the air conditioning system, or whatever other things might need insulation.

MR. SAWYER: We haven't made any specific insulation commitments in the SSAR. We were going to leave that, so we haven't said that certain things had to be metallic or mirror insulation or certain things have to be a special kind of fibrous insulation or anything.

What we have committed to do is to meet the Reg Guide and so if, for example, in the process of committing to meet the Reg Guide it turns out the strainer size is as big as the suppression pool, we clearly would have to re-review what kind of insulation we were using, but that is a design commitment that will be done in the detailed design.

MR. MICHELSON: I guess my recollection wasn't very good. I thought you were using metallic insulation for the vessel.

MR. SAWYER: That is traditional practice but I don't think the SSAR makes a specific commitment.

MR. MICHELSON: There isn't a commitment, even for that? So we could have a very large potential source of which you are saying you will evaluate them against the filter provisions or the strainer provisions?

MR. SAWYER: Yes.

MR. POWER: John Power. I wonder if I could make a couple of observations.

Unfortunately, the presentation this morning was covering a large gamut of older plants of varying degrees of differences and designs. It was also a presentation made not on the utility side or the operator side or the designer side but in an independent analysis side about what those sources of blockages and contributions would be.

Many of those plants have devices on the down-comers and on the vent systems that would preclude substantial amounts of materials going over, but no discussion was made of those, of course, this morning.

The unfortunate thing is this afternoon we are talking about the ABWR in light of that presentation this morning which was somewhat very critical relative to effects that could or may or possibly can occur.

We had had long and lengthy discussion with the Staff earlier this year on this particular subject and on March 1 we closed out the outstanding items on the FSER, which this one was one of. We had complete agreement with the Staff relative to resolution of this issue. And we documented that not only in draft copies which you received, copies they received, but also in our forthcoming Amendment 34.

Late last week, we received notification that that agreement somehow had been, let's say, put aside and that some of the observations were made that it was because General Electric's suggestion for resolution on this thing didn't have as much substance as the Staff would have.

At that time, we were accepting the analysis and the recommendations of the Staff relative to treating and addressing this issue and we were in full compliance with them. But it appears the Staff position changed.

We are hopeful that we are not going to, first of all, allow this issue to hold up a letter from you and, secondly, we have offered during the last week numerous times to discuss this issue with the Staff to get a resolution so that we could come here and not burden you with an unresolved or a potentially open item.

We would not like to see this letter delayed. I guess we are somewhat perplexed by this entire subject.

We think the ABWR has many features like reduced piping systems in the dry well, the vent system, the vent system actually being a combination of a couple of vent pathways and ultimately down to our suppression pool. With the capability of having high pressure cooling systems that worked even down to low pressure which other ABWRs do not have.

We think we have significant differences from those other ones to somehow convince you that those observations made this morning, as an example, were awfully pessimistic and didn't reflect on the ABWR at all. In fact, the only plan I see on the diagrams and pictures was a Mark I, which is a fairly large piping system with a very large volume with a large set of transportation down-comers and vent systems down into a pool that is relatively at the suction strainers, relatively constrained.

MR. MICHELSON: You had better be a little careful. You can't put very much constraint on the ability to relieve the pressure from the break down to the pool. You can't -- you don't ever want to trap that one because you blow the containment.

MR. POWER: We understand that but I am just saying that there are differences.

MR. MICHELSON: That's why they are big and open and very little trash accumulation capability because you don't want to plug them during the initial blowdown.

MR. CARROLL: Since we have allowed a half-an-hour presentation to go to 70 minutes, let me ask a question.

Is the Committee happy to let the Staff and GE resolve this thing?

MR. MICHELSON: You have to ask the Committee that.

MR. CARROLL: That's what I'm asking.

MR. MICHELSON: I think that's a letter writing process. We will vote on that one when we get to the letter.

MR. WILKINS: Let's address that question when we get to the letter.

MR. MICHELSON: We have heard the arguments, I think, on both sides and I think very good arguments on both sides and now it's up to us to see if they affect anything we might want to say.

MR. CARROLL: I guess I have one ABWR issue while we're still here.

Have we resolved the two issues that we had when we last talked about ABWR, the Ivan issue and the Charlie issue. Those are resolved?

MR. MICHELSON: Yes, those I think have been resolved.

MR. WYLIE: They included in the revision --

MR. MICHELSON: It was my understanding that all the issues we had once entertained, the 13 issues had all been satisfactorily resolved.

MR. WILKINS: I don't know how many of you are worried about whether the record will show this reference to the Ivan issue and the Charlie issue without clarifying what they are. I know what they are?

MR. CATTON: Do we need to clarify it for the record.

MR. MICHELSON: Let's let it go. Let the reader figure it out.

MR. CARROLL: It's an exercise for the student.

MR. WILKINS: Then I infer that this segment of the agenda has been completed.

MR. MICHELSON: Unless somebody else has a problem or a question, this is the last chance, this is it.

MR. WILKINS: I will accept Jay's reprimand for letting this run over a little bit, quite a little bit as a matter of fact. But this is our last chance.

MR. MICHELSON: When we first scheduled this, we weren't aware we were going to get popped with this whole sump thing and I thought half an hour was more than enough to talk about QA issue which we didn't think was particularly difficult for them. This one kind of came up at the last minute.

MR. WILKINS: Hit us in the rear end, yes.

All right, I think then we will go on to the next agenda item. And I believe that I am correct when I say that we will have no further need to transcribe the activities of the Committee.

MR. MICHELSON: I guess we should thank GE and the Staff.

MR. WILKINS: You didn't do that. I'll do it.

Thanks very much to both GE and the Staff for their presentations on this interesting topic.

[Whereupon, at 2:53 p.m., the meeting was concluded.]

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

NAME OF PROCEEDING: 408th ACRS Meeting

DOCKET NUMBER:

PLACE OF PROCEEDING: Bethesda, 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.

Marilynn Estep

Official Reporter
Ann Riley & Associates, Ltd.

System 80+ Design Review

April 1989	-	Initial Application Submitted
March 1991	-	CESSAR-DC Amendment I Submitted
May 1991	-	Application Accepted and Docketed as 52-002
September 1992	-	Draft SER Issued (637 Open Items)
June 1993	-	ITAAC Submitted
February 1994	-	Advance FSER Issued • No Open Items • Eight Confirmatory Items • Five Exemptions • Fifteen Applicable Regulations
April 1994	-	CESSAR-DC Amendment V, Expected • Staff Commences Consistency and Confirmatory Issue Verification • Staff Completes Independent ITAAC and Tech Spec Reviews
May/June 1994	-	ACRS Letter

MAY 1994	-	CESSAR-DC AMENDMENT W EXPECTED
JUNE 1994	-	FSER ISSUANCE SCHEDULED • INCORPORATES LEGAL AND EDITORIAL COMMENTS • ADDRESSES ACRS LETTER
AUGUST 1994	-	FDA ISSUANCE SCHEDULED
DECEMBER 1995	-	DESIGN CERTIFICATION SCHEDULED

CESSAR-DC Confirmatory Items

1.1-1	Incorporation of agreed upon CESSAR-DC markups
1.1-2	Staff Consistency Review of CDM and CESSAR-DC
1.10-1	Review of COL Action Items for Consistency with FSER
3.8.4.2-1	Joint Reinforcing Steel Details
14.3.7-1	Verify Incorporation of Additional Comments on CDM
14.3.7-2	Independent Quality Assurance Review of CDM and CESSAR-DC
16	Verify incorporation of staff comments on final TS, satisfactory completion of independent audit, and ABB-CE certification of final TS
17.1.1	Verify ABB-CE's design control practices (QA) afford an acceptable level of assurance of design integrity

System 80+ Exemptions

3.1.1	Operating-basis earthquake design requirement
3.11.3.1 9.3.2	Post-accident sampling
6.2.6	10 CFR Part 50, Appendix J, assumptions for leak rate testing
15.4	TID-14844 Radiological Source Term
19.2	10 CFR 50.34(f), dedicated containment vent penetration for severe accident mitigation

System 80+ Applicable Regulations

Section	Description of Applicable Regulation
3.9.3.1.1, 6.3.2, 20 (GSI 105)	Applicable regulation for intersystem loss-of-coolant accident.
3.9.6,	Applicable regulation for inservice testing of pumps and 6.5/6.6 valves.
7.1.3	Applicable regulation for digital instrumentation and control systems.
7.7.1.18 18	Applicable regulation for control room annunciators.
8.3.1	Applicable regulation for electrical distribution.
8.5, 20 (USI A44)	Applicable regulation for station blackout.
9.5.1	Applicable regulation for fire protection.
15.3.9 19.2	Applicable regulation for containment bypass potential resulting from steam generator tube ruptures.
17.3	Applicable regulation for reliability assurance program.
19.1.2.2	Applicable regulation for containment performance.

19.1.4.1	APPLICABLE REGULATION FOR SEISMIC MARGINS.
19.2	APPLICABLE REGULATION FOR HIGH-PRESSURE CORE MELT EJECTION.
19.2	APPLICABLE REGULATION FOR EQUIPMENT SURVIVABILITY.
19.3	APPLICABLE REGULATION FOR SHUTDOWN RISK.

INDIVIDUALS INVOLVED IN PREPARATION OF THE SYSTEM 80+ FSER

Administrative Support

Pam Shea (PDST)	Melissa Karras (PDIV-2)	Patty Wilson (OCM)
Michelle Clark (PDAR)	PJ Langston (OGC)	Beverly Sweeney (ADAR)
Sharon Green (PDST)	Patty Noonan (PDIV-1)	Patricia Zudal (PDST)

NRR Section Chiefs

Ralph Architzel (PDST)	Matthew Chiramal (HICB)	Tim Collins (SRXB)
Richard Correia (RPEB)	Adel El-Bassioni (SPSB)	Dick Eckenrode (HHFB)
Tom Essig (PRPB)	Robert Gramm (RPEB)	Jack Kudrick (SCSB)
Jim Lyons (SPLB)	Mark Reinhart (OTSB)	Mark Rubin (SRXB)
David Terao (EMEB)	Dale Thatcher (EELB)	

Chapter	Responsible Project Manager	Lead Reviewers
1	Tom Wambach (PDST)	ALL
2	Tom Boyce (PDST)	Robert Rothman (ECGB)
3	David Tang (PDST)	Syed Ali (ECGB) John Huang (EMEB) Harold Walker (SPLB)
4	Michael Franovich (PDST)	Larry Kopp (SRXB) David Smith (EMCB) (also Ch. 5,6,9,&10)
5	Kristine Shembarger (PDST)	Summer Sun (SRXB)
6	Stewart Magruder (PDST)	Jim Lyons (SPLB) Summer Sun (SRXB)
7	Tom Wambach	Michael Waterman (HICB)
8	Michael Franovich	Om Chopra (EELB)
9	Stewart Magruder	Jim Lyons (SPLB) Skip Young (PSGB)
10	Kristine Shembarger	Jim Lyons (SPLB)
11	Stewart Magruder	T. Chandrasekaran (SPLB)
12	Tom Wambach	Charlie Hinson (PRPB)
13	Tom Wambach	Skip Young (PSGB) Greg Galletti (HHFB)
14	Michael Franovich	Frank Talbot (RPEB) Tom Boyce (PDST)
15	Michael Franovich	Summer Sun (SRXB) Ken Eccleston (PRPB)
16	Kristine Shembarger	Angela Chu (OTSB)
17	Michael Franovich	Fred Allenspach (RPEB) Tim Polich (RPEB)
18	Stewart Magruder	Garmon West (HHFB)
19	Michael Franovich	Nick Saltos (SPSB) David Diec (SRXB) Michael Snodderly (SCSB) Bob Palla (SPSB) Seung Lee (ECGB)
20	Stephen Hoffman (PDLR) Jack Donohew (PDAR)	ALL

System 80+ Design Certification Program

Summary Presentation to Advisory Committee on Reactor Safeguards

April 7, 1994

Stanely E. Ritterbusch,
Manager, Standard Plant Licensing

ABB

acrs:4-94

SYSTEM 80+ LICENSING STATUS

- Overview

- Major achievements

- Effort remaining

ABB

SYSTEM 80+ DESIGN CERTIFICATION SCHEDULE

April 1989	-	Application Submitted
October 1991	-	Last Requests for Additional Information Issued
April 1992	-	Responses to RAIs Completed
September 1992	-	DSER Issued
February 1993	-	Responses to DSER Completed
March 1993	-	Follow-On Questions Initiated
June 1993	-	ITAAC Submitted
January 1994	-	Responses to Follow-On Questions Completed
February 1994	-	Advance Copy of FSER Issued
April 1994	-	CESSAR-DC Amendment V
May 1994	-	ACRS Letter Expected
May 1994	-	CESSAR-DC Amendment W
June 1994	-	FSER Publication Expected
August 1994	-	FDA Issuance Expected
December 1995	-	Design Certification Expected

ABB

SYSTEM 80+ LICENSING OVERVIEW

- 2896 questions responses in 1993
- 25,000 safety analyses report pages submitted in 1993
- Advance copy FSER issued February 28, 1994
  - On SECY-93-097 schedule
  - NO OPEN ITEMS
- NRC review has resulted in agreement on all design features and analysis to resolve all existing and emerging licensing issues - including those related to severe accident phenomena.

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SYSTEM 80+ FSER CONFIRMATORY ISSUES

- NRC verify incorporation of CESSAR-DC markups
- NRC complete review of Certified Design Material (CDM)
- ABB-CE review COL action items in FSER
- ABB-CE document additional re-inforcing steel details
- NRC verify incorporation of recent ACRS comments on CDM
- NRC complete independent review of CDM and CESSAR-DC
- NRC complete Technical Specification audit
- ABB-CE verify design control practices

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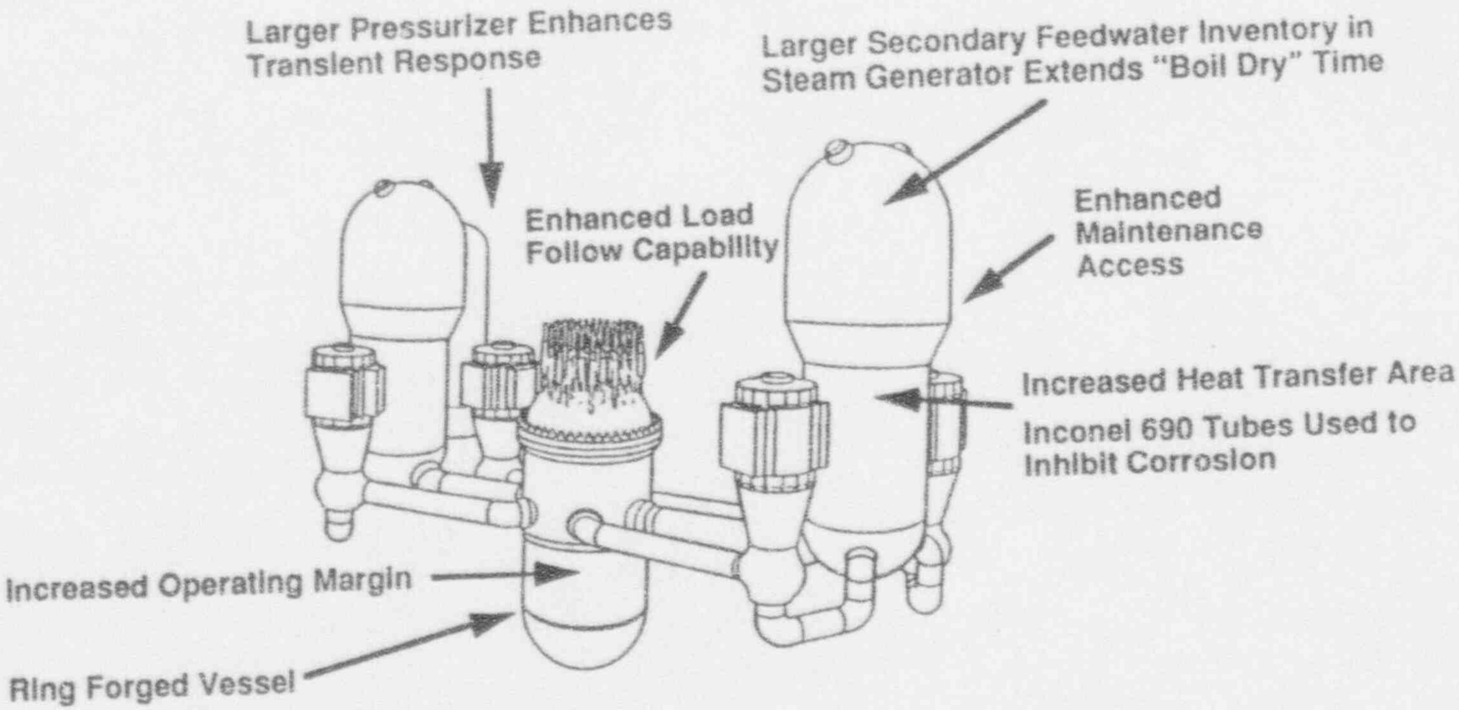
FINAL CESSAR-DC SUBMITTALS

- Amendment V scheduled for April 30, 1994
- Documents:
  - Changes resulting from NRC audit of Technical Specifications and CDM review
  - Additional information requested by ACRS
  - Changes resulting from ABB-CE's fourth integrated consistency review
- Amendment W scheduled for May 31, 1994
- Documents:
  - Editorial and Technical Specifications format changes
  - ACRS review and cleanup

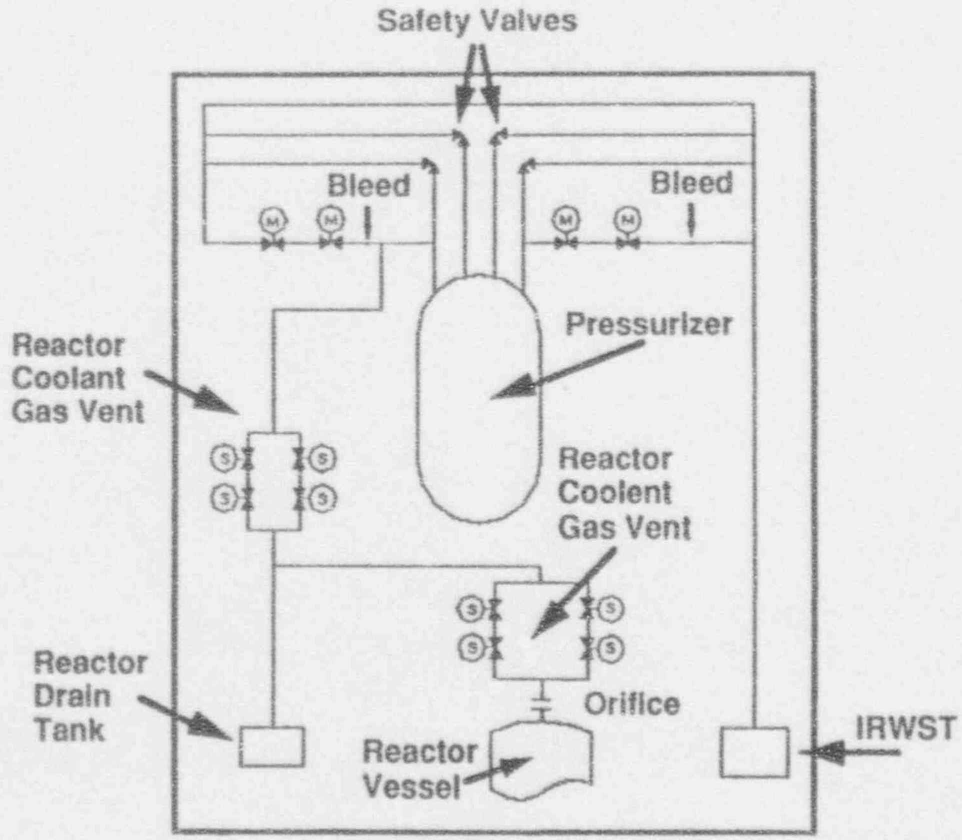
Principal Reactor Coolant System Improvements



System 80+ Defense-In-Depth Approach to Safety

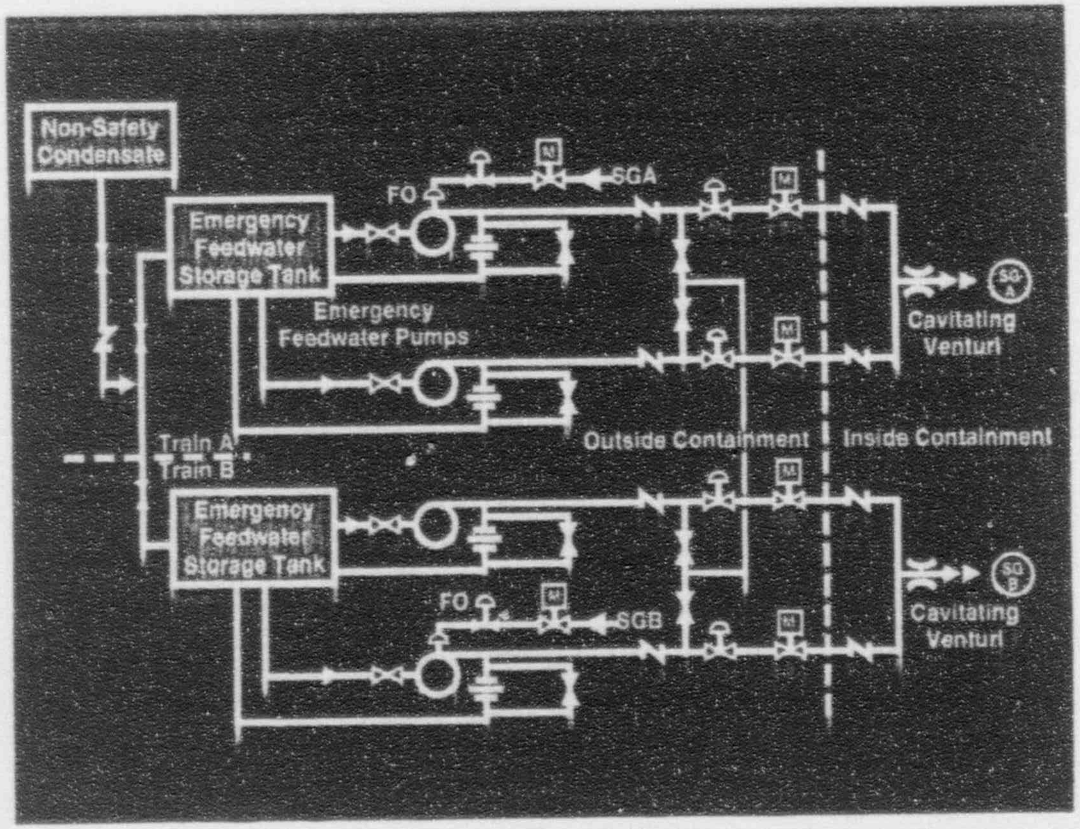
- **Design Margin Features**
- **Core Damage Prevention Features**
- **Severe Accident Mitigation Features**
- **Design Basis *Safety Analysis (Conservative)***
- ***Severe Accident Analysis (Best-Estimate)***
  - ***Probabilistic Risk Assessment***
  - ***Deterministic Evaluations***

Safety Depressurization System



ABB

Emergency Feedwater System



ABB

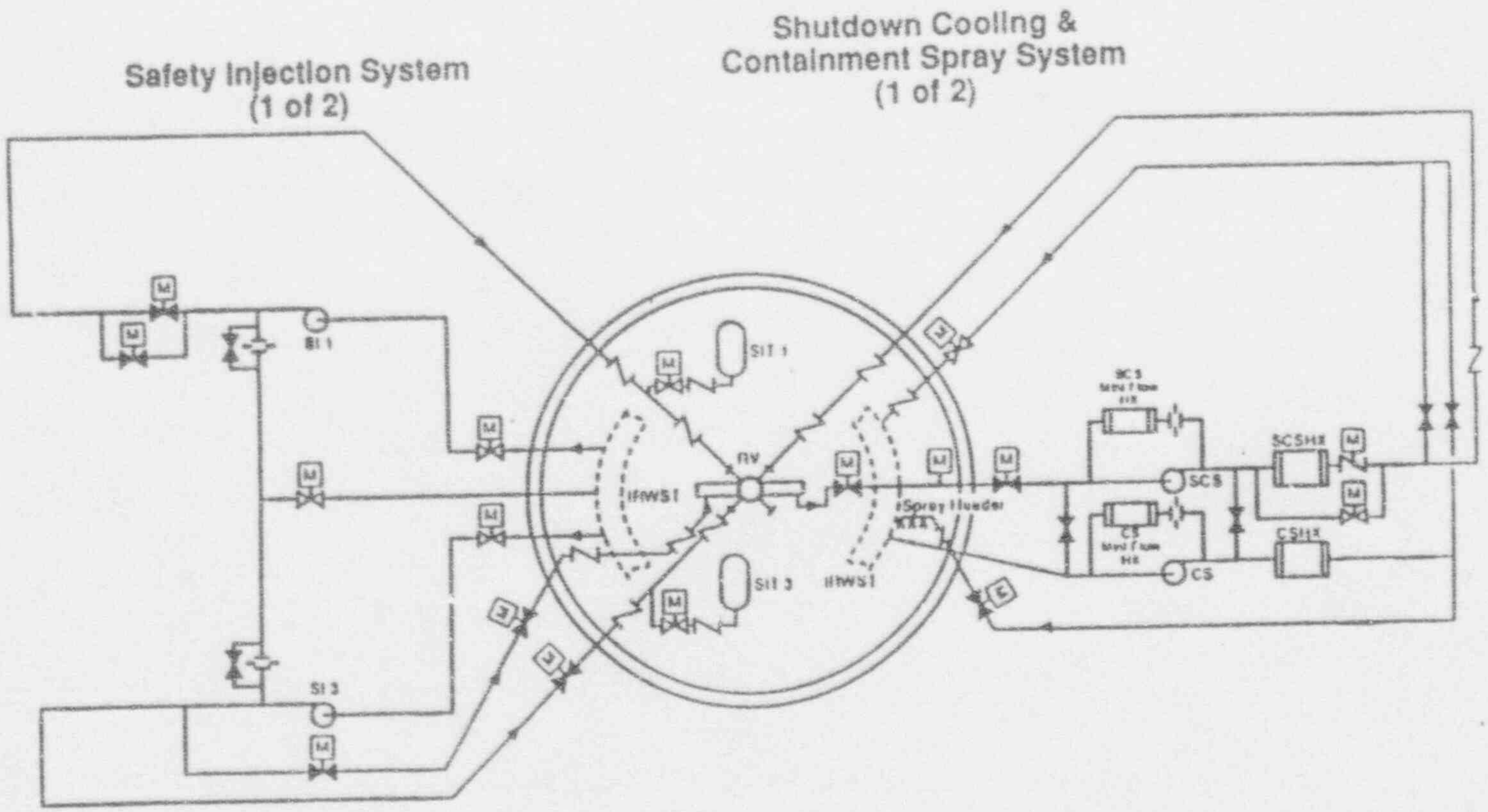
SSR2-11

SYSTEM 80+ MAJOR DESIGN AND LICENSING ACHIEVEMENTS

- Advanced Control Room - Human Factors Engineering
- All Digital Instrumentation and Controls
- Severe Accident Prevention and Mitigation
- Detailed PRA, including Shutdown Risk
- Seismic Design Envelope
- New Source Term Technology

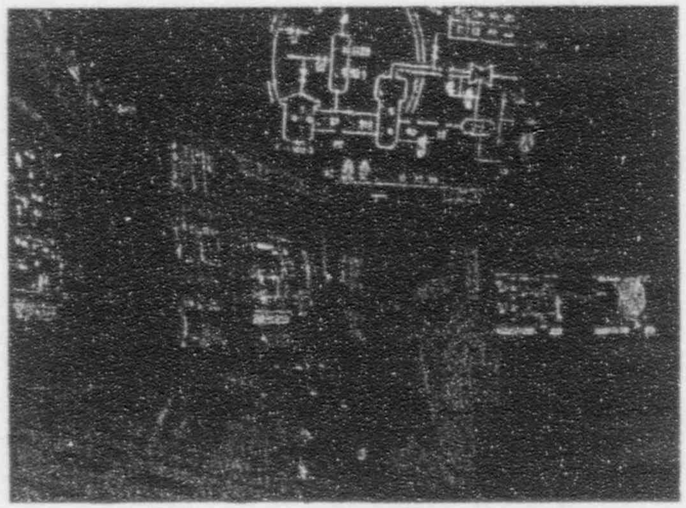
ABB

Integrated Engineered Safety Features System



Advanced Control Complex

- Large display screen
- Touch-sensitive CRT and plasma displays
- Microprocessors reduce operator burden
- Hierarchy of information
- Mode-dependent, prioritized alarms
- Fault tolerant systems
- Self-testing features
- Multiplexing
- Of-the-shelf equipment



ABB

ADVANCED CONTROL ROOM - HUMAN FACTORS ENGINEERING

- Established an NRC-approved Human Factors engineering review plan for major control room features.

- ABB-CE has exercised the plan and has developed a licensable Control Room design.

- NRC has approved:
  - Control Room Layout
  - Large Overhead Display
  - Standard control Panel Features
    - DPS display hierarchy
    - DIAS alarm tile display
    - DIAS dedicated parameter display
    - DIAS multiple parameter display
    - CCS process push-button switch configuration

- ITAAC includes the process for remaining panels and verification and validation of the complete control room.

ABB

SEISMIC DESIGN ENVELOPE

- Design plant to envelope the majority of potential nuclear sites
  - Broad range of seismic spectra anchored to 0.3g at high frequencies
  - Broad range of soil conditions
- Seismic Design Envelope sufficiently conservative to accommodate site specific ground accelerations in excess of 0.4g for design basis requirements.

ABB

ALL-DIGITAL INSTRUMENTATION AND CONTROLS

- Complete integration of protection, control, and monitoring systems
  - proven, commercially available hardware
  - functional segmentation and redundancy (not central unit architecture)

- On-line self-test, diagnostics, and information processing to reduce burden on the operator

- Programmable logic controllers with simple software

- Complete separation between safety and non-safety systems

- Complete separation between control and monitoring systems

SEVERE ACCIDENT PREVENTION & MITIGATION FEATURES

- Resolved severe accident issues without relying on future experiments (i.e., by demonstrating robust design features)
    - Large containment volume provides protection without need for venting during an accident.
    - Safety Depressurization System prevents high-pressure core ejection from reactor vessel.
    - Cavity Flood System cools core debris.
    - Hydrogen mitigation capability achieved through igniters.
    - Independent and diverse monitoring instrumentation and equipment controls provide backup if common failure of software disables safety systems.

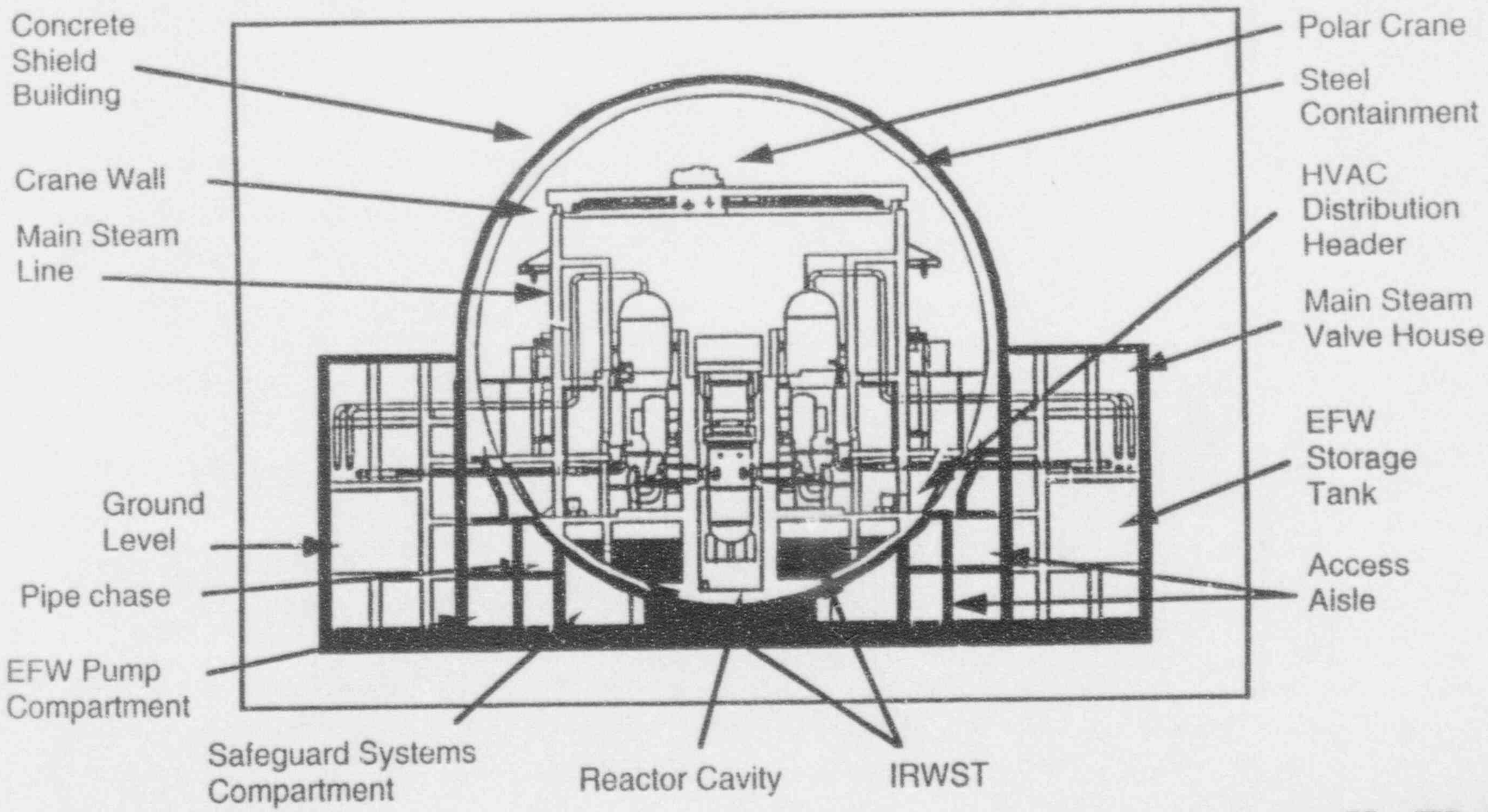
ABB

NEW SOURCE TERM TECHNOLOGY

- First application of the new source term technology to a specific design
- Equipment qualification uses graded approach
- Resolved related new issues:
  - Sump water pH control
  - Containment spray effectiveness
- Benefits:
  - Lower doses predicted for accidents
  - Potential for revised emergency planning

ABB

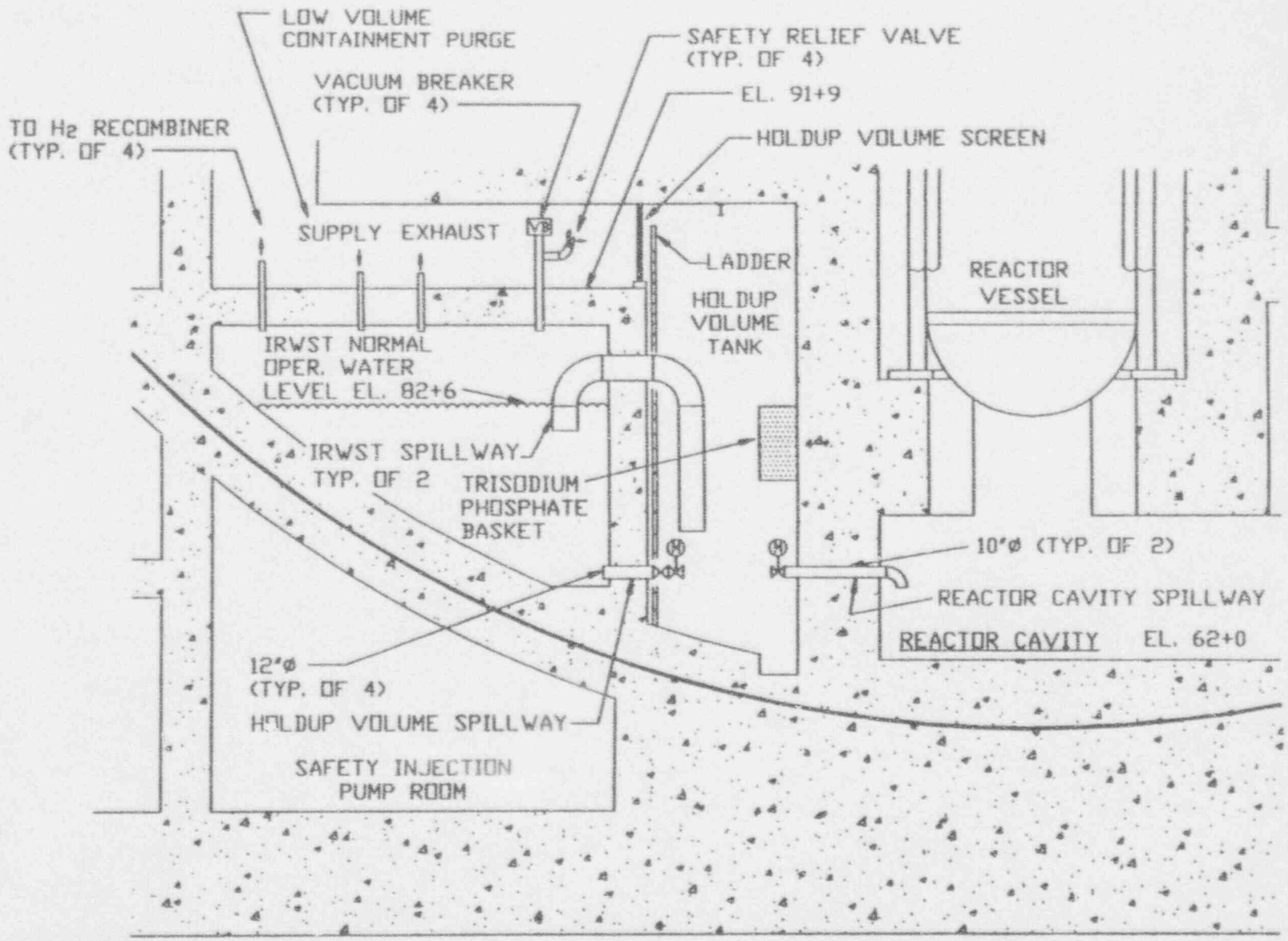
System 80+ Spherical Steel Containment



ABB

SEVERE ACCIDENT PREVENTION AND MITIGATION FEATURES (CONT.)

- Containment overpressure analysis shows that ASME Level C stress limit is not exceeded for approximately 60 hours.
- Cavity design promotes core debris retention and cooling.
- Reactor cavity wall analysis shows ability to withstand steam explosion from core debris - water interaction.
- Analysis shows that reactor cavity structure can withstand the most severe core-concrete attack for eight days without a significant release of radioactivity.



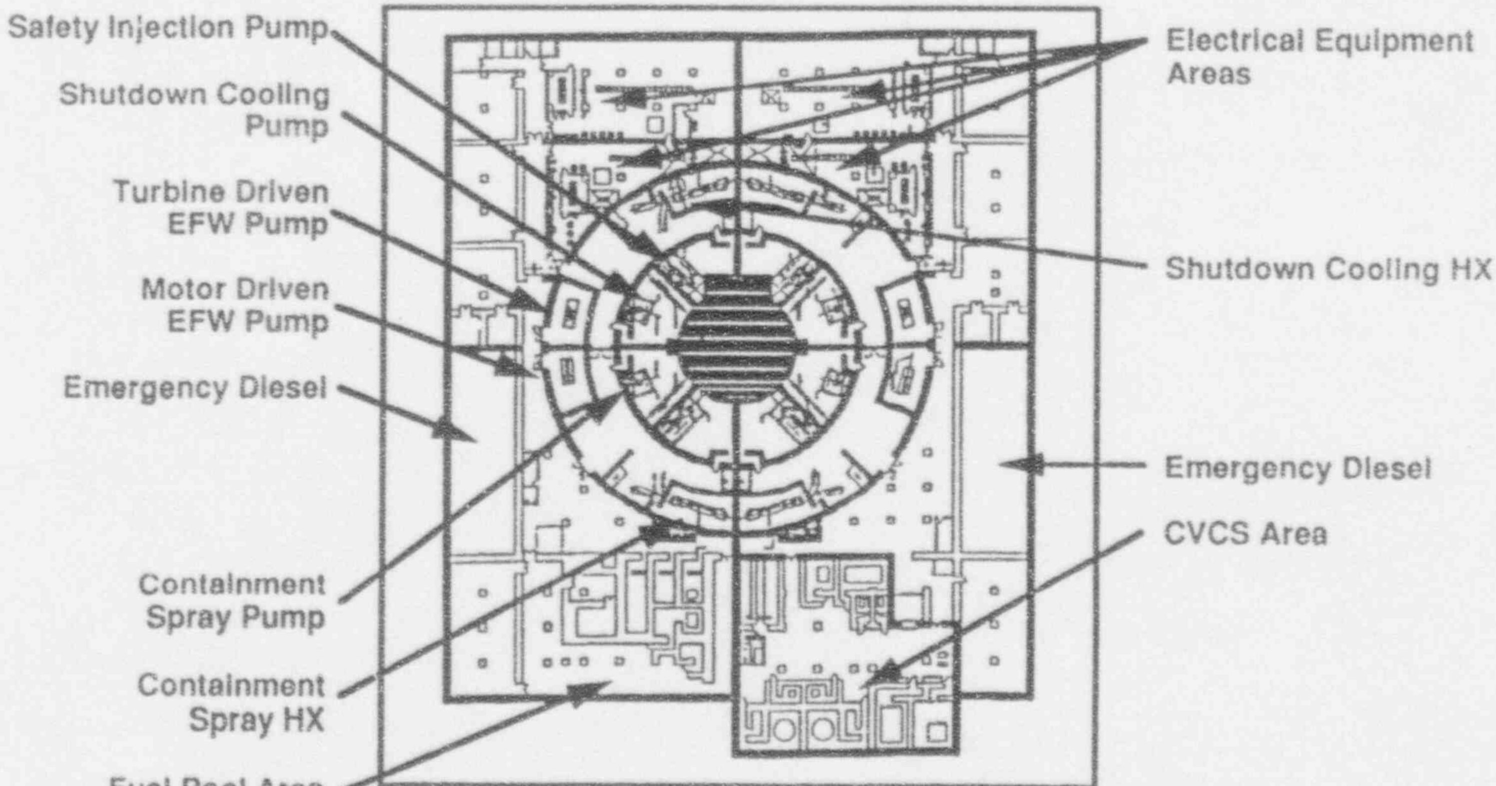
SYSTEM 80+™

CAVITY FLOODING SYSTEM

Figure 6.8-2

Amendment S
September 30, 1993

General Arrangement of containment and Nuclear Annex (Basemat level)

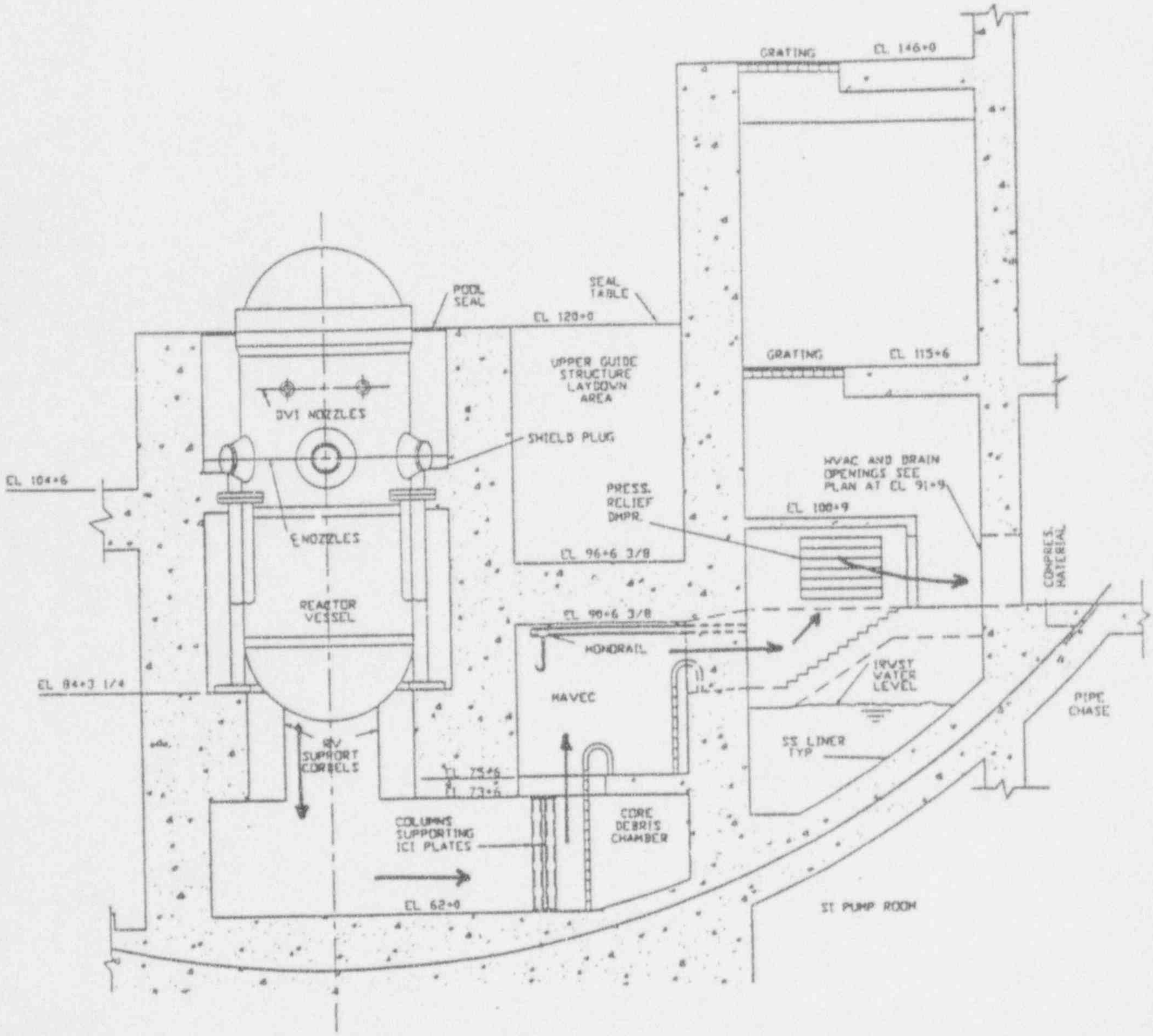


ABB

DETAILED PROBABILISTIC RISK ASSESSMENT

- NRC has approved full-scope, detailed PRA methodology-including shutdown risk evaluations.
- The NRC has agreed with analysis of corresponding severe accident performance.
- The System 80+ design can withstand an earthquake more than twice the magnitude of the design basis Safe Shutdown Earthquake (0.3g).
- The analysis indicates that the System 80+ design reduces the core damage frequency by more than 2 orders of magnitude as compared to current designs.

ABB



SYSTEM 80+ REACTOR CAVITY
WITH CORE DEBRIS CHAMBER

System 80+ Standard Plant
Core Damage Frequency Contributions

Initiating Event	System 80 CDF (Original Groundrules)	System 80+ CDF (Original Groundrules)	Major Design Contributor
Large LOCA	1.8E-06	5.0E-08	IRWST, 4T ECCS
Medium LOCA	3.6E-06	9.1E-08	IRWST, 4T ECCS
Small LOCA	9.4E-06	4.4E-08	4T ECCS, EFWS
Secondary Side Break	9.0E-07	2.0E-10	4T ECCS, EFWS
SGTR	1.1E-05	8.0E-08	4T ECCS, EFWS
Transients	1.2E-05	3.3E-08	4T EFWS, F&B
Loss of Offsite Power (Including SBO)	3.8E-05	1.0E-07	2 DG + AAC, EFWS, 6 BAT.
ATWS	4.8E-06	1.7E-07	4T EFWS
Interfacing System LOCA	4.5E-09	5.2E-10	High Pres. Pipe
Vessel Rupture	1.0E-07	1.0E-07	
Total	8.1E-05	6.7E-07	

ABB

DETAILED PROBABILISTIC RISK ASSESSMENT (CONT.)

- Shutdown risk has been reduced by a factor of about 40 relative to currently operating plants and risk is balanced among initiating events
- Radiological doses at site boundary for the most likely severe accident sequence is 0.3 rem, (Protective Action Guideline is 1 rem)
- NRC and ABB-CE have agreed on 71 PRA insights to be carried forward in the DCD because of their importance to safety and/or reliability.

ABB

System 80+ Standard Plant
Comparison of Shutdown PRAs

Event	System 80+	NSAC-84	NUREG/CR-5015	Seabrook
Total CDF	8.4E-07	1.8E-05	5.2E-05	4.5E-05
Loss of DHR	23%	71%	82%	61%
LOCA	16%	10%	8%	18%
LOOP	25%	0.7%	10%	6%
Fire	36%			4%
Other		18%		11%

ABB

System 80+ Standard Plant
Core Damage Frequency Contributions

Initiating Event	System 80+ CDF (Original Groundrules)	System 80+ CDF (Current Groundrules)	Changed Methods & Assumptions
Large LOCA	5.0E-08	1.1E-07	Include Check Valve CCF, Change HRA Calc. Methods, MOV Failure Rates
Medium LOCA	9.1E-08	3.1E-07	
Small LOCA	4.4E-08	2.1E-07	
Secondary Side Break	2.0E-10	2.1E-09	
SGTR	8.0E-08	3.0E-07	
Transients	3.3E-08	5.7E-07	
Loss of Offsite Power (Including SBO)	1.0E-07	2.8E-07	
ATWS	1.7E-07	4.9E-08	
Interfacing System LOCA	5.2E-10	5.2E-10	
Vessel Rupture	1.0E-07	1.0E-07	
Total	6.7E-07	1.7E-06	

ABB

SIGNIFICANT LICENSING ISSUES RESOLVED

- Diversity of digital I&C systems
- Intersystem LOCA risk reduction
- Containment bypass following a steam generator tube rupture
- Boron dilution after a small break LOCA
- Extension of Leak-Before-Break (LBB) technology
- Reactor Coolant Pump Seal Cooling

ABB

DIVERSITY OF DIGITAL I&C SYSTEMS

- Issues:
  - Methods for analysis of accidents with a common mode failure
  - Design of diverse hardwired backup controls

- Resolution:
  - Hardwired monitoring and control instrumentation added
  - Accident analysis assuming loss of all safety instrumentation and controls was completed successfully

ABB

INTERSYSTEM LOCA RISK REDUCTION

- Issue:
  - All low pressure systems connected to the Reactor Coolant System should be reviewed for potential failure due to overpressurization

- Resolution:
  - ABB-CE and NRC performed a systematic evaluation of all inter-connected systems.
  - Design changes made to increase system design pressures, add isolation valves, and eliminate system interconnections
  - Core damage contribution from Intersystem LOCA reduced significantly

ABB

CONTAINMENT BYPASS FOLLOWING STEAM GENERATOR TUBE RUPTURE (SGTR)

- Issue:
  - Potential for a stuck open steam generator safety valve after SGTR
- Resolution:
  - Added Nitrogen-16 monitors for unaubigious early detection
  - For a single tube rupture, operator action is not required for 4 hours to prevent safety valve lift
  - For a concurrent rupture of 5 tubes, operator action not required for at least 30 minutes to prevent safety valve lift.

ABB

EXTENSION OF LEAK-BEFORE-BREAK (LBB) TECHNOLOGY

- Issue:
  - LBB technology is generally applicable to a variety of piping systems, but previously approved by NRC for only main Reactor Coolant System piping
- Resolution:
  - NRC approval obtained for application of ABB-CE's LBB methodology inside containment to the Reactor Coolant System, Safety Injection System, Shutdown Cooling System, Pressurizer Surge Line, and Main Steam Lines.

ABB

BORON DILUTION AFTER A SMALL BREAK LOCA

- Issue:
  - Pure water assumed to accumulate in the RCS cold leg due to condensation after a small break LOCA

- Resolution:
  - Conservative analysis demonstrates adequate core cooling is provided even if pure water is assumed to be inserted to the core by natural circulation (RCP's are stopped by operators during a LOCA).

  - Revised emergency operating guidelines to minimize likelihood of premature RCP restart.

  - Realistic mixing analyses demonstrate adequate mixing of unborated and borated water in the reactor vessel which precludes criticality even if RCPs are restarted.

ABB

REACTOR COOLANT PUMP SEAL COOLING

- Issues:
  - Reliability of seal cooling during a station blackout
  - Susceptibility to intersystem LOCA from high pressure seal cooler tube failure through the component cooling water system

- Resolution:
  - Two diverse cooling systems normally operating
  - Added a highly reliable, diverse charging pump which can be powered from either emergency diesels or the combustion turbine generator
  - Added overpressure protection to the component cooling water system

ABB

CONCLUSIONS

- Very high confidence of improved public safety including prevention and mitigation of severe accidents
- The issuance of the advance copy of the System 80+ FSER without any Open Items represents a major milestone for the U.S. Nuclear Industry.
- 10CFR Part 52, to the extent exercised to date, is working very well.

ABB

RULEMAKING FOR PROTECTION AGAINST VEHICLES

- Staff believes that threat estimates not amenable to PRA

- Quantifying probability of actual attack not important to judgement of substantial increase in public health and safety

- Current regulations require protection against violent external threat

DESIGN BASIS THREAT [73.1(2)(1)]

- Determined violent external assault of several persons
- Well trained (including military training and skills) and dedicated
- Inside knowledgeable assistance
- Suitable weapons, including hand-held automatic weapons having long-range accuracy
- Hand-carried equipment, including explosives

VEHICLE INTRUSION

- Not suggesting that violent external assault more likely
- Adversary use of vehicle could provide advantages not previously considered
- Warrants installation of barriers

WORLD TRADE CENTER BOMBING

- Construction more likely to develop without advance indications

- Conditional PRA indicates that contribution to core damage frequency could be high

- Incremental costs to assure that barriers protect against bomb are justified

PROPOSED RULE CHANGES

- 180 days to submit descriptions
  (instead of 90 days)

- 18 months to implement
  (instead of 12 months)

PRESENTATION TO THE ACRS ON SUPPLEMENT 1 TO NRC BULLETIN 93-02

PRESENTED BY: R. LOBEL
SECTION CHIEF
CONTAINMENT SYSTEMS AND SEVERE ACCIDENT BRANCH
DIVISION OF SYSTEMS SAFETY AND ANALYSIS
OFFICE OF NUCLEAR REACTOR REGULATION
U.S. NUCLEAR REGULATORY COMMISSION

APRIL 7, 1994

AGENDA

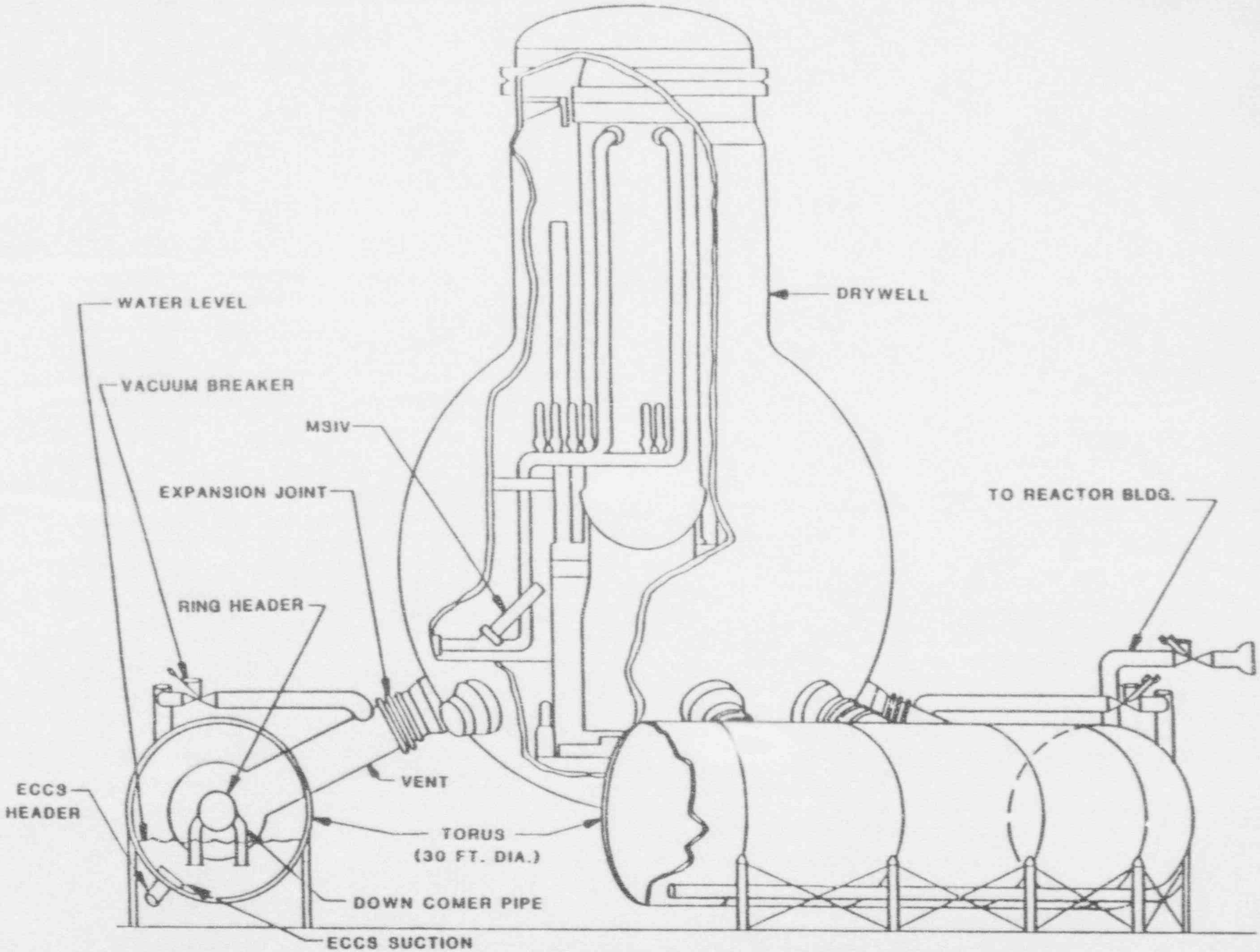
INTRODUCTION AND BACKGROUND

SUPPLEMENT 1 TO NRC BULLETIN 93-02

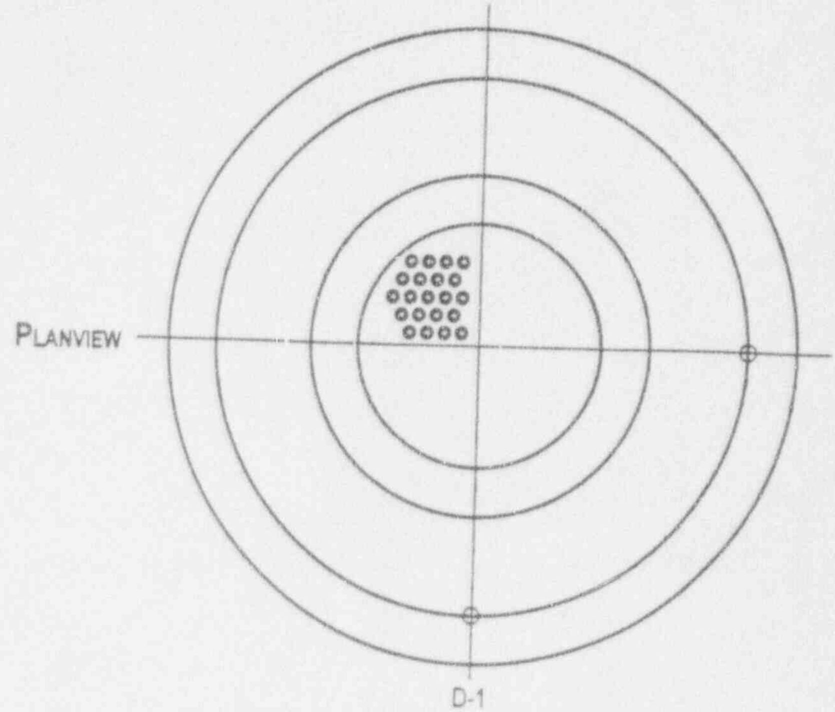
QUESTIONS AND DISCUSSION

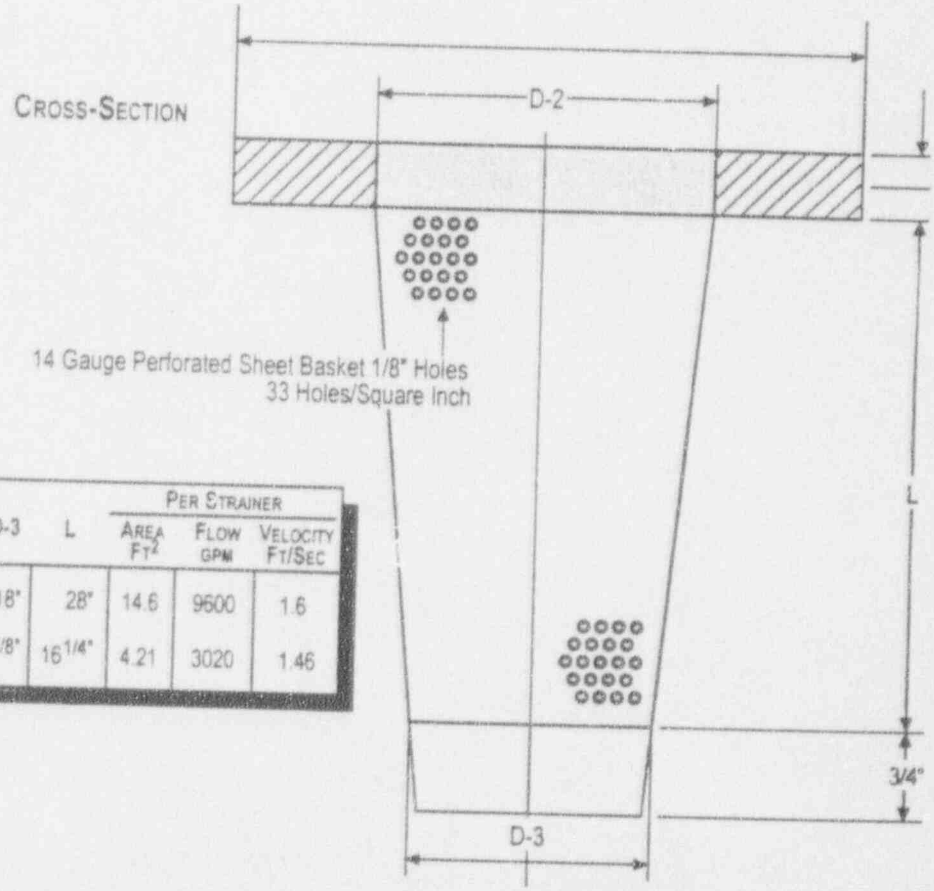
ISSUE

ISSUE: POTENTIAL COMMON CAUSE FAILURE OF ECCS, CONTAINMENT SPRAY AND CONTAINMENT ATMOSPHERE CLEANUP SYSTEMS DUE TO BLOCKAGE OF DEBRIS SCREENS CAUSED BY DISLODGED THERMAL INSULATION AND OTHER PARTICULATE DEBRIS



Primary Containment System





System	No.	D-1	D-2	D-3	L	Per Strainer		
						Area Ft²	Flow GPM	Velocity Ft/Sec
RHR	2	29"	24"	18"	28"	14.6	9600	1.6
CS	2	17"	12"	8 7/8"	16 1/4"	4.21	3020	1.46

Figure 3-15. Planview & Cross-Section of Strainer

BACKGROUND

- 1985 RESOLUTION OF USI A-43 "CONTAINMENT EMERGENCY SUMP PERFORMANCE"; ISSUANCE OF GENERIC LETTER 85-22, R.G. 1.82, REV. 1 AND NUREG-0897 REV. 1

  - GENERAL GUIDANCE/PLANT SPECIFIC ANALYSES NECESSARY.
    - NEED FOR 50.59 ANALYSES EMPHASIZED

  - USING DEVELOPED METHODS, MOST BWR STRAINERS UNDERSIZED.
  - DECISION NOT TO BACKFIT.
    - EXTENSIVE USE OF REFLECTIVE METALLIC INSULATION.
    - TRANSPORT ASSUMPTION PERCEIVED OVERLY CONSERVATIVE.

  - EMPHASIS PUT ON ADEQUACY OF PWR SUMP DESIGN

- BARSEBÄCK EVENT, JULY 1992:

  - STUCK OPEN SAFETY VALVE DISLODGED SUFFICIENT INSULATION TO CLOG STRAINERS.
  - CLOGGING COULD OCCUR FASTER THAN HAD BEEN ANTICIPATED.

- PERRY EVENT, MARCH 1993:

  - LOSS OF RHR PUMP DUE TO DEBRIS ACCUMULATION ON SUCTION STRAINER.
  - PROBLEM ATTRIBUTED TO FILTERING OF CORROSION PRODUCTS FROM THE POOL BY GLASS FIBERS ADHERING TO SURFACE OF THE STRAINER.
  - FILTERING PHENOMENA PREVIOUSLY UNRECOGNIZED.

  - STAFF ISSUED BULLETIN 93-02 IN MAY 1993

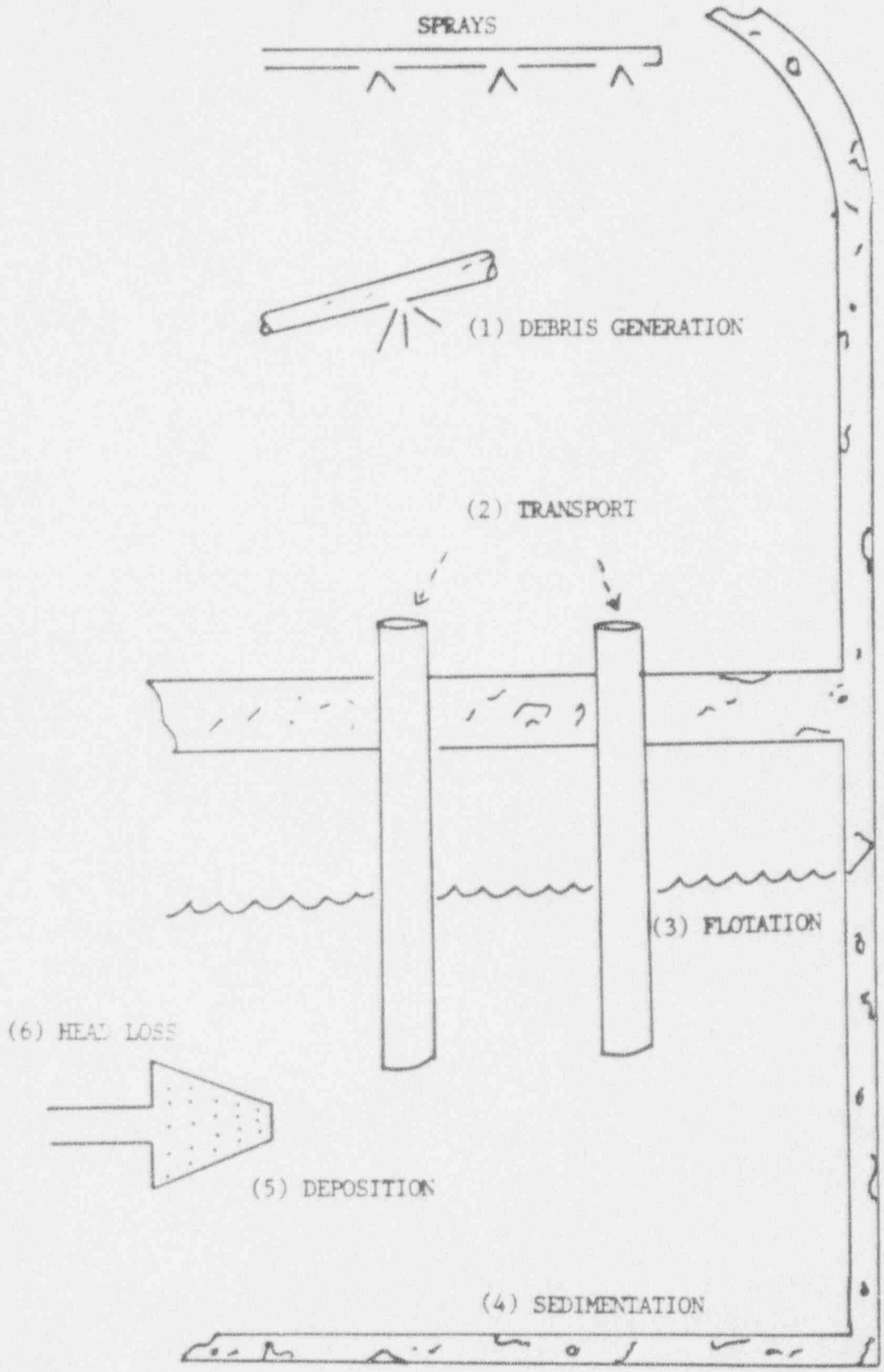
- FOLLOWING BARSEBÄCK, NRC STAFF PERFORMED CALCULATIONS FOR ALL DOMESTIC BWRs IN AUGUST 1993.

  - CALCULATIONS CONTAIN MANY APPROXIMATIONS ON PIPE LAYOUT, INSULATION THICKNESS, ETC.
  - CALCULATIONS SHOW POTENTIAL FOR LOSS OF NPSH FOR DOMESTIC BWRs. RESULTS SIMILAR TO SWISS CALCULATIONS FOR LEIBSTADT

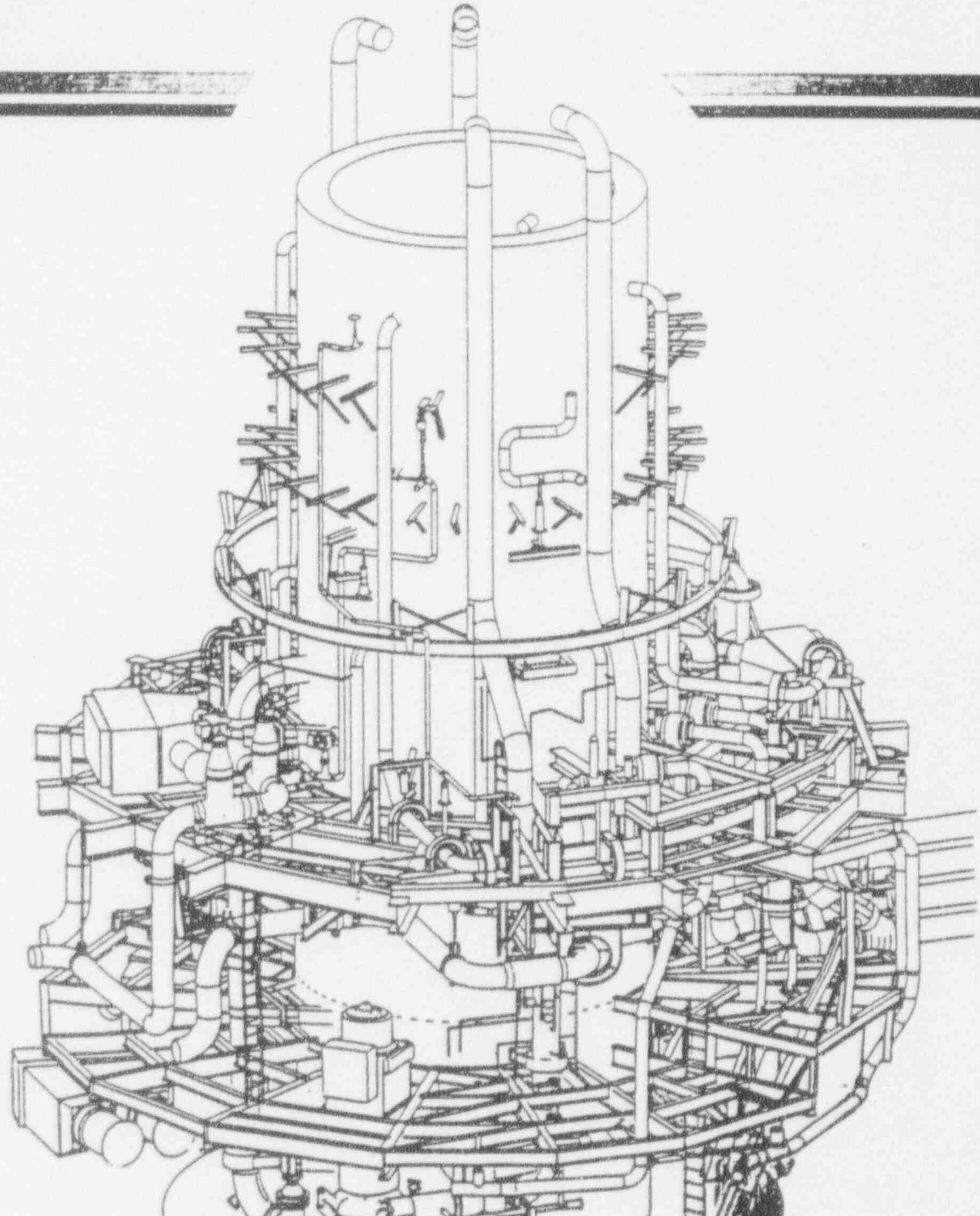
  - PROMPTED NRR REQUEST TO OFFICE OF RESEARCH FOR A DETAILED ANALYSIS.

- RESEARCH CONTRACTOR, SCIENCE AND ENGINEERING ASSOCIATES (SEA), PERFORMS A DETAILED ANALYSIS OF A REPRESENTATIVE BWR (BWR 4, MARK I).

- GOAL OF STUDY IS TO ESTIMATE LOSS OF NPSH MARGIN DUE TO STRAINER BLOCKAGE GIVEN A LOCA.
- PRELIMINARY FINDINGS OF STUDY INDICATE A CONDITIONAL PROBABILITY OF 0.60
- STUDY CONTAINS SOME CONSERVATIVE ASSUMPTIONS (E.G. TRANSPORT PROBABILITIES ARE HIGH).
- PRELIMINARY STUDY CURRENTLY DOES NOT MODEL EFFECT OF OTHER PARTICULATES IN THE SUPPRESSION POOL (E.G. CORROSION PRODUCTS, PAINT PARTICLES, ETC.).
- **ON BALANCE NON-CONSERVATISMS OUTWEIGH CONSERVATISMS.**
- STUDY IS ONGOING AND IS SCHEDULED FOR COMPLETION IN JUNE 1994.


SPRAYS
(1) DEBRIS GENERATION
(2) TRANSPORT
(3) FLOTATION
(6) HEAD LOSS
(5) DEPOSITION
(4) SEDIMENTATION

BWR Drywell Layout



- JANUARY 26-27, 1994 OECD/NEA WORKSHOP ON THE BARSEBÄCK STRAINER INCIDENT
  - ATTENDANCE FROM MANY FOREIGN COUNTRIES
  - DISCUSSION OF EXPERIMENTS, ANALYSES AND MODIFICATIONS MADE BY OTHER COUNTRIES
  - NRC AND BWROG REPRESENTATIVES ATTENDED
  - RESULTS OF MANY EXPERIMENTS AND ANALYSES PRESENTED WHICH REINFORCED STAFF VIEW THAT EXISTING NRC GUIDANCE MAY BE NON-CONSERVATIVE.
  - FURTHER EFFORT BY INTERNATIONAL WORKING GROUP PLANNED. FIRST MEETING IN APRIL 1994.

- SEA STUDY AND JANUARY 26-27 OECD/NEA MEETING RESULT IN DECISION BY NRC TO ISSUE AN URGENT COMPLIANCE BULLETIN AS AN INTERIM MEASURE UNTIL FINAL RESOLUTION OF ISSUE.

- EVENTS AND EXPERIMENTS IN THE PAST 18 MONTHS HAVE CHANGED PERSPECTIVE IN THREE KEY TECHNICAL AREAS:

  - **DEBRIS TRANSPORT**
    - AT BARSEBÄCK, 40 TO 50% OF DEBRIS ESTIMATED TO REACH POOL; A LARGE FRACTION OF THAT WAS DEPOSITED ON STRAINERS.
    - EXPERIMENTS INDICATE THAT 10% TRANSPORTS TO POOL DURING BLOWDOWN; ADDITIONAL TRANSPORT DUE TO SPRAY OPERATION
    - DEPENDS ON PLANT GEOMETRY AND BREAK LOCATION.
    - NUREG-0897 REV 1 NOT AS CONSERVATIVE AS PREVIOUSLY ASSUMED.

  - **HEAD LOSS**
    - NEW EXPERIMENTS PERFORMED BY SWEDES, SWISS AND INSULATION VENDORS WITH SAMPLES MORE REPRESENTATIVE OF ACCIDENT CONDITIONS.
    - HEAD LOSSES RANGING FROM 2 TO 10 TIMES HIGHER THAN NUREG 0897 REV 1 CORRELATIONS FOR LOW DENSITY FIBERGLASS.

- **FILTERING PHENOMENON**
  - SECOND PERRY EVENT DEMONSTRATED TRAPPING OF CORROSION PRODUCTS BY FIBROUS MATERIAL DEPOSITED ON STRAINERS.
  - HEAD LOSS NO LONGER LIMITED TO THE EFFECT OF INSULATION ALONE.
  - NO QUANTITATIVE INFORMATION ON THE MAGNITUDE OF FILTERING EFFECT.

SUPPLEMENT 1 TO NRC BULLETIN 93-02

- THE BULLETIN IS A COMPLIANCE BULLETIN.

- THE BULLETIN INFORMS LICENSEES OF NEW INFORMATION, SAFETY PERSPECTIVES AND THE NEED FOR ACTION.

- BULLETIN SENT TO PWR LICENSEES FOR INFORMATION.

- BULLETIN REQUESTS BWR LICENSEES TO IMPLEMENT THE FOLLOWING INTERIM ACTIONS IN THE SHORT TERM:

  - APPRISE OPERATORS OF THE VULNERABILITY TO SUPPRESSION POOL STRAINER CLOGGING THROUGH TRAINING AND BRIEFINGS.
  - ENSURE THAT SYMPTOM-BASED PROCEDURES COVER POTENTIAL LOSS OF NPSH.
  - INSTITUTE PROCEDURES TO TAKE COMPENSATORY ACTIONS AS APPLICABLE:
    - REDUCTION OF PUMP FLOW, WHERE POSSIBLE
    - REALIGNMENT OF EXISTING SYSTEMS TO PERMIT BACKFLUSHING STRAINERS, IF POSSIBLE.
    - INTERMITTENT OPERATION OF CONTAINMENT SPRAYS, IF POSSIBLE.
    - ALTERNATE WATER SOURCES.
    - OTHER PLANT-SPECIFIC MEASURES WHICH ASSURE AVAILABILITY OF SUFFICIENT CORE AND CONTAINMENT COOLING.

SUPPLEMENT 1 TO NRC BULLETIN 93-02 (continued)

- ALL BWRs ARE REQUESTED TO IMPLEMENT THE INTERIM ACTIONS WITHIN 90 DAYS.
- ALL BWRs ARE REQUIRED TO PROVIDE A WRITTEN CONFIRMATION OF COMPLETION OF INTERIM ACTIONS TO THE STAFF WITHIN 30 DAYS AFTER COMPLETION.
- ALL BWRs ARE REQUIRED TO INDICATE WHETHER THEY INTEND TO IMPLEMENT THE INTERIM ACTIONS IN THE BULLETIN AND PROVIDE A DESCRIPTION OF THEIR INTENDED ACTIONS WITHIN 60 DAYS OF THE DATE OF THE BULLETIN.
- PWRs HAVE SUMP SCREENS WITH LARGE AREAS. LOW APPROACH VELOCITIES. THEREFORE, ACTION ON PWRs CAN BE DEFERRED UNTIL RESOLUTION OF THE BWR ISSUES.

GE - ABWR
QUALITY ASSURANCE/DESIGN CONTROL INSPECTION

- Inspection conducted on September 7 - 10, 1993.
- Limited GE technical review of supporting calculations generated by International Technical Associates.
- GE audits of Technical Associates were programmatic in nature.
- GE corrective/preventive actions proposed for inspection issues.
- Follow-up inspection conducted on March 22 - 24, 1994.
- Reviewed design documentation related to GE interaction with Technical Associates.
- Found sufficient evidence of GE technical oversight of ABWR design evolution.

GE Nuclear Energy

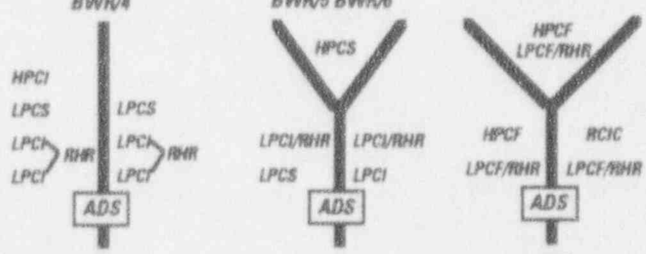
ECCS Suction Strainers

Presentation to ACRS

C. D. Sawyer, Manager,
ABWR Engineering

April 7, 1994

ECCS Key Performance Features



	Typical BWR/4	Typical BWR/5 BWR/6	ABWR
High pressure capacity	5000	1900	2800
Low Pressure capacity	42000	29000	19000
No. of large pipes below core	12	12	0
Peak clad temperature (App K), °F	1600	1100	No uncovery
Operator action	Required	Required	Automated-72 hours
N-2 capability	None	All but HPCS break	All but LPCI (A) break
On-line repair	None	None	Yes

Suction Strainer Issue

- GE originally committed to meet RG 1.82, Rev 1, for all ECCS suction strainers
- NRC Bulletin 93-02 described blockage from events at a European plant and at Perry which indicated existing regulatory guidance may not be sufficient
- GE was requested to address this issue for ABWR. In a December 29, 1993, letter the staff formalized its position by requiring a factor of three margin beyond RG 1.82, Rev 1, for the RHR suppression pool strainers. Open item F6.2.1.9-1.
- GE agreed to meet RG 1.82, Rev 1, with factor of 3 uncertainty factor for RHR strainers for all breaks except main steamline break. For this case, normal shutdown cooling can be used for long-term heat removal. The issue was closed - see March 9, 1994 letter to ACRS
- NRC reopened the issue in a March 30, 1994, letter to GE to also include RCIC and HPCF strainers:

> ". . . all ECCS suction strainers be sized to three times the area that would be calculated based on Reg. Guide 1.82, Rev 1. The sizing of each strainer should consider all LOCA scenarios for which that system impacts the design basis or the probabilistic safety assessment (PSA) risk, or is relied upon within the EOPs."

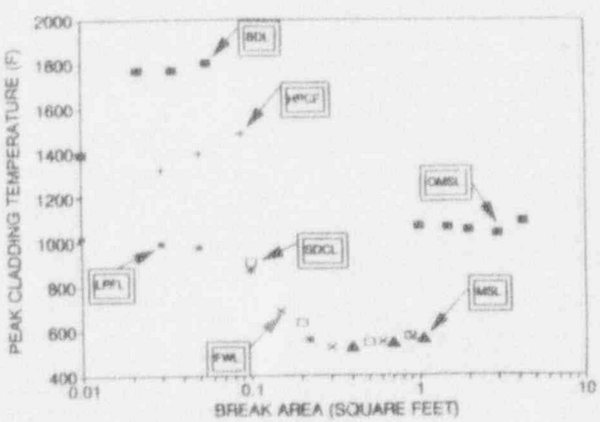
ECCS Success Requirements

- Core cooling function
  - One motor-driven pump will meet Appendix K, but
  - Small breaks (<5 cm² liquid or <280 cm² steam) RCIC alone can mitigate
  - Medium breaks (5cm² to 280 cm² liquid) ADS is required
  - Large breaks (>280cm²)
- Decay heat removal function
  - Two RHR systems within design basis Peak pool temp <207° F
  - One RHR system within PRA basis

Deterministic Evaluation

- *RCIC*
  - *Important factor for transients and small breaks*
  - *Virtually irrelevant for medium and large breaks*
  - *Primary suction from condensate storage tank*
- *HPCF*
  - *Important factor for transients and small breaks*
  - *Helps meet no core uncovery for medium and large breaks*
  - *Primary suction from condensate storage tank*
  - *For limiting analyzed design basis LOCA HPCF is not available*
  - *SSAR analyses performed for limiting events in which only low pressure systems are available shows PCT <1000°F*

SSAR Figure 6.3-76



Probabilistic Evaluation

- Core Damage Probability (CDP) 1.6E-7
- Medium LOCA CDP 3.4E-10
- Large LOCA CDP 9.0E-11

- RCIC
  - No credit was given to mitigate medium and large LOCAs
- HPCF
  - Fault trees were reun with strainer plugging probability set to 1
  - Very small impact on system unavailability
  - No effect to 3 significant figures on CDP

EOP Evaluation

- EOPs are not the basis for deciding design requirements
- No implications to operator to preferentially use safety-grade equipment, or assumptions that safety-grade equipment will work if selected
- Large menu of available options for medium and large breaks
  - Pumps
    - 2 HPCF
    - 3 RHR/LPFL
    - 4 feedwater condensate
    - firewater delivery
  - multiple water sources
    - suppression pool
    - condenser
    - condensate storage tank
    - external fire water connection

Conclusion

- GE has already accomodated NRC's uncertainty concerns by applying a factor of 3 design margin to relevant events for the RHR strainers
- A rereview of ECCS requirements from deterministic, probabilistic and EOP considerations shows no technical rationale for additional requirements on RCIC and HPCF strainers