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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

DATE: October 31, 1989

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Meeting of the Advanced Boiling

Water Reactor Subcommittee

7920 Norfolk Avenue

Room P110

Bethesda, Maryland

Tuesday, October 31, 1989

The above-entitled proceedings commenced at 8:30 o'clock a.m., pursuant to notice, Carlyle Michelson, committee chairman, presiding.

PRESENT FOR THE ACRS SUBCOMMITTEE:

D. Ward

I. Catton

H. Alderman, ACRS Staff Member

D. Okrent, ACRS Consultant

PARTICIPANTS:

GE PRESENTERS:

J.F. Quirk

C.W. Dillman

A.J. James

G.W. Ehlert

P.E. Novak

NRC STAFF MEMBERS:

Mr. Scaletti

Mr. Miller

Mr. Thomas

Mr. Tsao

Mr. Brammer

Mr. Chandra

P R O C E E D I N G S

[8:30 a.m.]

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

I'm Carlyle Michelson, Chairman.

The other ACRS members in attendance are Ivan Catton, David Ward.

Also in attendance is ACRS Consultant David Okrent.

Today's meeting will include a review the staff's safety evaluation report for Module One of the General Electric Company's Design for the Advanced Boiling Water Reactor.

Herman Alderman is the cognizant ACRS staff member for today's meeting.

The rules for participation in today's meeting have been announced and are part of the notice that was published is The Federal Register on October 11, 1989.

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

We have received no written or oral statements from members of the public.

It is requested that each speaker identify himself or herself and speak with sufficient clarity and volume so that he or she can be readily heard.

With those few introductory remarks, I will first see if I have any questions?

[No response.]

I am a little concerned about the status of the SAR with a large number of open items, information I have not received, and so on. I think there or a lot of open items.

I think the Committee should give careful thought, though, in terms of how we should proceed in going to the full committee at this time. We are presently scheduled to go from 8:30 to 12:30, something like that. We need to give serious thought as to whether we go to the full committee and if we do, what kind of letter we wish to take to the full committee to be proposed. We will have to put such a letter together between now and then.

I would like some direction as to how the Subcommittee feels about the situation.

I also think there is a question in my mind at least about how it is received. We have an agenda on which there are various items of the SAR. I have a number of questions on each item. I guess it would be better to just wait until the formal presentation on that particular item and then entertainment questions and then maybe give the Subcommittee members time to review them. These are basically the odds and ends kind of questions that just don't fit into the presentation. We will pick these up at the end of each particular section.

I would like to have as complete information as possible.

With those introductory remarks, do any other Subcommittee members have any questions or comments?

MR. WARD: I don't.

MR. MICHELSON: Do you have any?

MR. CATTON: No.

MR. MICHELSON: Let's proceed on this basis and see how it goes but please keep in mind of giving very careful thought as to where we go from here since this is presumably a SAR on which we would do a final write-off. Actually that is not possible though that was the original agreement and it is still our intention. The question is how much of this can we write off at this stage of the game?

MR. CATTON: Maybe we should get the other half of it?

MR. MICHELSON: It is certainly an incomplete SAR. I looked at the SAR to see what was there and I can see why the staff raised a number of questions. I guess part of the problem is the question-and-answer process doesn't move quickly enough to get the answers into the SAR to get it out but the staff will give us more information later.

I looked at the licensing agreement and definition of an "open item," and this appears to be an item because it was covered in other parts of the SAR as well it is now "closed" in those other parts. I find that open items are items that they just don't have the information yet on but those are different open items that were given to other parties so the staff will clarify that as we proceed today.

Okay. With those comments, then, I believe Mr. Scaletti is going to be first up -- Charlie Miller is going to do it.

Charlie, would you like to give your overview then?

MR. MILLER: I just have a few opening remarks, Mr. Chairman, and then I will turn over the presentation to D. S. Scaletti who is the project manager. Mr. Scaletti will be orchestrating the staff's presentation but during the course of the day various staff members will speak on portions of the SAR and will be able to answer any questions that you have concerning this.

I think our intent today is to try to be as specific as we can concerning the status at this time and answer any questions that you have concerning the chapters or subchapters or sections of the chapters that are before you.

MR. MICHELSON: Along that line it would be helpful at least to me if you would identify, insofar as possible at least, what areas you think are finished and for which you would like to see an endorsement of the ACRS so at least our letter, whatever letter can write, I hope will button up things and that everybody is satisfied with but I'm not quite sure in reading the SAR things those are because some of them aren't too clear as to whether the staff is even happy. We don't want to write a letter until we think we have reached the point that it is possible to do so.

Could you indicate, you know, where you think you're finished?

MR. MILLER: We will be able to do that as we proceed.

I would like to turn the meeting over now to Mr. Scaletti for presentation of the overview. From there we can proceed with the individual chapters.

Thank you.

MR. SCALETTI: Good morning.

[Slide.]

MR. SCALETTI: I will try to get through this as quickly as possible. As you can see right now, I'm trying to address some of Mr. Michelson's concerns with regard to the outstanding issues on the SSAR for the ABWR.

Fourteen of those issues are specifically related to information that is to be presented to the Committee and to the public in leader modules, Modules 2, 3, and 4 of the safety evaluation reports. I think this is basically the licensee review basis which is included as an appendix in the first module that was issued in August of this year.

MR. MICHELSON: Is that some of the material that is complete and only covered in this particular chapter? It's not considered an open issue? It's just additional information?

MR. SCALETTI: That's correct; incomplete information. It's just not part of a schedule that is presented at that time. In some cases, that information was not available at that time for the staff to complete its review on.

As you are well aware, the application came in over a period of a year, a year-plus, starting with Modules 4, 5, and 6 of the SSAR. So it was just a matter of trying to maintain some sort of recordkeeping for review. I planned to do this in each subsequent module. I plan to identify -- When I issue the module, I plan to identify those modules that have not been included in the SAR so that I will have a running record of all of the issues and the chapters that are necessary to complete the review.

MR. MICHELSON: Why do you have an open item that deals only with Chapter 4 when Chapter 4 is the subject of the SAR?

MR. SCALETTI: Well, all I'm saying is that there are 14 of the open issues in the supplement or in the SAR which relate to un-reviewed SSAR chapters, period; that's it. They are identified as that chapter being outstanding. There are 16 really; 17; there's one that I missed. Seventeen of those outstanding issues are concerned with Chapters 4, 5, and 6.

There are no outstanding issues in Chapter 17. That is all I am saying.

There are a multitude of issues that are open in Chapter 4, as well as 5 and 6 because of 17 there are outstanding issues.

MR. MICHELSON: They are open not because they are covered elsewhere, but because you don't have enough information yet or something of that sort to review?

MR. SCALETTI: They're there because the information is not yet satisfactory to the staff. They're there because some of the information the staff has to make decisions on which deal with containment venting system which is before the staff, which we have to come to grips with; how we are going to deal with this. GE has provided the information.

Some of the information, source terms, we have to come to grips with. So we have certain things. The removal of the isolation valve leakage control system, the information is before us. The staff has to deal with that issue. I'm not saying all information is in necessary for us to complete the review, but we have to make the decision on which way we are going to go before we get back to General Electric for more information if we do need it.

MR. WARD: So these aren't cases where you have gone back and asked questions or made a request further information or are just waiting for that? You haven't decided whether you need more information?

MR. SCALETTI: We haven't decided whether we need more information.

In some cases, we believe we believe we need more information. It is just a sensitive issue before the Commission. We have to wait until the Commission acts on this issue before we feel we have --

MR. WARD: Okay. So you are looking for some kind of general policy guidance from the Commission on certain issues?

MR. SCALETTI: That's correct.

MR. WARD: In what form is that going to come?

MR. SCALETTI: It would come back to the staff requirement document or memorandum to the staff directing us how to deal with with this or telling us that our proposal, the way we want to deal with it, is satisfactory to the Commission or they ask for more information to make their decision.

MR. WARD: I'm trying to find out how are those questions placed before the Commission at the present time?

MR. SCALETTI: The Commission has asked the staff to address these issues through staff requirements memoranda. We have now, I believe, four -- we have answered two. We have a couple of more to answer now and we propose a schedule to the Commission which we will answer.

MR. MICHELSON: The slide which you apparently didn't prepare which I found even as interesting and as it is, there are a number of sections in these chapters where it just says "we're going to do this later in amendment so-and-so." Those aren't open issues necessarily. It's just things you haven't done. Will they be covered as part of that chapter?

MR. SCALETTI: Again, some of those in Chapter 6, one of the issues deals with containment which comes to grip with the issue of containment venting prior to providing a safety evaluation. The Commission has to come to grip with that issue of containment venting.

MR. MICHELSON: We will get to that later, but I would like to go through the chapters and point out to you where I don't think it's an issue, but you just haven't told us anything yet and you don't tell us much later.

MR. SCALETTI: One of the issues is the one I just mentioned, which is venting. I thought for the sake of brevity it was easy to say it was going to be provided later. But even though we have had some discussion with GE, many discussions with General Electric, we have discussed it with the Commission in general.

MR. MICHELSON: That is understandable. Some of those we will talk about later that are a little less clear.

MR. SCALETTI: Again, Chapter 17 is complete as far as the staff is concerned. We would certainly like to get out a letter on that one for sure, as well as some of the other sections.

MR. MICHELSON: My problem with Chapter 17, I don't have the QA plan that is Chapter 17 but there is a reference.

Did any of the Subcommittee members receive a QA plan; and it wasn't scheduled to be a part of this module, so we hadn't asked for that sort of thing. I doubt seriously we could write a letter on Chapter 17 without seeing the QA plan. The problem there is that we just didn't get it.

MR. SCALETTI: We will assure you that you will get copies of it.

MR. MICHELSON: I think we can do it on our next letter, and I didn't see much a problem with it except I had nothing to read to speak of.

[Slide.]

MR. SCALETTI: Module 2, Safety Evaluation. It would include site characteristics and design criteria for structures, systems, and components.

There are those two chapters as well as an additional stuff in Chapter 1, that will be the next module we will issue.

Again, hopefully, we'll be able to respond to some of the open, outstanding issues at that time. If we should complete another section if we could put in there, I will include that also.

MR. MICHELSON: If you do, please let us know a little ahead of time so we can do some kind of preparation.

MR. SCALETTI: I will do that.

[Slide.]

MR. SCALETTI: Module 3 is made up, again, these outstanding issues. Again the staff has them under review. However, they are not ready for write-out for the safety evaluation report yet.

[Slide.]

MR. SCALETTI: The last module, which is Module 4, will include Chapter 15 analysis, tech specs, control room design review, as well as the severe accident design considerations.

MR. MICHELSON: That will be where the PRA will be also?

MR. SCALETTI: That's correct. It will be included in Chapter 19.

[Slide]

MR. SCALETTI: Getting down to the outstanding issues which are included within the chapters of the safety evaluation that you got back in August, Chapters 4, 5, and 6, Fuel System Design, Section 4.2, again, is one of the ones we said we would provide later.

Staff has that review, as well as the 4.3 and 4.4 essentially completed. It has been a matter of trying to define the fuels criteria in a manner which we feel would be acceptable in a design certification, rather than a blanket approval of "G-Star." This would be included as a criteria included within the design certification and somewhat independent of General Electric's "G-Star" or fuels document.

These standby liquid control system reliability analysis; we have the information. Again, it came in just recently. We have that under review. Hopefully, at the time of the next safety evaluation, we will be able to issue that.

MR. MICHELSON: We haven't received it yet.

MR. SCALETTI: No, you haven't received it.

MR. MICHELSON: So we are not including 4.6 as a part of our letter.

MR. SCALETTI: You will not include any of these as part of your letter.

MR. MICHELSON: I hope you won't include Chapter 4, because there's nothing else in it but the materials. That is the only thing in Chapter 4, in fact, that you gave us in the SER.

MR. SCALETTI: I agree.

MR. MICHELSON: Now, maybe we can write off on the materials. Is that your desire? Are you finished on those materials as far as getting a writeoff?

MR. SCALETTI: Yes.

MR. MICHELSON: You have a few unidentified open items there that will remain open for some time.

MR. SCALETTI: I understand the resolution of the outstanding issues.

John?

John Tsao from the staff.

MR. TSAO: I am John Tsao from the Materials and Chemical Engineering Branch.

As far as the reactor vessel material goes, there are no open items and the review is complete. So is Volume 4 where we reviewed the control rod materials and the reactor internal materials, those two sections are complete.

MR. MICHELSON: You said Section what?

MR. TSAO: 4.5.1 and 4.5.2.

MR. MICHELSON: Right.

MR. TSAO: 4.5.1 is a control rod drive structural materials and 4.5.2 is the reactor internal materials. Those sections are complete and there are no open items.

MR. MICHELSON: So you are ready for a letter on that as far as your side is concerned?

MR. TSAO: That's right, and also, Chapter 5.

MR. MICHELSON: Let's just talk about Chapter 4. So our letter on Chapter 4 can only do one thing; talk about these materials. That's all we are ready for.

MR. SCALETTI: Well, the control rod drive system is complete, as far as I know. I think the only outstanding issue is the final report of the in-plant test. I believe we just received that report a week or two ago.

MR. MICHELSON: So you think you are ready for a letter on 4.6 as well?

MR. SCALETTI: I think so.

MR. MICHELSON: Thank you.

MR. SCALETTI: Again, as I said, in 4.6, the in-plant test program, the test of the fine motion control rod we have just received so we're going to review that.

The outstanding issue No. 8; ASME Code Cases N-433 and N-451, GE has indicated that they are planning to drop the request to have those two reviewed and approved. The TMI Action Item relating to the safety relief valves; the information has been received and it is under review.

MR. MICHELSON: We weren't aware from reading the SER that GE decided to drop those.

MR. SCALETTI: That's correct.

MR. MICHELSON: The letter gets a little confusing. We will have to write the letter per the SER.

MR. SCALETTI: I agree. I will give you the status of that report right now.

[Slide.]

MR. SCALETTI: One of the ones that was missing was in the document that's missing in Section 1.8 was compliance with NUREG-0313, Rev. 2; GE indicated they will comply.

The in-service testing and inspecting and the pre-service inspection --

MR. MICHELSON: Did you skip a slide that we have? My next slide starts with 4.6, 5.2.1.2, and so forth and then it goes down to the one you are showing.

It has items 7 and 8 and 9 on it.

MR. SCALETTI: I just went through 7, 8 and 9.

MR. MICHELSON: I missed that. Yes, you did. You mentioned it. Okay.

MR. SCALETTI: That issue GE has not indicated what their plans are. They indicated they have it under evaluation.

Cleaning of the stainless steel components, GE has indicated they will respond in Amendment 9 which should be coming in shortly.

MR. MICHELSON: Let me ask specifically on Chapter 5. There are a number of flow diagrams and so forth in that five-point summary description. Since you really didn't say anything in your SER about them, I assume that you have reviewed and are essentially happy with all of those diagrams; is that correct?

MR. SCALETTI: 5.1 of the SSAR?

MR. MICHELSON: Yes.

MR. SCALETTI: I would have to say "yes."

MR. MICHELSON: We will raise some questions later about those flow diagrams. I had to work on the assumption you reviewed them and essentially wrote off on them since you didn't mention them. This is getting to be important because some of these are pretty important diagrams and I think they would be at least worthy of a note on an SAR that you looked at them and had no problem with them.

MR. SCALETTI: Staff has a standard review plan which dictates to it what the review will constitute for the designs.

MR. MICHELSON: Does it go into detail like the summary description? I don't know if that's the place where you reviewed a schematic in detail or not but it didn't seem to raise any questions either.

MR. SCALETTI: The schematics have been reviewed by the staff. Whether or not each and every one has been reviewed, I don't know specifically. We had requested full-sized versions from GE to review these.

We'll have to address that with a specific review of the plan at the time.

MR. MICHELSON: That was the intention though, even though not mentioned everything in the SER you have read. Does that mean everything you have referenced is covered by your SER has been reviewed to whatever extent you wish and you have no problem with it? Is that the basic approach?

MR. SCALETTI: We should have read and reviewed the whole SSAR.

Now, GE may have included some superfluous information in there that wasn't necessary. I'm not sure. I doubt if they included more than they had to include so I would assume most of the stuff in there has been reviewed.

[Slide.]

MR. SCALETTI: Again, some of the TMI-2 action items, we have the information.

I guess one of the things I failed to include in one of the earlier slides is that the TMI action items are being reviewed as a group and will be included in the last module. So I did leave that off. Certainly I should make you aware of that.

Okay, containment systems -- we brought this up earlier -- is an issue that we have been discussing with the Commission and with the industry. Until we have this issue -- the Commission has addressed it and feel happy with the course of action the staff has taken, it will remain an outstanding issue and that is why it is identified as a staff action.

MR. MICHELSON: I wonder if you would mind summarizing what you believe what the course of action that the staff has taken?

MR. SCALETTI: Some of the course of action the staff will take? Currently the staff believes the proposal that we have in front of us that GE has supplied as to the overpressure protection for the ABWR containment is the way you should go. The Commission and industry is not unified in that opinion. The Commission is listening to industry from all sides with regard to the ABWR overpressure protection, how it would relate to the other standard designs. We feel the ABWR is the correct way to go. We don't necessarily believe that the large containments and overpressure protection device built in but we do think the ABWR takes care of it.

That is staff opinion right now.

MR. OKRENT: Is that the only feature or different arrangement that you include under the term "containment systems"?

MR. SCALETTI: No.

MR. OKRENT: I'm trying to understand. You say, if I heard correctly, the approach to overprotection that GE is taking is the way to go. I assume you had something specific in mind and some other things presumably not in mind. Could you be more specific?

MR. SCALETTI: I will be as specific as I can.

We have before us a proposal from General Electric to deal with both overpressure and containment. We have had discussions with GE along these lines. General Electric has given us a design. The one they've provided it to us now is a passive device with a blowout diaphragm at the end of the line to allow the containment to rupture just prior to reaching ultimate strength.

The staff is not sure whether that is the best way to go or not or to make it a more active type device with the ability to vent at more opportune times if they feel necessary. We have not come to grips with that yet.

It is an issue we still have under discussion and so until we can determine that we can proceed with it, with an overprotection device as a feature that ABWR, the Commission has agreed to can do that -- that is about all I could say.

MR. OKRENT: If I can indicate why I'm asking this question, if I may, Mr. Chairman.

MR. MICHELSON: Yes, sir.

MR. OKRENT: As I read sections of the GE submittal, on the one hand they included a feature to bring backwater to cover molten core, should that get the bottom of the drywell through the vessel, it wasn't clear to me whether in your statement that what GE is doing is the way to go that was included. And on the other hand, they seem to have -- by the way, they didn't give, at least in what I read, a detailed phenomenological discussion of what might occur when this cool water and hot material first met.

On the other hand, they seemed to have judged that steam explosions per se are not a threat to containment integrity and apparently they have only one area of containment bypass that they think is potentially significant.

I don't think it includes the Vent B which was an earlier concern.

So I'm trying to understand what your original statement meant that GE is proposing is what the staff thinks is the way to go.

MR. SCALETTI: Well, I don't know if you received a copy of it or not but back on May 10th of this year, the staff sent to the Commission 70-89-453 which details the ABWR design features -- severe accident design features, what the staff thought of these design features, and the overall conclusion was that we felt it would take care of the Commission's severe accident concerns. However, the reviews on these issues haven't been completed yet. This covered the containment overpressure protection. It covered drywell and core flooding device. It covered the independent AC water makeup system. It covered the AC combustion turbine. It covered some other issues.

So I would be glad to provide you with a copy of that if you don't have it.

MR. OKRENT: If I have a copy, it has been buried in a mass of other materials so I would appreciate getting a copy.

Thank you.

MR. SCALETTI: Containment leak testing: Again, the information will be provided. The additional information coming in from GE will be provided in Amendment 9.

The control room habitability information has been provided to the staff and is under review and will be in the last amendment.

[Slide.]

MR. SCALETTI: The atmosphere clean-up system will be provided in a later SSAR supplement. GE has not indicated which one.

The main steam isolation valve leakage system: again, is one of the issues the staff has to say "yea" or "nay" before we do anything further, to see if we need any additional information. It clearly is an action which is still open.

MR. OKRENT: Can I come back to that previous SECY paper that you mentioned?

MR. SCALETTI: Sure.

MR. OKRENT: Just so I know. Was it that the staff thought there was sufficient information in hand on all of these features now to arrive at a judgment or that it was --

MR. SCALETTI: Clearly there is not enough information at hand right now. The information provided by GE has been very preliminary, and there is no detail associated with some of these things. Some is more clear-cut than others. The AC combustion turbines is one that is pretty clear-cut and the industry wants that. General Electric said they would provide it as part of the ABWR design. It was just a matter that the only reason the staff feels they needed it was that it was three diesels and the three independent trains.

Again, some of the other issues, such as the overpressure protection, how it is going to operate, is something we have to come to grips with. It is the way General Electric wants it, but certainly it is a very simple pass-through system which will rupture just before you expect the containment rupture under pressure.

The reviews aren't completed on these issues. We still need more information to complete our review, but we felt the innovations that GE had to pursue severe accidents early on in the process was what we would like to see from a vendor in dealing with their design up front, and giving us the features that we felt would be used with that design.

MR. OKRENT: The fact is, it is a very good idea to see it up front.

In the area of the recovery or the covering for the first time the molten corium, the water coming in, that is a little confusing section. Are there any research needs there, or is that just a question of more information, but not requiring research?

MR. SCALETTI: I believe there is ongoing research in this area. There is a difference of opinion among the staff as to whether or not steam explosions will exist or whether it's a good idea or not to do it. And this is something that is going to have to be resolved by the time the severe accident review is complete.

MR. OKRENT: But there is some mechanism or research progr that you people think will provide the information to enable this resolution?

MR. SCALETTI: I'm sorry. I guess I didn't understand. Is there a mechanism?

MR. OKRENT: Is there some mechanism or some research program so that the staff is satisfied will provide enough information to resolve whatever the cause of the current difference of opinion is?

MR. SCALETTI: Well, all I can say right at the moment is the Office of Research is the office that does the severe accident review for the Office of Nuclear Reactor Regulations. They have indicated some ongoing -- some branches, some sections of Research have indicated there is ongoing research on this area. We should look for it -- well, there is ongoing research, and we shouldn't make hasty conclusions with regard to core flooding. Again, that is something that is going to have to be resolved by the completion of Chapter 19, which is the last one. That is all I can tell you on that.

MR. OKRENT: Is it the NRC's job to examine this and supply the information necessary for its resolution, or is it the applicant's part?

MR. SCALETTI: Well, in some cases, I am sure NRC has research ongoing. I would assume the industry has research ongoing in these areas. It includes responsibility. It is ultimately -- I don't know, as long as the information is there, it is our responsibility to license a safe reactor, and the ultimate responsibility of who provides the information, I don't think is that important, as long as the information is there.

MR. CATTON: Doesn't somebody in your area have to know where the information is coming from?

MR. SCALETTI: Sure.

MR. CATTON: Is there any way I could find out which research programs are addressing these issues?

MR. SCALETTI: You will have to talk to Research. I will see what I can find out from Research.

MR. CATTON: Okay.

MR. SCALETTI: We don't have Research people here today.

MR. CATTON: I don't know of any of their programs that are addressing this particular issue in a meaningful way. Now, I may be wrong.

MR. MICHELSON: I would like to ask a general question. I went back and looked at your letter of August 7th, 1987, which dealt with the licensing review basis, Section 8.4 of that letter, called "ABWR Design."

The last paragraph states, and I will quote:

"The degree of design detail necessary providing essentially complete design is to be that detail that is suitable for obtaining specific equipment, and for construction bids, and to demonstrate conformance to the safety, the design safety limits and criteria."

Now looking at the SAR and your SAR evaluation, sometimes I think there is probably enough information to demonstrate the conformance. In many cases there isn't the kind of information that would be suitable for obtaining specific equipment or construction. Now that level of detail simply isn't there. It was agreed to in the original design basis.

We had long discussions about the completeness of design and the design I have been reviewing certainly is not complete, and not complete by this kind of definition, at least. Perhaps complete in some cases to be able to demonstrate conformance. In many cases, it's not complete enough to procure the equipment.

MR. SCALETTI: If you consult the SSAR, you are probably right.

MR. MICHELSON: What else do I look at? That is the document we are reviewing.

MR. QUIRK: My name is Joe Quirk from GE.

As I recall, Mr. Michelson, the section you were asking about, there are two parts that describe the information. One part, which is that which will be in the standardization analysis report; and the other part is that which will be available in back-up documentation at GE. And the sum of those two --

MR. MICHELSON: Well, I don't know; when I look at a flow diagram, and I look at the PNID, it doesn't even tell me what the size of the pipe is yet, it is hard for me to believe that is essentially complete. But I guess if I went to GE and sifted through enough drawings, I might find the drawing that would have the pipe. I don't know.

But there is a limit to what we can do. And we were supposed to be -- I thought we were dealing with an essentially complete design. That was our understanding of what was going on by the definition in your licensing basis letter.

MR. SCALETTI: By definition, I agree. However, that is not normally the level of information that we receive as part of an SSAR application.

MR. MICHELSON: I agree with that.

MR. SCALETTI: We would expect General Electric to have this information in their design offices. If the staff felt they needed this additional information, it would be there. If it wasn't there, then we would have to find out why.

MR. MICHELSON: Well, your licensee basis agreement letter doesn't lead me to quite that same conclusion. I don't necessarily disagree with your process. But I think what we have to recognize is that the only thing ACRS is looking at is the part concerning demonstration of conformance with design safety limits and criteria. If we haven't got any more information than that, we can't confirm this is an essentially complete design and that you can go out and procure the material and construct that design. We don't know what that design will look like.

We have a certification process that we we would also be a party to says that it is essentially complete and we are writing off on it, and it's a very difficult. We might decide it may be a trivial matter but I think I can cite many more details as we go through where, clearly, we don't know what the design is. It's just a PAR-level design is what it is, what we have normally seen in the past on a PAR. You can pull a SSAR off the shelf and find far more detail from some of those systems than you have in this one.

So, I don't know what the process is. I am puzzled as to what we are approving.

It would be nice to know that you were only expected to write off on the demonstration of conformance with safety criteria and not on the suitability of this design as ready for procurement.

MR. SCALETTI: Well, the level of detail expected in the design, realizing that this again is a hybrid plant, if you so want to call it, you are expected to be down to the level to be able to write procurement specifications. This is what is required by PAR-52 now. Material specifications are not required for the staff review, but that level of information is expected.

MR. MICHELSON: Is it expected, though, in the SAR, or is it expected somewhere else?

MR. SCALETTI: It is expected to be available if the staff needs it.

MR. MICHELSON: Has the staff called for the detailed PNIDs as opposed to the ones in the SAR which, in many cases, do not include pipe sizes?

MR. SCALETTI: We could call for additional PNIDs. Whether they include pipe sizes, I don't know.

MR. MICHELSON: Well, the ones in the SAR we will talk about them a little later. Some of those just tells you "later" and then you could figure out pipe size -- they haven't laid out the piping, but an essentially complete design for procurement has to lay out the piping because you have to decide how much you need.

So, I am very puzzled as to what we really are looking at. I do not call it an essentially complete design, at least the part that I am able to deal with. I just wonder if the part you are reviewing is essentially complete. You can tell me: "Yes, you can get the detail layout drawings." I don't expect you to review of all of them but you certainly ought to get them if you wish.

MR. SCALETTI: But again --

MR. MICHELSON: If it is an essentially complete design --

MR. SCALETTI: Again, we don't expect to get every detail of the design to review. We don't do that type of review, as you are well aware. But if we ask for something that we feel is necessary for us to complete our review in accordance with the standard review plan, then we will ask for it. If it isn't in there or if they don't have it, then we are going to have to find out why.

MR. MICHELSON: That would be another definition of "essentially complete" if you had said "essentially complete" to you meant there was enough information upon which to carry out the requirements of the standard review plan. I would have accepted that definition, but it would be quite different from what I read in here. You can't procure from what you ask for in a standard review plan.

MR. OKRENT: If I were to follow up on Mr. Michelson's question, in addition to what specific detailed information you may have a need of, plus a specific review, have you considered whether some kind of sampling problem or some kind of sampling program, rather than "problem", of the design to examine whether, in fact, where you sample the design is at the stage of completion that you would expect for a certification program. Have you considered whether such a sampling program would be of any value in this somewhat different kind of a review of previous, let's say, custom plants?

MR. SCALETTI: Randomly?

MR. OKRENT: I'm only providing an idea.

MR. SCALETTI: To look at procurement specifications to see if the level was indeed, there?

Again, I must go back to, if the reviewer feels -- and I know we did this on G-Star. We went back and we asked for other documentation with regard to specifications to review. This information was provided for us. It may not be a bad idea. However, this is going to be up to the staff to feel they need this information for me or for projects to go say, "okay, give us this information" and throw it to the reviewer. If the reviewer is only going to only look at it, even though he doesn't need it, it is a waste of time and, also, would provide a burden on our document control room. I'm not saying it's a bad idea. I have just not focused on it yet.

MR. OKRENT: Well, I am just trying to look for some constructive way of meeting what Mr. Michelson was reading as the state of design in that previous paper, report, or whatever sent to the ACRS. That is not the same as just specific areas where you want some information that goes more deeply than you ask for it.

Well, I will just leave it as a thought for now.

MR. SCALETTI: Okay. Just one comment: With regard to this type of information, we will have to satisfy ourselves, the staff, as well as satisfy this Committee, as well as satisfy the Commission that we have whatever this -- that this type of information is available and does exist. If it is not there then it won't be a part of 52, it won't available on a licensing review basis. This will have to be resolved, I think. Just how we are going to do that is not totally at hand at this time.

MR. MICHELSON: It may be that in essence what we are going to end up with, hopefully in doing this is certifying the design criteria and safety limits of this standard design, because I'm not sure that you even have the standard design in front of you. I'm not sure you have the manpower to review it beyond looking at conformance with design safety limits and criteria.

I think that is basically all you are doing presently, because that is all, really, the standard review plan gets at. There are sections, though, where you have to start looking at plant layouts and so forth. So I guess when you get to those sections where you deal with pipe breaks and that sort of thing, you will show how you pulled out a few typical drawings with piping layouts and you have satisfied yourself that they are doing a proper job. Or maybe you are just going to review the criteria they used in deciding how to lay out and leave it go out that. I don't know.

I have yet to see this detailed kind of consideration on even a sampling basis.

I consider the standard review plan mostly just demonstrating conformance with design safety limits criteria, which is only a part of what your letter said would be covered in this essentially complete design that you are looking at.

MR. SCALETTI: It is something we have to come to grips with.

MR. OKRENT: If I could add one more example: in the PRA, where they talk about seismic events, there is a set of design basis fragilities, if you will, or components or components to be designed and the analysis, such at is, is done in terms of that. And while at an earlier stage of the plan, in fact, that may be a good way to go, because you may be able to see where design basis fragilities will do the job or you might want to modify one and so on, but there is not information on the design that is going to do this, and I don't know if you expect that information to be in the detailed stage prior to certification.

MR. MICHELSON: Well, it would be if it was ready for procurement.

MR. OKRENT: I would think so.

MR. SCALETTI: We will have to address that. We would expect everything that is identified in the licensing review basis to be completed as part of the certification process.

If it is not, then we haven't done our job and, I guess, the applicant hasn't done their job.

MR. MILLER: Mr. Chairman, may I make a statement, please?

MR. MICHELSON: Yes.

MR. MILLER: I would like to take your comments today under advisement, the comments concerning the sampling process. Quite frankly I think we recognize that it is a hurdle that has to be overcome in order for us to be able to come to this meeting and recommend that we have completed the process and are recommending final design approval.

I'd like to be able to go back and do a little thinking with my staff. This is not just for the ABWR. This is for any certification procedure in the future. We have to come to grips with this issue. I think at this point in time, at this stage in the review, simply the staff has not gone out and done that.

I would like to come back to the Subcommittee at some future time with a recommendation for how we are going to achieve that.

MR. MICHELSON: We will make it clear in any letter we write that we are only looking at the criteria of the safety aspects. We are not looking at the detail aspects simply because the details were never presented to us. I'm not sure they were presented to the Staff, nor did the Staff look at them.

MR. MILLER: You touched on a couple things of keen interest, however. One of them is that I don't think there is the staff manpower available to look at each and every one of them in a lot of detail.

In a lot of instances, we could satisfy ourselves that at least that level of detail is out there.

MR. MICHELSON: Alternatively, maybe we need to redefine what a certification means.

MR. MILLER: We are bound by regulations at this point in time, Mr. Chairman, to a certain degree. I think we have to go back and make sure that in each and every aspect SAR Part 52 is met before we can recommend that the design be certified.

MR. MICHELSON: Do the present regulations specify it must be an essentially complete design that you are certifying?

MR. MILLER: SAR Part 52 is fairly explicit: in evolutionary plants, the ABWR plant is considered an evolutionary light water reactor and an essentially complete plan must be brought forward.

MR. MICHELSON: Then you have some homework to do yet.

MR. MILLER: I agree.

MR. MICHELSON: Why don't we proceed then. We are a little behind schedule already, which is not surprising, but I think we are ready now to go into Volume IV then. I believe GE is going to kick off with a short presentation on Volume IV and then the staff will talk about the SAR.

MR. QUIRK: Mr. Chairman, before we do that, I have a few comments I would like to make on the discussion that just took place with regard to design detail. I would like to express myself on that subject.

I'd like for the Committee to know that the ABWR design has been completed and construction is to begin in no more than a year at our site in Japan. As such, our procurement documents have been completed and are on file at GE for inspection by the staff as appropriate.

Now, the question arises as to what level of detail should be contained in a safety analysis report. And a licensing review basis document that you read from describes what information should be in the standard safety analysis report and separate from that, what information should be available on file at GE for subsequent inspection and audit by the staff?

I submit that the information we provided in the standard safety analysis report is sufficiently complete to enable the staff to determine compliance with regulations. That information is as detailed as is typically provided in any SSAR.

MR. MICHELSON: The problem is of course that that is not what we are certifying. We are certifying that aspect, plus the essentially complete design. If the ACRS is going to write off on such an essentially complete design, at least they need to know what one looks like.

MR. QUIRK: I understand that.

MR. MICHELSON: A PNID should at least have the pipe size on it.

MR. QUIRK: I agree with that. I think that is not a problem. I think our full-size drawings that the NRC got from GE contain that information, but I will confirm it.

I wanted to point out that the licensing review basis document tried to wrestle with how much information should be provided in a standard safety analysis report when it's a design of the customer, or is that is site-identified and does not preclude competitive bidding practices.

When we wrestled with that, we laid out an LRB, the recipe I just talked about a little while ago. I think it's fully adequate, fully satisfactory to approach it that way.

MR. MICHELSON: Yes. I don't think the Committee would disagree with that, except that we are trying to determine how much of that information is being reviewed before we write off on it.

The evidence indicates that what's in the SER is being reviewed, but not necessarily what is going on beyond that. It ought to be discussed in the SER because you are writing it off an a complete design, not just the SAR.

MR. QUIRK: Mr. Chairman, we have had to date three visits by the staff and quality assurance to come in and look at the product structure documentation and examine GE's files, et cetera.

So, in a case-by-case basis they have gone down into quite a bit of detail. So there is more review going on than just the information provided.

MR. MICHELSON: That was in the QA area?

MR. QUIRK: It was QA supplemented by technical people as required.

Look, I just wanted to offer those comments, hoping it was helpful in providing additional information.

MR. WARD: You point out the drawings for the Japanese plant are similar but there are differences in that design and some of the details on what we are going to be certifying?

MR. QUIRK: Yes, that is true. We have tracked those differences and for some reason, the differences may be different. For example, to comply with the EPRI requirements, we have added some modifications to meet U.S. codes and standards. We made some modifications.

MR. WARD: But are you saying those differences, where the plant is different; those design drawings are all available to the staff for review at the same level of detail?

MR. QUIRK: No, just --

MR. MICHELSON: An essentially complete design by agreement is one that I can walk out and build. Is it there with that detail?

MR. QUIRK: First of all, the difference we are talking about is a very small percentage of the overall project.

MR. MICHELSON: Specifically, though, where there are differences, are you going back and detailing those differences into new construction designs?

MR. QUIRK: No, we are not. In the very limited area where there are design changes, we are specifying the criteria and the conceptual design to meet those criteria and putting the record, on hold, the detail design, until such time as it becomes a project in the U.S.

MR. MICHELSON: How is that going to be handled in the certification process? Is the certification going to have a contingency in it saying certain things will have to be provided by the Applicant?

I thought a certification process was supposed to mean that you can build this anywhere, anytime; it is ready. It wasn't like you had to now customize it again, other than for site characteristics.

MR. QUIRK: No. I think the detail we are providing in this limited area we are talking about, would be sufficient for the staff to certify, and then the applicant would demonstrate that his actual plant was designed and constructed in accordance with that licensing basis. So the burden would be on him to show that his plant conformed.

MR. MICHELSON: The staff will not have the drawings to review if they wish to see how these differences have been incorporated into the standard design?

MR. QUIRK: They will have drawings, sir.

MR. MICHELSON: I thought you said they will only be criteria.

MR. QUIRK: I said they will have criteria and conceptual drawings implementing those criteria.

MR. MICHELSON: But not essentially complete by the definition of being ready for construction and procurement? It would not be to that level?

MR. QUIRK: In that area, yes, sir.

MR. MICHELSON: In this matter, I guess that the staff is aware that this difference will exist or differences exist from the Japanese plant?

MR. SCALETTI: We are aware of the differences in the U.S. ABWR. The conceptual design process is somewhat new to us and it has not been dealt with yet.

MR. OKRENT: Is there a list of the differences? Did I miss it in what I received?

MR. SCALETTI: I don't think a list is part of the SSAR. We do have the list of the differences and we can get you -- that we can get you.

MR. OKRENT: You can say some of the differences?

MR. SCALETTI: Some of them that we know of. The two units in Japan were single controller versus the single unit in the U.S. with a single control room. There are other ones.

MR. OKRENT: In the area of severe accidents, are there differences?

MR. SCALETTI: I don't know if the Japanese have committed to implementing some of the design features on the ABWR that GE has proposed in the U.S. or not. There have been discussions. The TETCO would tend to indicate, no, they will not put them on.

The Committee has not concluded whether they are worthwhile yet or not.

MR. OKRENT: But I believe I must say that the items mentioned didn't sound like minor differences in our just very recent discussion. So whatever that is worth; in other words, it was a question of like whether it is horizontally next to one another or there is a space far apart or something.

It is something that is not in great detail.

I am just offering my understanding of the word "conceptual," I suppose, and adding another adjective.

Could I ask GE a question? This may have been answered somewhere before, and if so, please refer me to it so we won't waste time.

I understand this is an over/under containment design. Mark II, you would call it, and you had been mostly selling Mark IIIs like Grand Gulf, et cetera.

Is there some documentation of this study of what should be the best next BWR which looks to the Mark II and Mark III, their pros and cons and gives the reasons leading to -- are there reasons leading to the choice?

MR. QUIRK: Not in the way that you just described it, no, but we do go through this process as far as our design evolution and looked at the strengths of Mark III, which are numerous, and the over/under design, and we incorporated bits of both.

You referred to it as "Mark II," but it's really not. There are different significant areas, such as pedestal vent concept and the horizontal discharge into the pool, and things like that.

But in looking at the demands of advanced containment design for the '90s, and having to deal with hydrogen and core damage event design basis, one concludes that early containment is quite desirable in that regard; whereas Mark III was such a large volume quench equipment in the containment and needed access to for maintenance and each unit provided that. So when you take the puts and the takes and look at the demands for a advanced containment, we concluded this design was superior.

MR. MICHELSON: We are going to have to move on. Let's make sure we understood the one point correctly.

Where differences exist from the detailed Japanese design, GE is going to provide a conceptual design and criteria related to those differ?nces. Is that correct?

MR. QUIRK: That is correct.

MR. MICHELSON: That is fairly important, and I just wanted to understand that.

MR. WARD: Are some of thos documents in place now? Presumably, they would be if the staff has reviewed them.

MR. QUIRK: Yes. In each of the cases, we provided the a criterion conceptual design to the staff.

MR. MICHELSON: The SAR is your design, not necessarily the Japanese?

MR. QUIRK: Yes.

MR. MICHELSON: We are dealing with the right general document, but we are not necessarily seeing any details. Now I understood we won't. It will just be the conceptual design. Mostly in the SAR.

MR. WARD: I had the impression there were some other documentation.

MR. QUIRK: You are taking that out of context, however.

MR. MICHELSON: Well, then, tell me again.

MR. QUIRK: When I talk about conceptual design, I'm talking about perhaps 1 percent of the 20 volumes. Let's not blow it out of proportion. So, 99 percent --

MR. WARD: It is 1 percent, but there are some key issues.

MR. QUIRK: There are some key issues, and they're in these -- the severe accident countermeasures are in that category, and you consider those significant issues. They are, of course, significant and near and dear to all of our hearts. We are dealing with these, and we are showing you what we believe these fixtures should do, how they function, what the bases are, and how they ought to be qualified.

MR. MICHELSON: Would it be unreasonable to expect you to give us a description of wherein these differences exist, and therefore what we read in the SAR will not be backed up by detail design?

MR. QUIRK: I think we can identify the differences.

MR. MICHELSON: But the control layout will not be backed up by detail design, which means a whole lot of wiring and other things are different. They will be different in Japan than they are here. And we would not expect to ever see in the certification process how that will be done, because there won't be the detailed drawings available, if I understood what you said correctly. So even defining one percent, this would be important. We would have to see that next time, but apparently the staff was unaware of how this one percent was being handled, and we weren't aware they were going over a conceptual, not the actual, is that correct?

MR. SCALETTI: For those differences, yes.

MR. MICHELSON: You thought they would be detailed?

MR. SCALETTI: Eventually, we would have a US-ABWR design. What GE defines as conceptually, we'll have to look into that.

MR. MICHELSON: For certification purposes, you expect that to be the detail?

MR. SCALETTI: For certification purposes, I expect it to have the US-AWR design.

MR. WARD: So there is a little misunderstanding? You expect to see drawings of the US version?

MR. MICHELSON: Oh, yes.

MR. WARD: As complete as the Japanese?

MR. MICHELSON: No, as complete as necessary for certification, whatever that is.

MR. WARD: He just said that he expected to see it as complete as the Japanese.

MR. SCALETTI: No. The Japanese constructed theirs in 1981, and we understand the US-AWR will not be to that level.

MR. MICHELSON: But the procurement and construction level which was the original agreement. So there is something we need to clear up, and you will let us know the next time.

Let's proceed.

Those were just extra remarks.

MR. QUIRK: We will proceed with Chuck Dillman who will provide a summary of Chapter 4.

MR. MICHELSON: Maybe this is shifting gears on you unfairly, but I think in view of the fact that a lot of Chapter 4 isn't going to be covered by our letter since it is all to come later, please kind of localize your remarks to the part of Chapter 4 that we are going to be able to write off on, which right now, I think is only Part 4.5, the reactor materials, and some parts of the reactor component, the reactor core system. The rest of it is all later. Therefore, we don't need our memories refreshed on the parts that we are not going to able to write a letter on anyway.

Does that seem reasonable? My first thought was we were going to write a letter on all of it, but clearly, the information isn't there on the part of the SAR. I'm not just saying you, it isn't there, but the SAR is really -- you can only comment on Section 4.5.

MR. QUIRK: We can emphasize the materials.

MR. MICHELSON: The rest of it is just not written.

MR. DILLMAN: Okay. Good morning.

I am Charles Dillman, Manager of Mechanical Equipment Design for the ABWR program organization of General Electric. I will go through this rather fast this morning in the interest of time.

Chapter 4 contains these items: reactor assembly, RPV and internals, fuel system design, reactor thermohydraulic design, reactor materials, and reactivity control systems.

In accordance with the chairman's request, I will try to skip over a couple of the charts, specifically the ones having to do with the internals. I will, however, show you the reactor picture.

[Slide.]

MR. DILLMAN: I want to show you the scope of what we are talking about. The control rod drives, as is typical of all BWRs, are mounted in the bottom, as are the internal pumps. And the core structure starts here with the shroud support, and the pumps go through the shroud support plates. The shroud comes up to the shroud head, and separators, which are of course removable for refueling, the upper and lower fuel supports, both core plate and top guide, the steam separators and the steam dryer.

The basic configuration of the internals is in concurrence with the configuration of BWR-6. The vessel is somewhat different, as required to accommodate the internal pumps.

As was mentioned by the staff, the fuel and thermohydraulic design is in accordance presently with the previous submittal of standard application NEDE 24011, and the staff is dealing with that.

A new feature of tying into the control system is we have eliminated the velocity limiter, and we will discuss why, as part of the control system design.

[Slide.]

MR. DILLMAN: Now, reactor materials.

The materials are primarily made of austenitic stainless steel.

The shroud support structure, however, is nickel chrome iron alloy 600, because it attaches to the vessel and provides a coefficient of expansion match better than the stainless steel would be.

The shroud head bolts also include nickel chrome alloy 600 to provide a thermal tightening to the shroud head bolts as the reactor heats up.

All the welding of the core structure components will be per ASME Section III with welders qualified to Section IX.

The material incorporates the latest technology and complies with Reg Guides 1.31 and 1.37 and 1.44.

Base material is solution annealed, preferably after welding. In the area of welds, we require a delta ferrite to be shown by test to be 8 average, 5 min.

As I say, components are preferably solution annealed after welding, especially where we have high stress or where we have had problems in the past. Materials are all low carbon. We control the weld heat input, and we also have controls on materials used for fabrication to avoid contamination with deleterious substances such as fluorides, lead, sulfur, items that would produce degradations in surface.

We also are using an approved nickel chrome iron alloy stabilized. Last year, on the 15th of November, we made a detailed presentation to this group of the materials, and we can review any part of that that you would like during this session.

(Slide.)

MR. DILLMAN: Now, the control system. The heart of the control system, and one of the features that makes the ABWR an ABWR, is the fine motion control rod drive. It is a key feature. It is based on successful experience in Europe. And one of its big advantages is it provides a diverse means of insertion -- having a hydraulic scram and also an electric run-in. It has an advantage over present design, at least in some people's opinion, in that it eliminates the scram discharge volume, which removes a radiation source of exposure to people during maintenance, and it eliminates a concern about common mode failure associated with that scram discharge volume.

MR. WARD: When you say advantages in some people's opinion, does that mean you don't agree there is an advantage?

MR. DILLMAN: Oh, I agree.

MR. WARD: I thought you meant something by that.

MR. DILLMAN: Well, I was trying to avoid being derogatory to the present design.

The second feature that we have added is that the control rod is positively coupled to the drive. It is a bayonet coupling.

Also in the drive there is a separation switch which allows the operator to stop the drive motion when there is a separation, and this eliminates a concern for rod drop.

The separation switches are redundant and Class 1E, as are their associated circuits, and this is the basis on which we eliminated the velocity limiter.

The fine motion capability originally was to avoid fuel failures due to PCI, but with improved fuel, that is not a concern. However, it still has advantages in that it allows plant automation, reducing start-up time, and complements the core flow load following ability.

Experience in Europe has shown this drive to be low in maintenance. In fact, the basic drive itself in the European plants has no planned maintenance, only the sealed housings and motors undergo a regular maintenance.

This causes less work and less concern about removing drives. Also the drive contamination is low because it does not have the reactor water go through it during a scram, like a locking piston drive does. The contamination to the drive except for the uppper end, which is in the vessel, is very low.

We also have a brake installed. The purpose of the brake is to provide a redundent means of protecting against rod ejection should a scram line break. We have never had a scram line break, but if it should, the brake backs up the check valve that is internal to the drive as a means of presenting rod ejecti .

More background on this.

There are nearly 2,700 drives in service in Europe with over 15,000 drive years of experience, and in addition, as Dino said earlier, we have tested the drive at LaSalle and recently submitted a report of that testing to the staff for review.

MR. MICHELSON: Before you leave, I guess you are not going to use that slide.

MR. DILLMAN: No, I was going to say, this is a slide which is in your handout.

[Slide.]

MR. DILLMAN: I, however, have a couple of colored slides that are a little easier to see.

MR. MICHELSON: Let me give you the question which I have, and which I want to be sure you discuss with the full committee at the appropriate time, and that is: This particular arrangement now no longer requires the rod catchers in case there is a fault in the weld and you reject the whole assembly. That is an engineered safety feature which has been removed from this design, as I understand it. So please go through the argument once more in a convincing fashion as to why it is no longer credible to eject these assemblies.

MR. DILLMAN: It hasn't been eliminated so much as it has been replaced with an improved feature.

MR. MICHELSON: It's been eliminated. It is no longer there as a grid assembly?

MR. DILLMAN: Right.

MR. MICHELSON: What are the postulated means of failure now?

MR. DILLMAN: The same postulated means of failure would be that there is a weld.

MR. MICHELSON: You might want to use your colored drawing.

[Slide.]

MR. DILLMAN: The weld shears, and that weld is right here (indicating). It is shown in a sort of cartoon representation, but if this weld shears, and this were to drop, -- I must go back to my other picture --

[Slide.]

MR. DILLMAN: In addition to there being a bayonet coupling here between the rod and the drive, there is also a bayonet coupling between the guide tube and the drive, and of course the housing -- and that goes around the housing.

Not shown in this picture is the fact that the guide tube can set down on the core plate.

It is not shown very clearly here either. But at this level, these guide tubes come up through this core plate.

And if that rod ejects, the guide tube is positively bayonet fastened to the housing so when this drops, the top of the guide tube catches on the core plate. That has been analyzed to show that it will withstand a full ejection load.

MR. MICHELSON: Now, you have that coupling if the rod disengages during this ejection? Is that what you are saying?

MR. DILLMAN: No. The rod, of course, is positioned -- the rod is positioned by the drive. And, of course, in service when we are at power and, therefore, pressure, when you would expect a rod failure of this weld, most of the rods are withdrawn. But in the event the failure occurred and the rod was in, inserted part way or even all the way, this could only drop about three-sixteenths of an inch.

It would not disturb at all the positioning of the rod or would disturb it only by that three-sixteenths of an inch.

MR. MICHELSON: I am a little confused about this. Are you saying the housing can't be ejected?

MR. DILLMAN: The housing cannot be ejected.

MR. MICHELSON: And the reason?

MR. DILLMAN: At this location there is a bayonet coupling to the guide tube that is not shown in this picture, but was shown in this picture.

[Slide.]

MR. MICHELSON: That is the dashed line?

MR. DILLMAN: That is the dashed line. The other end of the guide tube -- the upper end of the guide tube is above the core plate.

MR. MICHELSON: Now, what happens when you eject the housing?

MR. DILLMAN: When you eject the housing, the housing will drop a small amount, approximately three-sixteenths of an inch clearance between the flange of the guide tube and the core plate --

MR. MICHELSON: That is held by --

MR. DILLMAN: -- and then it stops.

MR. MICHELSON: Is it held now by the guide tube?

MR. DILLMAN: It is held by the guide tube which is positively locked to the housing.

MR. MICHELSON: What is the guide tube locked to in a positive fashion?

MR. DILLMAN: The guide tube is locked positively.

[Slide.]

MR. DILLMAN: The guide tube comes down through this area and bayonet locks to the drive.

MR. MICHELSON: What is the other end of the guide tube attached to?

MR. DILLMAN: The other end of the guide tube has a flange on it and is too big to go through the hole in the core plate.

MR. MICHELSON: When we meet before the full committee, if you would bring a sketch or drawing or something, because that is the question that I am sure is going to come up.

MR. DILLMAN: I didn't anticipate this question or I would have had it.

MR. MICHELSON: Any time you remove an engineering safety feature from our traditional design, it ought to be examined carefully. I hope the staff will do the same. They will tell us they have.

MR. DILLMAN: As I say, we don't look at it as having removed an engineering safety feature, but simply we relocated it to provide the same function in a cleaner manner with less interference of maintenance and, hence, less exposure.

MR. MICHELSON: I am sure it is all okay. But I just didn't have in front of me the kind of information to put it together right. I think it is an important argument that needs to be made.

MR. WARD: This seems to be a different description of this system than we got a year ago. Has the design changed?

MR. DILLMAN: Yes. In the process of finalizing the design, we eliminated -- the previous description was a collar on the housing. The problem with that collar on the housing -- in fact, it's shown in this old slide --

[Slide.]

MR. DILLMAN: The problem with that collar is that it produced a small gap here, which produced a crevice for that weld which then led to an enhanced probability of what you are trying to mitigate. So we discarded that and went to the feature that I just described.

MR. MICHELSON: Is that described in the SAR?

MR. DILLMAN: It is mentioned in the SAR. I can't say that it's described in any detail.

MR. MICHELSON: I guess that's why I hadn't come across it.

Okay. So you will give us a good explanation later.

MR. DILLMAN: Yes.

[Slide.]

MR. DILLMAN: Just to give you some more background on the drives, I mentioned the separation device. On this viewgraph, it is called the weighing device. Basically what it is is a spring here and a platform there. The translating assembly rests on that platform. If a portion of the weight, such as a rod, is separated and removed, that weight, therefore, isn't on that platform. The spring extends, the platform moves up, and two magnets trip lead switches giving this the redundant separation switch.

Some other features, of course, are hydraulic scram and that scram is by this hollow piston being pushed into the reactor by the pressure difference. There is a single scram line. Here is the ball check valve I mentioned.

The hollow piston, of course, has latches and has periodic stops along here that the latches can pick up. In the full end position it hits a buffer. The buffer is a series of bevelled springs and that mitigates the loads on the housing due to scram.

As soon as there is a scram signal and the pilot valve opens; the water pushes the scram in. It also actuates the motor here and the motor runs in the ball screw providing a redundant means of insertion.

At the end of the stroke, that ball screw will pick up the hollow piston and hold it.

MR. MICHELSON: Just to be sure, the change in your design on that support, you used to have what you used to call an in-vessel housing support. That is no longer there?

MR. DILLMAN: Right.

MR. MICHELSON: But Revision A even of the SAR didn't include your new design for some reason. That is why I missed it completely. You have a different design. Therefore, it's not clear.

These are the kinds of differences that give us a little problem in reviewing this thing, if we aren't aware of a change in design.

MR. DILLMAN: Right.

Now, on this FMCRD system, the FMCRD system is based on the use of proven components and designs. Basically, the scram pilot valves and scram valves are the same ones used in a lock and piston, just slightly larger. The reason they are slightly larger is that we use two drives for one hydraulic control unit. Of course, the hydraulic control unit here is a scram unit only. It does not have anything to do with positioning the rods, as in the case of lock and piston.

MR. MICHELSON: Before we get into this, let me get a couple more clarifications on this housing retention. Is the feature you are now proposing off the guide tube similar to what is already being used in Europe or do they use the old end housing support?

MR. DILLMAN: In Europe, they have not provided for that feature.

MR. MICHELSON: They have not provided for ejection at all?

MR. DILLMAN: No.

MR. MICHELSON: I don't know why, but that is their business.

The next question is: have you analyzed the results -- well, your argument still is you don't get any ejection, so you haven't analyzed it.

MR. DILLMAN: Right. Since the housing stays in the hole, is basically a plug, we have a relatively small leak.

MR. MICHELSON: Have you ever looked at what the situation would be if the housing ejected anyway? In other words, this design you have didn't work, maybe just as a severe accident? Have you looked at that to see how much trouble you are in?

MR. DILLMAN: Not in exactly that fashion. However, in finalizing our UCCS design, we considered a broad spectrum of bottom breaks and we concluded even with breaks well beyond the size of a break that you would get with a housing ejector, something over a one-foot square break, we would not have UCCS problems.

MR. MICHELSON: If you had a one square foot hole in the bottom?

MR. DILLMAN: We get enough cooling to keep the fuel cool.

MR. MICHELSON: This is just from flooding?

MR. DILLMAN: This is from the combined makeup capacity we have, even considering a single reactor failure.

MR. MICHELSON: That means flooding only because you don't get a spray action?

MR. DILLMAN: We have no core spray. We have all flooders. We have flooders outside. The low pressure flooders are outside the shroud; the high pressure flooders are inside the shroud, so we inject water through two paths, going two ways to the fuel.

MR. MICHELSON: You have looked at a one square foot break?

MR. DILLMAN: We looked at breaks that size and larger, actually. Basically, it was a series of studies we did to determine whether it was or wasn't an advantage to having a core spray. It was part of the decision to go to the flooder that those studies were made.

MR. MICHELSON: Those studies were made assuming an instaneous one square foot break in the bottom?

MR. DILLMAN: I guess, yes.

MR. MICHELSON: That's interesting. Thank you.

MR. DILLMAN: As I said, we have two drives per hydraulic control unit. This is a take-off on the European experience where they will have up to a six to ten drives per hydraulic control unit. We didn't want to go that far; again, because we wanted to use the proven valves, proven in U.S. BWR applications.

The system includes backup scram valves that are used in all BSWRs.

We have also included select control rod run in which uses an electric insertion and that is used as far as stability mitigation.

As I mentioned earlier, we have an automatic run in after scram.

The hydraulic system includes redundant charging pumps. However, that is not a safety feature because the pumps are not required for scram. It is an availability feature so that if one pump starts to deteriorate, we have a backup pump to continue operation.

It is not a safety feature since the accumulators are charged and will cause the scram without the pump.

Low pressure alarms on the accumulators and on the charging header. In addition, low charging header pressures will cause a scram. That is different than current BWRs with just alarms. And just about last year at this time we reviewed the failure modes and effects analysis with this Committee and also submitted a final version of that to the staff, at the end of last year.

[Slide.]

This is a very simplea schematic of the rod control system showing the hydraulic control unit which is basically a gas bottle and accumulator and the associated scram valve. The accumulator diameter is the same as our current product to maintain the piston's stability. The additional volume is made up in height making it a rather high accumulator. However, it has been size and weight tested and has performed satisfactorily under seismic tests.

We have two drives on the one accumulator with branch piping and these drives, of course, are separated so that a failure will not cause inability to get the cold shutdown.

MR. CATTON: What is the diameter of the drive, the diameter of the hole in the vessel?

MR. DILLMAN: The diameter of the hole in the vessel is -- I'd have to check that to be sure.

MR. MICHELSON: That should not be a problem.

MR. DILLMAN: It's much larger than one square foot. It's like a four- to five-inch pipe.

MR. CATTON: Where is the one foot hole?

MR. MICHELSON: They analyzed a one foot square hole for whatever reason.

MR. CATTON: In the bottom of the vessel?

MR. MICHELSON: Yes, for whatever reason.

MR. DILLMAN: Basically what we were doing that caused us to look at these big bottom breaks was four design basis events. We saw no advantage to having a core spray. We then got into a discussion internally as to beyond the design basis events with some day we would have a core spray. We kept looking at worse and worse events. That is how we got up to a one foot bottom break which is an arbitrary assumption to see where the core spray showed an advantage.

When we could find no advantage for the core spray, we ended up going to the flutter. By having done that work, it answers Chairman Michelson's question.

MR. OKRENT: What is the opening for the pumps?

MR. DILLMAN: For the pumps? Oh, the internal pump.

That shaft is about a six-inch diameter. However, there is a whole scenario on that that says we do not end up with that size hole.

MR. OKRENT: I'd rather not get into the pump question because that will be covered later but you will be asked at that time.

MR. DILLMAN: There is a whole scenario that says that leak is also trivial. In fact, the most likely event is that there is no leak.

MR. MICHELSON: Does that complete your discussion?

MR. DILLMAN: I think consistent with your requirement to stick to only the materials, yes.

MR. MICHELSON: I had one small question. On the SAR, page 4.6-12, on your analysis of malfunctions relating to rod withdrawal, there is a statement here, I don't know if it was brought your attention or not. I think there is an important missing word.

It presently reads, "there are known single malfunctions that cause the unplanned withdrawal of even a single control rod." I think what you meant there is "there are no"? Is that right? You have verified that?

MR. DILLMAN: Yes.

MR. MICHELSON: Otherwise, I would like to hear about the malfunction that you are talking about.

MR. OKRENT: What is the maximum reactivity reinsertion rate during startup?

MR. DILLMAN: I'm afraid I don't know that number. We will have to get that number for you.

MR. MICHELSON: Later on when we discuss some other matters, there is a statement which I can't find at the moment. It is buried in other papers. It is talking about trying to reduce the amount of cobalt-containing materials that the activity laid out. Yet I look over the reactor materials and control rod drive and I find guide rollers and roller pins and so forth are still Stellite No. 3 and No. 25.

Is that a lower cobalt-containing Stellite or are you still using cobalt?

MR. DILLMAN: No, we are going away from cobalt in the pins and rollers.

MR. MICHELSON: Is this incorrect, then, or is it reall still Stellite No. 3?

MR. DILLMAN: No, I believe that is incorrect.

MR. MICHELSON: So Revision B under the SAR hasn't quite caught up with your changes then. I read it and went back and looked at the material and said, gee, this again confuses a person when he thinks he is looking near the end of the process on a given chapter and now we are at the beginning of the process.

MR. DILLMAN: We will have to check that. I thought it was changed in the last revision.

MR. MICHELSON: I am looking only at Revision B which is the last one I have.

Any questions from the members on this 4.5 and 4.6 which I think are the only sections we can discuss, however, at this time.

[No response.]

MR. MICHELSON: When we get to the SER, of course, we will ask the staff questions but this is just for General Electric.

I see no further questions so I believe that takes care of it. Thank you.

MR. DILLMAN: Thank you.

MR. MICHELSON: I think this is a good time to take a break and then after the break, the staff can start with their SAR on this particular chapter. I think it is fair to say that we are probably going to be here for a long day today so plan accordingly. We really do have to cover these as we go. This is it. This is the last time we look at this particular material. We'll have to go right through.

That was the original understanding with the staff at least in one of the letters, the final letters, on modules. Is that still your --

MR. SCALETTI: That is correct.

MR. MICHELSON: That means this is our final shot on this particular one.

MR. SCALETTI: We are here as long as you want us.

MR. MICHELSON: Okay. Let's break until 25 till.

[Recess.]

MR. MICHELSON: I believe the staff is up next.

MR. SCALETTI: Yes. We are now into the Volume 4, No. 1, Item No. 1, control rod drive structural materials. Mr. John Tsao will do No. 1.

Item No. 2, reactor internals materials, the information that he gives out now will also cover some materials that he will present later on in the day on large vessel integrity.

MR. MICHELSON: While we are waiting for that, let me bring something to the attention of the committee, if I can find it again.

Did you have a copy of this?

MR. MILLER: Yes, I did.

MR. MICHELSON: I would like to bring to the attention of the committee that you have in front of you this document "Recommended Priorities for Review of Standard Plant Design." I understand this is a predecisional document that hasn't been signed off on by Mr. Taylor, but for our information, not to be discussed in our open meeting at this time. It's predecision. Be aware you have it. Be aware that we aren't supposed to discuss it publicly.

[Pause.]

MR. TSAO: I am John Tsao from the Materials and Chemical Engineering Branch.

As I mentioned before, the staff's review of control rod structural materials is complete, and there are no open items.

What we have done, we have used the SRP 4.5.1 as our guideline to review the GE submittals.

The material specifications, GE's materials, satisfy the ASME Code Section III, Appendix 1, which is the appendix which provides materials properties, allowable stresses, and that type of thing. Section II, the material specifications, Part A, is for the ferrous materials and Part B for nonferrous materials.

Also we used Reg Guide 1.85. Reg Guide 1.85 is the cold case acceptability. We also checked the compatibility of the control rod drive materials with respect to reactor coolant. We used ASME Code Section III Articles NB-2160 and NB-3120. NB-2160 provides requirements for deterioration of materials, such as the irradiation, and that type of thing. And NB-3120 provides requirements for corrosion, welding, and clotting.

We also reviewed the materiality of the austenitic stainless steel components. The requirement was that the cold worked austenitic stainless steel must have yield strengths less than 90,000 psi. Because if the yield strength is more than 90,000 psi, there may be potential IGSCC occurrences.

We are looking for -- particularly when using Reg Guide 1.44 as our guideline to make us sure that the control rod drive materials will not have the intergranular stress corrision cracking. And we also reviewed the welding technologies using Reg Guide 1.31, which requires the use of certain low delta ferrite content in the welds. Specifically our requirement is that the delta ferrite numbers should be between 5 and 20. And the ABWR uses an average of 8. So they do satisfy Reg Guide 1.31.

Also, the parts are accessible for inspection and replacement.

So pretty much this is the straightforward review and, as I said before, there are no open items.

MR. MICHELSON: Let me ask, we heard this morning about this method of re ,ining the control rod drive housing in the unlikely event of an errupt failure. Did you review the design wherein they used the guide tube support and so forth for rod retention? Did you review the fabrication and materials they used in that case, or did you review the design as in the SAR?

MR. TSAO: We reviewed it as in the SAR. We do not review the design, but we review whether the cold rod drive structure materials satisfy the fabrication part of the ASME code.

MR. MICHELSON: Any time you use a feature that prevents something, you look very carefully at the materials of that application of that feature. Apparently you haven't had an opportunity yet to look at it. Therefore, it is an open item, even though it is not on your open item list. This is new design. It is just not what you looked at.

MR. TSAO: Right. We specifically looked at the material specifications.

MR. MICHELSON: But I would like to know if you looked at this particular feature now from the kind of materials they propose, the specification they propose on the materials, and the fabrication they propose. I would think you would have to, because now it is a more important feature than it might otherwise have been before, because it wasn't a part of function of the guide tool arrangement before to do this retention and now it is. And now you have got to go back and rethink it.

So I assume that is an open item to be discussed or to be commented on later after you reviewed the design. Apparently you don't even have the design in house?

MR. SCALETTI: We have it in house, but there will be perhaps a later amendment. Is that correct?

I'm not quite clear on this item. I'm not sure whether this design change was made in a past amendment.

MR. DILLMAN: I am not sure relative to your specific question. However, the materials of the drive are not part of this feature. The guide tube is not part of the drive. It is part of the core structure.

MR. MICHELSON: We will have that in the next discussion. I was just inquiring as to whether that feature has been reviewed.

Has the staff received the amendment?

MR. DILLMAN: I would have to investigate that.

MR. MICHELSON: It may not even be in the staff's hands. At any rate, we would expect to exclude that retention feature in any letter, simply because I am not convinced that the staff is even aware of this. It may not even make any difference. I just want to make sure.

MR. SCALETTI: You are probably talking to the wrong person on the actual structural design itself. The materials, you are talking to the right person. Another person will handle the review on the structure itself, from the standpoint of accident prevention.

MR. MICHELSON: If it isn't a part of the reactor control rod drive, it is a part of the reactor internals, I hope.

MR. SCALETTI: John Tsao is a materials reviewer. Our Reactor Systems Branch will review the other portion of this.

My understanding is we have not looked at this aspect of the design yet to date.

MR. MICHELSON: I hope when you look at the materials, you look at the functional materials, because materials suitable for one function may not at all be suitable for another.

MR. SCALETTI: That's correct.

MR. MICHELSON: So you have to be aware of the function, and you weren't aware of it when you reviewed the materials, I don't think.

MR. TSAO: We looked at the design and fabrication.

[Slide.]

MR. TSAO: I'm also going to talk about the reactor internal materials. This section involved primarily the core support structures. We used the SRP 4.5.2 to review the materials.

The core support structures have to satisfy the ASME, Section III, NG 2000. The NG chapter is for core support materials. And any other materials not in the ASME code such as decanol and some of the alloys we will use ASTM.

We also reviewed the compatibility with reactor coolant using Section III, NG 2160 and NG 3120.

As before, with the control rod drive materials, we also checked the weldings, because most of the materials inside the reactor are made of austenitic stainless steel material and have to comply with Reg. Guide 1.44 and Section III, NG 4000 and NG 5000.

NG 4000 is examination and NG 5000, I believe, is -- excuse me. NG 4000 is the fabrication and inspection, and NG 5000 is the examinations.

And as before, we make sure the reactor material and core support materials satisfy Reg. Guide 1.44 and 1.31.

MR. MICHELSON: When you do your review, do you review to determine with respectibility of the various portions of the reactor materials?

MR. TSAO: Yes.

MR. MICHELSON: That is part of what you did?

MR. TSAO: Yes.

MR. MICHELSON: Now in case, again, to the guide tube that is now used as a retainer device, I certainly think it would be very important to make sure we can inspect the bottom portion of that guide tube for potential cracking, since it is the retaining device now. So, you would be doing that, I take it.

MR. TSAO: Yes, we will.

MR. MICHELSON: Now, in looking at the reactor internals, thus far, are there any noninspectable reactor internals, and that includes the control rod?

MR. TSAO: Not at this time.

MR. MICHELSON: You are satisfied that everything can be inspected?

MR. TSAO: Yes, sir.

And this concludes my presentation.

MR. MICHELSON: One section that I had trouble with were the SAR reviews. There is a section in SAR, a section 453, called "Interfacings". It doesn't say much, but in your writing up the SAR, you have only included 451 and 452 and remained silent on 453 and that means one of two things. Either you didn't have any comments or your comments don't include 453, and I am never sure.

This gets even more difficult as I go into other chapters. You start subdividing and you list and you omit things. I don't know if they are omitted because you have not done your review or because it is "no . mment". How do we cover that?

MR. SCALETTI: I will have to go to check Section 453 as to what it says, but all interfaces that are identified should be included in Section 1. That would be Section 1 in the 4.9, I believe, of the FAR, which lists interfaces. Those interfaces, the staff identifies, should be addressed in Section 110 of the SAR.

MR. MICHELSON: You are saying Section 453 is not covered. It will be covered in some other w'y?

MR. SCALETTI: I guess what I am saying is I don't know if it will be covered, and I am saying it should be covered now. The extent of the coverage may be that there is nothing brought up in there. I will check on it.

MR. MICHELSON: This has to do with the CRB Inspection Program. I didn't know whether you agreed with what they said or it was going to be covered somewhere else. I just didn't know. You said nothing either way.

MR. SCALETTI: I will check on it.

MR. MICHELSON: I have difficulty on several other SAR sections. You just skip things and it's not clear whether it is "later" or "no comment". Right now, we will assume it is not covered, since you haven't commented. If it is and you decided you didn't include it because you had no comments, how are you going to identify that? Are you going to list the sections and just say "no comment", for the sake of completeness, that is?

MR. SCALETTI: I will give that consideration later.

MR. MICHELSON: We will discuss it again later today.

Any other comments from the members on this section?

[No response.]

MR. MICHELSON: Let us proceed. I believe Chapter 5 is next. Wait a minute -- 4.6 is next.

Did you say everything you were going to say for 6, which is in your SAR?

MR. SCALETTI: Can I make a comment?

MR. MICHELSON: Yes.

MR. SCALETTI: I thought you were referring to a standard review section, 4.5.3, and interfaces would be identified, but there is a section here. Those interfaces, I assume that the staff has no comments on it. The interfaces are identified. We found it acceptable, and I apologize for not directly saying so, but we will take care of that in the future.

MR. MICHELSON: You put in 4.5.3 with no comment?

MR. SCALETTI: We will identify as Section 1 the interfaces that we believe are necessary beyond those that General Electric has identified for interfaces. It will probably be addressed in Chapter 1, and our Chapter 1 will only address those interfaces which we feel are necessary, which GE may not have brought forward. We will review Section 1.9 of the SSAR, which identifies all of the interfaces, and we will have drawn conclusions based on that.

MR. MICHELSON: Specifically, Section 4.5.3 -- you did review it?

MR. SCALETTI: Section 4.5.3 is quite long and there is a subsection. I have to -- reviewer has reviewed it, yes.

MR. MICHELSON: That component, you are satisfied with?

MR. TSAO: Section 4.5.3 discusses the inspecting of CRD control rod drive system. We have reviewed the inspections at Chapter 5, so this section will be covered under the regular ISI program.

MR. MICHELSON: It would be nice to say so when you write your SAR, instead of just leaving a blank. When you leave sections blank, I don't know what it means.

MR. TSAO: When we reviewed, last year, Section 4.5.3, it was not there exactly. This is through Amendment No. 8, I believe.

MR. MICHELSON: Look at revision C. I don't know whether you have seen it. When you don't say anything, I think you're going to have to address each item of the SAR.

I believe it's mandatory that you address each item, and if you have no comment, say "no comment", but don't leave a blank, because now people don't know what you have done with it, whether you have covered it somewhere else or what. It is total confusion. I will point out later today, on some of the other parts, even more confusing, where it is very important, but here it is not so important. So, if you have some thought --

MR. SCALETTI: We will endeavor to indicate that we have reviewed the whole SSAR.

MR. MICHELSON: Where nothing is talked about, that means you have no comments?

MR. SCALETTI: That's correct.

MR. MICHELSON: But when you say you're going to do it somewhere else, that is a comment and that has to be pointed out. Otherwise, I will look for it and say, you have it here and that you are satisfied. That is what you just have gotten done telling me.

MR. SCALETTI: Okay.

MR. MICHELSON: Are you going to do 4.6?

MR. SCALETTI: We are now dealing with item -- structural design of the plant and the control rod drive system and I think we have viewgraphs here. Hold on, I will get them.

MR. MICHELSON: Maybe as a preliminary statement, we should say this is fuzzy.

MR. SCALETTI: These slides also will cover this portion of Volume IV as well as Volume V, which Mr. Thomas will discuss later on today.

MR. THOMAS: My name is George Thomas. I am from the Reactor Systems Branch. We essentially completed the CRB system review. We have probably one open item in this chapter and that is it was the rule to comply with that rule. As you know, ABWR works with hydraulic and electric scram.

The hydraulic scram -- the electric scram is not safety grade and GE takes credit for this electric scram in their compliance that was approved. So that particular issue is still open. We are still talking with GE.

Another thing which is different for the ABWR is the steps. That is why they call it a fine motion control rod drive. This is for metal reactivity control and for good field management.

As was told before, there are two drives per accumulator. We checked that even though one accumulator will fail, it won't make two rods which are near each other -- they will be separated from each other and as in all, there are so many problems with the scram discharge and failure, so in this AWR, we decided there is no more scram water volume.

The water is going into the reactor. It's not coming back to the discharge only. We believe that we have decided the water movement or the current design --

MR. WARD: Is that a separation of the drives that are the same common accumulator? Is that hard-wired into the design?

MR. THOMAS: It is part of the design.

MR. WARD: Is it something that can be varied, once a plant is built, or is it fixed?

MR. THOMAS: It is already fixed. It is in the design. They cannot put in two rods which share the same accumulators. There are at least three or four sets -- separation, so a single failure will not have an effect on the shutdown capability.

MR. WARD: That is something that can be adjusted or modified?

MR. THOMAS: It is in the design, the working design.

MR. OKRENT: Are there any seismic considerations that should enter into your evaluation process?

MR. THOMAS: Basically, it was going into the rule. We do not get into seismic considerations.

MR. OKRENT: I really don't care what may or may not have been omitted from a past rule. I am looking at safety and risk, so I am asking whether the staff has looked at this plant in terms of earthquakes, not only as moderate, but more severe, but are there any which, in the first place, lead to a scram function and in the second place, to a lesser reliable operator function and which, in fact, involve a scram where you would like to have them.

Perhaps that doesn't occur, but I would like to know or ask the staff to examine this consideration.

MR. THOMAS: The hydraulic control unit; they are all seismically qualified for a seismic event. The scram insert line -- they all supported seismically, so whatever equipment necessary for the scram is all seismically qualified and seismically supported.

MR. OKRENT: I'm afraid that is really not a very good answer to the question.

SCALETTI: We will consider the design basis and accident scenarios in Chapter 19. We have this under review. I think it would be more appropriate to respond when the staff has completed its review during the Chapter 19 review.

The answer is; we will look at it, but we have not done that.

MR. OKRENT: But that is a fair answer, if that is the answer. I think that should be a qualification which is a part of your discussion at this time.

MR. MICHELSON: Proceed.

MR. THOMAS: I am through with my presentation. If you have any questions --

MR. MICHELSON: You're discussing, I assume, Section 4.6 of the SAR; is that correct?

MR. THOMAS: Yes, sir.

MR. MICHELSON: When you look at the staff's evaluation of 4.6, they do not show any subdivision, so I assume that you are really talking about parts 1, 2, 4, 5, and 6 of that section 4.6? You have covered the whole thing in your review; is that correct?

MR. THOMAS: Yes, we are obviously talking about the CRD system.

MR. MICHELSON: I know what you are talking about. I want to know what the staff has done in terms of its evaluation of Section 4.6. I want to be sure as to whether it covered all of the material covered by GE's 4.6, but I have to assume that since you have made no caveats like part of it will be done later or part of it will be done some other time.

SCALETTI: That is correct.

MR. MICHELSON: Now, it's your turn to ask questions on what GE said to 4.6; is that correct?

SCALETTI: Yes.

MR. MICHELSON: Since you reviewed it and it is covered by your evaluation, I want to ask, on your safety evaluation at page 4.5, the first full paragraph at the top, are you talking about you have done a failure mode analysis of the CRD system?

It says in the middle of that paragraph that this system is designed so that failure of electric power will cause the control rods to scram, thereby protecting the reactor. The question I had was; did you analyze the partial loss of pressure in terms of ability to scramble?

You said you took care of lost instrument error. I wonder if you took care of full instrument air pressures or if you just assumed no pressure in the analysis?

MR. THOMAS: We looked only at the complete loss of the air. We didn't look at a loss of partial instrument air.

MR. MICHELSON: Isn't that a more likely and legitimate way you will lose instrument air pressure? You don't lose it instantaneously? They just start degrading, drop down? I would like to be sure that you looked at the full spectrum of air pressure.

MR. THOMAS: We can go and look at that again to be sure that comes up.

MR. MICHELSON: Yes, it's not clear from the SAR whether you looked at the full spectrum or only the total loss of air. I have the same question on electric power. If you degrade the voltage, what does that do to the ability to scram as opposed to losing it completely? Certainly, for future reactors, we ought not to keep asking questions about voltage drops instead of fails. What happens?

You have to go back and change this section now in the new co-rod rambling device housing, which is different. If your scram line breaks, and the ball check valve fails to function, what effect does that have on the environment around the equipment? This doesn't seem to be covered, either. Clearly you assume the check valve did not function because that was assumed when you did the analysis of the velocity of the rod. Therefore, I ask you if the situation is your scram line breaks, and the ball valve doesn't function, you have an uncontrolled thing that you can't stop, what do you do, environmentally?

MR. THOMAS: It is controlled by the brakes.

MR. MICHELSON: Is it a significant disturbance to the environment in some areas? I'm just asking. Has that been analyzed? Let's see. All of these lines are inside contained. None of them penetrate containment. Look at the HCUs on a line break. I'm going to be outside containment. And the ball check, if it doesn't fit, then you have a non-controlled LOCA outside containment with no valve there. Did you look at that environmentally?

MR. DILLMAN; Those environments are considered in developing the environmental parameters for various areas.

MR. MICHELSON: Outside of containment?

MR. DILLMAN: Wherever there is a line, a break is considered for the area, and any safety related equipment in the area is appropriate.

MR. MICHELSON: Where would that be appropriate in the SAR?

MR. DILLMAN: Chapter 3, we believe, 3.11.

MR. MICHELSON: I will raise the same question when we get to Chapter 3.11, and at that time you will be prepared to tell us how you will deal with that.

On page 4-7, you talk about the standby liquid control, and apparently it is so far a mangled operation.

MR. THOMAS: Yes.

MR. MICHELSON: The detailed justification is going to be submitted for staff review, so, therefore, it is not covered.

MR. THOMAS: Right.

MR. MICHELSON: I understand that part. I haven't got to my question yet. Elsewhere in this document, I keep reading we have something like a 30 minute accrual on manual operation, and GE i claiming they can't do anything for 13 minutes in terms of manual operations. Will that 30-minute rule pertain, and how clearly will it pertain? You're going to have to amend your words, when you have your 30-minute rule, when you have standby liquid controls. It's going to have to be something less than 30 minutes, but I don't know how much. Maybe the staff will have to look at that. I just wanted to clarify that. Clearly, a 30-minute rule is not quite right.

MR. OKRENT: I would ask to comment. This is why I raised the seismic issue. It should cause the shut-down requirement. It complicates the life of the operator.

MR. MICHELSON: Another item included for later is the in-plant test program. Apparently, again, I will have to read a supplement to find that material. These things are just sprinkled throughout as they are. Sometimes, I find them on the open item list, and sometimes I don't. I consider that an open item and something that has to be supplied later before we can complete the review.

MR. SCALETTI: Which item is that?

MR. MICHELSON: For instance, the in-plant test program for the plant motion control drive.

MR. SCALETTI: It was an outstanding issue.

MR. MICHELSON: It might have been.

MR. SCALETTI: It was.

MR. MICHELSON: Okay. I think that takes care of my questions on this section.

MR. OKRENT: Can I ask one question? It was mentioned that there was good experience with the supplementary drive system. Were there any adverse experiences while they were looking at the good experience and reports? Were there problems?

MR. SCALETTI: I don't have an answer to that. Do George?

MR. THOMAS: I don't know. Maybe GE can tell us that.

MR. OKRENT: Isn't it something, though, that the staff would routinely ask and want to know about a new system? I am sort of curious that it wouldn't have been something that you didn't already have already.

MR. SCALETTI: I assume we would want to know what the operational experience is. We just asked for and recently received the LaSalle report.

MR. OKRENT: We were told of some number of reactor years, I thought, which was really a basis for confidence, but ti seems to me that it would be interesting to know whether any unusual or surprising failure modes or whatever -- well, let me just leave it at that.

MR. MICHELSON: Let me point out another problem in Section 4.6.2 of the SAR. It points out that the failure mode and the analysis will be covered by Appendix 15B, which I assume is an appendix to Chapter 15.

MR. THOMAS: Yes, sir.

MR. MICHELSON: Yet, in looking at the SAR, I didn't find that you took any exception. Did you look, then, at 15B as part of the review of Section 4.6, or are you going to look at for further review in Chapter 15, or how do I know which way you have done it? There are no comments; therefore, if you have already done it, it means that you have no problem with it. If you haven't done it, you didn't tell me that it is excluded from your discussion of 4.6. Again, it is just tracking this thing. It's extremely difficult to know what you have done and haven't done. You know, but I don't.

MR. THOMAS: When we got that analysis, it was only a short time ago, so we didn't have time to entirely review that.

MR. MICHELSON: Why didn't you say that when you did your safety evaluation, that you were going to do it later so I know it is an open item.

MR. THOMAS: We said it is preliminary.

MR. MICHELSON: Our letter is going to be preliminary if you guys keep hedging it, if you keep saying we haven't said it all yet. We will have to write a letter, "We don't know it all yet, and we are not ready to comment."

MR. SCALETTI: Mr. Michelson, if analysis is provided in 15, we have not written our FER chapter 15 analysis.

MR. MICHELSON: It is in Section 4.6.2.

MR. SCALETTI: Section 15.

MR. MICHELSON: I don't know if I pull Appendix 15 out now or do it when I read Chapter 15. I don't know. There is an Appendix 4A that goes with this thing that I find is not discussed. I don't know if you're going to look at it later or look at it now, since it is a part of Chapter 4. You don't discuss these things. You don't give me any roadmap to look at. Four-A was the control rod pattern, and so forth.

4-A is -- was that covered as part of your review of Chapter 4 or is that going to be covered later?

MR. SCALETTI: Yes, it is going to be in another section to be identified later.

MR. MICHELSON: Will you tell us what you are doing? Your argument on 15 is fine but what about your argument on 4? Is a 4.3 where Appendix 4-A is mentioned?

MR. SCALETTI: That's correct.

MR. MICHELSON: Eventually I guess I will ask these questions or we will know which things are covered when.

MR. SCALETTI: We will do the best we can.

MR. MICHELSON: SER says you will cover section 462 and section B is a part of 462, which it is, and I expect it is either covered or you explicitly point out. I can find it somewhere else.

MR. SCALETTI: For the sake of trying to be consistent with the process here, it was discussed in SAR, Chapter 15. We will cover it in our review of Chapter 15. If it's an appendix to Section 4.3 we will cover it at 4.3. So hopefully we can have that much consistency in the process.

MR. MICHELSON: But if 4.6 had just referred to 15-B as to where you covered it and that doesn't tell me it is a part of Chapter 15 necessarily. There is a reference in 4.6.

MR. SCALETTI: All right.

MR. MICHELSON: Therefore it either should be covered in 4.6 or put it in 15. I have a couple of more questions here. Excuse me. I think that was the last one. Go ahead.

MR. THOMAS: Okay, that concludes my presentation if there are no other questions.

MR. MICHELSON: Are you doing Chapter 5?

MR. THOMAS: Somebody else will do that.

MR. QUIRK: Next on the agenda there's Tony James to provide a summary on Chapter 5.

MR. JAMES: Anthony J. James, General Electric Newport News Division.

Mr. Chairman, I am here to give you a brief overview of Chapter 5. Before I get into it, I could perhaps amplify a little bit on a question you had earlier about the operator time. You correctly said that we are complaining that 30 minutes is all that is required for operator time on the ASWR. That is true, a basic defect.

MR. MICHELSON: That is not a design basis?

MR. JAMES: It is not a design basis that is being discussed there. We have had a failure of the hydraulic scram. We have had a failure of the electric power which is the backup scram capability on this plant. So we are now into the 10 to the minus 8 numbers. So we're talking about what if territory. Clearly, if you add into that what-if territory, the question now is you have failed the hydraulics. You have failed the electrics. How long has the guy got to initiate a complete shutdown via standby control system. The answer is not 30 minutes. The answer is less than 30 minutes. I don't have the number at my fingertips but as I recall the limiting event is something like a minute and a half to assume a full hour to resume activity, et cetera, et cetera.

So by way of trying to explain that a little, Chapter 5 --

MR. OKRENT: Excuse me, it is not clear to me from the seismic point of view to the 10 to the minus 8th, your analysis would -- what analysis have you done to show that?

MR. JAMES: I think that is the staff's comment that it will be covered in Chapter 19 which will pick it up. So if I could continue or start with Chapter 5, brief GE overview. Chapter 5 is the reactor coolant system. The subjects I would like to cover with you this morning, I would like to give you a brief overview of the reactor coolant system, discuss briefly the integrity of the reactor coolant pressure boundary, touch on the reactor vessel and internals.

I think that has probably been amply covered earlier and then go through the components and subsystems that are listed and discussed in section 5.4 of Chapter 5. So that is my agenda.

[Slide.]

MR. JAMES: What I have first is a tabular summary of the subjects that are covered in Chapter 5. I have a table here of the feature and very much encapsulated summary of what we are doing, of reactor vessel materials. It is a large 278 inch vessel, basically using established BWR technology. This design of ours is very much an evolutionary design that is using established BWR technology incorporating many of the lessons we have learned in the past, some of them painfully but it is basically an evolutionary design.

For core heat removal, as we have already discussed, we are using forced circulation using 10 reactor internal pilots with adjustable speed motors. These guys are 10 pumps located around the base of the reactor.

There are ten pumps which take place of the external loops that we are familiar with on earlier BWR designs. If you look at the pump in a little more detail --

[Slide.]

MR. JAMES: That is an artist's drawing, but it is very accurate, showing the key features of the pump. Basically, it is a wet motor. This whole casing runs at reactor pressure, 1,000 psi. It is a purge design. There is a purge inlet flow which comes in right here which keeps a trickle of water going up between the shaft and this tube here.

So the water chemistry and pressure conditions are controlled here by continuous purging of cold water. As I say, it is a wet motor design. There are sealed section here, a pump and a pillar diffuser arrangement up there. The discussion that came up this morning as to what happens if one of these falls out in terms of the hole on the bottom of the vessel and what have you, I think as a broad general statement you should understand that the design of ejector with respect to all of these penetrations that we have on the bottom of the vessel, the pin we have here for the pumps and the 205 that we have for the drives, the basic design principal is we are going to preclude blowout of any of those devices.

We have designed provisions which prevent complete failure and blowout of these pieces of equipment and to leave you with a hole, so to speak, in the bottom of the vessel. In this particular case, for the RIP, the pump mechanism if it was going to happen anywhere, it would be complete failure here in this weld that welds the pump casing to the nozzle inside the vessel.

So if you say to yourself, okay, I'm going to break that piece of equipment and why doesn't this blow out and just leave me a great big gaping hole, there are several reasons why it won't happen. But first let me answer the question from this morning, which was how they would hold if that happened anyway.

The ID here is about ten inches, which translates, I believe, into something like about half of a square foot hole in the bottom head. Well, that is a theoretical discussion because it won't occur for several reasons. Firstly, if it did rupture, if this ruptured, you can see this little orange guide running down through here. That is a so-called stretch tube which keeps this assembly tightly meshed with the inside edge of the nozzle here.

So if this broke off, this whole assembly would drop down so this piece here would seat right here on this assembly. So if this is all gone, this drops down onto here, and it precludes further blowout of liquid. Obviously it will leak a little, but there would be no large gaping hole because this will be seated here precluding a large blow down.

Even if this does break, the stretch tube, first off, is very strong. It will probably just support this entire assembly. There is a lock nut down here that locks it in place. So even if this outer part failed, we have done it an analysis, say this little orange stretch tube guide here will over-strap by quite a large margin, but, in fact, will preclude this from blowing out.

The ultimate barrier, though, is that this device here, this is what we call motor casing, has a blowout retention assembly. There are little lugs welded onto the vessel here and there is a strap that comes down and grasps the bottom of the motor here. If this did fail, it could separate, but will not blow off and become a missile in the lower region.

MR. MICHELSON: Where is that feature shown on the SAR?

MR. JAMES: Good question. I think the answer, Mr. Chairman, on that is I'm not sure that it is shown.

MR. MICHELSON: Well, if you have a good argument for failure to eject, it ought to be shown in the SAR and the essentially complete design has to tell you about things like that.

[Slide.]

MR. MICHELSON: Do the Japanese use this feature or is this something you are just putting on your design, James?

MR. JAMES: No. It is a common feature of both designs. I believe that is true.

MR. DILLMAN: Yes.

MR. MICHELSON: I am surprised it wasn't in the SAR. If it was, I sure missed it.

MR. JAMES: That is what it looks like. There are braces welded to the vessel. It is offset like this so ISI equipment can get in there. There is a bracing device that comes here and holds the assembly which prevents it from becoming an unrestrained missile.

MR. MICHELSON: Was the staff aware of this feature?

MR. SCALETTI: The staff has seen it on the new facilities and on the Japanese design. I'm not sure whether it is in the SAR or not. We are aware of it, though.

MR. MICHELSON: It is an important feature to be discussed.

MR. WARD: While you are looking there, what are the materials in that strap?

MR. JAMES: I can't answer that question.

MR. DILLMAN: Stainless steel. Are you talking about the shoot-out rod? It is stainless steel. It absorbs the energy.

MR. WARD: Given this sleeve, the internal sleeve that is shown in orange, why do you need this strap arrangement?

MR. JAMES: Belts and braces, I guess. That is facetious. I think the real answer is that the basic design, the design process went in the following sequence.

[Slide.]

MR. JAMES: This is a potential missile. We have to prevent a potential missile from blowing out of the reactor. We have to put restraints on it. We have to put an external restraint to stop it from blowing off and being a missile. After the fact, we say to ourselves maybe this stretch tube could also hold the assembly together. So it was sort of after the fact. And to people like yourselves, we have the design margin. It was after the fact.

This stretch tube is a vital piece of a basic assembly of the pump. It holds this assembly, the diffuser assembly tight on here. It comes down here and there are threads on it and a large nut which does exactly what it says. It stretches this tube. It puts an axial weight on it which holds this tight to this. So it is a vital part of the pump itself.

By the way, it will also hold the internals in if the casing ruptured. This is a part of the sequence that enables us to completely disassembly the pump, take everything, without defueling the reactor. You can come in here with the reactor full, cold obviously, not pressurized, but full water nonetheless, and you can take off the nut here and drop out a lot of the internal assemblies; put the cap back on here and because you have not taken the tension off here, you can come here with your tools and take off the top. So this is an integral part of the pump assembly.

That was a long-winded answer.

MR. CATTON: What happens if it fails?

MR. JAMES: You mean disintegrates?

MR. CATTON: Yes.

MR. JAMES: You would have loose parts in the reactor.

MR. CATTON: That is it? They wouldn't jam up in there and do some damage?

MR. JAMES: It probably would. It would make a mess, I would guess, depending on the failure modes. If this failed, there is about 800 horsepower coming. It is turning around pretty good. But I don't think -- I'm going to shoot from the hip now. I can't see any reason why it would jeopardize the pressure boundary here. This being all pressurized anyway, it's not as though you have a restrained high reactor pressure from getting into the casing assembly. It is all running at the same pressure anyway.

MR. CATTON: If it jammed up, it might put quite a bit of torque on it.

MR. DILLMAN: If I might interject. Whether that has been analyzed, including the weld, it has been analyzed for the weld. Once again, the weld has been analyzed for the torque of that vent of the shaft seizure with the motor running full power. The shoot-out restraints are also designed not only to take the blow off force of the pressure, but the shoot-out torque or, excuse me, the motor running full power.

In addition, there has been an analysis of potential missiles from the inside, assuming it disintegrated from some unknown means and the missiles will do no harm. So there has been a fairly thorough evaluation of possible failure modes of this.

MR. MICHELSON: Where does that discussion appear?

MR. DILLMAN: To the best of my knowledge, that has not been documented in the SAR. It was done after the SAR was submitted and the staff has asked us to submit it.

MR. CATTON: Well, what about weld failure?

MR. DILLMAN: Where there was weld failure, it could, it probably would cause the housing to try to shoot sideways. However, the stretch tube would hold it from moving and the stretch tube would then not be on the shaft. But again, we've analyzed for that effect.

MR. CATTON: So the outside straps could take the whole load?

MR. DILLMAN: We analyzed them blowing out and twisting at the same time if the weld failed and with no consideration for the stretch tube having absorbed any of the energy. If that failed due to some mysterious thing, even though an analysis says it would not have an over-stretched blow-out load.

MR. MICHELSON: When you do various analyses, particularly after the fact and the SAR has been submitted, you mentioned this particular one was done after the SAR was submitted. Since it doesn't appear as a reference in the SAR and so forth, how is the staff -- how is the NRC staff aware that you have even done it?

MR. DILLMAN: They may not necessarily be aware. However, if they had asked us any questions, we would have submitted it.

MR. MICHELSON: I have a question about this. Unless they ask the question, you would not tell them.

MR. DILLMAN: Not necessarily, no. But it is in our files for inspection at any time.

MR. MICHELSON: That doesn't mean a whole lot because the library is always available for inspection, too. These are fairly important considerations because of the high energy device of this pump. I guess the staff just has to be smart enough to ask the right questions so you can respond. Otherwise they are unaware of it.

MR. JAMES: Okay. If I could move on, Mr. Chairman, the next subject on my table here is the reactor coolant and reactor overpressure control equipment, which is at Chapter 5. I really only have one diagram here. A one-line answer is or a one-line summary is that it's a pretty conventional technology.

We have four 28-inch steam lines, two 22-inch feedwater lines, 8 mainstream isolation valves, and 18 safety relief valves in the plant. The steam lines are shown in red here, with the MSIVs. There are four inboard and four outboard. Green is the feedwater piping, two pipes coming in here, leading, in each case, to three risers per pipe going into the vessel and into spargers inside the vessel.

The safety relief valves are spread out on all steam lines. They are not actually shown here, but the steam discharge safety relief valve, which is in MSIV, is piped out to this pressure pool down here through conventional devices.

The next item in Section 5 is control of reactor water quality. We have a reactor water cleanup system.

MR. MICHELSON: Before you get to that, let me ask you, in Section 5.1 of the SAR, you include a PNID within the core system. On the PNID, you happened to tell me on the slide what they were, but I was lost through all of that. You didn't tell me what the design pressure temperatures were. All of these were going to be worked out by the designer?

Essentially, for complete design to read an SAR describes systems as all being later, about sizes and design features, that leaves me a little bit cold. Is it possible to put your line sizes on your drawings?

MR. JAMES: Yes. I understand your frustration, Mr. Chairman. I guess I'm going to throw a wrench in your procedure works here, but the PNIDs that you have were submitted quite some time ago.

MR. MICHELSON: There is one later revision, albeit the latest revision. You don't date things, unfortunately, or put the revision number on it. I don't know when Revision A came through.

MR. JAMES: I think the message is there are later things which have the date, like pipe size and to show the design pressure and temperature.

MR. MICHELSON: It is frustrating to try to do this, having incomplete information. I wonder if we should even be doing it where design is the consideration. I do not know what the lines sizes are.

MR. JAMES: Okay. If I could move on to the next subject at my table here, the control of reactor water quality, and this is, again, just a summary.

We have what is typical for BWR. We have a closed loop water cleanup system that has got two pumps. It is a conventional figuration, very largely. It is a system that takes flow from the reactor, puts it through a regenerative heat exchanger, which is just a heat exchanger, which has hot water leaving and returning, so we minimize the impact. It again goes through parallel lines and nonregenerative heat exchangers until the time it gets here. Our process conditions are down to lower temperatures, 120 degrees Farenheit, typically, which is then sufficient low to put it through the filter demineralizer equipment, which is conventional parallel-type cleanup equipment and back into the vessel, through the nonregenerative heat exchanger back into the exchanger there.

As many of the systems with ABWR, we have incorporated the lessons learned and the evolutionary design improvements that are available to us. A couple of examples here: We plan on these pumps to use can pumps, very similar to the other pumps, not at capacity, but they are can pumps and purge water and there are no seals.

One of the recurring problems we have had on our reactors is the problems with the seals on these pumps, because traditionally they are back here in a hot part of the process. They are down here in the cold part of the loop with a can design, but apart from taking advantage of evolutionary design improvements, the cleanup system -- there are no real surprises there.

The next item on my table is the main steam line flow restrictors. As I am sure you are aware, a very important consideration in the ABWR technology has been steam line rates. We have these large pipes that attach right to the steam space. The analysis of ruptures of those pipes has always been a central part of BWR accident analysis.

[Slide.]

MR. JAMES: Steam line breaks, traditionally, have been most limiting for some events. Ruptures of these steam lines that run from the vessel out to the turbine traditionally have been the limiting event for a containment design. We have always had flow restrictors in them. Like, typically, if you have a 28-inch line here, we somewhere would put a restrictor that has a diameter of, typically, like 16 inches -- 16 to 18 inches.

In the past, these flow restrictors have tended to be outside, inside the drywall, but out of the main runs of the steam lines. What we have done here for ABWR is put them at the vessel nozzle and neck of the nozzle down and make that restrictions. That has a couple of benefits. The major benefit is it limits the size of the steam line break. This is a flow from the reactor that gets choked to this small section here, rather than, in the past, a large 28-inch diameter nozzles. We have improved the performance of the reactor by putting restrictors up there.

MR. MICHELSON: Are those forgings welded into the vessel, the restrictors?

MR. JAMES: They are forged nozzles.

MR. MICHELSON: The cool assembly is welded?

MR. JAMES: I believe we are doing that. We are welding nozzles in.

MR. DILLMAN: Yes. The nozzle welding is forged into the vessel. However, the extending is a separate piece.

MR. MICHELSON: Is that shown somewhere on the SAR? Is there some kind of a central drawing with those restrictors?

MR. JAMES: Yes, Mr. Chairman, there is. I was just seeing if I had a copy, but I don't think I have. No, I don't, but I do know for a fact there is a cross-section of the restrictor in there somewhere.

MR. MICHELSON: In Chapter 5?

MR. JAMES: Yes.

MR. MICHELSON: That is where it belongs. Yes, it is

Figure 5.4.6.

MR. JAMES: Okay. Thank you.

I'll go to the next item in my summary table. The reactor core isolation cooling system is another item covered in Chapter 5. Basically, that is a pump system that if main feedwater flow is unavailable, this system will provide reactor coolant, but it is a small turbine-driven system that is very familiar to anybody who has been around BWRs for a while.

It is a standard core isolation cooling system, which is an auxiliary cooling pumping system, which takes steam from the main steam lines at a point inside the containment, runs it through a small impulse turbine with exhaust to the suppression pool. The turbine runs a pump which can take it either from the suppression pool or from the condensate storage tank, with preferential alignment, to the condensate storage tank, because of all our quality considerations. Again, the same speech -- it is convention BWR technology.

With incorporation of lessons learned from the past -- and on this particular system, there were many lessons learned from the past -- and taking advantage of any enhanced technology that is available, it is truly an evolutionary version of the standard RCI system.

MR. MICHELSON: Does it include a sparger under the water level?

MR. JAMES: Yes. It is not a sparger in the sense of the large spargers that we use on the main safety system. It is a vertical type with a lot of small holes in it. It is the same concept.

MR. MICHELSON: It is the same as the HVI system?

MR. JAMES: Exactly.

MR. WARD: The taper off for the steam source -- where is the isolation?

MR. JAMES: These guys are the isolation valves here.

[Indicating.]

MR. JAMES: This is a schematic.

MR. WARD: No, on the main steam line.

MR. JAMES: These can take steam even if the main steam line isolation valves are closed. The MSIV is right there. That is why we dogleg into the containment, rather than taking the easy way out here.

Still going through my summary table here, the last item on my summary table is the residual heat removal system, RHR. There have been some noteworthy improvements here in this system. We now have three completely independent loops. They are classified as engineered safety equipment, and they are cooled by the intermediate cooling loop in the reactor building. Again, I have a schematic PNID here.

[Slide.]

This heat removal system has several modes. I have outlined in red the shutdown, cooling mode which is covered in section 5. Understand now, this is a low pressure system. This only comes into operation when the vessel pressure is down to approximately 130, 140 p.s.i. When you are down there, it can take flow directly from the vessel out through the HMR pumps and back straight to the vessel.

The big delta from earlier designs is that we provided three completely separate loops here. Earlier designs has various other systems. BWR 1 or 2, BWR 6 had various overlaps or system commonalities in it. For example, very frequently, the system of BWR 4, 5, and even 6, there was a common line here which had two loops of RHR.

So there were vulnerabilities. There were single fair knocking down both shut down cooling loops. We have done away with that completely. We have three independent loops, independent, mechanically, electrically and physically separated to the ES divisions. So we think that is an enhancement of earlier design.

MR. WARD: Let's see. Where are those in the vessel -- inlet and outlet relative to the shroud?

MR. JAMES: They are all outside the shroud, above the core. Suction is taken through large, like 14 to 16 inch nozzles located above the core at about the elevation of the top out of the shroud but the same elevation -- high speed water sparger. There are just plain suction large nozzles because one of the key things you have to worry about is PNF whatever.

The return is in the same general area. In fact, I think I have a chart that shows the various locations of a new one I'm talking about, the cooling systems. I could put it up and show you. It is an expanded envelope showing the various features there but basically, these three -- I'll have to be careful now -- two of them come back in (indicating) and the spargers are located at about that elevation. The third one which is not shown here, goes back in through one of the feed water lines.

So this isn't exactly equal to all feed loops. Two are like this and a third goes up here to the feed water lines but this afternoon I will pull out my picture and show you where those various nozzles and spargers are. Okay that does it with a summary of what is in Section 5. Now there are several key sections. Section 5.2 is the first I would to briefly run through. Let me use the pretty picture again here.

Section 5.2 addresses the integrity of the reactor cooler panel boundary. This is a summary of why we think the design is adequate in this area. We are meeting the key code requirements. It is an entirely Section 3 vessel. We have overpressure which conforms to all of the requirements. Those are the valves I refer to you on the main steam lines. We have deep pressurization capability which is an automatic depressurization system, ADS, which can blow the vessel down and flood it with low pressure, core cooling equipment. That is a key feature of all BWRs.

The key thing to safety just blow the vessel down and flood the vessel with water. We could do that through the relief valves or safety valves on the feed lines. The ADS does make use of eight of the safety relief valves which are tied into the ADS system. Just to refresh your memory, we did discuss this at one subcommittee meeting earlier. The terminology with BWRs is as we all talk about SRVs, that is really, safety relief valve and those valves are dual function. They have a safety function which is to lift against the spring force and a relief function which is an open signal using a pneumatic actuator.

Ours does the two functions in one assembly although the codes are very restrictive. The two functions must be complete, separate, and independent and able to interact with each other but that is what our SRVs are. They do actuate and limit the reactor present to 110 percent of design pressure per code allowable parameters. For those reasons, we think we have the issue of pressure boundary integrity pretty well in hand.

MR. MICHELSON: On the ADS valves, page 5.2-5 of revision A of the SAR, you indicate that you have accumulators -- a certain portion of the valves and the accumulators are designed for two actuations of the ADS valve. Is that correct?

MR. JAMES: Yes.

MR. MICHELSON: Only two?

MR. JAMES: But they are supplied by safety grade backup bottles, two divisions of backup bottles which can keep them open.

MR. MICHELSON: I didn't find that described but maybe there is so much to read, I didn't find everything. Is that described in the SAR -- the backup to the accumulators that you do describe in there?

MR. JAMES: Yes. It is described in what is called the nitrogen supply system which I think is towards the end of section 6.

MR. MICHELSON: I'm surprised of course. In Chapter 4 when you talk about it, you said if you need more than two actuations, now you rely on the nitrogen system or something like that. That would help me out a little bit and then too, I think if you're going to have two actuations of a safety grade statute, you're going to indicate a basis of why there is no danger. I would like to look at that analysis. Apparently the nitrogen system is also a safety feedback up or non-safety?

MR. JAMES: It has two portions. Part of it is safety grade --

MR. MICHELSON: The ADS portion on the nitrogen side is safety grade?

MR. JAMES: Yes.

MR. MICHELSON: Perhaps I did miss it then.

MR. JAMES: Mr. Chairman, I think it is in Chapter 6.

MR. MICHELSON: Yes, but it is pertinent to the discussion of the accumulators. That is the key, the ability to operate the valves, to indicate all means of operation. You only indicate one here which is the accumulators. It may be somewhere else that you discuss something but that doesn't help us in doing a review unless you are making a claim for it and in that case, I don't care. I'm just asking the basis for the two actuations. If you are claiming you can do more than two, then you had better give me the basis and so on and so forth.

MR. JAMES: I think the basic thought was we only need one. In ADS mode, there is no question of opening and closing.

MR. MICHELSON: Do you mean your operator cannot close them again?

MR. JAMES: Once they are open, no.

MR. MICHELSON: I did not read it that way. If that is the case, fine.

MR. JAMES: He can delay actuation. There is a time delay in there that allows him to do that.

MR. MICHELSON: Is it 30 seconds?

MR. JAMES: 29. I'm sorry.

MR. MICHELSON: That also seems strange because the present ADS I thought was about two minutes. Under present design. That is my recollection, is a couple of minutes, and now we have -- how did we get down to 29 seconds all of a sudden? Isn't it two minutes yet? Because you don't want it to start until you are really -- two minutes is a good thinking time. Twenty-nine seconds is pretty short reaction time in which to decide whether to enter it or not.

MR. JAMES: I'm sorry. I can't answer that question.

MR. MICHELSON: When we talk to the staff, we will ask them. We will do that this afternoon and get their views on it but I found it real surprising. Then when it didn't mention nitrogen supply but go ahead.

MR. JAMES: Okay. I guess there is a second page here that continues with the discussion of the integrity of the reactor coolant pressure boundary in 5.2. I don't think I need to go through this. I think this is just a restatement of the design philosophy with respect to materials and water chemistry. Do it right per today's known definition is one light summary.

Reactor vessel pressure internals which is Section 5.3. Again, a summary. We have eliminated the recirculation flow piping below the core by using these internal pumps. For those of you who aren't familiar with our earlier products, these pumps here which have no small penetrations in the bottom head replace two large loops which are very large, 28 inch, 30 inch, something like going out external pumps which draw into this whole section of the vessel here in a critical area up to the top of the core, is free of any large nozzles now because we have been able to go to these internal pumps. Steam separation, this right here is standard BWR steam separators, two phase loads comes into them.

There are swirl veins in there which cause them to spin out and the water forms a film on the outside and that is stripped off and the water goes back this way and the steam goes that way. Standard BWR 6 point technology. As part of going to internal pumps and getting rid of these large nozzles, we have gotten rid of a lot of equipment associated with the extra loops and that is as you will see this afternoon in section 6, has been a significant factor in the containment figure that we have gone to, the elimination of these loops has enabled us to do a lot of rationalization containment arrangement.

A key point, the larger diameter of it puts the material well away from the core. This reduces it to much lower values than we have been used to. What that refers to is this gap here between the shroud here which goes all the way around the core and the vessel here. This gap had to be expanded so we could get these prop assemblies out. If we have to work on the diffusers or the impellers here, they have to be taken out this way so this gap has to accommodate and got bigger because of that and is a sort of by product that's helped with fluence levels.

This line of the vessel. Internal pump. I will address the question again this afternoon. This is a little misleading the way it's written. It says internal pump inertia provides a means keep fuel within thermal limits. That is sort of misleading because one things these pumps don't have is high inertia. The internal pumps had large pumps with motors with quite a lot of inertia so if you lose power, they coast down for quite a while. These guys don't have the same high inertia but nonetheless, we think that the design as its now defined as sufficient inertia and I was going to discuss that a little more this afternoon in the Section 6 discussion.

Flow restrictors I have already mentioned. The small nozzles here combined with the elimination of the large nozzles for the reflow groups has really improved what I call load performance of this machine. The loss of cooling water accident floats on inside and out and when it gets to that point. it makes the design basis for the containment system less severe but also, and just as important, it's less severe on the internals. One of the consequences of large holes in our vessel is not only containment aspects but fairly significant loadings across these internal structures.

For example, if they suddenly ruptured this steam line, the shrouder assembly, the fairly significant upward force. So the load performance both internally and externally we think has been enhanced and a key point right down here at the bottom if you can see it, at least for the belt line area of the vessel, there will be no wells. The intention is to have this entire ring here force assembly so there will be no welding.

MR. MICHELSON: On page 5.3-7, Revision A of the SAR, you made a statement that the vessel will not be designed to be annealed. Is that still your position?

MR. JAMES: Yes.

MR. MICHELSON: We will ask the staff this afternoon whether this is an acceptable position or not. I was a little surprised you were not making provisions for annealing your vessel.

Does that mean it is not possible to anneal, or you are just not making any provisions to anneal? Have you thought about it anyhow? Do you have to anneal this vessel in 50 years? What are you going to do?

You don't believe it could be annealed? We don't need it. If we did, we couldn't do it anyhow.

MR. MICHELSON: I just wanted to see what your thoughts were, thank you.

MR. JAMES: You can do anything if you have enough money.

MR. MICHELSON: But it would be very impractical.

MR. JAMES: That's correct.

MR. MICHELSON: Thank you.

MR. JAMES: What I have here in the last couple of pages -- for the sake of completeness, I went through Section 5.4 and picked up the various areas that were relevant to the BWR. I think I covered most of this, and I don't think I need to say more about the internal pumps or pipes or flow restrictors or the NFIV or the RCIC system.

We've pointed out one important feature which is system operation which is totally independent of AC power. We think our little turbine-driven, non-diverse power system is a big improvement. The thrust of that provides a new type safety of our equipment.

The second page; I think the same. There is really nothing there that needs to be discussed in more detail. I have discussed all of those. This is a very sweeping statement here and it covers a lot of territory here, but I think it's consistent with the overall design 50 of a BWR as to incrementally proved things, just through evolution.

So that wraps up the overview.

MR. MICHELSON: What I would like to do with the time remaining before lunch, is go through any questions committee members have on Chapter 5 on the SAR. We'll start with mine, since that is my privilege.

What I would like to do is to delay the staff discussion until first thing this afternoon. So let me go through my questions and then the other members can see what questions they have on Chapter 5. I'm just going to have to do it by pages since that is the way I marked them.

It's on page 5.2.9 that you discuss the pins and roller situation. You say you replaced them with non-cobalt alloys, so apparently, you go back and make that change so that two parts of the section will be consistent.

This was done in answer to other questions. I assume that will be cleaned up. You will also have to make changes on the cool cases that you decided to implement. On your figure 5.2-8A, which has to do with lead production and isolation systems, there is a Note No. 6 which says a bypass timer shall be used to delay RCIC, WTCS steam line isolation of main steam tunnel R temperature.

Could you tell me what that is about, because I couldn't find it anywhere in the SAR. What kind of words is that?

MR. JAMES: Maybe I can answer that best by drawing a picture here. We had trouble in the past on the RC/IC system -- is it okay if I write on this thing? The RC/IC system; this is the main steam line. The RC/IC system takes steam from the main steam line and goes to the turbine over here.

In this line here, there is a flow meter, combined flow meter and flow restriction. The primary containment sits here. The intent of flow restrictor, flow measurement device is to close the isolation valves in the RC/IC steam line in the event there is a rupture here.

If the RC/IC ruptures here, it would get high flow here into the reactor building. This flow device will, A; restrict the amount of flow you get, and B; will tell the detection isolation system that you have a problem and will run these isolation valves closed.

The RC/IC isolation is to protect against ruptures. What happens in the field is; if you plot flow through here, steam flow through here, as a function of time for a normal startup -- not forget ruptures. We are just starting the system up here now -- you tend to get a very short term spike in the steam flow, just because things are -- well, it's to do with the initial opening of the steam emission valves to the turbine, so you get a very high flow spike which is of no safety significance whatsoever.

The trouble is, it trips the system, so you put in a time delay, and I thin it was ten seconds was the time delay we put in.

MR. MICHELSON: That is the ten second feature.

MR. JAMES: It says the high flow feature in this for ten seconds.

MR. MICHELSON: I was aware of that time on isolation, but I wasn't sure it was the same device referred to here. Generally, that is an elbow meter.

MR. JAMES: We use various sorts, elbow meters, et cetera.

MR. MICHELSON: I know ten -- shows during cleanup system surges. Tell me what that is all about?

MR. JAMES: The same principle.

MR. MICHELSON: No, it can't be quite the same principle because this is normally open and functioning. Now you have got something that will tell that it might be breaking or it might not. So it isn't just a surge on opening.

MR. JAMES: I'm sorry, I spoke too fast. It's the same principle in the sense that you are getting short term flow spikes associated with the normal operations. For example, let's say we are valving out or valving in on the filter to mineralizers or starting up a pump.

MR. MICHELSON: This is your normal operations. How much time delay are we talking about?

MR. JAMES: I can remember RCI -- but I can't remember it.

MR. MICHELSON: My question is for the record then. We have -- the water cleanup has to be isolated very quickly. It's non-seismic in your case, beyond isolation valves?

MR. JAMES: Yes.

MR. MICHELSON: Certainly, if there are ruptures out there, you want to isolate it very quickly. I'm not sure that ten seconds would be an acceptable delay, unless you have done the calculations to show it.

MR. JAMES: As a general principle, those smaller lines that go from the reactor out into the reactor building are therefore pressurized.

MR. MICHELSON: These aren't small. Again, I assume it's about 6-8 inches, which is not small in terms of the effect on the environment outside.

MR. JAMES: Smaller -- I guess my calibration on what is big or small is more of the steam lines which are 28 inches and a shutdown cooling suction line which is about 16 inches. Those, in my mind, are big.

Something like reactor water cleanup is smaller, especially if it's 6 inches versus the 28 inches you are talking about. You are talking maybe ten percent of the flow in that area.

So as a general principle, these smaller lines at RC/IC and backwater, don't have to be that fast.

MR. MICHELSON: If you have done the environmental effect analysis on outside containment, you might find it's a little faster than you think.

MR. JAMES: These lines are relatively mild compared with, let's say, steam line.

MR. MICHELSON: I will be looking forward to reading your analysis of deep water breaks.

MR. JAMES: Typically, these do not have fast acting isolation valves.

MR. MICHELSON: I assume they're 20 seconds.

MR. JAMES: Maybe even 20-30 seconds.

MR. MICHELSON: The analysis which I think you have to do as a regulatory requirement, will include the time delay to close the valve and the time delay before to close the valve even starts. The input numbers to your analysis, but your analysis is not correct.

In other words, this time delay, whatever it is, is going to be added into the analysis.

MR. JAMES: It clearly would have to be.

MR. MICHELSON: Is that a Train A, Train B timer? One on each of the two valves separately? In other words, that is a redundant isolation? There must be redundant timing also?

MR. JAMES: On the reactor water cleanup, there is only one.

MR. MICHELSON: But there are two isolation valves, I hope.

MR. JAMES: Yes.

MR. MICHELSON: Each one is on a separate train?

MR. JAMES: They are separate divisions.

MR. MICHELSON: There are timers on each division?

MR. JAMES: Yes.

MR. MICHELSON: The only question is the time delay you are injecting as to its calculation.

MR. JAMES: I would like to repeat the point to make sure you understood me, Mr. Chairman. On these smaller lines, there's no need for thermographic isolation.

MR. MICHELSON: From the viewpoint of safety, but from the viewpoint of the environment, you would have to prove it.

MR. JAMES: When we do do the environmental study in terms of radiological --

MR. MICHELSON: I'm talking about the equipment exposure and the steam around the equipment and whether the walls blow out or the door blows out and whether you get it under control before something worse happens. That is the part I assume you will convince me you have done.

On page 5.3-7, okay, I saw that already. That is the annealing question, and you confirmed that it will not be capable of annealing. On page 5.4-5 and one of the amendments which is on Provision C, you injected a statement of failure modes and effect analysis for the reactor internal pumps which is presented in Appendix 15-B.

That will be looked at by the staff later in terms of the discussion we had earlier, but it is in there, I assume. It says it is, at least.

MR. JAMES: I hope you are not interpreting my silence as agreement, Mr. Chairman.

MR. MICHELSON: They apparently put it at 15-B and perhaps that is already in the hands of the staff. Now, on page 5.4-9, which deals with safety evaluation of -- part of this being a flow restriction discussion and so forth, it talks about -- it says to verify its capability and this is the capability of the main steam isolation valve to close -- to verify the capability to close.

That is somewhere between three and four and a half seconds response time for full closure. It is set prior to plant operation at 3 seconds minimum, 4 and a half seconds maximum. Each valve is then at a separate rate of pressure and no flow.

Is this to mean that flow has no effect on the rate of closure? Since you set it with no flow, you tested it with no flow and you now think it closes between three and four and a half seconds with flow, which is the only way you ever want it to really close? Is this to say that there are no flow effects on rate of closure?

MR. JAMES: There probably are, but t would tend to be faster.

MR. MICHELSON: But faster is not better, necessarily for flows of three seconds. That is why you have a three-second minimum.

MR. JAMES: Yes, too fast and too fast being like one second or less.

MR. MICHELSON: Now you have to convince me that if you were to test at full flow, it would still be three seconds minimum, because that is your spec, your requirement to close between three and a half seconds.

Well, give it some thought. This afternoon you can answer. It's on page 524. I was a little puzzled because I know little about these valves and I was puzzled that the flow didn't speed them up any in less than three seconds.

That is a very fast closure. It could well be.

Page 5.4-10A of revision 3 -- pardon me -- revision C, that last item on that page talks about loss of basic power for 30 minutes in terms of how the RCI behaves, in terms, it says, "While the RCIC is designed for 30 minutes of operation during loss of power, the vacuum capacity should allow over four hours of operation which would meet this requirement . . . " and so forth. Why is it designed for 30 minutes only, and what is the pinch point behind 30 minutes? You said the values are a lot longer, but you didn't say the system would operate a lot longer.

MR. JAMES: There are a lot of confusing semantics on this subject. The one-line answer to your question, which is why is it designed for 30 minutes in essentially a blackout, that was the Japanese design basic requirement for RCIC, that it be capable for 30 minutes, the assumption being that up to 30 minutes, in Japan, at least, you have taken other options.

MR. MICHELSON: We are not certifying Japanese plants, we are going to certify US plants.

MR. JAMES: If you go to the US regulations, there is no firm requirement for any length of time. We get into this whole question of the station blackout, which is more of a capability analysis rather than a design basis requirement, and, as you know, for more and more years now, we have been looking at our plants and asking the question: What is their capability? You have the design documents. What would this plant really do if there was a blackout? And the answer always comes back: Four to eight hours minimum.

MR. MICHELSON: You didn't tell me that you had back-up capacity. You didn't tell me about room ventilation or any other consideration that might prohibit you from running 48 hours. What about that?

MR. JAMES: Room ventilation is usually the first thing we start to worry about.

MR. MICHELSON: You didn't tell me about that.

MR. JAMES: I didn't think that that section called for this presentation.

MR. MICHELSON: It called for in the core cooling system. You make a statement that you are designing it only for 30 minutes.

MR. JAMES: It is a true statement, Mr. Chairman.

MR. MICHELSON: This afternoon, I'm going to ask the staff if they accept 30 minutes as the design for RCIC. If not, what are they going to do about it? I didn't have any problem reading your statement it was clear.

On page 54-11, Item 3 on that page, you talk about something I asked you about earlier. It says, "The RCIC currently exhausts line vacuum breaker system...It has two automatic mode operator valves and check valves." And then it says, "This line will run between the pressure pool and the air space, and the terminal exhaust line downstream of the exhaust line check valve."

I assume what you are really saying is that the vacuum breaker goes into the air space, and the other line goes underwater through a sparger, but I could never find your discussing this sparger, and I wasn't quite sure what that statement meant. You said this morning you had a sparger on it, and it was not going to be in the open air.

MR. JAMES: Yes. Although it doesn't show it very well, we can discuss it here.

[Slide.]

MR. JAMES: The vacuum relief system, this line has to have vacuum relief on it because after the steam flow stops, the pressure can drop to zero, in effect. We put a line in this space, a little wet well space here, and to this line here.

MR. MICHELSON: That has to be in the air space, of course?

MR. JAMES: Right.

MR. MICHELSON: The other one goes under, and it's connected to an L-shaped kind of sparger?

MR. JAMES: Not L-shaped; it is just a vertical pipe with a lot more holes in it.

MR. MICHELSON: It is a vertical pipe with holes in it?

MR. JAMES: Same principle as the main sparger. You disburse the steam through a lot of little holes.

MR. MICHELSON: It would be nice in the SAF. It would have said that it was a sparger. But since this is, it essentially completes the line I am reading about.

On page 5.4-16, the last item on that page, we are talking here about residual heat removal system, and we are talking here about the two check valves which isolate the RHR and the primary system.

It says, "Two or more malfunctions are necessary to close piping system for reactor piping pressures with design pressures greater than or equal to one-third reactor operating pressure," which we're saying is two check valves et cetera, all it takes to not worry about overpressures.

We have some concerns about how check valves really are, and we have seen cases where two valves, et cetera, stuck open. It would be nice to read in this argument something more than just the fact that it takes two such malfunctions.

What happens if you do get two such malfunctions? I don't think it's incredible. It has been happening. In future design, I would like to think there are either very good provisions for checking those check valves all the time, which you didn't discuss, or there is a very good reason to believe that these are good and reliable check valves that the old experience won't pertain.

And then I leave open your valve section. There are other kinds of things. You are not doing anything different than you have always done about check valves.

MR. JAMES: That is correct, but before you go on, Mr. Chairman, I didn't quite follow you. I think you were talking about the RHR injection line?

MR. MICHELSON: Let me go back and get it a little more into context. The Section 2 says, "The ABWR design basis against interfacing, loca concerns and facing loca concern by requiring that, one item, two or more check valves."

I'm saying I'm not sure two check valves will not eliminate the problem from past experience, unless you say something real special about check valves and testability, or they are new and different designs, more reliable. Two: check valves just aren't an answer in arresting a loca.

MR. JAMES: I think that is poorly written.

MR. MICHELSON: Let me read back again. Item 2 says, "The ABWR design basis against interfacing a loca essentially eliminates loco concerns by requiring that: A: two or more malfunctions are necessary to expose piping system reactor operator pressure for design pressures greater or equal to one-third of the operating pressure; and --

MR. QUIRK: It doesn't mention check valves?

MR. MICHELSON: It says when you have been doing it. In other words, you won't let two check valves in a series be an enhancer for an interfacing system. Is that right? If it is, that's great. I felt that this allowed you to use two check valves, and it goes to talk about three or more.

MR. JAMES: I think we are meeting all of the current isolation requirements that don't allow --

MR. MICHELSON: Then what you really should have said, if it takes two or more malfunctions, and they are not involved in check valves, then I would agree. But if you are talking check valves, two malfunctions is not a good basis.

MR. JAMES: Anywhere where we are reliant, any line that has two check valves in it also has a motor operator valve in it.

MR. MICHELSON: I don't know that motor operator valves are necessarily the answer. It depends, when you hook them in, how they function, or how fast they close, and a whole lot of things, on whether they will be an enhancer or not.

MR. JAMES: You must understand on some lines we have one motor operator valve and two check valves which do what you just said. So if you start postulating the motor operator valve failed, opened inadvertantly, or whatever, then we are reliant on two check valves to be positioned between the real high pressure reactor pressure and low-pressure piping. So in the event the postulated failure is the motor valve --

MR. MICHELSON: These were general design criteria that are being used. I am just saying I agree with your criteria that two or more malfunctions are necessary unless those malfunctions are involved check valves. Then, I would not agree. Just from a lot of experience we have had, if you are never doing it, you don't mind inserting the words?

MR. JAMES: I think you are going to have trouble with the design, Mr. Chairman, because the first theory is a motor operator valve, and we have two check valves, and the second theory is one of those checks valves is stuck open.

MR. MICHELSON: On the next part of the page where you talk about three or more malfunctions, I agree that two of them can be check valves then.

MR. QUIRK: I don't think we are disagreeing here.

MR. MICHELSON: I think we need to clear up a little bit. I didn't think you were using two, but I didn't have time to go over all of the drawings to see where you might use two check valves.

On page 5.4-7 -- let's skip that one. On 5.4-16A of the revision C, you talk about "Interfacing loca design basis requires motor operated ECCS injected valves to be tested with the reactor vessel at low pressure, and ECCS injection lines to have inboard valves, with a positive indication at the control room." You make no mention of how often -- what do you have in mind? Just that you are testing them? What if it is every five years?

MR. JAMES: No. If the reactor is up for twelve months uninterrupted, then it will be twelve months to do the test on that outboard motor operating valve.

MR. MICHELSON: It could be as much as 18 months, then, because I think that is your cycle.

MR. JAMES: Fifteen to 18.

MR. MICHELSON: So you are depending upon a test once every 15 to 18 months on that check valve and the motor operated valve to tell you that you don't have an interfacing loca problem?

MR. JAMES: To do the test on those valves, that is what we are -- the operability test.

MR. QUIRK: On the motor valve, that is correct. On the check valve, those can be checked during operation.

MR. MICHELSON: They can be checked more frequently?

MR. QUIRK: Yes.

MR. MICHELSON: On the motor operator, you don't want to open, for some reason?

MR. QUIRK: Common sense.

MR. MICHELSON: On page 5.4-17, it says, near the end of the page, "Relief valves of the pump suction and pump discharge lines are to protect the lines against overpressure." What relief valve are you talking about there, how big are they, and where are they located?

MR. JAMES: These are --

MR. MICHELSON: It says they are on the pump suction and the pump discharge lines.

MR. JAMES: Typically these lines. Here is the shutdown cooling suction line here. Typically, in this case -- this is suction -- those are normally closed motor operated valves. There would be pressure relief capability on this line here. They are small liquid relief valves.

MR. MICHELSON: Leakage?

MR. JAMES: Just to take care of any leakage coming through here.

MR. MICHELSON: In case of an interfacing systems problem where you are pressuring from the other side for whatever reason, and you want to protect the suction side of the pumps, there is lower pressure design, and they have a 600 pounds, also? They would have to?

MR. JAMES: This whole system is five- to six-hundred.

MR. MICHELSON: That is just to take care of leak-off?

MR. JAMES. Leakage and leak protection.

MR. MICHELSON: Protection against overpressurization of temperature? What is your basic approach? Are you considering having any problem at that stage?

MR. JAMES: I'm not sure I follow you.

MR. MICHELSON: If you repressurize the reactor at low pressure, is there a problem?

MR. JAMES: Oh, you mean from NET-type considerations?

MR. MICHELSON: Right.

MR. JAMES: No. Mr. Dillman probably has a better number than I have, but there is -- the transition temperature is a low number.

MR. MICHELSON: You are not providing any over-protection low temperature, then?

MR. DILLMAN: There is no need for it. There was too much to read here, so I could not find where that was discussed. If there is no need, I think that is an important consideration. You can say the basis is there. I couldn't find that basis. I kind of speculated. You didn't have any provisions.

On Page 5419, again we are discussing now pressure relief capacity of RHR, observing a high pressure check valve where closed to prevent reverse flow should the pressure increase. Is that a testable type valve, then, that you are talking about this high pressure check valve that will prevent reverse flow?

MR. JAMES: I have to get a better idea of where it is, Mr. Chairman.

MR. MICHELSON: I would have to go back because, again, this is under a general paragraph and just talks about design basis for a pressure relief. It says relief valve in the RHC system, thermal relief and leakage and control valve failure. Then it makes a statement. Well, first of all it says redundant interlock to prevent upper flooding and then it says in addition, the high pressure check valve will close to prevent reverse flow should pressure increase. It says relief valves and discharge piping, etcetera.

You tell me which one it is talking about.

MR. JAMES: As a general principle, it would be in something like this where this is the injection line of the vessel.

MR. MICHELSON: Are those testable check valves?

MR. JAMES: Those are testable. Typically, it is not shown on this schematic. There would be a pump discharge down here. There would be another check valve, HCPF, RCIC system. There would be another manual check valve out here. I think the sentence you just read refers to that typical pump discharge.

MR. MICHELSON: Unfortunately, I read you everything that is under that section. It wasn't very clear, for sure, but you do use testable checks in the same positions you have always used.

MR. JAMES: Right.

MR. MICHELSON: On Page 9420, you talk about valves and one of the statements you make under valves is all the directional valves in the system, and this is the RHR system, are conventional open-and-close. My question is some of these valves are going to have to do throttling. Are you using the conventional gate and door valve that returns to the pressure pool?

MR. JAMES: The only throttling valve that I'm familiar with, which is this one here, which is a by-pass.

MR. MICHELSON: That isn't one here? What about as to the pressure when you bring it back because you have to drop a couple of hundred pounds of pressure across the valve because of the suppression pool?

MR. DILLMAN: Are you talking about the other line?

MR. MICHELSON: It isn't so intermittent when you have an accident. That is the way you cool the pool. I don't want it -- I would like to know the design basis that happens to be in the area where there is quite a bit of hydraulic disturbance in the path. It is also an area which the people just recently discovered and has a current problem and it gives that valve a problem, and there are all kinds of bad things like that. I just wondered what you were doing on the ABWR to quiet down the test return line on the suppression cooling line.

There is r´ e than one solution than the path that has been used. There was a special arrangement.

MR. JAMES: Normally, when the process conditions don't change over time, we wouldn't rely on a throttle valve. We would have the right flow.

MR. MICHELSON: I didn't find that on the flow diagrams, but maybe you can show me how you did it, if that is what you are doing.

MR. JAMES: On that, I do have the systems description. I will look in there and find it on that film. You don't need to tell me.

MR. MICHELSON: Hopefully it's in your systems specifications, if you've got one.

MR. JAMES: You understand, though, Mr. Chairman, if you look at the RHR system, the system documents should be considered as a set. The system spec and ID and the process diagram and the other diagram. Those are a set.

MR. MICHELSON: I don't find the others. Maybe I'll find it in this document. I haven't looked at it yet. If I don't find it there, then you are intending to put one in. You haven't described how you address the question, but those are not good throttling valves. Even the old valve which is used traditionally did not turn out to be a good throttling valve at

200-and-some pounds of pressure.

This was one of the more complete sections of the SAR, by the way. It was, in general, I thought, quite good. But just a few questions. This is going to be a question more for the staff. On Page 5.4-20, you indicate that you are running a seismic qualification only on the steam lines in the feed water out to a certain restraint point and beyond that it will be non-seismic.

Could you tell me roughly where that is, where that restraint point is, please? It's not shown and it is not clear from any of the descriptions as to where your restraint will be located relative to the outboard isolation.

MR. JAMES: It is right outside the outboard isolation.

MR. MICHELSON: You are saying most all of the steam tunnel and so forth is going to be non-seismic piping then, because your outboard isolation valve is hopefully right where you enter the steam tunnel. And if your restraint is right there also and is non-seismic beyond that, then we are talking about non-seismic feed water and main steam in that tunnel.

MR. JAMES: Yes.

MR. MICHELSON: Okay. I will ask you about that later in another chapter.

MR. QUIRK: Yes. That is shown at Chapter 3.

MR. MICHELSON: I want to make sure that is where this thing was located. Again, I would of thought I didn't have to struggle much with them as they are; that is describing a complete design. It doesn't even tell you where it is.

MR. QUIRK: It is shown.

MR. MICHELSON: But not at that point.

MR. QUIRK: It is shown in Chapter 3.

MR. MICHELSON: It just shows outboard isolation valves somewhere. Page 5.4-29, you make a statement here which maybe you could explain. It says a motor is used with valve leaders which will be furnished in accordance with applicable industry standards. What does that mean? Does that mean you will go out and buy whatever the industry offers or are you going to specify what your standards are and the industry has to offer a valve that meets that standard?

MR. JAMES: It means whatever requirements are called for, Class I-A.

MR. MICHELSON: In a Class A, you shouldn't tell me you will buy whatever the industry standard. You should tell me your standards that this valve should be bought to, if there are any. I assume there are.

MR. JAMES: There are. If you look at our procurement documents.

MR. MICHELSON: You should have said you're going to buy it in accordance with GE standards, but not applicable industry standards. You don't go out and buy that way. You use them in the process.

MR. JAMES: It is a mixture of both when you get right down to it. We have very clear nuclear-related requirements and there are other standards that the industry uses.

MR. MICHELSON: On the same page, another. Power operators will be sized to operate it successfully and at the maximum differential pressure determined in the design specification. Now, we know and I am sure you are well aware of a number of tests that have been done a motor operated valve that indicate opening or closing under maximum differential pressure alone is not the criteria. It is the flow condition. It is really the loads of LC under flow that count and this doesn't talk anything about flow.

Are you going to go back and give us a new spec for valves or a new description or how are you going to buy valves or what, because you just say here you're going to use differential pressure alone.

MR. JAMES: My understanding is that is a plan that we are working on.

MR. MICHELSON: This is an open item. Maybe we'll find it as open on the list. That is certainly not closed and I think you understand why. Now, a whole lot of other sections in this 5.4, like 5.10. Pardon me, 5.12, safety relief valves. I will talk to the staff this afternoon. These weren't in their SAR. I wonder if it was in some other section.

It is in your SAR, at least. Do the other members have any questions on this chapter? This is the final shot at it.

MR. CATTON: I have a rather simple question relative to the question of this item. With the core flooder, could you show me how water is entered into the vessel? I can't tell from the pictures. Is it just the pipe stuck in there?

MR. JAMES: No. There is a sparger in there. The flooders come in -- two of the flooders come into -- that doesn't show.

MR. DILLMAN: Is your question on the high pressure flooder?

MR. JAMES: No.

MR. DILLMAN: The high pressure flooders are in here inside the shroud head and you see the nozzle here. See the nozzle here and the expansion loop here, and then the penetration through the shroud head. This is a slip joint coupling that handles the thermal expansion plug. I keep saying it's through the shroud head. It's really through the extended shroud wall. So it flows through this nozzle, down this loop, up, and discharges in here.

The pressure, and this is a sparger similar to the feed water spargers.

MR. CATTON: That just has the holes -- point to the part that has the holes in it.

MR. DILLMAN: Well, it is a pie, horseshoe shaped pie that follows the circular contour. It has elbows on the top and nozzles on each elbow. The low pressure flooder, and you can, by the way, see it's kind of dark, but you see that little thing sticking up. That is the elbow. The low pressure flooder is a similar sparger and the connection there is it is welded right to the safe end of the nozzle, so you have a direct shot. And the low pressure flooder goes into the anneals.

MR. CATTON: So it floods from below.

MR. DILLMAN: The flow path of water coming in here, depending upon your pipe size, will come down here and some of it would come up and feed the break. In this case, it comes up here and goes down, and some of it goes up.

MR. CATTON: Just one more question What is a testable check valve?

MR. JAMES: It is the test valve with an enhancer on it, using activator and have the flutters moved so it flaps. The position indicators will show the position of it. It's a twistable check valve that enables you to check the motion.

MR. CATTON: It doesn't tell you anything about the water or anything like that. It's just the flapped --

MR. JAMES: That's right.

MR. CATTON: You can have the shaft worn and not know?

MR. JAMES: Yes.

MR. CATTON: It is not like some of the diagnostics in the check valve portion.

MR. JAMES: No.

MR. CATTON: Okay.

MR. MICHELSON: Let me ask one other thing. On Figure 5.4-12B and 12 are unreadable in the SAR. Could you -- when you take the drawing and scale it down to this size (indicating), you can't read it. I don't know how the staff does it. But if you would, send me a copy of the PID. You have to look at this one. It is unreadable.

MR. QUIRK: Tell me what page.

MR. MICHELSON: It's Figure 5.4-12A and 12B in Revision A. It's just way too big a drawing. It needs to be scaled down. It is fairly important because -- and I did want to read it.

This afternoon, we will pick up with the staff SAR on the Chapter 5 and discuss Chapter 6. We will adjourn until 2:00.

[Whereupon, at 1:00 p.m., the conferences was recessed for lunch, to reconvene this same day at 2:00 p.m.]

AFTERNOON SESSION

[2:00 p.m.]

MR. MICHELSON: Let's start again. I'll turn to the staff to discuss their SAR, Chapter 12.

MR. SCALETTI: We have Mr. Brammer from the staff who will make a presentation.

MR. MICHELSON: Again, could we try to identify as we go in Chapter 5 those parts that you feel -- you are all finished with and would be appropriate for us to comment on? Is that possible in Chapter 5?

MR. SCALETTI: Obviously with the exception of the outstanding issue of Chapter 5, Chapter 5 and Chapter 17 are the two most complete chapters in the staff safety evaluation.

MR. MICHELSON: Do you think all of Chapter 5 is ready? Is that what you are saying?

MR. SCALETTI: Yes.

MR. BRAMMER: I am Jim Brammer of the mechanical engineering branch. I would like to briefly discuss the staff's review of those portions of the SAR which deals with code case applicability and compliance with the code.

[Slide.]

MR. BRAMMER: This section has two broad requirements to code compliance. The first one is components must meet requirements for components and be in an acceptable edition of the code, Section 3.

Now there are a few exceptions to this. For example, if a component can meet the exclusion portions of the 10CFR50.55a, the ASME class 2.

The second requirement that all ASME class 2 and 3 components in the plant must meet the requirements in acceptable editions of the code.

Now the staff's review of this issue generally speaking, the first thing we do is to determine whether the definition of reactor coolant pressure capacity meets the requirements in 10 CFR 50.2.

If we review the text in the CFR to determine that the boundaries are located in conformance with the requirement in 50.2, after this, the staff has arrived at the following conclusion: that all applicable components are properly classified as ASME Class 1 and will be constructed in accordance with ASME Section MB. ASME Class 2 components will be constructed in accordance with NC and NG.

Just an aside, the other group will be discussed in SAR Section 3.2.

The final conclusion is, the SAR contains acceptable commitments to the MSE code addition and agenda dates. As far as the code cases are concerned, these are periodically produced by ASME -- the code cases are -- to document editions or revisions to the code.

The staff routinely reviews each of the code cases and documents their conclusion relative to whether it is acceptable or not.

Reg. Guide 1.84 or 1.85. The guide that the staff uses as far as evaluating the SSAR, the code cases that have been requested and the code cases must be either in Reg. Guide 1.84 or 1.85 which is the materials code case. After a review of this issue, the staff has concluded that of the 17 code cases listed in the Table 5.21 of the SSAR, 16 have been encrypted, either 1.84 or 1.85. The one lone exception so far is code case N451 which is alternative rules for analysis of class 1 piping undersize loading and that is it.

MR. MICHELSON: You say that's it. Is that Chapter 5?

MR. BRAMMER: No. As far as the staff's evaluation of compliance with the code and code cases only, that is a very narrow and a very broad review.

MR. MICHELSON: Now there is the quest on as the annealing of the vessel is a code requirement. What is your position in the SAR?

MR. BRAMMER: I don't know if that was discussed. Is John still here?

MR. MICHELSON: Is that still an issue?

MR. BRAMMER: I would say it is but I didn't review that or no one in our branch reviewed that particular issue.

MR. SCALETTI: John Tsao from staff.

MR. TSAO: We will talk about that when I come to that item number four, I believe.

MR. MICHELSON: It's coming up later?

MR. TSAO: Right.

MR. MICHELSON: I thought it was part of the boundaries.

MR. BRAMMER: I would say it is but not as far as code cases. It fits indirectly.

MR. MICHELSON: Any questions?

[No response.]

MR. MICHELSON: If not, then let's proceed.

MR. SCALETTI: George Thomas from the staff on Item No. 2, overpressure protection.

MR. THOMAS: My name is George Thomas. I'm from the systems branch. In our special overview we find that there is nothing different than the current design. This overpressure production meets the ASME Section 3 code and in the analysis, they -- it is by the spring activation, not for the relief mode and in the analysis, there is the high flux gram and it is only for the second scum.

The peak calculated pressure. The peak calculated pressure is 1,274 p.s.i.g. which is less than 1,375 p.s.i.g. -- same pressure. Again, we completed this review and we don't have any open items in this particular section.

MR. MICHELSON: Any questions?

[No response.]

MR. MICHELSON: Which section is this?

MR. THOMAS: 5.122.

MR. MICHELSON: Is the GE group here going to take the same plan?

MR. THOMAS: Most of the time yes but in some cases, I don't think they follow the exact numbering.

MR. MICHELSON: I notice in a number of cases, there is a discrepancy between how you title sections and how they title sections. I wonder if that is the same section or if who is using the standard and who is using some other title?

MR. THOMAS: I plan to use the standard of review plan. That's what I will go by most of the time.

MR. MICHELSON: What is the title in the standard review plan?

MR. THOMAS: That's right.

MR. MICHELSON: All right.

Why don't you proceed?

MR. SCALETTI: All right. Next on the agenda is reactor coolant pressure boundary leakage detection.

MR. CHANDRA: I am Thyagaraja Chandra of the Plant Systems Branch.

The first topic is the reactor coolant pressure boundary leakage detection system.

Now, as to how we evaluate this standard. This is a special section on the basis of the acceptance criteria identified in its standard review plan, 5.2.5. That standard review plan identifies compliance with GDC 2 and GDC 30, and GDC 2 says the design is supposed to be compliant with GDC 2, provided the design meets the RG 1.29, positions C 1 and C 2, which deal with the seismic qualification for safety-related components and systems, and C 2 deals with the requirement that the non-safety-related components of the system, in the event of a seismic event, a seismic event, should that occur, fail and in a manner that it will impair the safety-related equipment systems components, and all of this section tells you how to identify the leakage is collected.

GDC 30 -- I should mention this fact. The system is supposed to be in compliance with GDC 30, provided it meets the regulatory position that it meets regulatory guide 1.45. That is how we evaluate the acceptability of the system.

Regulatory guide 1.45 deals with such issues like the requirement to collect the leakage -- to segregate the identified leakage from the unidentified leakage and, also, the seismic qualification for the guide and the sensitivity of the reduction systems and the number of the detection systems that are required and what are the various detection systems that are to be used for unidentified leakage and so on and so forth. Therefore, we evaluate the compliance on that basis.

[Slide.]

MR. CHANDRA: This slide explains how the unidentified leakage is collected and also talks about the inter-system leakage.

Even though we are primarily concerned with the identified leakage detection systems -- and for the ABWR, it essentially means the leakage in, say, the dry well. Let's say the dry well equipment breaks up, but for purposes of completeness, we generally discuss, also, leakage outside the dry well, like it has been defined over here -- the reactor building equipment areas mainstream tunnel and the turbine building. It talks about detection methods and, also, about the total leakage limit.

Incidentally, the reactor coolant present boundary of limitations are identified in the plan specifications and, also, the limits for the leakage and unidentified leakage as to the total leakage, they are all identified and the plans typical expected specifications. So, it is an expected requirement.

[Slide.]

MR. CHANDRA: The last one tells, of course, about the RCIC makeup, and we find the reactor coolant pressure boundary leakage detection system, as discussed in Section 5.2.5 of the standard review plan, 2.5 acceptance criteria. So, we have no open item as far as this particular section is concerned.

MR. SCALETTI: Questions?

MR. MICHELSON: At the end of the section, about page 5.2.28, there are a number of references given. To what extent did you review any of these references?

MR. CHANDRA: Do you mean the standard safety analysis report?

MR. MICHELSON: In the ABWR standard report.

MR. CHANDRA: I have no gone into great details about those references, but I did read that particular section, and they were evaluated on that basis of whatever I found in that item, and I did have a large number of questions at the RA stage, and I requested additional information, and I found that they provided detailed responses to my questions.

MR. MICHELSON: Relative to these references, when you find that you have no problem with the Section 5.2, other than the ones you have stated, does that mean that you don't have any problem with the references either? How do I interpret the extent of review of the referenced material? Is it just there for reference only and not a part of the eventual certification process?

MR. SCALETTI: I think Mr. Michelson is asking if we, when we reviewed the references, are those references supporting your analysis for this design?

MR. CHANDRA: By and large, we did not review those references in particular. We found that the material provided by General Electric in the responses provided for a very large number of questions we generated in that area.

MR. MICHELSON: I don't have any problems with the question-and-answer process. I think I understand that, and I realize, to an extent, that it is, indeed, part of the final document, but what I don't understand is the status of references in the SAR relative to the certification process. Are we certifying the references are acceptable, or are we going to put a caveat that says that we haven't reviewed these references and they have no status as far as certification, or just what? How will I interpret them?

MR. SCALETTI: Again, those references which are critical to the review will certainly be culled out.

MR. MICHELSON: You will cull that out?

MR. SCALETTI: They will be referenced in our report, in our safety evaluation report. Those references that are not critical to the review, we believe, have not a great deal of status or importance to what we are doing.

Clearly, we would consider them as being part of a design certification. In other words, when we certify this design, we aren't certifying that reference is the gospel, or however you want to put it.

MR. MICHELSON: I think that is a reasonable position, if that's the one you want to use. Therefore, if I find that a reference is not cited in your SAR as having be used as a basis for your determinations, that would then mean to me that either you haven't reviewed it, or you looked at it and felt that it was not a sufficient contributor to cite it or whatever, but it would not be a part of the certification process.

We are not certifying these reference documents unless it's a part of the SAR and stated in the SAR charter. I think that's --

MR. MICHELSON: Sometimes, I look at these references and they were quite important. Now, I find that they are omitted in the SAR. Then we will talk about it. If they are cited in the SAR, I know what your process is.

MR. QUIRK: That is fine.

MR. MICHELSON: Sometime there is a multitude of references. Are there any other questions?

[No response.]

MR. MICHELSON: Then let's proceed.

MR. SCALETTI: Next on the agenda is Item No. 4, reactor vessel integrity. Mr. Tsao.

MR. MICHELSON: Is that control room habitability going to be picked up later on the agenda? We are jumping back and forth.

MR. SCALETTI: We have been following the agenda.

MR. MICHELSON: I was mainly trying to follow the handouts. Where are we at now?

MR. SCALETTI: At the last page. Go ahead, Mr. Tsao.

MR. TSAO: I am John Tsao. What I am going to talk about is the staff review of 5.3.3, Reactor Vessel Integrity. Most of our review is typical and straightforward. Since Mr. Chandra raised the question of reactor vessel annealing issues, let me just talk about that topic right now.

That topic, the annealing problem, will be addressed in fracture toughness. The Appendix states that if the referenced temperature, the ductility transition versus temperature exceeds 200 Fahrenheit and the upper shelf energy is below 50 foot pound, then the reactor vessel will have to be annealed.

In our review of GE's submittal, we have found that the RT-NDT shift is 28 degrees for welds and 8 degrees for base plates. Now, this is not the total referenced temperature shift. This is a shift plus. We have to add some margin to this and initial RT-NDT.

In our estimation, we believe the ABWR reactor vessel will not exceed 20 degrees Fahrenheit at the end of 60 years, plus we have energies, and since the copper content of the reactor vessel plates and welds is way below the vessel, then a number of ABWR reporting zero, 8 percent copper content -- by the way, copper content has some direct relationship with the embodiment of a reactor vessel.

With .08 percent copper content, the upper shelf energy will definitely be above 50 foot pound, plus we looked at their new found fluence. Their estimated fluence is 4 times 10 to the 17th N/CM squared. That is about one order of magnitude and the current boiling water reactor -- for a magnitude lower than the pressurized water reactor.

So from these three points, we believe that the ABWR rector vessel does not need annealing. That's all I have to say as to whether there is intergranular stress corrosion. The ABWR SSAR states that they will not use sensitized stainless steel, so that resolves the IGSCC problems and the IGSCC resistant materials.

This concludes my presentation on reactor vessel integrity. Any questions?

[No response.]

MR. MICHELSON: Seeing none, let's proceed.

MR. SCALETTI: Item No. 5, George Thomas on reactor recirculation.

MR. MICHELSON: Which is standard? What number?

MR. SCALETTI: What number?

MR. MICHELSON: Yes.

MR. SCALETTI: What is the number?

MR. THOMAS: This is 5.4.1. My name is George Thomas. As you know, a reactor recirculation system replaces the external pumps and this eliminated the big pipe size, a typical DBA.

There is now a larger pipe below the core and because of this, there is no core problem. This has had a very significant improvement from the prior design, and because of this, there is less ECCS capacity.

Typically on project there are about 31,000 with high pressure and low pressure systems typically, but in the ABWR, there is like 31,000 and this is not a new concept. Already there have been some operating in Europe.

We have had a good experience with this, and there is no core problem. There is a significant safety improvement.

MR. CATTON: What does this do to the stability of the core? Does it shift?

MR. THOMAS: It is quite possible on ABWR. I think we've going to have a separate meeting on that coming up in November, I think, in San Jose. That meeting --

MR. CATTON: I was hoping to get at little extra insight.

MR. THOMAS: There will be more detail there next month.

MR. SCALETTI: Is there anything you can add, George, on the instability issue of the ABWR?

MR. THOMAS: There are some design features.

MR. CATTON: I was interested in the difference and how it interacted with the core. Can you answer that?

MR. THOMAS: There is the possibility in the ABWR.

The design is not complete in dealing with this issue.

MR. CATTON: **Are you better off with pumps?**

MR. SCALETTI: **Never mind.** There is a brief writeup in 153 with regard to **stability.** I don't know whether that would help you or not.

MR. CATTON: I **was** just curious, because loop is different when you have **pumps.**

MR. SCALETTI: I can't answer that.

MR. CATTON: Maybe GE can help.

MR. DILLMAN: Maybe we can make a couple of comments anyway. The stability or instability is primary function of the natural circulation as well. We get about the same circulation flow and flow loss with the installed pumps as we would the other pumps. We have done other things with the design to improve stability. Is it we have more separators for the same size core and we have shortened the separators by phase so we have more stability.

You also get an advantage -- whether the jet pump plant when you trip one. You must have these pumps where -- at the ABWR, we have individual pumps. Now, you have several other pumps before you get to those pumps.

MR. WARD: You are talking about inadvertence?

MR. DILLMAN: Right.

MR. THOMAS: RNRCIC and ABWR, this is a ECCCS system. Typically, it is a centigrade system so there is nothing very much different than the current design in ABWR. There are some features. There is a reactor start out reactor low level and dry well high pressure. Currently in the design, they only have a low level so there is some change for RCIC now and their current operating plans, there are some problems with the RCIC in that there are so many overtrip so now they put a timer in the turbine steam inlet.

There is a small bypass line around the turbine inlet. So bypass will open for a short time then only the main inlet valve will open. So this will reduce the chances of an overspeed trip and the current design, there is no testing now for the suppression pool. The testing is done only from the condensates storage tank because RCIC is now part of the system. There is a full float test line from the suppression pool back to the separation pool and this system now meets all of the separation criteria -- additional criteria amendments and qualifications, seismic qualifications -- all of those, ECCS requirements.

So this is an improvement on current design of RCIC.

[Slide.]

MR. THOMAS: We think that this is a significant improvement from the current design.

MR. MICHELSON: If you are finished with RCIC, I have questions and it might be appropriate at this point. On page 5.35 of your statement of evaluation report, you talk about little transmitters on the condensate storage tank and you say they are going to be supported and mounted in such a way that automatic suction transfer to the suppression pool from the non side of the tank will take place without failure during a seismic event.

Now it puzzles me a little bit -- the nonseismic tank, how you mount and so forth the level transmitters so that even though a seismic event occurs, you can have a proper transfer. Can you tell me roughly how that is done?

MR. THOMAS: Typically a condensate storage tank is not seismically qualified but a transmitter can be supported in such a way, it will do it as a switchover.

MR. MICHELSON: It is mounted on the tank; isn't it? It's mounted on the nonseismic tank and the nonseismic tank is the thing that is collapsing, I guess. That is what we are concerned about getting a transfer even though the tank is fluxing. How do you make sure that this level indicator does the right thing before the collapse?

MR. THOMAS: It is failsafe.

MR. MICHELSON: How could it be a failsafe device that is attached to a nonseismic tank. I'm not sure what failsafe means in this case. It means that the tank is collapsing and someone does the right thing. I'm asking how you design to do the right thing under those circumstances.

MR. THOMAS: Right now there are plans to transmitter seismically to support the tank.

MR. MICHELSON: Sometime I was going to do the right thing even though it is a structure attached to it is failing and in an unknown way, that is what you are saying?

MR. THOMAS: Yes.

MR. MICHELSON: I am kind of interested how you do that.

MR. THOMAS: I don't know the details but I understand it can be done.

MR. MICHELSON: It can be done?

MR. THOMAS: Yes.

MR. MICHELSON: That it is failsafe?

MR. THOMAS: Right.

MR. MICHELSON: It can only -- after the collapse starts since there is no seismic instrument that says we are having an earthquake now, do something. Somehow it is doing the right thing even though the tank is collapsing. I did not know that that was possible.

MR. CATTON: How does it know that the tank is collapsing?

MR. MICHELSON: How does it know that the collapse has started. Take any part of the collapse, I don't know how it's going to occur.

MR. JAMES: The usual way you do that is to provide a parallel standby in the area of the suction condensate storage tank. It's a parallel.

MR. MICHELSON: The instrument is on a parallel standpipe so you are monitoring a level on that?

MR. JAMES: Yes. That is a long run of pipes.

MR. MICHELSON: It is far enough away from the tanks so it won't be affected by the collapse? I assume the standpipe is outside?

MR. JAMES: It is outside, separate from the storage tank.

MR. OKRENT: So it is on some kind of pedestal?

MR. JAMES: On a structure.

MR. MICHELSON: I think that is a good answer. I just wondered how it was done.

MR. WARD: You said the usual way that we do that. Does that mean it is not designed yet or the detail --

MR. JAMES: I put an advocate. I'm not quite sure. That is the usual way of doing it. There are other ways to build a condensate storage tank. Part of that will be in seismic area one.

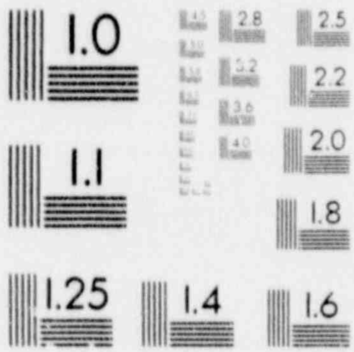
MR. WARD: Apparently that decision has been made already?

MR. JAMES: Yes.

MR. MICHELSON: It would puzzle me as these things are written down and some of the stuff I read, maybe I just didn't see it. Is it described in your SAR? It is an

1

IMAGE EVALUATION TEST TARGET (MT-3)



150mm

6″

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IMAGE EVALUATION TEST TARGET (MT-3)

150mm

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1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

important feature. It is an important point. Where is it described in this document?

MR. QUIRK: I don't -- is it in a section?

MR. SCALETTI: Mr. Thomas, do you know where it is?

MR. THOMAS: 5.46. I don't think they're going into detail on this particular subject. It is not there.

MR. MICHELSON: You learned about this from some other source?

MR. THOMAS: Right. From previous experience.

MR. MICHELSON: That doesn't count. What counts here is what is being proposed and what you are reviewing. We aren't reviewing your own knowledge, we are dealing with what they are saying they're going to do. They have already made the committment to do this somewhere. You must review that committment, I hope. That is what you are reviewing.

MR. THOMAS: What I was trying to say it is in the questions and answers.

MR. MICHELSON: That is where I will find that question and that answer will explain how it is being done.

MR. THOMAS: Right.

MR. MICHELSON: Okay, I will look it up. You don't recall the question?

MR. THOMAS: No, I don't recall the number.

MR. MICHELSON: Okay.

One other question, since we are finished with RCIC.

Could you tell me how the RCIC room is being cooled, and particularly, for these --

MR. THOMAS: That is being reviewed by Plant Systems Branch. I don't go into that detail.

MR. MICHELSON: That is another chapter?

MR. THOMAS: Another chapter, maybe Chapter 9, that aspect.

MR. MICHELSON: Even though it's an RCIC system, since it is room cooling, it is treated under room cooling? We will get to that.

Another question I guess we're going to get elsewhere, you are going to do an analysis of what happens when the steam line ruptures outside a containment going down the RCIC terminal and what effect that has on the building and so forth. You are going to review what the ABWR says about that?

MR. THOMAS: I think it is already done. I don't think we're going to do anything more than what we already have done.

MR. MICHELSON: Maybe it has been done, but I haven't read it in your SER. If you reviewed it, that would be nice to say so under RCIC, since the RC steam line is concerned here.

MR. THOMAS: I can go back and check it.

MR. SCALETTI: Which one is that?

MR. MICHELSON: The RCIC steam line would contain a hazard outside the containment. I wondered whether that was analyzed elsewhere in the --

MR. THOMAS: I think at 3.11, where we talk about containment qualification.

MR. MICHELSON: We will get it there?

MR. THOMAS: Yes, 3.11.

MR. MICHELSON: That's it. Thank you.

MR. THOMAS: RHR and ABWR, there is only a single common section line coming to shut down fully. Now there are three individual systems, mechanically independent. So, that is a very big improvement over the current design, and the RHR modes of operation are typically staggered design. A low-pressure flutter mode is started automatically. All other modes are started manually.

There is nothing different than the current design, so I don't think I need to repeat the whole RHR modes of operation.

MR. OKRENT: I either read or heard somewhere that the low-pressure systems connected to the primary system are designed for 500 psi. Is that correct?

MR. THOMAS: The low-pressure portion is designed for 500 psi, yes, Sir.

MR. OKRENT: If we stay on that chart for a moment, then, if I remember correctly, wherever I read or heard this, it was stated that this led to expected failure pressure of about 1,000 psi. What pressure is the plant run at?

MR. THOMAS: Shut down or cooling or what?

MR. OKRENT: Total normal operating.

MR. THOMAS: Normally, it is around 300 psi.

MR. OKRENT: The primary systems.

MR. THOMAS: Primaries are 1,500.

MR. OKRENT: I was wondering if I should take great comfort or some comfort or just what from the 500 psi design point. It seems like it doesn't quite leave the RHR invulnerable, even if it's exposed to full system pressure. Am I correct in that assumption?

MR. THOMAS: There are some pressure values. Typically, there is --

MR. OKRENT: I am assuming for the moment that the RHR low-pressure part exposed to under constant system pressure, ideally that I should not assume that it's invulnerable. Is that correct?

MR. THOMAS: You can put this is the, say, 400 or 500. It may be able to stand more than 500 psi.

MR. WARD: If the low-pressure system, 500 psi system, is pressurized to 1,050, what is the probability of gross failure?

MR. THOMAS: There is a high probability that it can fail. There is a relief rod there and pump discharge, and there is a system and, still, you have other systems which are not degraded.

MR. MICHELSON: The relief valve is just for small amounts.

MR. THOMAS: No, it is not an overproduction, no. That will blow, still, but you are to assume three failures. There is, in the lock, a check and there is a second one. So, you have to assume all those types of failure.

MR. OKRENT: You said three failures? There are two valves, aren't there, normally, in most of the lines?

MR. THOMAS: In the shut-down cooling mode, when you take a section from the reactor?

MR. OKRENT: No. When you are at power, each of the RHR lines, where it connects to the primary system, are the three isolation points or two?

MR. THOMAS: No. I am talking about the check well number 1, and number 2 is the intersection well, and then number 3. That is what I am talking about, three.

MR. OKRENT: But I thought we just had a discussion which said that the piping was vulnerable at system pressure. Correct me if I'm wrong, but I thought that is what I read, and when I said this, nobody interjected and corrected.

MR. MICHELSON: I don't agree to 1,000 pounds being a pressure point.

MR. JAMES: With that a point for GE to interrupt, we don't concur with that either. You have piping that is designed for X psi and 2 psi. In all probability, there will not be a catastrophic rupture. The seals may leak, but there is not a high probability of rupture.

MR. MICHELSON: Unfortunately, as to the ancillary equipment like the pumps and things like that that aren't designed to the same kind of pressure boundaries, and sometimes, those will give out sooner, but generally it is about 3 times the design when you figure a very high probability of rupture. Say you expose it to 1,500 pounds.

MR. SCALETTI: That is Section 1.3, where we indicated it is a GE design criteria of having to have a minimum of two failures, at 500 psi, at low-pressure design. Greater than one-third the system pressure would require two failures of the system to subject that pipe to that pressure.

MR. OKRENT: So, I did read it, and it is something the staff wrote?

MR. SCALETTI: Right.

MR. OKRENT: It was stated it should fail at about 1,000 psi's.

MR. SCALETTI: It said with respect to the operation, the operating pressure was about twice the design pressure and we thought it was probably too high.

MR. MICHELSON: So it would survive?

MR. SCALETTI: Yes.

MR. OKRENT: I will have to go back to look to see whether what you have said conforms with my memory. I'm not quite clear what Mr. Michelson is saying. Do you expect that, given system pressure, you will have substantial leaks out of the RHR system?

MR. MICHELSON: At 1,000 pounds pressure, it wouldn't be surprising. They don't design all the sealed coolers with the same criteria. It would be small leaks, not capacities.

MR. CATTON: It says that it is designed for 500 psi piping, which provides for rupture pressure of approximately 1,000 psi.

MR. MICHELSON: That is what it says here. You are correct. That is what it says.

MR. OKRENT: So, if I accept what the staff says --

MR. CATTON: Or what they wrote.

MR. OKRENT: I'm sorry -- or what they wrote, I am left with at least a significant probability of failure, given your full-system pressure. I don't know whether it is a gross or a large leak, anyway, and unisobolized also. I am wondering whether the part of the staff we are hearing from today doesn't report to Dr. Murley or Dr. Murley has changed his mind since the last time I heard him express concern about such accident, or just what is the situation.

MR. SCALETTI: Certainly, the staff you are hearing from today reports to Dr. Murley.

MR. OKRENT: Has he changed his mind about the importance on this scenario?

MR. SCALETTI: Interfacing system?

MR. OKRENT: Yes.

MR. SCALETTI: I believe not. I do believe, though, that he addressed the ACRS the last time. He indicated he thought it to be a problem and would like to resolve it, if I remember correctly, but I do think he didn't believe it would be a severe accident problem, I think is how he put it.

MR. OKRENT: I don't know what that means. If he was concerned, the concern he expressed at ACRS wasn't in those terms, as a severe accident problem. His intuitive, subjective probability was that it's higher than what the PRAs were finding, and I might note, just in passing, that I read something recently where he indicated a preference for future LWRs that have connecting systems able to withstand the pressure. I wonder, is it GE's position, the fact that this one will stand primary system pressure? Are you close to that? What I had up to now is read this, -- which I read in a hurry.

MR. SCALETTI: Before GE responds, let me just state one more thing, to be totally accurate on what Dr. Murley said.

I don't know if it was a severe accident problem. He was concerned with it, but Dr. Murley concurred on the Commission paper. He is in full agreement with what is in the Commission paper. So, from that standpoint, beyond that, and what exactly are the words he said, I haven't reviewed the transcripts of the former ACRS staff opinions, is that GE has provided adequate measures to protect against an interfacing system load, and I believe, at this time, it is Dr. Murley's opinion, subject to completion of the review.

MR. OKRENT: How do you determine the capability -- will it stand system pressure?

MR. QUIRK: You said two things. Dr. Murley asked that this be addressed on ACRS review, and that is specifically why it is a line item. So it was asked to be looked at and it was looked at and the staff concluded their findings.

Number two, we believe that two times x, if x is 500, is subjected to a thousand pounds pressure, GE says that the pipe will not fail.

MR. OKRENT: I am naive about pipe design. Is there something magic about 500? What are you designing this to 500 and 600?

MR. JAMES: Not much.

MR. QUIRK: Not much.

MR. OKRENT: Not much. I don't have any other questions.

MR. WARD: Is the RHR system in this ABWR design; what is x?

MR. JAMES: It is the same, because x is around 450 or 500.

MR. WARD: So this isn't a change that was made in the ABWR design? I mean, have you looked at secondary sources of leakage, pump seals, heat exchange coolers and that sort of thing?

MR. QUIRK: We have looked at components that are less than 500 and concluded that there will be additional strains on oversized loads.

MR. WARD: They are all protected?

MR. MICHELSON: In the case of the heat exchanger, is this accommodated by some immediate capability or what happens? How is that intercepted so you don't destroy your cooling system? You certainly don't want to destroy the reactor building cooling system.

MR. JAMES: The reactor water cooling system is not designed to --

MR. MICHELSON: We are speculating though about the pipe being of concern. It's higher than a thousand, but how about the heat exchangers? Are they going to rupture at a thousand?

MR. JAMES: If anything, they are probably less like to rupture.

MR. MICHELSON: But have you made any calculation about the degradation and things that can happen? That doesn't necessarily have to happen in the pipes.

MR. JAMES: I guess it is that there are more pipes.

MR. MICHELSON: The code will cover those tubes, will it? The shell is the reactor building; isn't it? As I recall, the RHR side is the inside of the nuclear side. I don't think once you are inside the heat exchanger, --

MR. JAMES: You are correct.

MR. MICHELSON: Well, at what pressure will they rupture then? I don't know. There are a whole lot of things that could happen from leakage. They might not break at the pipes; I agree with that.

Now I would like to know how that is accommodated within the system?

MR. JAMES: The simple answer is that it isn't.

MR. MICHELSON: I don't think that is a very good answer then. Something should be done about that. This wasn't a problem on the old RHR. We used to use a different system in cooling.

MR. JAMES: Of course, these heat exchangers have activity sensors.

MR. MICHELSON: But this is all over before the -- hopefully it has a surge tank and you could tell me how much time I have on the surge tank. But certainly I would expect an analysis. Has the staff looked at that?

I don't think there's anything like a thousand pounds necessarily. Do you have anything with numbers or contingencies regarding the tubes?

MR. DILLMAN: Even if so, it should be quite in excess of a thousand pounds.

MR. MICHELSON: I don't know. If you haven't done the numbers --

MR. DILLMAN: We can give you the numbers.

MR. MICHELSON: I think I need to see an analysis of what that is an improbability.

MR. DILLMAN: Also, relative to the pumps in the sealed coolers, the pumps are equipped with throttle bushings in the seals to stop leakage, particularly so that the sealed coolers won't fail because they are very small.

MR. MICHELSON: I wasn't concerned about that aspect. I was just raising the issue on heat exchangers. They are not using a cool cycle system to cool.

MR. OKRENT: Well, it seems like a bit curious that, given experience around the world, let's say, that staff is satisfied with the proposed system and that it doesn't have -- or looking at perhaps options, whatever they might be, let alone an analysis of the type that Mr. Michelson mentioned.

I don't care that somebody wrote a SECY paper. I can find a variety of issues that are not addressed adequately in mind in the SECY paper, and this is just one of them.

MR. SCALETTI: I don't think -- did you say we don't have an interest? Dr. Murley is in the process of developing a program to study it in detail. So there is an interest.

From the staff point of view, ABWR, however, -- that we thought that the design criteria that GE used was satisfactory to solve the problem. Clearly, if somebody has a study of the design going, we will have to present it at that time.

MR. MICHELSON: By criteria, you mean it takes two failures to do it?

MR. SCALETTI: Two failures -- those pipes are designed to one third of the reactive pressure and three failures to get to those pipes, which is less than one third.

MR. MICHELSON: You did look at the heat exchanger tubing on this?

MR. SCALETTI: We can check into it, but we haven't at this time.

MR. MICHELSON: The failures we were talking about are the same as the check valves, depending upon the particular arrangement?

MR. SCALETTI: Whatever valves.

MR. MICHELSON: In case of the motor-operated valve, I have a stuck open valve, and I inadvertently operate the motor operated valve. That is a human failure. Is that the sort of thing you discount?

MR. SCALETTI: We have not done that yet, so this would come about as a part of our severe accident review. We have a human factors portion of the design under review now.

MR. MICHELSON: What are we writing off now as far as the interfacing system? Is it an open issue or a closed issue as far as the staff is concerned?

MR. SCALETTI: As far as the staff is concerned, it is closed right now.

MR. MICHELSON: It's irrelevant to this document. It's all done. Once we ran off on this particular one, we don't have any sub-issues.

MR. CATTON: I don't think we can.

MR. MICHELSON: I'm just making sure.

MR. CATTON: This kind of incident occurred on a European plant where the check valve stuck open.

MR. MICHELSON: Was it opened by operator error?

MR. CATTON: It was an operator who tried to get the valve closed and couldn't, and then they had other problems. He went home and left it. That is a separate issue, but the check valves were stuck open. He could not get them closed.

That is your three.

MR. SCALETTI: Check valve and the isolation valve; is that three?

MR. CATTON: They had check valves and the isolation valve wouldn't close.

MR. SCALETTI: That is two.

MR. CATTON: That is two check valves.

MR. WARD: You know, when you insist on two failures, this is moving off on the single failure, you have an additional burden then -- a substandard for assuring that these failures can't be related or somehow are related. How are you doing that?

Is there a particular method that you have?

MR. SCALETTI: We have Mr. Chilliah is here.

MR. CHILLIAH: My name is "Chilliah."

We are conducting right now -- conducting tests on that as part of the PRA review. We are trying to do two things.

Number one; we are looking into the interface of the analysis, the frequency of the insulative facing loco of various concentrations. Some other things we are looking at are; are you including the type of interfacing loco which you could postulate what Dr. Michelson said about outside the containment in competition with failure to isolate, particularly for the station blockouts?

Also there are thermohydraulic calculations for this ABWR design. They are realistic calculations that we are going to perform.

As part of this, we would be looking into the water systems. This obviously -- but we are looking at a more outside list. For example, the two loop versus the three loop with the interfacing loco, for example, so we plan to do that.

MR. OKRENT: In all of the PRAs that I can recall looking at, a kind of event that occurred in a european reactor would not have been included in the PRA. It was an actually an error of commission in violation of procedures and so forth, and those don't appear in the PRA.

MR. CHILLIAH: As a part of the -- I guess in the APRA, he has given us some of their recent experiences, particularly some of the German experience. He has provided them in another document. As part of their review, we are just to look into the review, how to combine, like some of the check weld failures versus the type of human failure that one of the hatches, for example, the check weld didn't go in properly.

We looked into other variables.

MR. OKRENT: It seems to me that while past experience is certainly interesting, the fact that one has had a double interface valve opening, that if you look at a possible lesson from Chernobyl, it is that somebody may have hit the bypass interlock and so forth, for some reason you can't pick up.

The reason why I originally asked about this 500 psi question was to try to understand first; had there been a change and if not, is there a modest change in the pressure of that system. That would, while it might not make you completely invulnerable, a problem from exposure to system pressure would change the probability by a considerable margin.

It might not be very hard to do. For instance, in the original design, the point I was trying to explore came -- is it an expensive thing?

MR. OKRENT: But I'm not the one to answer, but it sounded like probably not, from what GE said.

MR. JAMES: A thousand psi, including all the heat exchangers and valves --

MR. OKRENT: But that wasn't the question I posed. It is a question of not a functional operation of the pressure, but having a very high probability of sustaining a system over-pressure.

MR. CHILLIAH: Dr. Okrent, answering your question with respect to the -- on the PRA, we asked one question of General Electric, where we had our PRA meeting, about one of the scenarios, particularly in the original system. That is along the line of what Dr. Michelson asked.

We are not interested -- we are worried about what we have stated.

MR. OKRENT: I suggest that you might want to take a broader perspective and look at things like Chernobyl, but not necessarily involving reactivity, but just involving the failure to follow strict administrative procedures.

MR. MICHELSON: While we are on the subject, let me ask another question about heat exchangers. The shelf side is on the reactor side of the building. What is the designed pressure for that?

MR. THOMAS: I think 200 psi is what they told us.

MR. MICHELSON: On that heat exchanger shelf, now you have to pick up an item for the tubes. I don't know whether the cold will give you too much help on that, how big a relief that has to be. But there is some capacity that has to be -- to take care of that. The unfortunate thing is that we are worried about the interfacing system.

I don't think there is any connection on the cooling side, but if you are in a mode where you have more than one of these RHR loops because of tube structure and one heat exchanger, then you have a problem. I'm not 100 percent sure, but there must be some kind of a design philosophy on this whole thing, and I have the RHR system, whatever you call it, specification.

I assume that will be in the protection system section.

MR. JAMES: Piping protection.

MR. MICHELSON: That's right. There will be a cooling water systems. Are we ready to leave this?

MR. THOMAS: Do you have any more questions?

MR. WARD: I have a question. How independent of the first item are the three systems, independent of, I don't know, air supplies? Is there a building instrument air required? What about interdependence on the HVAC system, physical separations?

MR. THOMAS: Only the pump rooms are separated. They are separate compartments. So that would be separated from the pump room. There won't be any --

MR. WARD: There are three divisions?

MR. THOMAS: Three separate rooms. Each division will be separated for all three.

MR. MICHELSON: I have one other question. On RHR, you point out in your SAR, Page 5-38, a provision for not only discharge line and so forth; in an actual accident scenario, it is probably unlikely that you will lose outside power at the scene of the accident. But if the building finally collapses from loss of that particular generator, so what happens if you have a big RHR and the pumps are open and you lose off-site power? Now, the pumps start, the valves don't do anything and they are essentially off the emergency buses and the emergency buses haven't been energized yet. They have to be loaded and the pumps go back to their sequence.

How do you keep the pipes filled with water so you don't get severe water damage when the valves are open? I couldn't tell entirely from the complete range, but I think there is a fair amount of opportunity that this is a question for whomever. This is particularly interested in the cooling. How do you keep the pipes full of water before you restart the pump?

You can assure yourself there is no damage or any loss of power in the normal expected modes of operation to be in.

MR. JAMES: I think there are two answers. One, there is pipe drainage that is going back through the pump discharge check valve.

MR. MICHELSON: If you're on suppression cooling at the time and the pipe that goes to the suppression cooling jams.

MR. JAMES: The second answer is there are -- it is essential equipment.

MR. MICHELSON: But they don't have to instantaneously refill. It depends upon how small they are. They are designed for leakage

MR. JAMES: None of the pipes will be totally empty in any of those scenarios.

MR. MICHELSON: And the present BWRs are perhaps different and they will drain very quickly because of the heat exchangers. Now, could I follow it up. I didn't have enough time to chase the heat exchanger orientation to see where the elevations are, but the present one, you drain it from the top of the heat exchanger all the way to the suppression cooler, all the way down.

MR. JAMES: Yes. It is a downhill drain. I am thinking of the pump discharge. There is a check valve.

MR. MICHELSON: But the concern is after you've passed through the heat exchanger, but through a heat exchanger on the pump, there should be no problem. I couldn't quite figure out the orientations to see if you had a drainage problem or not. Have you thought about it? And you are assured you are designed for that kind of thing?

MR. JAMES: I am not quite sure what the question is, but those pumps are intended to feed the entire network, keep it filled with water.

MR. MICHELSON: To make up for leakage.

MR. JAMES: To make up for leakage.

MR. MICHELSON: To open valves.

MR. JAMES: There is nothing to stop it from draining and it will probably drain.

MR. MICHELSON: What happens if you are in a mode of operation where the valves are open and the pumps are running, which is a perfectly acceptable mode, and you trip the pump without opening the valve, which is a loss of power.

MR. JAMES: There is no question what you are postulating is draining, but the heat exchangers are on the discharge side of the pump.

MR. MICHELSON: Yes, but on that side, that only keeps the pump full of water. It doesn't keep the pipe full of water.

MR. JAMES: Only if the trip valve leaks.

MR. MICHELSON: But the drainage towards the suppression pool. If I recall looking at your drawing, it discharges to the pool. There is nothing to keep it full and

MOR. Depending upon where the elevation of the driving force is. It might be the heat exchanger.

MR. CATTON: It starts and pushes out water.

MR. MICHELSON: Then it creates a hydraulic disturbance, particularly with the valve open. I just wondered if the fill system had taken this into account or not.

MR. JAMES: I think a generic answer to the question is have we looked at every scenario where we were starting and stopping power supplies, the answer is no.

MR. MICHELSON: That is the most likely thing to happen. It is the loss of the generating units that causes problems further down and there would be a problem with no off-site power.

That is the only question I had. Why don't we proceed. The next subject is --

MR. QUIRK: We are at the point in the agenda where we begin the summary.

MR. MICHELSON: Were we going to have a discussion about the after water? You covered this briefly this morning, but I was wondering. I have a couple more questions, but I guess we'll get to it with the staff.

MR. QUIRK: Mr. James will begin the summary overview of Chapter 6. He will be followed by Gary Ehlert to finish off that summary.

MR. JAMES: Same format as this morning, Mr.

Chairman. I'm just going to give you a brief overview, GE overview of Chapter 6, and Mr. Ehlert will cover this chapter. The subject we want to discuss with you to give you an overview of the ABWR engineer safety features which are largely the subject of Chapter 6, I will give you some more details on emergency core cooling systems, and Mr. Ehlert will cover the primary and secondary containment designs, and the habitability sections. I will be covering Section 3, and Mr. Ehlert will be covering 621 and 623 and 64.

[Slide.]

MR. JAMES: The same format as this morning. I tried here, before we give you the details, to summarize the main items in Section 6 in the format of a table with the major sections, and in brief capsule summary.

Primary containment -- before I get into that, I was intrigued by Bill Okrent's question this morning about why we picked the containment design we did, and I vowed I would volunteer to give a couple of explanatory slides that might address that issue.

The issue is there are many, many factors which guided us to the basic containment feature we have now, a whole mosaic of influences. None of them were absolutely dominant, but a lot of them were important.

It had to be economic, obviously; it had to be pressure suppression, because that is our philosophy, that containment systems had to fit around ABWR. One of the big ones for the ABWR was the need to enhance the general maintainability of equipment.

One of the feedbacks that we get from a lot of our customers is that access to and working on equipment in our containment, especially inside the primary containment, has traditionally, I guess to be generous, has not been that easy. So, in effect, we have had a feedback from our users that maintainability and useability, they would like to see improved.

This was especially true from the Japanese users. For those of you who have not worked with the Japanese, they place a great deal of emphasis on routine maintenance and accessability. That was one of the main drivers.

I have a couple of pages here that might try and illustrate that for you by way of answering your question this morning, Dr. Okrent. Before I do that, though, I would just like to make sure we all understand the terms here.

[Slide.]

MR. JAMES: This is a simplified cross-section of the ABWR containment. It is a pressure suppression containment. The blue represents the primary efficient product barrier. This is the leak-tight primary containment barrier. Here is the suppression pool, and typically, we have a dry well and a wet well air space connected by that system. That, I will get into in a little more detail in a minute. That is the primary containment.

The secondary containment, which is one which captures any leakage from the primary containment and processes it through a standby system, is that. You will notice that it is not quite the whole of the building. The standby containment does trek through part of the building. That is the terminology.

[Slide.]

MR. JAMES: It is pressure suppressant. One of the big things I believe that influences the basic arrangement of ABWR containment was the big change that occurred in the reactor system outline. What I tried to do here, very roughly to scale -- very roughly to scale; I can't draw too well on the airplane, but as to scale as I could get -- this is the whole outline. If you go to ABWR 6, here is the vessel, and here are those big external loops, with the motors and two pumps.

Do you see what that does? That forces a sort of outline of the reactor system that I call a "pear." That is an outline that looks like a pear. Once you do away with these guys, it considerably simplifies that outline. That outline now looks like this.

What that enabled us to do on ABWR was, I think, very significantly rationalize the access to the important equipment that needs routine maintenance.

There are two basic areas in the ABWR. There is this area down here, which we call the under-vessel or lower dry well. There is clearly a lot of equipment in here that needs routine excess pump, heat exchangers, drives, what have you.

Up here, in this whole region up here is the upper dry well, and it also has a lot of equipment that needs routine maintenance. Safety relief valves, vacuum breakers, HVAC equipment, et cetera, et cetera. So there are two areas here that need plenty of access.

What we think we have achieved is ABWR's good access to those areas. For the lower dry well, there is an equipment and personnel tunnel that runs across from the reactor building to the under dry well, so there is direct level access to here onto a platform which gives good access directly to the equipment you need to work on.

The Japanese, following up their emphasis on maintenance, are intending to provide a lot of automated equipment in here that minimizes operator exposure. For example, equipment that would come in and automatically, on bolt drives, drop the spool pieces out, put them in carriers, and cart them out. So there is good access here, straight out here, and the equipment servicing areas are located in the reactor building at the same level where this access tunnel exits.

The same philosophy up here. We have provided platforms and monorails that go all around the upper dry well, that go through this equipment and personnel hatch here, give good access to all this equipment in this area here.

We think we have addressed pressure suppression; we have addressed a lot of the issues that have caused problems in the past in terms of access to the equipment. So there is no one easy answer to your question, but this was an important consideration that drove us.

[Slide.]

MR. JAMES: So primary containment, like I say, it's a reinforced concrete structure. This is an artist's rendition, but it's a good picture of this. This dark area here is the dark -- here are the access tunnels I was talking about, the upper dry well access tunnel is here. It is structurally integrated.

This structure and the main reactor building structure that goes around it is a uniform integrated structure. It uses the horizontal pressure suppression vent system which was developed for Mark III, and has further developmental testing for ABWR.

[Slide.]

MR. JAMES: This cross-section shows it a little clear. The pressure suppression system works by a loss of cooler access. It releases steam, which can pass down through vertical pipes here, set in concrete, and then out into the suppression pool in horizontal vents that are the same design as the Mark III vents.

MR. CATTON: Except it is pipes rather than a mote.

MR. JAMES: Yes, this here is pipes.

The geometry in this region where the steam actually gets condensed in the water is the same as Mark III, same diameter vents, same spacing.

MR. CATTON: Did you test these?

MR. JAMES: Yes, and Mr. Ehlert will give you some additional information on them. They were tested as part of Mark III. Then the result, of course, is that this containment isn't quite like Mark III because it is a much smaller wet well free space. So a containment after an accident will look more like a Mark II than a Mark III. But working with our customers in Japan, we did do some additional testing of this configuration for higher conditions.

MR. OKRENT: Where are the steam relief lines in the picture?

MR. JAMES: They are not shown on that picture, but they do run. A relief valve will be sitting here on the main steam line. That is one right there. No, that is a hanger, I'm sorry. They will be sitting on the main steam lines right here. The relief valve lines run down through here, through here, and down into the suppression pool into quencher devices here. The line is missing. It runs from here up to the safety relief valves here.

MR. OKRENT: That is supported where?

MR. JAMES: They are supported. The base supports come off of the lower dry well here, so the piping will run down here, with supports running out here.

MR. CATTON: No equipment in the wet well is clean?

MR. JAMES: Yes. I think there should be a caveat, that there are a few items in there, nothing significant. There are a few catwalks for inspection. There is nothing like a Mark III original, a Mark III revision. We have floors and things. There is none of that in the ABWR design.

So if I could move along, the containment heat removal we have already discussed to some extent. There are three divisions of safety grade containment cooling. We discussed it in the sense that you are using the RHR system in another mode for containment heat removal.

[Slide.]

This is the same diagram I used this morning. Now, the red shows the containment heat removal mode within the system. There are three completely separate divisions. This is engineered safeguard equipment, so it is mechanically electrically separated, fire protection, etcetera, etcetera, etcetera. It takes suction from the suppressor, through the pump, through the heat exchanger, back out into the pool, or to the vessel, or we do have on two of the loops options for a containment spread which is dry well spread and wet well spread.

The secondary containment I have already mentioned. It surrounds the primary containment. This is the primary containment. The secondary containment is the barrier here that will go through this reinforced concrete structure. It does, in certain places, indent in and leaves these areas as clean non-secondary containment areas. But the important point is it does completely surround the primary containments when a leakage from the secondary containment is into the primary containment, and it's usually operated at a slight negative pressure to make sure that end leakage occurs.

The containment isolation systems. Now, of course there are many systems that penetrate the containment, and the intent here, the design for the ABWRs is to use conventional containment practices. And our intent is to meet all requirements.

We are not trying to advance the state of the art in terms of new requirements. We are going by the book on containment isolation.

Containment leakage testing is a subject that Mr. Ehlert will be covering in more detail. Again, the guiding philosophy is to use accepted practices and to meet these requirements.

Emergency core cooling system. That is something I have a little more detail on that I will cover in a little more detail, but there are three separate mechanical and electrical divisions: core cooling, containment cooling and shutdown cooling.

There was an attempt to simplify the systems. And as you will see, we have taken advantage of the superior local performance with regard to reducing some of the capacities. A key point we think for this design is their is no core uncoverage, for any pipe break.

On control room habitability, we have those features. And Mr. Ehlert will go into more details on those subjects. I am going to wrap up, giving you two or three extra charts, to give you some of the details on the emergency core cooling systems.

I am sorry. I was in a little too much of a rush there. There is one more page of my summary table here.

[Slide.]

MR. JAMES: Fission product removal and control. There are three elements of strategy for containing fission products.

There is primary and secondary containment that I just told you about. This is the primary boundary. Any leak that gets into secondary containment, which is still a controlled area, we treat those through a standby gas treatment system for processing and discharge to the environment.

As you will see from the Staff's evaluation report, the standby gas treatment systems is still an open item. We are preparing additional information to submit to the staff to try to convince them of what we are doing.

The background on this system, the standby gas treatment system, is a new processing system that draws on the secondary containment and puts the air and any entrained fission products through a process system of filters and charcoal absorbers, and removes the fission products before discharging effluent here.

By way of background, that is why this is an open issue.

On this docket, the Japanese have a designed basis for the standby gas treatment system that is substantially similar.

From what pertains in this country, they take a much more simplified view of the world on the standby gas treatment system, and we have concluded that the design they developed for Japan is so different that it really is not appropriate to use it directly for this country.

So while we are revising the process, we are revising the Japanese design in this area.

This is a one-line summary of major differences between what the Japanese do and what is done in this country.

Theirs is a much smaller capacity. They do not have as rigorous a set of design bases for SGTS as are in place in this country.

MR. OKRENT: Why do you think they have a reduced capacity? Is it based upon LOCA performance, or what?

MR. JAMES: It is based upon, in terms of the flow capacity to the fans, to the flow capacity of charcoal. It is the flow capacity of the fans. It is tied in in a much more simplified way of calculating pressure response in these buildings. They have a very simple view of how you maintain negative pressure here. You provide flow capacity that equals whatever leakage you might think might be coming in from the outside world, which is typically 50 percent of this enclosed volume. The Japanese say: "I'm going to use something like a thousand cubic feet here. I'm going to exchange 50 percent of that per day. That gives me the CFM." Then we know what the fanned cooling will be.

Because of deregulation in this country which calls for things like heat loads, significant heat loads into the building from emergency equipment that is operating and containment and more severe weather conditions on the outside which give you pressure differentials across the building. So this country has much more rigorous and detailed on an analytical basis I guess you would call it for sizing the fan.

Where we are now we think if you use the U.S. methods you end up with a fan capacity which is at least three times what the Japanese require.

It is largely because the U.S. has more detailed and more rigorous set of analytical bases which are to be used when sizing the fan.

So anyway, that is an open issue, and it is culled out in the Staff report.

This was the item that was briefly mentioned this morning -- the nitrogen gas supply.

That is discussed in Section 6.7 I think it is of this chapter.

It provides autogas supplies for SRV accumulators for ADS backup and there is also a nonessential function for providing other nitrogen requirements in the plant.

MR. MICHELSON: The nitrogen supplies is going to be in a supplement? According to the SER it is going to be in a supplement?

MR. JAMES: It is in the SAR.

MR. MICHELSON: So we will play it by ear if it is going to be in an SER.

MR. JAMES: That is correct.

MR. MICHELSON: Thank you.

Now, what about 6.7?

MR. JAMES: There it is.

MR. MICHELSON: I don't have it or maybe I didn't bring it with me because it wasn't going to be covered in the

SAR. I would have brought it but I am not positive when it is in the SAR yet or not -- well, I can't be sure.

At any rate it will be later.

MR. JAMES: Mr. Chairman, I know it is in one version.

Are you still looking, or shall I proceed?

MR. MICHELSON: Proceed.

MR. JAMES: I would like briefly to go through the ABWR CCS network that we have developed.

[Slide.]

First off, I would like to just like to what the design objectives were as we headed into the design work. Clearly we wanted to eliminate past problems that had arisen.

We wanted to eliminate any unnecessary multifunction systems because this again is viewed as a source of frustration to some of our customers whether a system has many, many functions. A key objective is to avoid emergency system initiation during transients.

We wanted to maintain no fuel uncovery during LOCA accident.

We wanted to make sure that the core damage frequency is less than the current BWR and we wanted to provide diverse motive power.

Those are the design objectives.

[Slide.]

MR. JAMES: That is a summary of the improvements. Before I go through the improvements, let me just show you the network that we have developed.

This is a chart that is in the material that shows the high pressure systems. What we have on the high pressure systems now is that I discussed this morning that has now been upgraded to emergency safeguard status and two high pressure core flutter systems that have the same configuration as the earlier high pressure core spray systems that we have in our 5 and 6 designs. It's simple systems that take suction on the pool, in this case flood into the core inside the shroud.

The key thing to note on that high pressure network is that we have one more than we normally have. This is the current generation of reactors. We have in effect one here and one here. For ABWR we have two high pressure systems. That is an expensive addition, but we think it brings with it merits that are worth the expense, which I will explain in a minute.

[Slide.]

MR. JAMES: The low pressure systems that we already discussed before. to the pool and heat exchangers into the vessel for low pressure, and there are three divisions of RHR.

[Slide.]

MR. JAMES: The last package in your chart is a summary of the ABWR -- compares the ABWR to the earlier designs. Here is ABWR, showing -- this is shorthand that says there are three divisions, three divisions here, and just two divisions here, and the older BWR/4 generations, you can see the divisions. We have a high pressure in each division and low pressure in each division, and the low pressure also picks up shutdown cooling and containment cooling, so there are three divisions of shutdown cooling, and containment cooling.

So it is noteworthy, this table has some noteworthy items in it. The high pressure capacity has gone up compared to the 5 and 6, it has gone up to 2800. It is interesting to note that the total low pressure capacity -- and this is load capacity for both low pressure system and also the high pressure systems when their pressure decreases. The high pressure will still be operating.

The sum total of everything in the low pressure is considerably less than some of the earlier designs.

This is a result, of course, of the elimination of that large load break in the reactor. We no longer have to overwhelm our reactor with zillions of gallons of flow. We can get away with less flow and just still achieve superior performance because here is the peak clad temperature. 5 and 6s are down to 1100 and, of course, with no core uncovery, there is no heat above the fuel. It stays at saturation or less.

So that is the network. This is a summary of what we think that network has achieved for us. A complete three separate mechanical electrical divisions, all the way from injection through cooling through electric power through whatever else.

The containment cooling, we have arranged it so that the heat exchangers are always in the loop. Before, on our current designs, when we wanted to establish containment cooling, as opposed to core cooling, we have to manually line up the heat exchange equipment. In this case it will be done automatically, as part of systems start-up.

We have got rid of some unnecessary complications of the emergency systems. The steam condensing mode of the RHR has been eliminated, and this was where they could condense steam directly from the reactor. But that was a very complex, cumbersome and not a very popular configuration.

The head spray function has been eliminated from these core cooling systems. part of normal reactor water clean-up systems which makes sense. And overall, we have been able, because of change like this, to reduce an upper valve and pipes that form the systems in this network.

There has been a capacity reduction, which I have already discussed, reduced capacity and improved performance, which is nice.

The three high pressure systems have improved the isolation response. They have clearly avoided any question of low pressure systems coming on for a wide range of transient type pressure. Even with failures we can now see one or two of the high pressure systems during isolation transients not an issue of the full blown LOCA response on the reactor. That is really the benefits of going with those three high pressure systems. That translates also into improved response during small breaks. With the larger, high pressure capacity we can handle without getting it to a blowdown situation, large or small breaks so to speak.

We have a bigger rupture of high pressure in a small pipe and control it with the high pressure systems before you get into a crash blowdown flood full-blown LOCA sequence and it gives us that. That, of course, is a self-imposed criterion which we think is very useful. It builds the claims for our reactor.

And that raps up my brief summary of the core cooling systems.

MR. MICHELSON: Questions?

[No response.]

MR. MICHELSON: I think we might as well proceed.

MR. JAMES: Mr. Ehlert is going to cover primary containment and secondary containment, yes.

MR. MICHELSON: This is probably a good time for a break.

Let's break for 15 minutes.

[Break.]

MR. EHLERT: Good afternoon. My name is Gary Ehlert with General Electric. I'm going to talk to you today about the primary and secondary containment functional design and the control room habitability.

First on the primary containment, it's basically a reinforced concrete cylinder. It's a 90 foot steel line structurally integrated with the surrounding reactor building and upper pools at the pool girders and its various floor abrasions. It's designed to seismic .3G SSE and the design pressure is 45 psig minus 2 psid to 45. It is based on a limiting break of the feedwater lines, which is actually about 39 psi which gives us about a 16 percent margin. The containment pool space sizes is as shown. It is a standard suppression type. If you modified it, the venting system is similar to the MARK 6 or MARK 2. It uses horizontal vents, a vertical vent into three exit vents into these pressure pools horizontally. It is basically identical to the MARK 6 or ABWR 6. The closed suppression chamber is similar to MARK 2.

MR. CATTON: What is the submergence on that top vent?

MR. EHLERT: If I remember right it is about a meter and a half. I would have to look it up, about five feet.

The vent openings of the diaphragm floor, there are 10 of them, 10 vertical vents. The openings are roughly two meters by one meter at the top of the pedestal and essentially direct a LOCA steam release down into the suppression drum.

The reactor pedestal is structural steel filled with concrete but the load carrying is based on steel.

The containment is designed to both the SSE postulated LOCA worst case along with loss of outside power.

MR. CATTON: Where would the fusable link be?

MR. EHLERT: Pardon?

MR. CATTON: Fusable link between the pool and underneath the reactor, where is it going to be?

MR. EHLERT: You mean the pressure boundary?

MR. QUIRK: The travel flutter.

MR. EHLERT: I am not quite sure. I would have to to check that.

MR. JAMES: It runs from the suppression pool crossing to the lower drywell. I have a chart somewhere.

MR. WARD: While he is looking for that, could you show us in a little more detail the flow path into the suppression cooler from up above? You have these vents in the diaphragm floor.

MR. EHLERT: You have ten vents in the diaphragm floor leading to ten pipes leading down and each pipe has three vents for a total of 30 vents.

MR. WARD: Now what is that thing going to the -- over the upper part of the lower drywell.

MR. EHLERT: This is to allow in case of a break in the lower drywell area, still allows venting into the suppression pool.

MR. WARD: Is there a check valve or anything like that?

MR. EHLERT: There is a vacuum breaker system set up to minimize the delta between these but I don't think there is one here.

MR. WARD: So in other words steam from above the diaphragm floor can't fall into the lower drywell and thus the suppression pool?

MR. EHLERT: Yes.

MR. WARD: It will build up the pressure.

MR. EHLERT: Build up the pressure and then flow back.

MR. JAMES: I don't have a picture of it but it runs between the vents. It runs across here (indicating), so this would be the fusable plug that would get delta by here and it would flood in and cover it.

MR. WARD: Then it is up pretty high then? It takes a lot of core input to flood, to get up that high?

MR. JAMES: I don't know exactly where it is located height-wise. This pool is 20 feet deep. You don't need much surface here. You only decrease this by a few feet to flood it to an equal level here so this is probably about halfway level to flood into the lower drywell.

I am saying this area is very much bigger than this area (indicating).

MR. WARD: But there has to be enough volume to come down and cover the end of that link, right?

MR. JAMES: No. That is not the way it is intended to work. It is intended to work by irradiation, convection, heat transfer.

MR. WARD: The gases in there are not hot enough?

MR. JAMES: Yes.

MR. WARD: So it melts before the core actually arrives down there.

MR. JAMES: No, I think the idea is that the core will get down there and is thermally radiating, heating up that.

MR. WARD: So the water goes on top?

MR. JAMES: Yes.

MR. MICHELSON: Is there some kind of steam explosion in that link or what happens?

MR. JAMES: I don't think our phenomenological experts are here, Mr. Chairman. I think our GE opinion is there will not be a steam explosion.

MR. CATTON: But that is not a shared view, as we all probably well know.

MR. JAMES: I understand.

MR. EHLERT: The containment load is developed to our basically taking the proven test results of the BWR-6 and confirming them through a six full-scale and subscale test. The test program did confirm the loads. We thought we had to find the load you'd have in Chapter 3.

Moving on to the secondary containment, it basically is the portions of the reactor building and this so-called "contaminated zone", control zone, which completely surrounds the primary containment. These systems are kept in a clean zone, which are basically diesels, central, electrical, and kept outside of that zone, so it will not be affected by any of the pipe breaks or other problems inside the flow zone.

The objectives of the secondary containment, which may lead from the primary containment through the walls, through patches, penetrations, and so forth, the fuel systems have water seals or valves or a combination of the two. It operates at negative pressure both with respect to atmosphere and the clean zones, roughly. It was a quarter of an inch of water negative pressure.

[Slide.]

MR. EHLERT: This is a sample. This is basically one elevation, which is the basement, whereas this is the primary container boundary and hot air would be the secondary container boundary. Everything inside is considered to be contaminated or can be contaminated, due to pipe breaks, and if you go up higher in the building, such as up in the diesels, you will find the secondary containment walls are pulled in from the outside of the reactor building and the diesels will be sitting outside the clean zone, and the central electric is just one floor above this -- no, one floor below. Excuse me.

[Slide.]

MR. EHLERT: So, the only penetrations from the clean zones into the secondary containment are the electrical power, electrical control, and power lines from central electrical and from control building and others into the equipment inside the secondary containment, the main steam and feedwater lines, which, of course, are leaving, and the 50-percent leakage rate is mostly based on the fact that the building is fairly well sealed off.

There is like four doors throughout the whole building. There is controlled access for personnel. There are two hatches for equipment removal. One is a cargo door, and one is just a standard equipment hatch. Then there is the electrical penetrations and some piping penetrations.

MR. QUIRK: Gary, may I interject? Within the potentially contaminated zone, there is separation, is there not, Howard? There is separation for all three divisions. If the RHR system blows out or has to be isolated, it could be isolated from division B or division C. There is no cross-connection piping.

MR. MICHELSON: How about environmentally? Are they cross-connected?

MR. EHLERT: Yes.

MR. MICHELSON: Is it cross-connected or are there zones?

MR. EHLERT: There are two HVAC systems. There is one for general air flow of the building, which is used for supplying fresh air, fresh outside air, circulated through the building. Then each of the essential equipment has its own, essentially room air conditioner, a room cooler, which is a fan and cooling coil, which is on the same division as the equipment it is serving. So, therefore, the HVAC room cooler for division A essentially cools only the RHR pump in division A, and there is another similar unit for division B.

MR. MICHELSON: As to the room coolers, is that the only means of cooling that room, or do you have the non-qualified ventilation?

MR. EHLERT: We have non-qualified ventilation which is supplying fresh air.

MR. MICHELSON: That non-qualified ventilation, then, is supplying hot air to the rooms that is being cooled by such a cooler, does that ventilation system also tie into the other two rooms?

MR. EHLERT: Yes, that is the cross-connection

MR. MICHELSON: Indeed, if one of the pipes in one of these -- what prevents the steam from going into this ventilation system and into other areas?

MR. EHLERT: Nothing.

MR. MICHELSON: So, when I read about your pipe-break analysis, you will describe that as a non-problem?

MR. EHLERT: Right.

MR. MICHELSON: It is not an environmental separation. I thought you did have, indeed, an environmental separation. I have a lot of questions about this area.

MR. EHLERT: The environmental separation is between the clean areas, and there are fire dampers between the divisions.

MR. MICHELSON: Will they prevent smoke into the other areas, or will they just satisfy the fire-cooling laws and not allow heat buildup?

MR. EHLERT: They should be able to provide a 3-hour firewall and provide as to smoke.

MR. MICHELSON: I am talking about a real barrier to smoke.

MR. EHLERT: Having a seal?

MR. MICHELSON: A smoke seal. Otherwise, you get smoke into the other zone and the smoke detectors think there is a fire in the other zone and start screaming. Unfortunately, a damper that satisfies the fire code doesn't satisfy environmental protection. I think test results show that. It is an issue which will come up when we discuss fire protection. Now I understand a little better, though, as to the separation.

Is the ventilation system common to the whole building?

MR. EHLERT: Just to secondary containment.

MR. MICHELSON: Just to the three divisions?

MR. EHLERT: There is one non-qualified HVAC system.

MR. MICHELSON: That is going to be quite an interesting thing to look at.

How about your sewer lines? I hope they are not interconnected, but that is another discussion, I guess.

MR. WARD: Earlier, when the staff was discussing the three divisional RHR, I asked whether there was a separate HVAC, and I thought I got the answer that the staff believed there --

MR. EHLERT: The cooling capability is separate. It contains the room temperature for each division.

MR. WARD: Maybe I didn't ask the question carefully enough, or was the staff not aware of this other part of the design or what?

MR. SCALETTI: I think we took total separation. I will have to check the review.

MR. THOMAS: I was talking about room cooler, basically.

MR. MICHELSON: Were you aware of a single combination ventilation system?

MR. THOMAS: No, I'm not aware. That is by some other branch, the Systems Branch, Plant Systems Branch.

MR. QUIRK: May be a part of the problem, but I understood, similar to you, Dave, that we had done a fire-hazard analysis and demonstrated fire in one division will not propagate into another.

MR. MICHELSON: I think this is a different question. Do you have a common ventilation system as far as air exchangers is concerned? The answer is yes.

MR. QUIRK: In normal operation, you do.

MR. MICHELSON: We are concerned about an environmental connector. I was wondering if the staff was aware that there was a single system. I didn't get that awareness from reading the SAR, but maybe I haven't seen the right section yet. I was looking at habitability sections.

MR. EHLERT: It is Section 9.4 or Chapter 9.4.

MR. WARD: They are separate. You can claim credit for the isolation.

MR. MICHELSON: Yes. As to the dampers, you can see how efficient they are and what can they dampen against and how good they are. If they are good enough and you get the right singles in the safety sense and a safety grade isolation damper of the right kind of quality, you can claim the separation, but we are going to find out.

MR. EHLERT: Now I would like to talk about the secondary containment bypass leakage. This was, to some extent, brought up earlier about breaks inside the secondary containment for primary systems coming into the secondary containment.

[Slide.]

MR. EHLERT: The building is sealed off, as I already mentioned earlier, and most of the systems are closed within the secondary containment. The only systems that pass from within the direct pressure boundary out through the secondary containmont wall are main steam water lines and main water lines. All of the reactor pressure boundary systems terminate inside the secondary containment. The only two systems to go from inside the primary containment to the outside secondary containment are the HVAC, chilled water, and these systems are providing, basically, the drywell cooling, along with equipment cooling in the secondary containment.

MR. MICHELSON: How many cooling do you have?

MR. EHLERT: Three.

MR. MICHELSON: Let me ask it differently. You have three divisions of engineering safety features. Each of those divisions has its own dedicated chillers. Is that correct?

MR. EHLERT: That is correct.

MR. MICHELSON: How about the control room? Is it running off one of those, or does it have its own that is dedicated to the control building?

MR. EHLERT: The control building has two separate control units running off two separate divisions.

MR. MICHELSON: Not related to the other three?

MR. EHLERT: They are related.

MR. MICHELSON: So, you mean if I lose one of my pump divisions, a cooler might be involved that might also affect a portion of the cooling of the control building?

MR. EHLERT: Correct, but we have two systems.

MR. MICHELSON: Where do we read about your analysis of those situations? Where will this chilled water system be covered? That isn't in Section 6.4. Perhaps it is some other section.

MR. EHLERT: Perhaps, if I remember right, it is in Chapter 9, and the HVAC portion of it is in 9.

MR. MICHELSON: What is the purpose of 6.4 on habitability, and then describe habitability sections, instead of waiting until Chapter 9 to describe what you are doing?

MR. SCALETTI: The standard review plan calls it out in 6.4.

MR. MICHELSON: It is in two places?

MR. SCALETTI: Control room is Section 6, and then the cooling water is in Chapter 9.

MR. MICHELSON: But cooling and habitability are Chapter 9? Is that correct?

MR. SCALETTI: Yes.

MR. MICHELSON: What is Chapter 6 supposed to talk about? It is not talking about the system? What is it supposed to talk about? What else is there?

MR. CHANDRA: I will discuss it when I discuss control-room habitability systems.

MR. EHLERT: Let's move along here to containment leakage testing.

[Slide.]

MR. EHLERT: It basically is standard trying to meet the requirements -- nothing new. Basically it is just to meet the requirements.

MR. MICHELSON: Let me ask a question on containment leakage. You are using seals for certain penetration.

MR. EHLERT: Is probably as to the equipment hatch air lock and the resilient seals also on the electrical.

MR. MICHELSON: These are rather large penetrations in so far as diameter so if you had very large leaks -- do you have any feeling for how big a leak will be going on?

MR. EHLERT: We are still in the process of doing the leakage evaluation.

MR. MICHELSON: It will be a substantial leak.

MR. EHLERT: Right.

MR. MICHELSON: Now, what provision -- this again I couldn't find from what I read -- what provisions are you making to assure continuity of air pressure for a long period of time? Do you have a safety grid air system for this or non-safety grid? What is the plan in case the seals fail?

MR. EHLERT: I will have to check back with you on that. Off the top of my head, I couldn't give you an answer.

MR. MICHELSON: I couldn't find it. I'm going to ask the staff in a little bit what they did on it but this has been done in the past. it is going to become an issue if you use inflatable seals. How do you keep them for whatever the magic number is that you decide you have to keep them inflated? How good is that inflatable seal? When are you going to have accidents and these seals are going to go? There could be very significant releases then.

I don't find any discussion of this.

MR. EHLERT: Are there any questions on the containment leakage testing?

[No response.]

MR. MICHELSON: Seeing none, I guess we have none. Just as a matter of curiosity, is there some reason why you really want inflatable seals rather than the other seals?

MR. EHLERT: Offhand I would say it was done that way in other plants.

MR. MICHELSON: Some use it. Some don't. I'm not sure on BWRs. It is a mixed bag. Some do and some don't.

MR. EHLERT: We have been using the inflatable seals.

I believe our SVR sixes do.

MR. MICHELSON: There are questions as to how you keep it inflatable.

MR. EHLERT: Habitability systems is basically to provide a secure control room from outside missiles and storms and radiation shielding from any major LOCA in the containment leaks from the secondary containment.

MR. WARD: Could you show us on one of those plates where the control room is in the building? It's not in the reactor building. It is a separate building.

MR. MICHELSON: Is the steam tunnel going underneath? You couldn't show me where that steam tunnel goes. MR. EHLERT: We don't have a copy.

MR. MICHELSON: You ought to know where it is.

MR. EHLERT: The steam tunnel goes over the control room.

MR. MICHELSON: Over the control room?

MR. EHLERT: It is part of a BWR designs of three buildings that are out of line, the steam tunnels, the control building is in the middle. It is in a steam tunnel.

MR. MICHELSON: That is non-seismic piping.

MR. EHLERT: In a seismic one building.

MR. MICHELSON: Sometimes you have to deal with that piping and the basis for that is going to be another question.

MR. EHLERT: Both of those, I believe, will be covered in the Chapter 3 section.

MR. CATTON: Which chapter?

MR. EHLERT: Structures and missiles. The habitability system also provides for the HVAC system with dehumidified and humidified as the case may be to keep a working environment for the control room operators.

MR. MICHELSON: Is the same common ventilation system in that secondary containment? Does that also serve those diezo generators rooms?

MR. EHLERT: No.

MR. MICHELSON: Are they outside?

MR. EHLERT: Yes. Each diesel has its own dedicated HVAC division. The control building in HVAC maintains the heat, provides hot air, cold air, humidified, dehumidified, whatever, radiation, filtration through charcoal filters and so on, toxic gas smoke removal.

MR. MICHELSON: All of the electric boards relay cabinets, those are all outside of secondary containment?

MR. EHLERT: Yes.

MR. MICHELSON: Are you going to tell us about ventilation then?

MR. EHLERT: Chapter 9 is the ventilation system for everything. To bring it up to date, the control building HVAC is located inside the control building itself so it is also missile protected and everything. So when one is down, the other one will provide a full system. It automatically transfers to isolation mode including high radiation which will seal the control building system and essentially will button it up.

MR. MICHELSON: Chilling water systems -- is that separate? Is it the same? Where do they get their cooling water?

MR. EHLERT: The reactor building cooling loop is on the bottom floor is where the pumps and heat exchangers are located for the reactor building. HECW heat exchangers are located also in the control building and there is a separate loop to essentially provide the chilled water necessary for the HVAC systems.

MR. MICHELSON: Within the control buildings, it's my understanding there are three separate reaction buildings, one for each of the divisions. All three of those are in the control building I believe you said?

MR. EHLERT: Right.

MR. MICHELSON: Environmentally, is there a physical separation?

MR. EHLERT: They have a total physical separation. They have a separate HVAC system and a separate room.

MR. MICHELSON: There are three of them and since you only need two to cool the building, do you work from two of those three somehow?

MR. EHLERT: I'm not particularly sure on that. I think all three are running but you only need two.

MR. MICHELSON: But it is a two-division arrangement as far as the control building.

MR. EHLERT: As far as the HVAC.

MR. MICHELSON: As far as -- there are two chillers?

MR. EHLERT: I think there are four coils and we run a mixture of coils off of those.

MR. MICHELSON: Then of course, you have to ask -- and it goes along with maybe more detail so I can understand. Any time there are divisions within a cooling bank, you have to worry about the fans and so forth.

MR. EHLERT: The fans are all separate.

MR. MICHELSON: I mean a disintegration of the fan may not wipe out the cooling water systems.

MR. EHLERT: The divisions of cooling water -- there are two divisions. Those divisions are separated.

MR. MICHELSON: They are common.

MR. EHLERT: They are common at the heat exchanger.

MR. MICHELSON: They are common with water going out to the reactor building in three divisions. So if there's one division because of this leak, I have also lost one division out and the reactor building at the same time?

MR. EHLERT: Right. You also have less panels in the control room.

MR. MICHELSON: We will have to take a look at it. If you have two divisions, then I have a multiple of two. Division A and Division B tubes them pumps with one fan and if you knock off both fans, you knock off two cooling systems unless you make appropriate provisions.

MR. EHLERT: The HVAC system is basically the ESF ductwork runs off the diesels. The temperature and humidity maintains I already spoke of. It provides for smoke removal and there is an emergency subsystem which provides charcoal and HEPA filters for emergency filtration.

MR. WARD: Gary, what drove you to provide missile protection -- the regulations?

MR. EHLERT: Regulations. It is required for the control room and most of the Class 1 equipment inside it.

This concludes my introductory remarks. Are there any questions?

MR. MICHELSON: Any questions?

[No response.]

MR. MICHELSON: Being none, I believe that takes care of that. I believe the staff is next. Mr. Scaletti, Mr. Thomas will lead off.

MR. MICHELSON: Your staff starts off with a short bit of material. Are you going to discuss that ESF or are we to just ask questions on it?

MR. SCALETTI: You can ask questions on it. Beyond that, your first discussion is Subsection 6.2.6 as to testing. Everything else is skipped in between for later. The letter we write can't have anything in it beyond 6.6.

MR. MICHELSON: Go ahead.

MR. THOMAS: My name is George Thomas. Essentially, we have completed review of emergency core cooling systems. We have already discussed that, and I did not want to go through that again. High pressure core product loops typically are the same as the high pressure core system, except for the core product.

It is started between Level 192, rather than the current design which starts at Level 2, so it's started at a lower Level than the current design. There are two loops between the high pressure systems and a low pressure flooder that's a PHR-3 that has conducted to the area outside the shroud.

This is started automatically on Level 2, instead of the Level 1. The area is typically the same as the current design. There are eight safety relief valves around the radius and it starts at Level 1 plus low pressure pumps running or high pressure pumps running. So there is nothing different in the logic from the current design.

The lower pressure core flutter is outside the shroud, and we have inside the shroud, something else mounted above the core. Before startup, there will be testing done of the ECCS system according to the REG Guide 1.68, just like the current practice.

There will be a test according to SEM Section 11 requirements. They will be tested monthly or once in three months, depending upon the core requirements. As I mentioned before, there is no core uncovering at all, and the loca analysis is by approved current methods, except for some of the cores that are approved to incorporate the new design.

It complies with the current requirement and the PCT requirement is very much lower than 3200 degrees Fahrenheit. There is no basic difference from the current practice.

All analysis is done according to the current practice and --

MR. WARD: Which core practice?

MR. THOMAS: Right now --

MR. WARD: In analysis, there are sort of two approaches now. There is the evaluation model approach and I hate to use the term, "best estimate." We have 10CFR5046 and it is available below 3200 degrees or your best estimate calculation is that you don't get any increased PCT, is that right?

CATTON: I have the same kind of an odd feeling that now that you have best estimate codes, why don't you use them? It seems kind of silly. On a new plant, they use Appendix K. That is ridiculous.

MR. THOMAS: We have done both, actually. They have done both.

MR. WARD: The law was changed.

MR. CATTON: Does that affect you guys?

MR. MICHELSON: It is an alternate now.

MR. CATTON: It is best estimate -- do the best you can?

MR. MICHELSON: I thought it was save on capacities and so forth, this very fine machine they have.

MR. CATTON: You kind of think so, but you would like to see the best estimate anyway.

MR. WARD: But it might have been close to design, but apparently not.

MR. CATTON: It's an interesting business that we are in.

MR. THOMAS: If there are any questions, I will try to answer them.

MR. CATTON: Why do you think they used Appendix K rather than already best estimate approach?

MR. THOMAS: Initially, they are looking at temperature. Best estimate was even more than our present scale value.

MR. CATTON: Would you say that again? They got a higher peak of value?

MR. THOMAS: Yes, so they went back and did an analysis again; put the more consideration on assumptions, and now they show Appendix K values are more than the best estimate values.

MR. CATTON: We are going to hear all about this next week, I hope.

MR. SCALETTI: What George is saying, I believe, is that they went back and did the K-calculations at our request.

MR. CATTON: But best estimates are higher in number than Appendix K? To me that says that your Appendix K is not conservative, and if you are not conservative, aren't you in violation? Don't you have to fix it?

MR. THOMAS: I brought a table here which shows the assumptions.

MR. CATTON: Some aspects of this are different.

MR. QUIRK: We are not getting the full picture here. We are trying to make sure that Appendix K is most conservative.

MR. MICHELSON: This will be on your agenda.

MR. CATTON: You can do that next week. There will be no more in this same area. They were somewhere else, I will guarantee you.

MR. SCALETTI: Do you have another figure?

MR. THOMAS: Yes, I have a letter with all the assumptions which put in parameters which are different. They did it before I could show you that one.

MR. CATTON: We will get into this next week, so I think we should just wait.

MR. THOMAS: All right, fine.

MR. MICHELSON: I assume your discussion on relative 6.3 -- which is the emergency core cooling system; is that correct?

MR. THOMAS: Yes, sir.

MR. MICHELSON: I have a couple of questions just out of curiosity. I find that for some reason this always leaves confusion on review. Look at 6.2.4.1. Which one is correct as far as the standard review plan?

Have you changed the titles on the standard review plan, or did GE change them? I thought we were using the same standard plan. Section 3.4.1 has been retitled? By your analysis, it's called preoperational tests, plural. GE called that ECCS performance test.

MR. SCALETTI: I tried to maintain the headings consistent with the standard review plan. That is not to say it didn't get changed, but I assume the SER has the standard heading.

MR. MICHELSON: I assume that if AR uses the standard review plan, but you both can't be right.

MR. QUIRK: I heard your comment earlier.

MR. MICHELSON: For instance, 6.3.5, the staff calls that performance evaluation and you call it instrumentation requirements. There is no relation, unless I have lost my mind completely. It goes out when I start trying to find out what you're talking about, wherever it is.

In 6.3.5., the SAR calls that instrumentation requirements. The SER calls it performance evaluation.

MR. SCALETTI: The SER should be right.

MR. MICHELSON: 6.4.3.2; GE calls that periodic reliability test and inspection. The staff calls it periodic component tests. Every once in a while, I run into differences in titles, and I fall back to the standard review plan to see who is right. I thought you were both using the same.

MR. QUIRK: Yes, our intent was to use the same title. We do a lot of things, but we usually don't improve on the staff's.

MR. MICHELSON: It creates some confusion, because I wasn't sure about this one on instrumentation. It was a totally different title. It makes it unnecessarily confusing. At any rate, it will be consistent some day.

MR. SCALETTI: Yes. We will be consistent with the standard review plan. Whatever GE calls for, as long as the information is there for the staff to review.

MR. MICHELSON: GE says they attempted to use the title from the standard review plan, too; at least that is their intention.

MR. MICHELSON: We are ready for the next presentation. While he is getting ready, Dale, maybe you can answer something for me. Once in a while I read applicant in here. In the middle of the page, it talks about the applicant shall do something. Who is the applicant?

MR. SCALETTI: Applicant should be purged from the document. It should be General Electric unless it refers to an interface requirement that specifically is directed at a utility.

MR. MICHELSON: I think in this case you meant GE but I wasn't sure. There were a couple other places where you talk about applicant but you are going to correct that by being specific to GE. If it says "applicant," it will be GE?

MR. SCALETTI: It might say "utility applicant." If it doesn't, then it means GE.

MR. MICHELSON: Okay.

MR. CHANDRA: My name is Chandra and I am in the plant systems branch. I will be making presentations on three different topics. The first one is control room habitability systems. Some time back, there was question on what exactly habitability systems are and why there are two different sections of the standard safety analysis report. The habitability systems include the control room ventilation system but not necessarily limited to the control room. The ventilation system goes far beyond that.

It deals with some of the systems like how we have missile protection is provided, how radiation sealing is provided, how radiation monitoring is provided and also it deals about the air filtration and ventilation, lighting and personal and administrative support and last but not least, fire protection and so it deals with a number of issues and that is the reason why I would imagine that the standard of your plan has two separate sections -- one for control room habitability and the other is about control room ventilation systems which of course is a big part of control room habitability to ensure control room habitability.

When you talk about control on habitability, we have to comply with the acceptance criteria that is identified in standard review plan 6.4 which in turn is compliance with GDC 4, GDC 19 and DMI 3D34.

I have not found any mention of 3D34 because General Electric has taken a position, this 3D34 which essentially deals with protection against toxic substance release, protection for the control room operator will be reviewed a site specific basis and we have so identified it in our safety evaluation also.

So we are primarily dealing with GDC 4 and GDC 19. The first one talks about moderate environmental and dynamic effects that some there is a discussion about dynamic effects that we have a six inch fire protection line. The six inch emergency cooling water which is safety related line to the coolers, six inch chilled water heater and water system lines and then you have of course the smaller lines for drinking and a sanitary pipe.

The protection is by seals and floor drains. General Electric has recently used Section 341 which deals with fire protection. The staff is in the process of generating additional information on that particular section and down the road, after we have received responses, we will be able to determine whether protection against moderate energy pipe cracks in all those water lines they are talking about is adequate.

It would appear to me on a superficial review that it looks as though it is adequate although I do not necessarily stand by that but our real concern about the GD4 is the steam tunnel through the control building. The steam tunnel runs between the reactor building on one end and the event building on the other end. In a figure, I think figure 1.2-1, of the standard safety analysis report and 3.5-2 which deals with missiles and other missile sections, there is shown the steam tunnel. Figure 1.2-1 gives me the very clear impression that the tunnel is not included in the control building.

It looks to us as somewhat -- we have somewhat of a concern that events designed at the tunnel should run through the control building. This tunnel of course is housing the feed water lines and the main steam lines. It is of course true that the floor of the computer room is about 7 or 8 inches thick which provides --

MR. MICHELSON: How thick? How thick is the floor?

MR. CHANDRA: The floor of the computer room is 78 inches thick for shielding but our main concern is that below there is a compartment analysis for the steam tunnel including the effects of high energy. Piping failures in the tunnel on safety-related structures and components have not been provided and we are not necessarily saying that the design of the tunnel through the building is unacceptable but we are concerned about the standard running through the control building and GE has not provided any subcompartment analysis.

MR. MICHELSON: Isn't that really a subject of some other section as to applicability? GE didn't discuss all of this.

MR. CHANDRA: I agree.

MR. MICHELSON: Is this the right place to discuss it? Are we going to discuss it when we talk about other parts like structures in other such chapters?

MR. SCALETTI: This is probably not the right place. I agree.

MR. MICHELSON: Go ahead.

MR. CHANDRA: I think there is a legitimate concern. What happened is, at the time that the safety evaluation report was done, we went by the statement where GE said, there are no high energy lines in the vicinity of the control room. I do not know whether they said control room or control building. I am not sure but there was a statement. We went by their statement. Subsequently I found out from their figure, 1.2-1, that the tunnel is running through the building but what we are saying is, they have not provided an analysis.

If they would provide an analysis which would indicate that the failure of high energy piping or something in the tunnel does not impair adversely devices and components, it is possible the staff may find it acceptable.

MR. CATTON: Is there anything in the tunnel other than the steam line?

MR. CHANDRA: Our concern is the tunnel running through the building and the tunnel houses the high energy steam lines and the feedwater lines.

MR. MICHELSON: I'm confused now. I'm looking on page 622, the bottom line, the last paragraph or the last line on the first page where you discuss all of this, it says the staff concludes that the control room habitability system satisfies the -- you are telling me you don't have the information to whether it does or it doesn't. What kind of an SER am I reading? It's either the staff accepted it or they didn't.

If they did, they've given me their reasons. If they did, they may not give me the reasons for it but in this case, I'm hearing both stories.

You did mention earlier there are things that you have to protect on the basis of the system -- habitability systems --

MR. SCALETTI: I think it is probably a little premature, the structure of the control building and we should just deal with the control room habitability and take this in Chapter 3.

MR. MICHELSON: This is not the right place to get into it. It is a legitimate concern, all right, and the SER threw me for a loop. I thought everything was fine.

MR. WARD: The concern is not about the control room, but it is something else. What is the concern about?

MR. CHANDRA: I said, if it can be shown, there is a compartment analysis or something, or steam tunnel.

MR. WARD: Is there equipment in the steam tunnel that you are concerned about, or you don't know yet?

MR. CHANDRA: I haven't seen any such analysis to know.

MR. CATTON: The concern is the integrity of the structure. If it stays together, there is no problem. Is that it? Do you want to see that?

MR. QUIRK: I am going to ask Gary Ehlert to keep me honest here. But I recall that steam tunnel, and the fact we need to evaluate again the steam lines in the tunnel. I think we have done that, and that it is in Chapter 3.

We are still doing our in-house review.

MR. MICHELSON: The concern is that he hasn't seen it, not that it is a problem. We don't know that it is a problem, because he has not seen the analysis. I was concerned about the SER anyway.

The last line says you don't have any problems. You satisfied GDC 4.

MR. CATTON: Chapter 3 shows it.

MR. SCALETTI: One of the hazards of doing this review is to review Chapter 3 and come to favorable conclusions on analysis done for Chapter 3. Did that integrate the whole thing at the end in a review process?

MR. MICHELSON: We are showing that hazard, you realize, and trying to write a letter along with you.

MR. QUIRK: It will only get better. The first one is difficult to write because of all the downstream chapters, until all of those reviews are complete. I think as long as the SER comes along, it will come out all right.

MR. CHANDRA: The only thing I can say in defense of that statement that it complies with GDC-4 was on the basis of the findings of the review earlier, the statement in SER Section 6.4, that there are no high energy lines in the vicinity of the building or of the control room.

MR. MICHELSON: But your SER says there will be high entry lines for the control room. Therefore, the habitability will be prote~ted against dynamic effects that may result from possible failures of such lines. And then it goes on to say on that basis they are okay.

You can't make that statement about it yet, because you don't have all of the information. Once you get that information, then the statement will become correct. But only at that point. See, it is an open item right now, in my book. I am keeping my ears open, because several other things were in that same section.

MR. CHANDRA: There are two physically separated and redundant supplier intakes for the emergency area pressurization, and these are located on each end of the control building, top floor, side walls. They have automatic selection features for the intakes, so that when the intake, one of those intakes shows that the area is contaminated, then it will shut off and the other intake will be used.

In the event that both of those intakes are contaminated, then the control room operator can override them, this feature, and arbitrarily select one of those intakes for, intake for pressurizing the control room.

MR. MICHELSON: Are any of the diesel generators located therein?

MR. CHANDRA: I don't know the answer.

MR. MICHELSON: They are in the reactor building, but outside the primary containment. I wasn't quite sure, because the drawings I've got show pretty pictures, but a completely different arrangement, I think.

MR. CHANDRA: The control room is adequately protected against outside air contamination and portions of the control room are physically located underground with sufficient shield to protect the operators from normal steam and gamma rays and nitrogen exchange, and the exterior walls of the building are 35 inches thick, not to speak of additional shielding by reactor building and event building exterior walls. And all doors are double-door type.

MR. MICHELSON: Is the radiation source from the steam lines taken into account?

MR. SCALETTI: Can I have your question again?

MR. MICHELSON: I wonder if the radiation source from the steam lines took into account the hydrogen-water chemistry, because that elevates the source to some extent.

MR. QUIRK: The answer now from GE is yes.

MR. CHANDRA: I think I will pass on to the next slide.

[Slide.]

MR. CHANDRA: There is no assurance of a minimum .25 inches water gauge during pressurization following LOCA. The reason why we have identified this as a concern is because the writeup under Section 6.4 of the safety analysis report indicates that the control building will be pressurized to zero point to 1.5 inch water gauge at all times. And the mechanical equipment room will be pressurized 0.02, some value, I do not exactly remember, .5 inch water gauge. And this will be actually, there will be a technical specification limiting this pressurization.

But what we find is when General Electric talks about a range that can be always maintained within this range, it is not too clear that during the pressurization, more than operation, it will be maintained at .25 inch water gauge. And that is all.

Also, we find that it does not have any piping and instrumentation diagrams for the control room HVAC. I haven't seen any. It is possible they have been included more recently. But I haven't seen any, even in Section 941, which has been more recently submitted. And there is no table on treatment system component description about the heat size and the characteristics.

There is an ambiguity about redundancy of filter train, which may not comply with SPR Section 6.4 acceptance criterion II.2.b. But I think this may not necessarily be correct. I gather that they do have two filter trains of two-inch depth. And the reason I put this was because of the general argument that is put forth by General Electric that the filters are considered as passthrough components and they need not be redundant.

This was the discussion provided, and also there was no table of treatment system components, so I thought that is not too very clear.

But I gathered they do have two filters, and General Electric can probably confirm that.

MR. QUIRK: We do confirm that you do have redundancy in the filter trains.

MR. CHANDRA: Also, the last two bullets are about compliance. Regulatory Guide 1.52 position is not discussed, and minimum instrumentation requirements not discussed. What the Staff is essentially looking for is some tables in the Section 6.4 of the SAR where each of the regulatory positions that are identified in Regulatory Guide 1.52 will be discussed. And if they are not, what is the equal, and protection of equal and design thereof?

Also, about the instrumentation requirements, these are identified as standard review plan 6.5.1-1.

The reason why I point out these two bullets in this viewgraph are because of the fact that the staff usually requires the applicant to demonstrate compliance with regulatory positions identified in 1.52 and also in Table 6.5.1-1, in order to make a determination about the efficiency that can be assigned to the charcoal absorber for the removal of the element or the organic species of heat pump and removal of the particulate species.

MR. CATTON: So that is instrumentation for the filtering system?

MR. CHANDRA: Filtering efficiencies. So actually, these last two items are also discussed under Section 6.1, which is use of the filters, and the cleanup systems.

MR. WARD: What is 1.52?

MR. CHANDRA: 1.52 identifies all the regulatory positions that have to be satisfied; that filter efficiency can be assigned, and that the filter efficiency is also given in that guide; what kind of filter efficiency can be granted or acceptable.

MR. WARD: You are including charcoal here?

MR. CHANDRA: Charcoal -- right charcoal absorbers.

MR. WARD: You are not looking to radioiodine or methyliodine or whatever?

MR. CHANDRA: Right, because in order to find with GDC-19, it is basically those criteria for the control room operator. You must obviously use grade filters and those filters -- how are the grade filters -- and they are identified in the Regulatory Guide, 1.52.

MR. MICHELSON: From all you have told me and from what I have read on page 621 about the habitability systems, I think I am forced to conclude that we are not ready to write any letter on such as 6.4 or Chapter 6.

There is nothing but old items, information to be received, things that you haven't seen and so on and so on. There is nothing we can comment on yet. It's just all up in the air; is that your observation or can you argue as to why ACRS ought to write a letter and include Section 6.4?

If you take 6.4 out, how much is left as to Chapter 6. There are a whole lot of things later. Section 6.2 is later. 6.3 is a little bit possibly right. It is open. 6.4; I don't think we can write.

6.5; I'm going to hear about in a minute, I guess -- whether we can write. There is nothing left in the chapter.

MR. SCALETTI: I agree about Chapter 6. It would be helpful to write a letter on anything we can get, or do you feel comfortable in writing on some of these sections? So, please do it. That is all I can say.

Earlier, we mentioned Chapters 55 and 17.

MR. MICHELSON: I just wondered if I was getting unduly disturbed.

MR. SCALETTI: There is a lot of information still outstanding.

MR. CHANDRA: Also, the control room doses have to be evaluated --

MR. SCALETTI: Yes.

MR. CHANDRA: -- in order to comply with GDC-19.

MR. SCALETTI: We have standby gas system up next.

We have more information outstanding, but you can go through it. It would behoove us now to spend that time going through that. Obviously you are not going to want a write off on this portion to be included on review.

Maybe we ought to just skip on to the Chapter 17 information.

MR. MICHELSON: As to 6.5.1, you have identified the cleanup systems as an open item? That is Section 6.5.1, the last line. 6.5.3 is also identified as an open item. I am reluctant to write letters on open items.

MR. SCALETTI: The standby gas system certainly would be.

MR. MICHELSON: 6.6.3 is open and 6.6.4 is an open item. The conclusions; I don't think we can start commenting on before we have seen all of these sections. I just think this thing is kind of strange.

To try to write a letter on something in this state of development, we will have to ask the other subcommittee members and then move to the full committee to see what we should do.

I have a little problem with what that says.

MR. SCALETTI: We fully understood the process from the beginning. We knew it was going to be in this format. Each one of the modules would not stand alone and the whole review process has to be completed before.

MR. MICHELSON: That I understand. What I don't understand is getting an FER in which you haven't yet gotten that information for that item, for that particular chapter.

MR. SCALETTI: Part of the process that we go through is that we identify these issues in the safety evaluation. They work out the details with the vendor to resolve these issues. The process by which we go through this -- now there are items in Chapter 17, as I said before. Basically, Chapter 5 is complete. There are a few outstanding issues, but they are minimal, and I can believe those to be addressed with the understanding that the whole review has not been integrated, obviously and that there is more to come.

We will see no more of Chapter 17. You will see resolution of the outstanding issues in Chapter 5, and you will see a lot more in Chapter 4. You will see a lot more in Chapter 6.

MR. MICHELSON: We will have to see what the Committee would like to do. I thought we were going to get a somewhat more firm SER on the module, recognizing, of course, that there is some interplay that you haven't completed.

But if there is no interplay, it is just a lack of information for that part of the module we should be seeing until it has been cleared up. Inasmuch as what we are seeing here is just everywhere and if there's more information needed, something you haven't seen, --

MR. SCALETTI: The ACRS has to be earlier in the process. We certainly were involved early in the process. I assume that if you have comments on these issues that are outstanding, you can comment on them.

MR. MICHELSON: That may be the approach we will have to use, rather than saying we agree with the conclusions on FER, Module 1. We will just make comments on the Module.

MR. CATTON: Or just consider this a progress report.

MR. MICHELSON: Yes. I am struggling a little bit as to what kind of letter we can write.

MR. SCALETTI: I think if you don't write a letter, at least on the sections that are relatively resolved, then if you have any problems with them, we are not going to find out about this until the end of the process.

MR. MICHELSON: What would be extremely helpful for me in a couple of weeks is for you to identify to the ACRS, the sections you believe are essentially done. Make sure you go back and make sure you read your FER and see what it says and look to see if there is information still to be coming in that you haven't seen yet, and therefore you're putting a caveat on it.

I expect that what we would want to write a letter on are those things that are caveat-free, except to the extent that there may be other chapters. I can't define what a couple of --

MR. WARD: It seems to me -- I don't have examples. I haven't run across anything, but if there is something the Committee, even a chapter section that we reviewed as completed -- if the Committee has something to say about it, I think we ought to say it.

I think that is the whole idea of an early review.

MR. MICHELSON: The original concept of the early review, as I understood it -- I understood that the staff wished to write off on these modules as they came up, and not go back to them again, except in one file wrap up that took care of interfacing.

I am reluctant to write off on Module 1 with the state of knowledge that I have.

MR. WARD: Let's not. Don't make a writeup. Just make any comments you think are appropriate.

MR. MICHELSON: That is a different kind of letter. That I think we can write and I think it would be useful.

MR. SCALETTI: The intent was to get a resolution with the ACRS on each module as we pursued it. However, you will agree that there are issues that are outstanding. There are issues that we have present before the Commission that deal with these chapters, so we can't expect a write off on those.

We haven't come to grips totally with those ourselves yet, but we would like to see a letter which shows your comments. If you felt that any of the sections or chapters were satisfactory, then we hope that you will so state, so we have an understanding of where you are coming from.

It will help us.

MR. MICHELSON: I think certain materials are relatively complete, but unless the full Committee has problems, I think we can write off on the materials section which is only a fraction of this module.

The rest of this module, I am having a hard time finding anything we can write off on, any kind of definitive piece.

MR. SCALETTI: You have to look at Chapter. I don't think there are any issues that remain open as far as the staff is concerned. If there is anything you wish us to look at, obviously, we will.

MR. MICHELSON: I think Chapter 5 is a little less complete than you think.

MR. SCALETTI: Chapter 5 has two of the outstanding issues which are TMI Action Items and those will not be addressed until a later module anyway. The in-service and pre-service inspections are outstanding. GE was going to drop that, so really, Items 10 and 11 are the ones of concern in Chapter 5.

MR. MICHELSON: If you read through details of your FER, I keep coming across statements that say, this issue will be addressed in Section 19. There is a page and a half of discussion and then it says, it will be discussed in the supplement. What do I do with that?

I'm looking at page 540. It starts on -- there are several things which are in the supplement. The heat removal systems on 1236. The first mention of a supplement is on 538 at the middle of the page. The isolation will be discussed in Section 6.2 of the supplement.

Well, if it's in the supplement, I'm not going to write off on the section because I haven't seen any supplement. Then I go on.

MR. SCALETTI: That is because Section 5 --

MR. MICHELSON: What you think is essentially complete; there's a pretty large caveat.

MR. SCALETTI: You are not writing off on containment isolation in Chapter 5.

MR. MICHELSON: What are you writing off on?

MR. SCALETTI: You are writing off on containment isolation in Chapter 6.

MR. MICHELSON: It is in Chapter 5, the section on residual heat removal system; this is the first of the supplements which will appear elsewhere.

MR. SCALETTI: This is the normal course of action. We address all of the containment items in Chapter 6. The ECCS systems --

MR. MICHELSON: Let's talk about it in view of what is said in here.

MR. SCALETTI: Wherever it refers to another chapter, more information will be presented. If it's not there --

MR. MICHELSON: My problem is; it is not the chapter that is not there. It is the supplement. I can go read GE's chapters. I have no trouble with that, but when you refer to supplements that haven't been written and are not in front of me, it is very complicated to know where you are at.

Again, on page 540, the same thing again. The staff assumes a condensate storage tank will not be available during that but this issue will be addressed in Section 19 of the supplement SER. Unless I read Section 19, how will I know?

MR. SCALETTI: This is directed to Chapter 19 for the design basis for the plant, the other chapters. We could see that throughout. Wherever there were issues that were similarly related in Chapter 6, we indicate some of these again in Chapter 19. That is a fact.

MR. MICHELSON: Once you address it and we read about it, we may change our minds because of what you tell us elsewhere. The Committee will have to decide what kind of letter is appropriate. It does get complicated with a lot of large caveats and a hard-to-write letter on one module.

Proceed.

MR. SCALETTI: Do you want to continue with the standby gas treatment system?

MR. QUIRK: Let me interject. GE has already offered that portion. It is being reevaluated, and the bottom line is that both sides of capacity will increase. We are putting it together in an amendment, so I think it is premature.

MR. MICHELSON: So it is not worth discussing now.

Is that the rest of the handout?

MR. QUIRK: Mr. Michelson, let me just try the example you gave as to Chapter 5. It talks about the system itself, the purpose of the system, how it functions, what turns it on, what turns it off. There is an awful lot that is to be dealt with there.

Now, with reference to 2.6.4, it is containment isolation provisions, and basically, 6.2.4, you identify the number of barriers, what is inside, what is outside, what is motor operated, and what the staff has done -- it has lumped all of that to be addressed in the containment section, under isolation.

I think the concept of a modular review is that you could deal with all aspects of RHR that is dealt with in Chapter 5, but keep in mind that the isolation provisions for RHR and all other systems are dealt with in Chapter 6. So you would have to say we find RHR acceptable given the extent to which it is talked about here, and we'll conclude on its isolation capabilities when we review Section 6.4.

MR. MICHELSON: There is much more missing than that.

MR. QUIRK: I tried to take one example.

MR. MICHELSON: It is all over. I think we can write a letter that says yes, we have read Chapter 5, and we don't have any problems with it except the following, but I can't read it the same way, when they put all the caveats in Chapter 5. I will have to deal with those caveats. The staff hasn't yet evaluated it. So, therefore, are we ready to go ahead on this thing?

MR. SCALETTI: The caveats are there, because they have not been reviewed yet, until an SER is going to be written on the device. It is also the way the standard review plan is structured. We don't have a problem with it now, but we feel we can write an SER with the caveats, but this information is going to be provided later. It is information that says you have to see this information in Section 7. It's all through the document. You can't help that. This thing isn't going to go away.

When you write your letter, it's based upon what you have here. And so when you do write a letter, it is going to be -- people are going to know it is written based upon Section 5.4(a) and not what you did in Section 6.4. So that is something we are going to have to come to grips with, because we clearly -- we like to have what action we can have as early as possible from the Committee.

MR. MICHELSON: We will see what the Committee wishes to write. It is not an easy process.

MR. CATTON: We need a spread sheet.

MR. SCALETTI: We do, too.

MR. MICHELSON: We can certainly give them comments.

MR. CATTON: You can agree in principle with their philosophy.

MR. MICHELSON: But there are too many omissions here.

MR. SCALETTI: The final write-off doesn't count until the end of the review process.

MR. CHANDRA: I think we are all through.

MR. MICHELSON: I think we are finished with that presentation.

At this stage, unless the Committee has any other questions, we can go off the record to discuss --

MR. SCALETTI: How about 17?

MR. MICHELSON: How about Chapter 17? We have never put it in module 1. It was added later. We did get a briefing on it. We haven't had a chance to study it. I don't even have the QA document. I don't see how we can do anything on Chapter 17.

MR. SCALETTI: Haven't you been briefed on 17?

MR. MICHELSON: We haven't even got your QA document.

MR. QUIRK: What do you mean you don't have it?

MR. MICHELSON: I don't have it. The Committee doesn't have it. Maybe the staff has it.

Do you have it?

MR. SCALETTI: I don't have it with me.

MR. MICHELSON: The Committee has never seen the document.

MR. SCALETTI: It is a GE standard document that has been reviewed with each plan that comes through.

MR. WARD: Is there anything different about this?

MR. MICHELSON: I don't know. I have not seen it.

MR. NOVAK: That is one of the SARs. Basically, this would be my presentation. This is what we work to. The NRC has approved, accepted this for 15 years. It was also recently reviewed by the NRC in March of this year, and one of the reviewers was also a reviewer for the ABWR certification.

Now, what Chapter 17 does is point out the unique and additional features that we go through, because ABWR certification in the U.S. uses several hundred -- over 1,000 documents that were prepared under what we call common engineering by three companies for an international project. The three companies are GE, Hitachi, and Toshiba. I briefly went through that back in May and I was prepared to present an overview for you tonight.

MR. MICHELSON: Do you wish to proceed with it?

MR. CATTON: He is here.

MR. MICHELSON: I would certainly like to hear it. I will say, though, this is a case of where the SER keeps saying see reference in Section 1, reference 1; see Section 2, reference 1. I don't have reference 1. Reference 1 is the GE. I don't know if that's one or what it is.

MR. NOVAK: Yes, it is. The March 31, 1989, was accepted by the NRC in our March 31, 1989, most recently. We have been using this basic document for over 15 years. As there are organizational changes, new requirements come up, but this is basically how GE does it.

MR. MICHELSON: In this case, you are doing this business along with the Japanese? Is that somehow folded into the plan?

MR. NOVAK: That would certainly be our objective, yes.

MR. MICHELSON: That is the only wrinkle here.

MR. WARD: That is what we are interested in, it seems to me.

MR. MICHELSON: Yes.

MR. NOVAK: First of all, my name is Philip Novak. I am the ABWR Program Q Manager for GE, and as I briefly said in the back, I am to present to you a brief overview of the QA in Chapter 17.

First of all -- well, I covered with you just now -- I don't know how much is on the record or whatever, but Chapter 17 --

MR. WARD: That was all on the record.

MR. NOVAK: Good. We are so used to working to a nuclear QA program that we focus on the differences immediately, and sometimes we forget that our readers, who are starting from ground zero and have looked at many other companies' programs and so forth, perhaps, are not as intimately and up-to-speed familiar with the documents as we are, so the way we wrote Chapter 17 was basically referencing our overall QA plan and then saying this is how it is different, because it is an ABWR, because it is being created by three companies, and a fundamental inequality in a program of any type is who is responsible, and in this particular case, it requires special consideration.

There are three companies who are both each responsible and all responsible, because we are doing a joint venture to create these, approximately 1,300 common engineering documents, which are the major portion of the work that is being presented to you in the safety analysis report.

[Slide.]

MR. NOVAK: How do we do that? It requires very, very close integration. I believe Mr. Ward, last time, who said, "Wow, is that possible that I made the comment to the effect of that?" Well, yes, it is possible, but it sure is a lot of work because in creating each document of these, approximately 1300, each company must formally review and approve the document. The lead responsibility is assigned to one company. It's roughly one-third. Each company has three to 450 documents, of which they have the lead responsibility, and up to this point, it is a pretty standard process.

To do the design work, they draft the document, then they run it through their internal review quality assurance program. At that point, here is what is unique to ABWR because, at that point, they must obtain review, formal review, by the other two companies.

Furthermore, we have a process. It is a documented procedure. It is done on what we call internal review memorandums. Each and every comment must be formally addressed and resolved to the satisfaction of the commenter, not the responsible organization alone, so that all three organizations must agree to the resolution of every comment, and, believe me, there are many comments. It takes, sometimes, months to get a document through, and that is part of the territory because we are doing it as a joint venture.

MR. MICHELSON: And these comments have to be translated from English to Japanese so the Japanese can read them?

MR. NOVAK: The language of the j int venture is English.

MR. MICHELSON: You mean everything is written in English?

MR. NOVAK: In terms of the documents that we are preparing.

MR. MICHELSON: What do you mean -- all three companies?

MR. NOVAK: Say again?

MR. MICHELSON: What do you mean -- all three partners?

MR. NOVAK: Yes, sir. In terms of the documents we are preparing, we are required to prepare them in both English and Japanese. We work originally in English, we end up translating it to Japanese, and they do the reverse.

In the case of the comments, as I said, the working language of the project, of the joint venture, it is English. So comments do not have to be translated. They understand English a whole lot better than we understand Japanese. So we work in English in the joint venture. The resulting product is done in two languages.

MR. MICHELSON: But the specifications, for instance, are written in two languages?

MR. NOVAK: Correct.

MR. MICHELSON: What kind of assurance do we have that the translations are reasonably accurate? In other words, the intent of the designer was translated in the proper language and back and forth. You can change a word here and there and change a whole lot in the design. How do you control the quality fo the design with that kind of a problem?

MR. NOVAK: Basically what we do, we take an independent translator -- in other words, the translations are initially done -- let's say if you are going from Japanese into English, they will -- "they" being Hitachi and Toshiba -- will create the English version. We will then have an independent translator translate the Japanese version that goes along with it. And we maintain identity in terms of red levels on the documents, and then we have a responsible engineer that document.

While we are for that system, we have lead responsibility to prepare only about a third of the documents. We have engineers responsible for systems for all of the documents, and that engineer then goes and reads the translation made by an independent person of the Japanese to see does it carry the essence over.

One word can make a difference, that is right, but he will go and look at it, because frequently, one word does make a difference, but he will pick up on that and go through it on a word-by-word basis as an independent translation.

MR. MICHELSON: Does this refer to a QA description?

MR. NOVAK: This is part of the project.

MR. MICHELSON: If it part of the project to keep it straight?

MR. NOVAK: It is part of the project to keep it working for the ABWR, our certification program. We are interested in the English versions, only. For Hitachi, we are interested in both. It is not part of the ABWR certification program.

MR. MICHELSON: It is not a part of the QA program, as I understand it?

MR. NOVAK: No. Well, you say QA program -- it is not in Chapter 17.

MR. MICHELSON: It is not as part of the program up on the slides.

MR. NOVAK: It is part of the procedures.

MR. MICHELSON: Is the staff aware of this process? Do you think that is adequate control over the quality fo the design?

MR. SCALETTI: Yes.

MR. MICHELSON: It wasn't stressed in your evaluation. I had to ask. You did explore it, though? You didn't see it was important to put in the evaluation?

MR. SCALETTI: We looked at the English language version, and one of the staff was responsible for that. We looked at the whole correspondence back and forth with the companies, including the design documents presented, the questions asked, the responses to the questions, the questioning and so forth, all of which -- our opinion was that the three-company review was so extensive that it was in itself, although GE takes credit for it, it was in itself essentially, for all practical purposes, a design and verification process.

MR. NOVAK: I disagree with that. As long as the information is correctly interpreted, so the other two companies, when they read the Japanese version, its the same version, a wrong question or improperly stated question.

MR. SCALETTI: My opinion would be, with the level of questioning going on, the level of detail of these questions, it would be very unlikely that any kind of significant design error would creep through the translation because they were looking down at the level of the design and generating questions at that level.

MR. MICHELSON: You don't think this needs to be in a QA plan, this control of language translation, to make sure it's reasonably accurate?

MR. SCALETTI: No, I don't think it has to be part of the QA program.

MR. MICHELSON: We have a whole lot of things that aren't much different than that. This is the first time we have ever dealt with the QA, as far as I know. I would have liked to have seen the discussion, at least had the assurance you looked at it and satisfied yourself.

Proceed.

[Slide.]

MR. NOVAK: After the comments are reviewed, each document must be formally approved again by all three companies. It is issued by the lead company for that particular document, and changes are to be handled in the same manner.

[Slide.]

MR. NOVAK: Quality Assurance. We, GE, Hitachi and Toshiba, for the Tokasaki project, are committed to the Appendix B and JEAG-4101-1981. I have reviewed those, other people have reviewed and compared these, too, and while the format is somewhat different, JEAG-4101 captures the point in Plan CFR 50, Appendix B. However, if it does or it doesn't, Hitachi, Toshiba, as well as GE are committed to meet this for all common engineering documents. That is a nice commitment.

MR. MICHELSON: I understand what you tell me. Does that mean that this JEAG-4101 -- it is a Japanese, I assume?

MR. NOVAK: We have a translation. It is a Japanese document.

MR. MICHELSON: The real key document is Japanese, and it has been transferred back to English?

MR. NOVAK: Yes.

MR. MICHELSON: Do you have some person go back and read JEAG and translate it himself, and see if he comes out with the same things you were reading?

MR. NOVAK: On that document, I don't believe so.

You have to --.

MR. MICHELSON: They are already reading their Japanese interpretation. It's the Japanese language interpretation, which is that JEAG, as I understand it.

MR. NOVAK: You have a point, but then what we do? This is a commitment, but those are words. How do we know that they are doing it to your point? You are looking at the translation; we took it to the next step. What are they doing? What have they said in their next level of document, and we have done two things. These, again, are by the contract. I use the word "ready" because I copied it out of the contract, but, in fact, this was done several years ago. We reviewed, and we say so, in the SAR, we did review the adequacy of the actual program in place at both Hitachi and Toshiba.

MR. MICHELSON: That was written in English?

MR. NOVAK: Yes, it was prepared for us in English. We went there; we did not use the word "audit" over there; we used "review." We did a review of several days going over the program after we had the document here. And what does this mean? How do you do that? Because we know what 10CFR 50, Appendix B says, and we would measure against the document.

MR. MICHELSON: When you do so, do the people you talk to reply in English, or do you have to get a Japanese interpreter to find out what they are saying?

MR. NOVAK: Most of the people reply in English.

MR. MICHELSON: That is interesting.

MR. NOVAK: We take along our Japanese member of our Jetco staff who is multilingual. In other words, when I went, I had the Jetco employee wiht me, and we both asked answers, and checked answers. At the time of the review, we have multilingual capability in real time. However, that was the QA program. The next step is, do they follow it? There is a commitment to annually review each other's implementation of QA program.

MR. MICHELSON: Let me clarify another point. The reason, I guess, we're concerned about this whole QA area is that we are going to certify a design which is actually being done and detailed by the Japanese for possible use in the US.

MR. NOVAK: Yes.

MR. MICHELSON: So we are quite concerned, although there is no criteria formulated by a GA, we are quite concerned that the implementors on all the details understood those criteria correctly, and carried through correctly, and supplied a product for a plant built under the certification of this country, and expected QA is followed through all of the way. I think it is something you can't take too lightly.

MR. NOVAK: Oh, no. We take it very seriously.

MR. MICHELSON: I understand when the Japanese say one thing, that means a little different than what I thought it meant. I can't get around all of these technical details.

MR. NOVAK: I think that probably the technical detail is what makes it the most saving of the situation in that when you start talking about what is the diameter of this, what is the stress of that, or did you exceed the yield of this or that, engineering is more of an international language than Japanese or English, at that point, when you look at the graphs the computer outputs that they do use, our arabic numerals, and, in fact, much of their record files are in English because they know they are working back and forth with us.

MR. MICHELSON: What isn't so easy to come up is basic design criteria and philosophy that is written down and our regulations have carried out. When you see the end product, you can't really tell, in many cases, whether it's carried out or not. You have to go back through all of the paper process and the design process to see if they really understood the criteria and implemented it correctly.

Those are the kinds of things I'm concerned with. Some things jump out very easily. You can't always look at the end product and tell whether they followed the criteria. You can say, do you follow that criteria? You committed to it. Only in an audit sense can you check on it. There are just too many things going on in between. We do have an implementation audit each year where we select documents, do into their records and ask, it is an audit process. It is not a 100 percent process in terms of quality assurance aspects.

However, each document has to be approved by our engineer responsible for that system as well as our projects people.

[Slide.]

In terms of our ABWR certification, as I already pointed out, we are working to an NRC accepted program. It meets the reg guides in effect at the cutoff date of the certification effort which is March '87. We are responsible for the content of all of the common engineering documents, as I explained to you. While we may not initiate all, we are responsible for all because we review all in great depth and we approve all and we comment where comments are needed and they usually are just because engineers being what they are.

We then must formally review and approve and finally, we do have an annual review of our partners each year and we have done that and are scheduled to do it this year. That is the overview. Any more questions?

MR. MICHELSON: Questions?

[No response.]

MR. MICHELSON: I see none.

MR. WARD: One question. The manual you held up, the manual that GE has that has evolved and is updated, does it say anything about this joint program?

MR. NOVAK: No. That is why we focused -- maybe it was smart, maybe it wasn't smart. I thought it was smart --

that we focused on the differences because that is why we say reference -- we just presume since we live with it everyday the rest of the world does too. That perhaps was an error but the difference is this basic review process, were highlighted and that is the part in Chapter 17 that is unique to this project.

MR. MICHELSON: You mention here the QA plan. Does it discuss as I just heard your answer, the QA plan does not discuss this three-party process.

MR. NOVAK: Chapter 17 of the SAR.

MR. MICHELSON: You ought to look at Chapter 17. I never got what I heard today from reading Chapter 17, but I guess that is because I didn't read it too well. I probably could go back and figure it out now. QA to my thinking is such a major involvement by the other parties --

MR. NOVAK: They are doing --

MR. MICHELSON: -- I would think. That is my own opinion. I can understand subcontracting a QA program but this is far from a subcontract.

MR. NOVAK: As I indicated, and it was on one of the viewgraphs, there is a project procedure which we call the ABWR project document where basically the review process because that is the key -- that review process -- the ABWR organization procedures manual, that outlines in excruciating detail even to the point of what the stamp looks like, how the documents are to be reviewed and how they are to be approved.

MR. MICHELSON: Is that part of the QA plan?

MR. NOVAK: When you use the word, "QA Plan," that word doesn't ring to me. It is not part of the green book I held up.

MR. MICHELSON: Let me read the title -- Nuclear Energy Business Operations Quality Assurance Program Description, May 1987. That is the only reference here.

MR. NOVAK: That is not part of that.

MR. MICHELSON: If it is not part of that, it is not part of the QA plan at least as defined in Chapter 17. It is not mentioned in 17. It's not referenced in 17. It's not part of the reference that is in Chapter 17.

MR. NOVAK: I believe Chapter 17 explains the process in sufficient detail to understand what we are doing, that it is a problem but that is the concept rather than I cited one document that was key. I didn't feel it was fair to cite a whole bunch of documents in greater detail and take it down to a level much below the rest of the discussion.

The staff, I believe, has seen this. They can address that when they get to that point.

MR. MICHELSON: I would like to hear that discussion from the staff. Thank you.

MR. HOOKS: My name is Kenneth Hooks. I am currently assigned to NMSS Division title of voice management but prior to that I was with the group that was reviewing the GE work. I did not personally review Chapter 17. That was done to the best of my knowledge by Jack Spraul who is unable to be here today. I have discussed it with him. My understanding is that he feels that GE's description of the QA plan presented in Chapter 17 of the SAR combined with their standard QA plan -- you were shown but do not have at this time -- to meet the requirements of the review plan of Chapter 17.

I think that is pretty much what is stated. Now Jack and myself and other NRC personnel made three visits to GE in San Jose with the intent of the implementation of their QA program, of the design of the ABWR. It extended over a period of just about a year with three different inspections. During the inspections, whatever the euphemism is that's used in this, during those inspections, we looked at samples of the documents that GE had present at their facility.

We looked at systems that were designed originally by GE. We looked at systems that were designed originally by Hitachi and we looked at systems that were designed originally by Toshiba. Admittedly, we looked at the English translations. Although on the final inspection that we did, they -- a gentleman was visiting over here and he did some spot checking of the translations between Japanese and English for us at our request and so that is the only check that NRC did on the accuracy of the translations.

It was our opinion that the three-party review that was going on was very extensive, that it in itself was probably equivalent to most design verification processes I would expect to see done in the States. Although it was not taken for design verification, each of the designers has their own design verification program. As part of the final inspection we did out at GE, we had requested in advance that GE supply for us copies of Japanese design documents where the Japanese had translated for our purpose down to the level where they actually did the work.

We got to see their verification process -- both Hitachi and Toshiba. We found a very minor in our opinion glitch in their interpretation of the independence of the design verifiers. That was essentially the only problem we had with the way the Japanese were conducting what we understood their QA program on their designs they were doing themselves.

We also discussed GE's audits of Hitachi and Toshiba with them before they went over to audit. We told them the kinds of things we thought they should look for. When they came back, we looked at their records and reports of the audits they did at Hitachi and Toshiba and we discussed those audits with them and although they did in our opinion essentially a process or procedure, they did look at whether the designs were good. They merely looked at the process that was being used to control the design.

MR. MICHELSON: They did not do any sampling of the testing process?

MR. HOOKS: To the best of my knowledge, when GE was looking at Hitachi-Touhiba's design in Japan, they sampled different pieces of work but they weren't looking at the question of engineering accuracy. They were looking at the question of the control of the process.

MR. MICHELSON: It wasn't accuracy, it was just correct interpretation of engineering requirements as reflects -- what was X for? Which is a design process -- not a QA process per se?

MR. HOOKS: They would have necessarily had to do a limited amount of that in order to understand the paper they were dealing with but there is an amount of that going on all the time between the three companies. It's hard to appreciate the extent of that three company review until you actually sit down and look at the files and get pieces of it and see the levels of questions and responses and requestioning. We did follow through to see how a question finally came out.

It is NRC's understanding that GE holds the design that is being licensed here in the United States. In turn, they accept total and full responsibility for that design and we have talked with GE's engineers and designers on that point. Our understanding is that they check the basis premises of the design. They check how the designs are interpreted. They check the results of the designs. When they say it meets the

United States requirements, NRC requirements for licensing, they are not saying that the Japanese does. They are saying that GE has done a complete review from the ground up and GE says it does.

MR. MICHELSON: That would be somewhere in Chapter 17, if that is the case. I would be quite happy if they took full responsibility for the designer and all aspects of it and have a process that assures that all specs --

MR. HOOKS: I do not know whether that is in Chapter 17, because I did not perform that review, but that is my understanding of the process.

Now, a couple of other things that might be worth saying in trying to clear up some of this is that any changes made between the design that would be used in Japan to build the two reactors that are essentially on order there and the design that GE feels is necessary to license the plant here in the United States, GE will actually make those design changes and that will be under their control. That will be under the same design process.

MR. MICHELSON: I understood it somewhat differently. They are not going to detail the differences. They are only going to conceptually design the differences, and some interface requirements. But they are not going to detail differences, if I understood correctly.

MR. HOOKS: Unless I misunderstood three times.

MR. MICHELSON: Did I hear that?

MR. QUIRK: No.

MR. MICHELSON: Well, then you tell us exactly.

MR. QUIRK: We have a QA process.

MR. MICHELSON: This is as to design. Whether there is difference in the design and the one you want to present here.

MR. QUIRK: We have the QA process at GE that tracks any difference between the ABWR certification design and the Japanese design. And it tracks these in the following way: it identifies what the difference is, and we assess that difference and determine, given that, how we ought to proceed. And we explain this to the staff. If we have a difference, here is the reason for the difference, and here is how that will affect our certification design. We put in a description, we put in a simplified flow diagram and we put in the number of hours, and explain, with sufficient detail so that the staff can get a feel for what it is we are going to add to the plan.

MR. MICHELSON: But you are not planning to do it to the design? You are not going to detail it. Is that what you are saying?

MR. QUIRK: That is right. At the point we have a U.S. application and it is a real U.S. project, engineering will be done.

MR. MICHELSON: But that is after certification. All right.

MR. HOOKS: True. But the level of detail of design that is carried out for licensing at least in my experience is almost always less than that that is required to actually buy and build.

MR. MICHELSON: You have no experience with certification. Certification would be on the level of detail ready for procurement. That is what our design basis letter says.

MR. QUIRK: I am not arguing that point. We explained the recipe for that was two steps. Number one, there would be information in the SSAR. Number two, there would be information back at GE in the files that would provide information.

Let's try to say it in a slightly different way. Maybe we can agree. Okay?

If the Japanese design something with three valves, and GE decides in order to license that design in the United States it takes four valves, at the point of this application for the SAR, GE may simply show four valves. But if they sell a plant in this country, it is my understanding that GE will do the detailed design necessary to say how big a valve, and what kind of valve and all of the rest of it that goes with making that change in the basic design and GE will not only own that design in the sense of having understood what the Japanese did but they will have made the design modification themselves under their own design control program or QA program. Does that --

MR. MICHELSON: You are acquainted with the licensing basis document, aren't you, which defines what this certification process is supposed to do.

MR. HOOKS: I have read it. I will not guarantee I understand it.

MR. MICHELSON: It says it is a complete design ready for procurement and construction. You can't construct it if you haven't done details, so you can't certify. This is a problem we are running into. What are we really getting? There are some big differences. The orientation of the building is right angles. And in this detail it is not clear how you do a safety evaluation.

MR. HOOKS: I can't answer on that.

MR. MICHELSON: This plant hasn't even been started yet with the different orientation.

MR. HOOKS: In any event, disregarding the fact that I can't speak on how complete the design has to be in order to satisfy those criteria, the NRC Staff did feel that on the basis of the sample we looked at, that the implementation of the design control process that GE was applying to the work of Hitachi and Toshiba, in this case we felt that the program was qualified. I think that is essentially how we said it in the

SAR.

So I will try to answer any questions that I can.

MR. MICHELSON: Question.

MR. WARD: I have a question for Mr. Novak. Really two questions. In previous and earlier projects where GE was involved in building a plant for Japan, designing a plant for Japan, you worked I guess in some of these cases with either Hitachi or Toshiba or both. I don't know if it was at the same time or not.

Was this common engineering? I don't know what you call that approach used there. Or were there more traditional divisions?

MR. NOVAK: No. In the previous work that we did in Japan, GE had the prime and Hitachi and Toshiba were subs to us. And everything at that point was English. This is a new case where actually it is a common understanding of the common basis that has to be arrived at by the three companies. And getting international viewpoints really makes a very powerful design. It is a difficult process, and a time consuming process, but one I think will bear great dividends.

By the way, to Mr. Michelson's comment on Section 17.1.1, we say -- last paragraph, the lead responsibility to produce each specification, blah, blah, blah, is formally assigned to one design organization. However, the content of each document is approved by GE, while all common engineering documents reflect the formal consensus of all parties. GE is responsible for the design and the supporting calculations and record for the project.

I am reading from the SAR. Do you have another question?

MR. WARD: The other one is what about Hitachi and Toshiba joint projects? Have they used the common engineered approach? Who knows?

MR. NOVAK: We know. And no.

MR. WARD: Do they take turns being the prime contractor?

MR. NOVAK: As we understand that is Japanese business. I really can't address that fully. But my understanding is there are Toshiba plants, there are Hitachi plants. But this is a joint venture for them, too. They are having learning experiences with that also.

MR. MICHELSON: It says that GE is responsible for the design. Is it correct to interpret it that GE in the QA process has assured that GE requirements have been correctly interpreted by the Japanese designers, and that the design they turn out meets the requirements of GE? Is that what that means?

MR. NOVAK: When we do an internal audit, it doesn't --

MR. MICHELSON: I could be responsible for the design and not have anything to do with it.

MR. NOVAK: No, it is not a shot in the dark.

MR. MICHELSON: That is one interpretation of responsibility. Another interpretation -- I would be responsible to dream it up and make sure that the people who did the detail did it right and take responsibility for that. That is not quite the way I read this.

Questions?

[No response.]

MR. MICHELSON: I think that completes the coverage of Chapter 17. I think it is adequate for our purposes. The Committee will have to think about whether or not they want to write off on Chapter 17 without seeing the detailed document which is the heart of Chapter 17, because there are repeated references, to find out what is going to happen. That is up to the Committee.

If there are no other questions, then, I think we can now adjourn the meeting.

MR. QUIRK: There was one last item.

MR. MICHELSON: The 30 minutes that you were going to talk about? I would like to delay that, unless you have people here.

MR. QUIRK: I was going to say that at the last ACRS Subcommittee meeting, we devoted about an hour and a half to that, and we addressed it at the Subcommittee meeting before that. I was just going to do a summary.

MR. MICHELSON: We were mostly interested in has anything changed? What is really your position? We do get mixed signals from other people, and that is why we wanted to just kind of confirm exactly what your position is on this.

MR. QUIRK: Our position hasn't changed. We offer to include an ABWR design containment venting. We have described that, and it would be set very close to ultimate pressure of the containment, downstream isolation valves and ruptured diaphragm pressure would be set ve lose to open failure pressure containment and subsequently close and reestablish containment. We offer this because of the unique features of the pressure system in our ABWR design that precludes larger leaks.

MR. MICHELSON: Is it something you are doing because --

MR. QUIRK: No. We have shown in our PRA submittal that the ABWR design meets the regulations and requirements for venting. So, at the same time, EPRI has developed a very aggressive requirements for the next generation plant. They have improved significantly the prevention aspects of ABWRs, but the likelihood that you would get core damages are --

MR. MICHELSON: Is the requirement --

MR. QUIRK: Let me get to that. They have also required significant mitigation , such as the combustion turbine stacks that was mentioned earlier, and such as the an alternate AC power supply, which backs up our independent, three-division, standby AC power, and such as an alternative AC input. So, EPRI has significantly improved them.

MR. MICHELSON: So, when we get around to reconciling differences between GE and EPRI requirements, you have essentially said you would meet the EPRI requirements. This is still one of the areas you will take exception to?

MR. QUIRK: I don't think we have to take exception. What we have said is we would meet the EPRI requirements, and in this case, we have exceeded it.

MR. MICHELSON: You have gone beyond.

MR. CATTON: You have done a little better.

MR. QUIRK: It is not their intent to put a ceiling on safetu. They're trying to establish the minimum which must be met, but we are well above by a substantial margin. This is one case where we have gone more because of the inherent characteristics of our design. EPRI said that may apply to you guys, but it doesn't apply to containments, and that is the reason they haven't endorsed it.

MR. MICHELSON: We have heard something about that. You just confirmed that, no, you haven't changed your mind. It is still the same.

That takes care of all of the agenda items.

MR. WARD: What do you call just before failure, it says that is a pretty big plus or minus on that. Do you really mean twice design or one and a half times design or what?

MR. QUIRK: Well, let me -- I will have to confirm this with the people who aren't here, but our design pressure is 45 psi. We would say ultimate containment failure would be around 100, and as such, we would look to certain ruptured diaphragm, maybe 90, 80, but somewhere high enough such that it would -- its performance function was up there.

MR. MICHELSON: Any other questions for GE?

We will adjourn the meeting, but we need to discuss what we want to present to the full Committee, and it will take a Subcommittee discussion.

So, seeing there are no other questions, we will adjourn the meeting.

[Whereupon, at 6:45 p.m., the meeting was adjourned.]

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: Meeting of the Advanced Boiling Water Reactor Subcommittee

DOCKET NUMBER:

PLACE OF PROCEEDING: Tuesday, October 31, 1989

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.

Dean A. Robinson

Dean A. Robinson

Official Reporter
Ann Riley & Associates, Ltd.

INTRODUCTORY STATEMENT BY THE CHAIRMAN
OF THE ACRS SUBCOMMITTEE ON ADVANCED BOILING WATER REACTORS (GE),
OCTOBER 31, 1989,
ROOM 110, PHILLIPS BUILDING, BETHESDA, MD.

THE MEETING WILL NOW COME TO ORDER. THIS IS A MEETING OF THE ACRS SUBCOMMITTEE ON THE ADVANCED BOILING WATER REACTORS (GE).

I AM C. MICHELSON, CHAIRMAN. THE OTHER ACRS MEMBERS IN ATTENDANCE ARE I. CATTON, D. WARD [redacted]. ALSO IN ATTENDANCE IS ACRS CONSULTANT, D. OKRENT.

TODAY'S MEETING WILL REVIEW THE THE STAFF'S SAFETY EVALUATION REPORT FOR MODULE ONE, OF THE GENERAL ELECTRIC COMPANY'S DESIGN FOR THE ADVANCED BOILING WATER REACTOR.

H. ALDERMAN IS THE COGNIZANT ACRS STAFF MEMBER FOR TODAY'S MEETING.

THE RULES FOR PARTICIPATION IN TODAY'S MEETING HAVE BEEN ANNOUNCED AS PART OF THE NOTICE OF THIS MEETING THAT WAS PUBLISHED IN THE FEDERAL REGISTER ON OCTOBER 11, 1989.

THIS MEETING IS BEING CONDUCTED IN ACCORDANCE WITH THE PROVISIONS OF THE FEDERAL ADVISORY COMMITTEE ACT AND THE GOVERNMENT IN THE SUNSHINE ACT. WE HAVE RECEIVED NO WRITTEN OR ORAL STATEMENTS FROM MEMBERS OF THE PUBLIC.

IT IS REQUESTED THAT EACH SPEAKER FIRST IDENTIFY HIMSELF OR HERSELF AND SPEAK WITH SUFFICIENT CLARITY AND VOLUME SO THAT HE OR SHE CAN BE READILY HEARD.

DO ANY SUBCOMMITTEE MEMBERS HAVE INITIAL COMMENTS AT THIS TIME? (CHAIRMAN'S COMMENTS, IF ANY) WE WILL NOW PROCEED WITH THE MEETING, AND I CALL UPON

ABWR STANDARD PLANT

CHAPTER 17: QUALITY ASSURANCE

PRESENTED TO

ACRS SUBCOMMITTEE ON THE

ADVANCED BOILING WATER REACTOR

OCTOBER 31, 1989

BETHESDA, MARYLAND

GE NUCLEAR ENERGY

Chapter 17 Quality Assurance

o DESIGN QA PROCESS

- Each company must formally review and approve each Common Engineering document.

  - Lead responsibility is assigned for each document. This includes:

    - Draft document

    - Internally process & verify

    - Obtain review by others

    - Resolve comments

    - Obtain formal approval

    - Issue and maintain

    - Control changes

ABWR
STANDARD PLANT

CHAPTER 17 QUALITY ASSURANCE

- DESIGN RESPONSIBILITY

  - GE AND ITS TECHNICAL ASSOCIATES, HITACHI AND TOSHIBA, PERFORM JOINT "COMMON ENGINEERING" FOR 2 ABWR'S IN JAPAN.

    - THE 3 COMPANIES ARE RESPONSIBLE FOR ALL DESIGN UNDER THE JOINT EFFORT.

Chapter 17 Quality Assurance

o Quality Assurance

- GE and its technical associates, Hitachi and Toshiba, are committed to the QA procedures in the "ABWR Organization and Procedures Manual". This requires that:

  - GE, Hitachi, and Toshiba meet both JEAG-4101-1981 and 10CFR50, Appendix B.

  - Each party may initially review the adequacy of the other's QA program.

  - Each party annually reviews the implementation of the other's QA.

CHAPTER 17 QUALITY ASSURANCE

o ABWR CERTIFICATION QA

- GE WORKS TO AN NRC ACCEPTED QA PROGRAM

  - THE GE PROGRAM COMPLIES WITH ALL QUALITY RELATED REG. GUIDES IN EFFECT MARCH 31, 1987 OR NRC ACCEPTED ALTERNATE POSITIONS.

- GE IS RESPONSIBLE FOR THE CONTENT OF ALL COMMON ENGINEERING DOCUMENTS. QUALITY IS ASSURED BY:

  - FORMAL REVIEW AND APPROVAL OF EACH DOCUMENT.

  - ANNUAL REVIEW OF HITACHI AND TOSHIBA QA.

ABWR STANDARD PLANT

CHAPTER 6: ENGINEERED SAFETY FEATURES

PRESENTED TO

ACRS SUBCOMMITTEE ON THE

ADVANCED BOILING WATER REACTOR

OCTOBER 31, 1989

BETHESDA, MARYLAND

GE NUCLEAR ENERGY

ACRS ABWR SUBCOMMITTEE
10/31/89 REVIEW OF STAFF SER

GE OVERVIEW OF CHAPTER 6

AGENDA

- o OVERVIEW OF ABWR ENGINEERED SAFETY FEATURES
- o EMERGENCY CORE COOLING SYSTEMS (SECTION 6.3)
- o PRIMARY AND SECONDARY CONTAINMENT FUNCTIONAL DESIGN (SECTIONS 6.2.1, 6.2.3)
- o HABITABILITY SYSTEMS (SECTION 6.4)

ACRS ABWR REVIEW 10/31/89

OVERVIEW OF ABWR ENGINEERED SAFETY FEATURES

FEATURES	ABWR APPROACH
PRIMARY CONTAINMENT	-REINFORCED CONCRETE, STEEL-LINED PRESSURE SUPPRESSION SYSTEM -STRUCTURALLY INTEGRATED WITH SURROUNDING REACTOR BUILDING -UTILIZES HORIZONTAL PRESSURE SUPPRESSION VENT SYSTEM (MARK III CONFIGURATION)
CONTAINMENT HEAT REMOVAL	-THREE DIVISIONS OF SAFETY GRADE CONTAINMENT COOLING - DIRECT COOLING OF THE POOL - DRYWELL AND WETWELL SPRAYS -HEAT REJECTED TO THE ULTIMATE HEAT SINK VIA AN INTERMEDIATE COOLING LOOP
SECONDARY CONTAINMENT	-SECONDARY CONTAINMENT BUILDING SURROUNDS THE PRIMARY CONTAINMENT -OPERATES AT NEGATIVE PRESSURE -LOW LEAKAGE DESIGN (50% DAY)
CONTAINMENT ISOLATION SYSTEM	CONVENTIONAL CONTAINMENT ISOLATION DESIGN PRACTICE; INTENT IS TO MEET ALL REQUIREMENTS

ACRS ABWR REVIEW 10/31/89

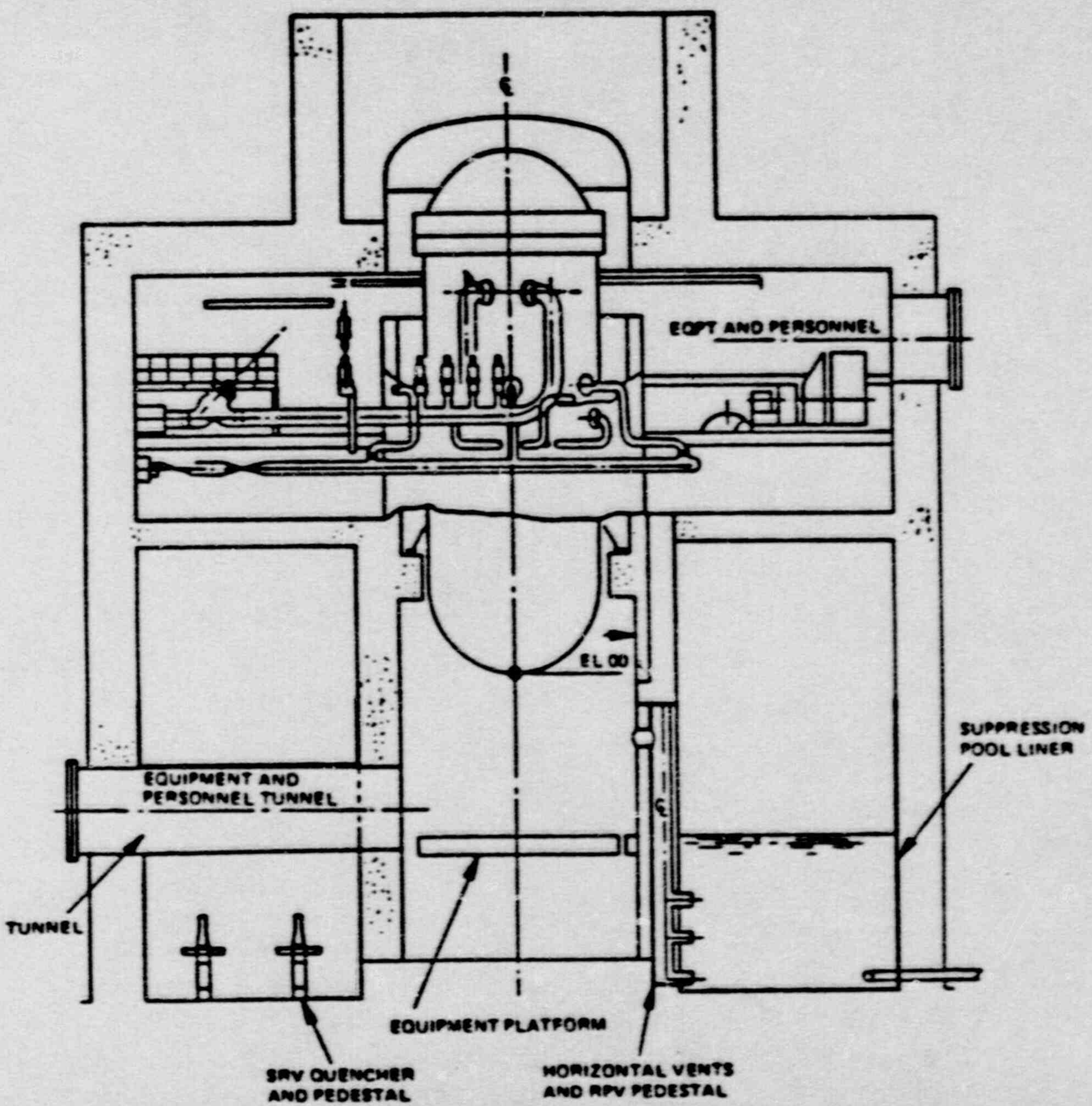
OVERVIEW OF ABWR ENGINEERED SAFETY FEATURES (CONTINUED)

FEATURES	ABWR APPPOACH
CONTAINMENT LEAKAGE TESTING	-ABWR WILL USE ACCEPTED PRACTICES TO MEET ALL REQUIREMENTS
EMERGENCY CORE COOLING SYSTEMS (ECCS)	-THREE SEPARATE MECHANICAL AND ELECTRICAL DIVISIONS - CORE COOLING - CONTAINMENT COOLING - SHUTDOWN COOLING -SIMPLIFIED SYSTEMS AND REDUCED CAPACITIES -NO CORE UNCOVERY FOR ANY PIPE BREAK
CONTROL ROOM HABITABILITY	-DESIGN INCLUDES FEATURES WHICH PROVIDE: - SHIELDING - HVAC - FOOD, WATER, AIR SUPPLIES - KITCHEN/SANITARY FACILITIES - PROTECTION FROM AIRBORNE CONTAMINANTS - SLEEPING FACILITIES - SMOKE REMOVAL

OVERVIEW OF ABWR ENGINEERED SAFETY FEATURES (CONTINUED)

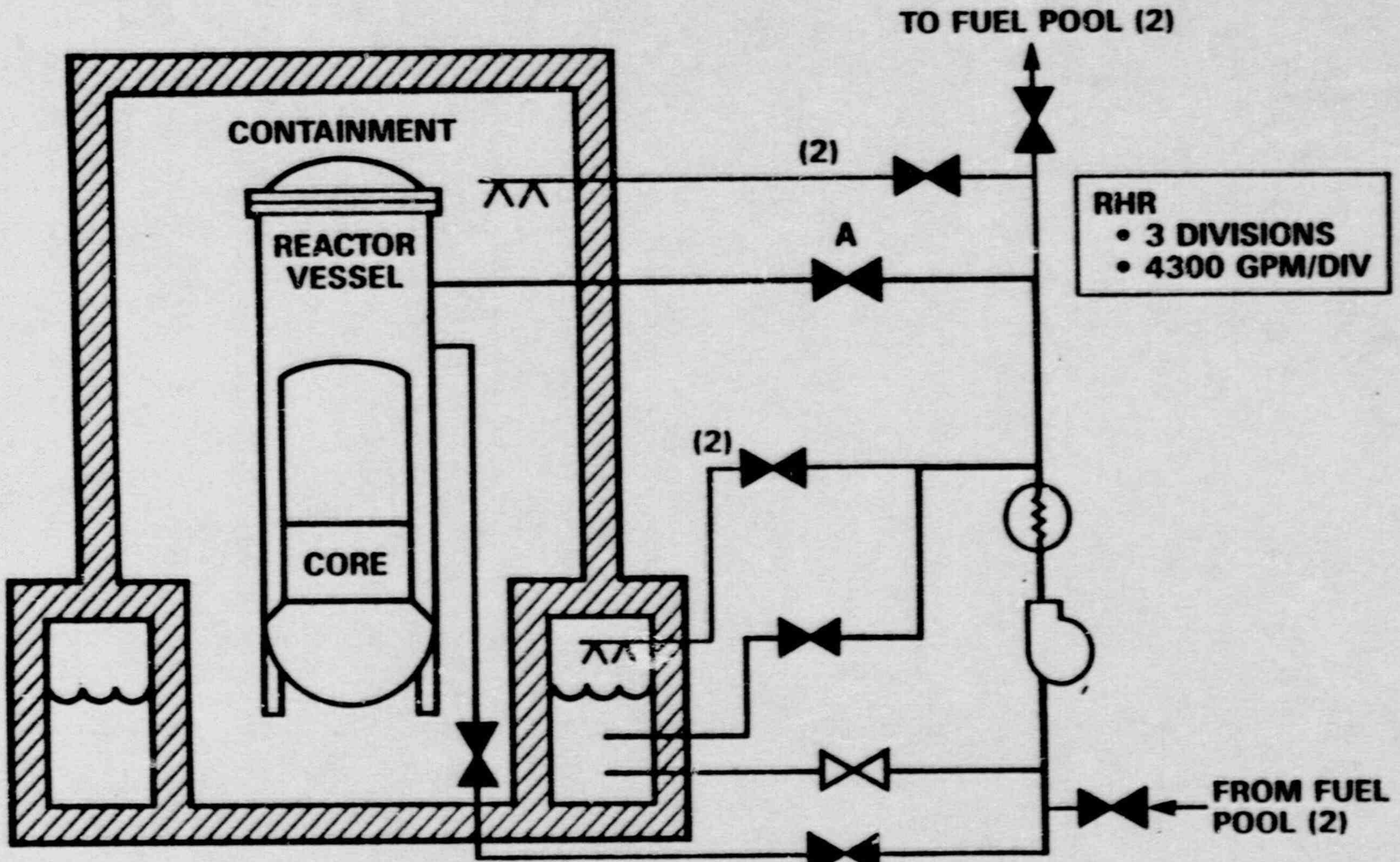
FEATURES	ABWR APPROACH
FISSION PRODUCT REMOVAL AND CONTROL	-CONTROL PROVIDED BY PRIMARY AND SECONDARY CONTAINMENT TOGETHER WITH A STANDBY GAS TREATMENT SYSTEM (SGTS) -SGTS IS BASED ON ESTABLISHED TECHNOLOGY -SGTS DESIGN DETAILS CURRENTLY BEING FINALIZED BY GE
NITROGEN GAS SUPPLY	-BOTTLED SUPPLIES FOR ESSENTIAL FUNCTION (SRV ACCUMULATORS FOR ADS) -LIQUID STORAGE/EVAPORATORS FOR NONESSENTIAL USES

CHAPTER 6: ENGINEERED SAFETY FEATURES

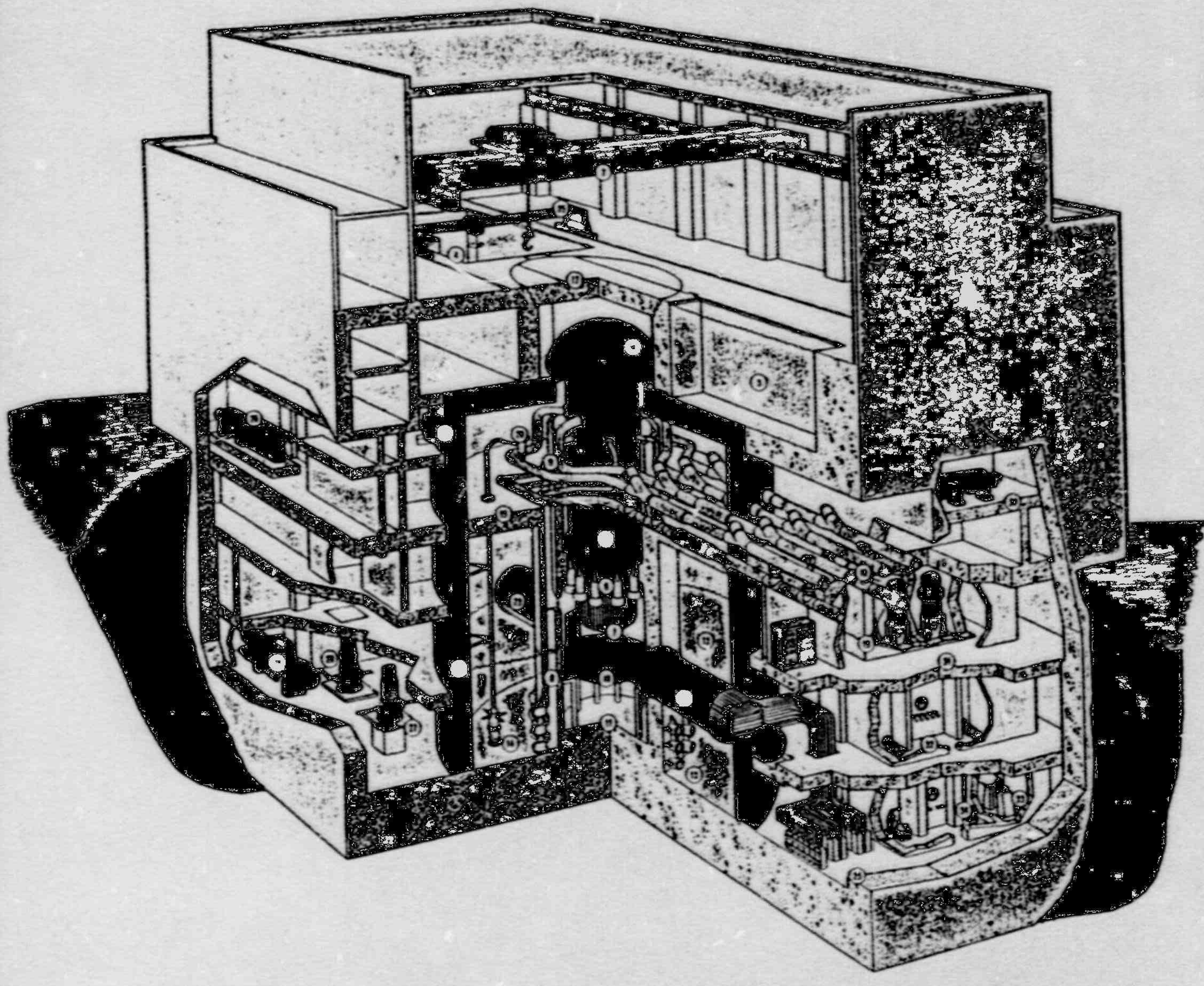


CHAPTER 6: ENGINEERED SAFETY FEATURES

RESIDUAL HEAT REMOVAL SYSTEM (RHR)



CHAPTER 6: ENGINEERED SAFETY FEATURES



ABWR
(Advanced Boiling Water Reactor)

REACTOR BUILDING

1 REACTOR BUILDING
2 BRIDGE CRANE
3 STEAM DRYER AND SEPARATOR STORAGE POOL
4 SPENT FUEL STORAGE POOL
5 REACTOR PRESSURE VESSEL
6 REACTOR INTERNAL PUMPS
7 FINE MOTION CONTROL ROD DRIVES
8 REACTOR PEDESTAL
9 REACTOR SHIELD WALL
10 LOWER DRYWELL EQUIPMENT PLATFORM
11 LOWER DRYWELL
12 SUPPRESSION POOL
13 HORIZONTAL VENTS
14 SRV QUENCHERS
15 UPPER DRYWELL
16 DRYWELL HEAD
17 SHIELD BLOCKS
18 MAIN STEAM LINES
19 FEEDWATER LINES
20 SAFETY/RELIEF VALVES
21 PRIMARY CONTAINMENT VESSEL
22 LOWER DRYWELL PERSONNEL LOCK
23 LOWER DRYWELL EQUIPMENT HATCH
24 UPPER DRYWELL EQUIPMENT HATCH
25 HYDRAULIC CONTROL UNITS
26 DIESEL GENERATOR
27 HPCS- PUMP
28 RHR- PUMP
29 RHR- HEAT EXCHANGER
30 FPC- HEAT EXCHANGER
31 RWCU- FILTER DEMINERALIZER
32 RWCU- HOLDING PUMP AND OPERATION ROOM
33 RWCU- PUMPS
34 RWCU/SPCU- BACKWASH PUMP AND OPERATION ROOM
35 REFUELING PLATFORM

ACRS ABWR REVIEW 10/31/89

EMERGENCY CORE COOLING SYSTEMS
(SECTION 6.3)

DESIGN OBJECTIVES

- ELIMINATE PAST PROBLEMS/CONCERNS
- ELIMINATE UNNECESSARY MULTI-FUNCTION SYSTEMS
- AVOID EMERGENCY SYSTEM INITIATION DURING TRANSIENTS
- NO FUEL UNCOVERY DURING LOCA
- CORE DAMAGE FREQUENCY LESS THAN CURRENT BWR
- PROVIDE DIVERSE MOTIVE POWER

ACRS ABWR REVIEW 10/31/89

ABWR SAFETY SYSTEM IMPROVEMENTS

- THREE COMPLETELY SEPARATE MECHANICAL AND ELECTRICAL DIVISIONS FOR MOST IMPORTANT FUNCTIONS
  - CORE COOLING
  - SUPPRESSION POOL COOLING
  - SHUTDOWN COOLING

- AUTOMATION OF POST-LOCA POOL COOLING
  - HEAT EXCHANGERS ALWAYS IN THE LOOP

- ELIMINATION/TRANSFER OF COMPLEX MODULES
  - STEAM CONDENSING
  - RPV HEAD SPRAY
  - REDUCED VALVES, PIPES

- SIGNIFICANT CAPACITY REDUCTION
  - REDUCED EQUIPMENT SIZES

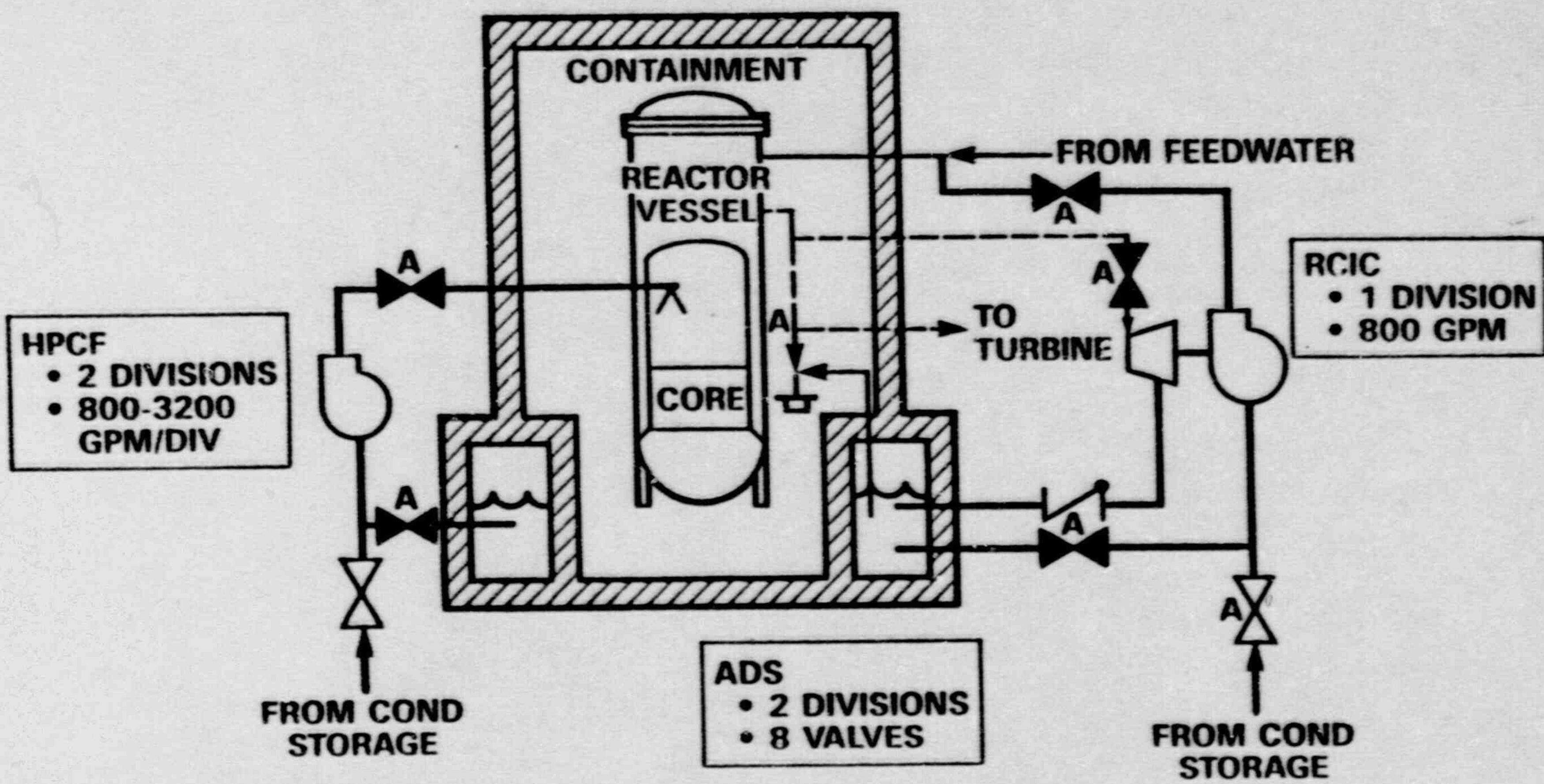
- GREATLY REDUCED DUTY DURING TRANSIENTS
  - N-2 CAPABILITY AT HIGH PRESSURE

- IMPROVED SMALL BREAK RESPONSE
  - REDUCED NEEDS FOR ADS

- NO FUEL UNCOVERY FOR ANY PIPE BREAK

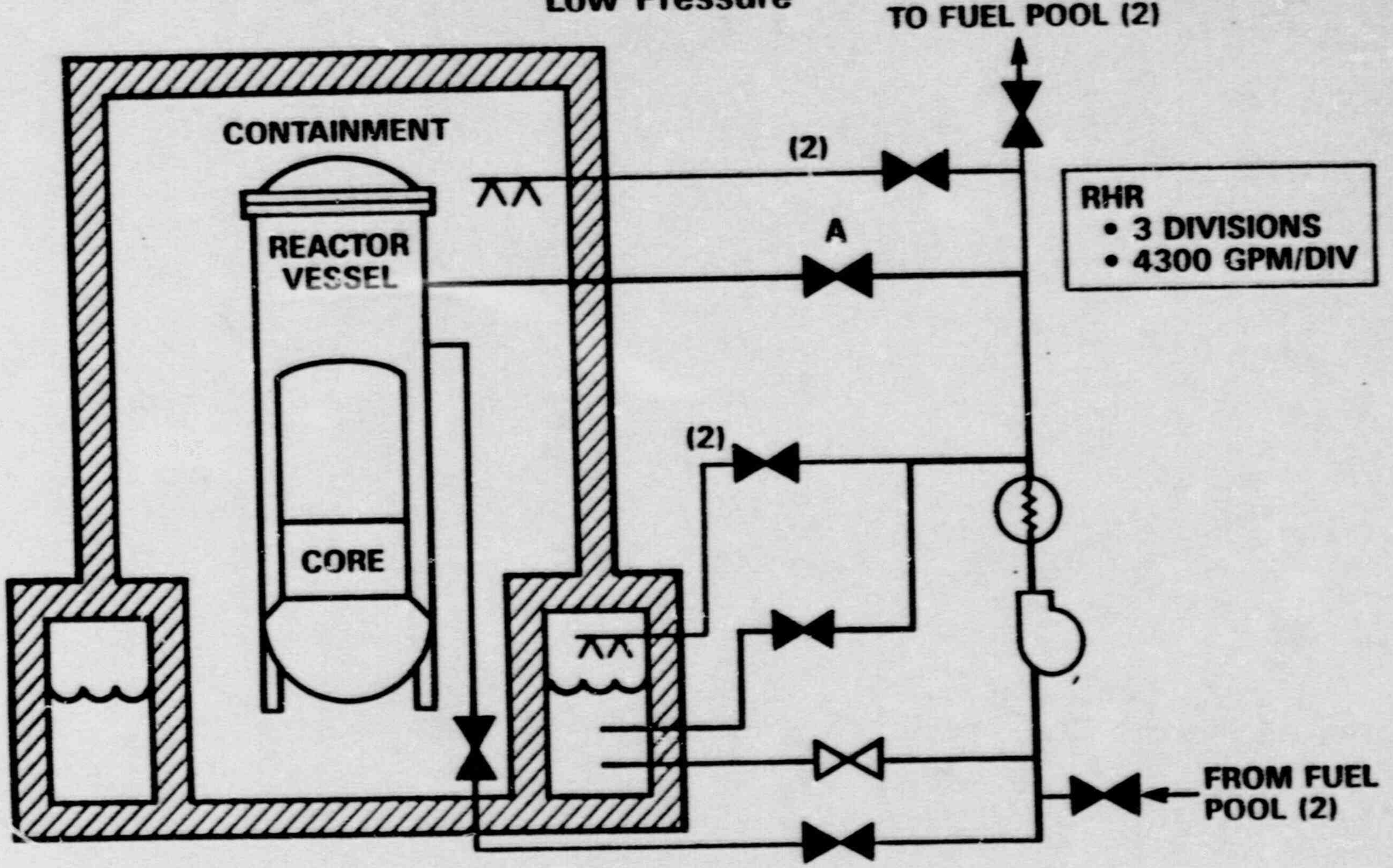
ABWR EMERGENCY CORE COOLING SYSTEMS

High Pressure

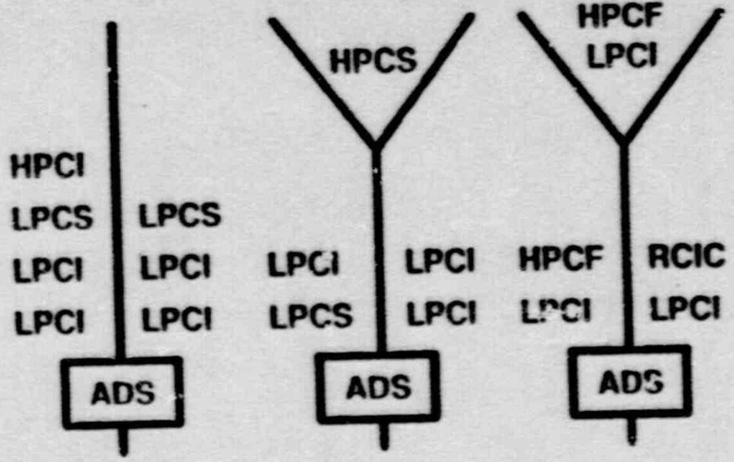


ABWR EMERGENCY CORE COOLING SYSTEMS

Low Pressure



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 Temp (APP K), °F	1600	1100	No Uncovery
N-2 Capability	None	All but HPCS Break	All but LPCI (A) Break

* @1100 psi
** @ 100 psi

PRIMARY CONTAINMENT FUNCTIONAL DESIGN

- o REINFORCED CONCRETE CYCLINDER
  95 FT ID X 96.8 FT HIGH
- o STEEL LINED
- o STRUCTURALLY INTEGRATED WITH SURROUNDING REACTOR BUILDING & UPPER POOLS
- o SEISMIC DESIGN 0.3G SSE
- o DESIGN PRESSURE 45 PSIG & (-) 2 PSID
- o CONTAINMENT CHAMBERS

CONTAINMENT CHAMBERS	CU. FT.
UPPER DRYWELL	223,000
LOWER DRYWELL	36,000
SUPPRESSION CHAMBER	
AIRSPACE	210,500
POOL	126,400

- o PRESSURE SUPPRESSION TYPE
- o HORIZONTAL VENTS
  - CONNECT DRYWELL TO SUPPRESSION CHAMBER
  - INTEGRATED RPV PEDESTAL AND CONNECTING VENTS
  - MARK III CONFIGURATION & DATA BASE
  - TEPCO SPONSORED FULL & SCALED TESTS

SECONDARY CONTAINMENT FUNCTIONAL DESIGN

- SURROUNDS PRIMARY CONTAINMENT
- COLLECTS FISSION PRODUCTS WHICH MAY LEAK FROM THE PRIMARY CONTAINMENT
- FLUID SYSTEMS TO CLEAN AREA HAVE WATER SEALS OR ISOLATION VALVES
- OPERATES AT NEGATIVE PRESSURE RELATIVE TO PRIMARY CONTAINMENT & REACTOR BUILDING CLEAN ZONES
- MAXIMUM IN LEAKAGE 50% OF SECONDARY CONTAINMENT VOLUME/DAY
- COMPARTMENTS VENTED FOR HIGH ENERGY LINE BREAKS
- AIR FLOW FROM LOW TO HIGHLY CONTAMINATED AREAS
- EXHAUSTS ARE MONITORED & CAN BE ROUTED THROUGH SGTS

SECONDARY CONTAINMENT BYPASS LEAKAGE

- VESTIBULE TYPE DOORS THROUGHOUT
- ALL DOORS MONITORED TO MINIMIZE INLEAKAGE
- HVAC PENETRATIONS DOUBLE VALVED
- MSL AND FWL ONLY FLUID SYSTEMS TO PENETRATE REACTOR PRESSURE BOUNDARY AND SECONDARY CONTAINMENTS
- HNCW AND RBCW ONLY FLUID SYSTEMS TO PENETRATE PRIMARY AND SECONDARY CONTAINMENTS

CONTAINMENT LEAKAGE TESTING

- o CONTAINMENT INTEGRATED LEAKAGE RATE TEST
  - TYPE A ILRT TEST
  - TO ASSURE THAT LEAKAGE THROUGH CONTAINMENT DOES NOT EXCEED THE ALLOWABLE LEAKAGE RATE
- o CONTAINMENT PENETRATION LEAKAGE RATE TEST
  - TYPE B
  - MEASURE LEAKAGE THROUGH PENETRATIONS THAT HAVE RESILIANT SEALS
  - PENETRATIONS GROUPED FOR TESTING
  - RESULTS ADDED TO ILRT
- o CONTAINMENT ISOLATION VALVE LEAKAGE RATE TEST
  - TYPE C
  - MEASURE LEAKAGE THROUGH CONTAINMENT ISOLATION VALVES
  - RESULTS ADDED TO ILRT

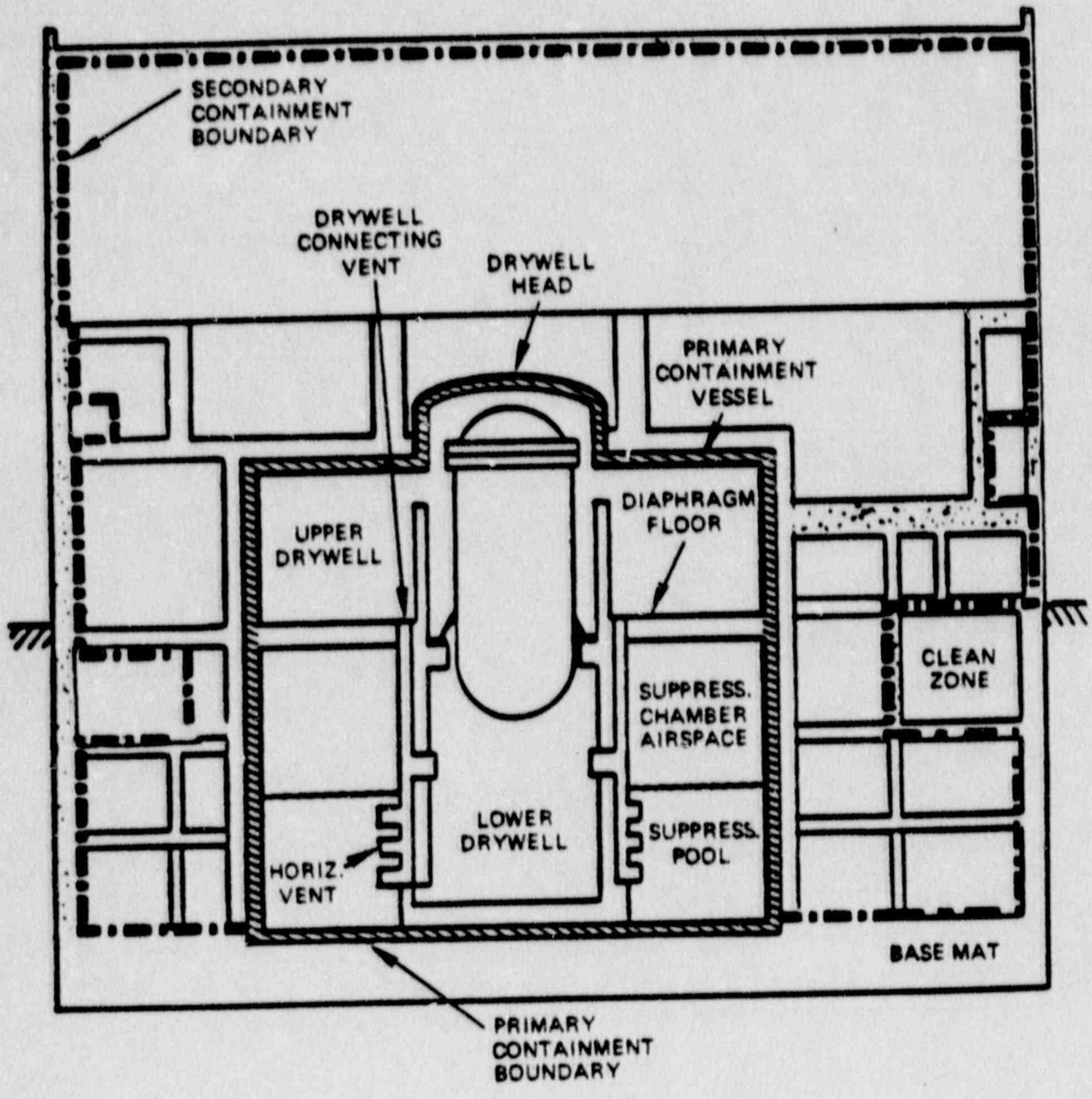
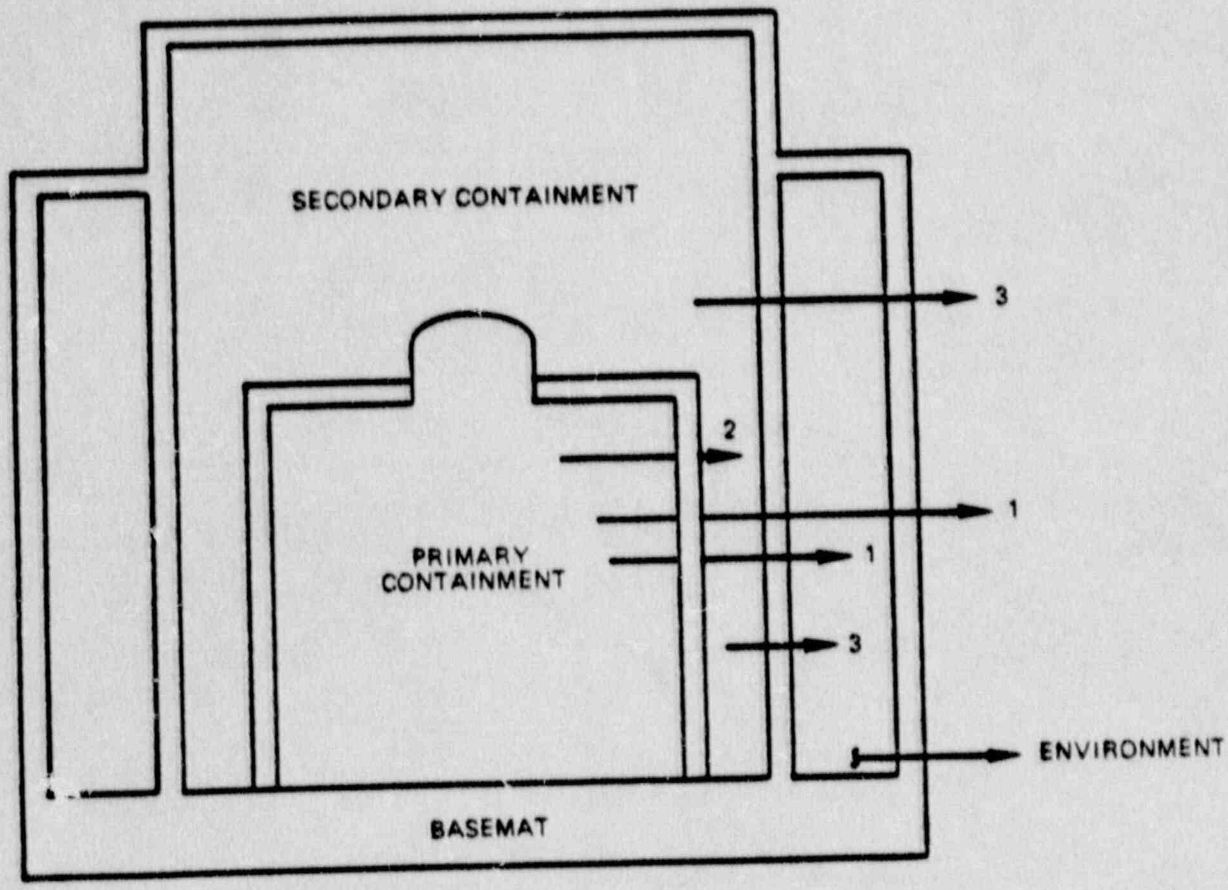


Figure 6.2–26 ABWR CONTAINMENT BOUNDARY NOMENCLATURE



LEAKAGE FROM:

1. PRIMARY CONTAINMENT TO ENVIRONMENT OR CLEAN ZONE
2. PRIMARY CONTAINMENT TO SECONDARY CONTAINMENT
3. SECONDARY CONTAINMENT TO CLEAN ZONE OR THE ENVIRONMENT

87-245-29

Figure 6.2–27 THREE BASIC TYPES OF LEAKAGE PATHS

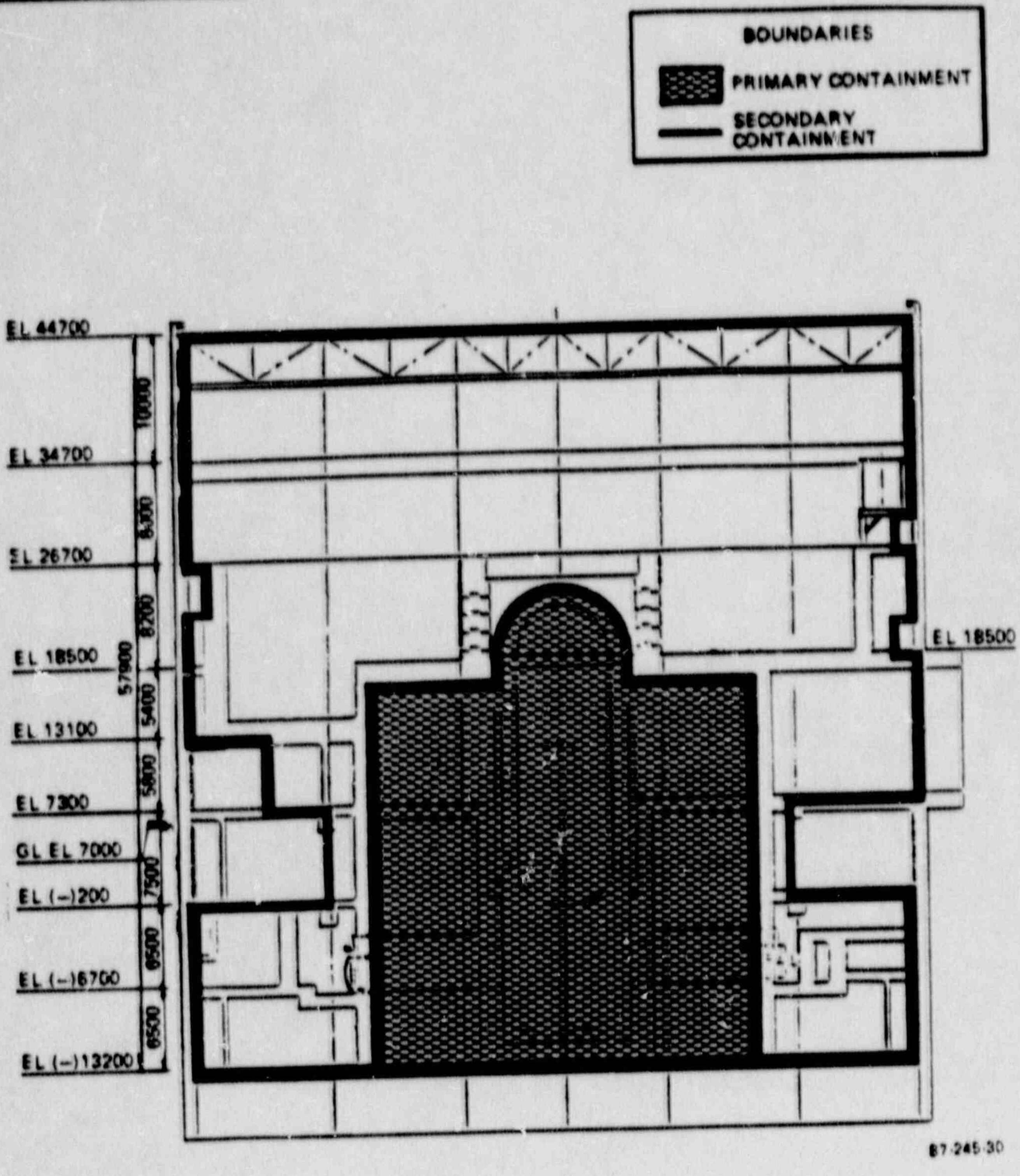


Figure 6.2–28 CONTAINMENT BOUNDARIES IN THE REACTOR BUILDING – PLAN SECTION A–A (0° – 180°)

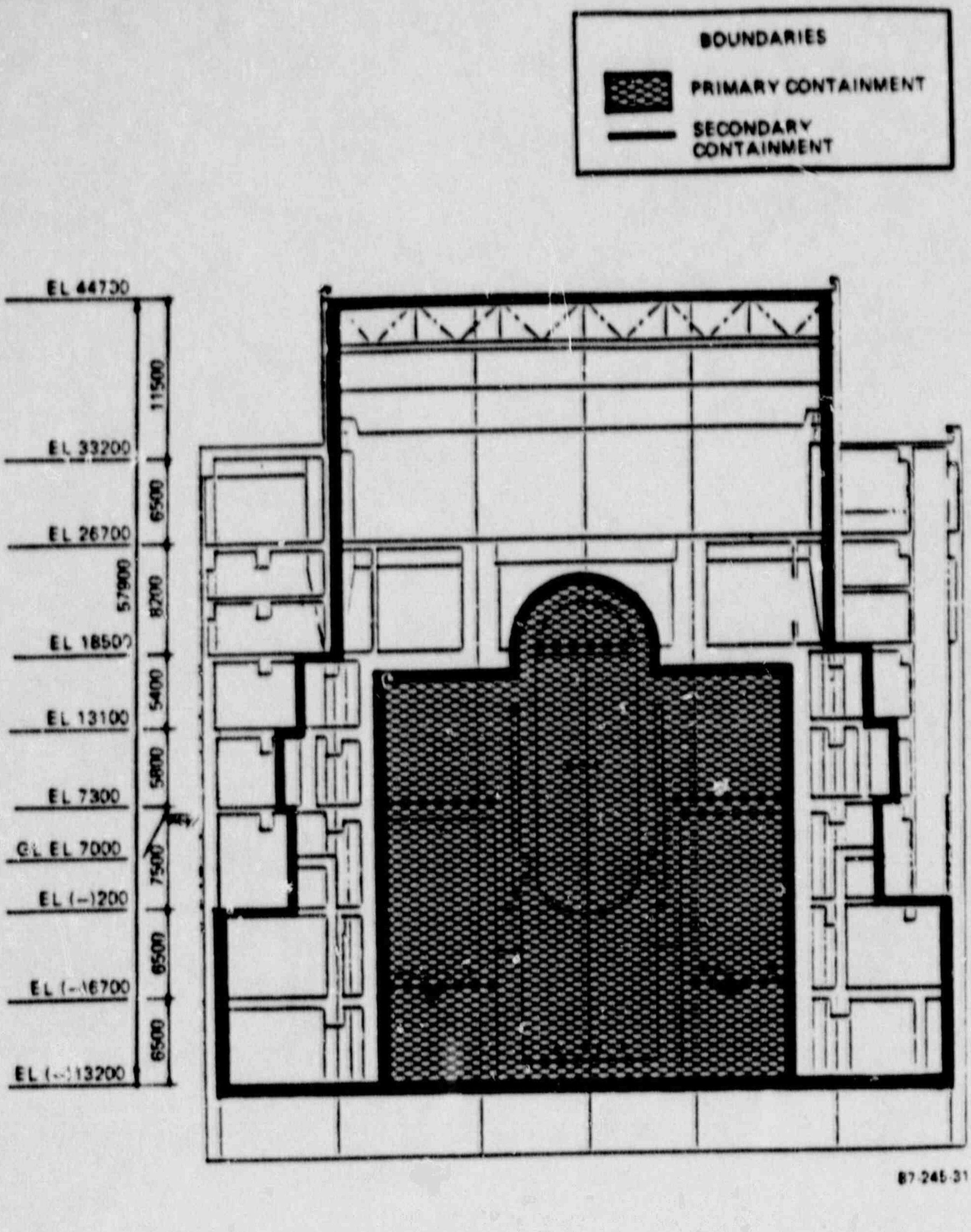
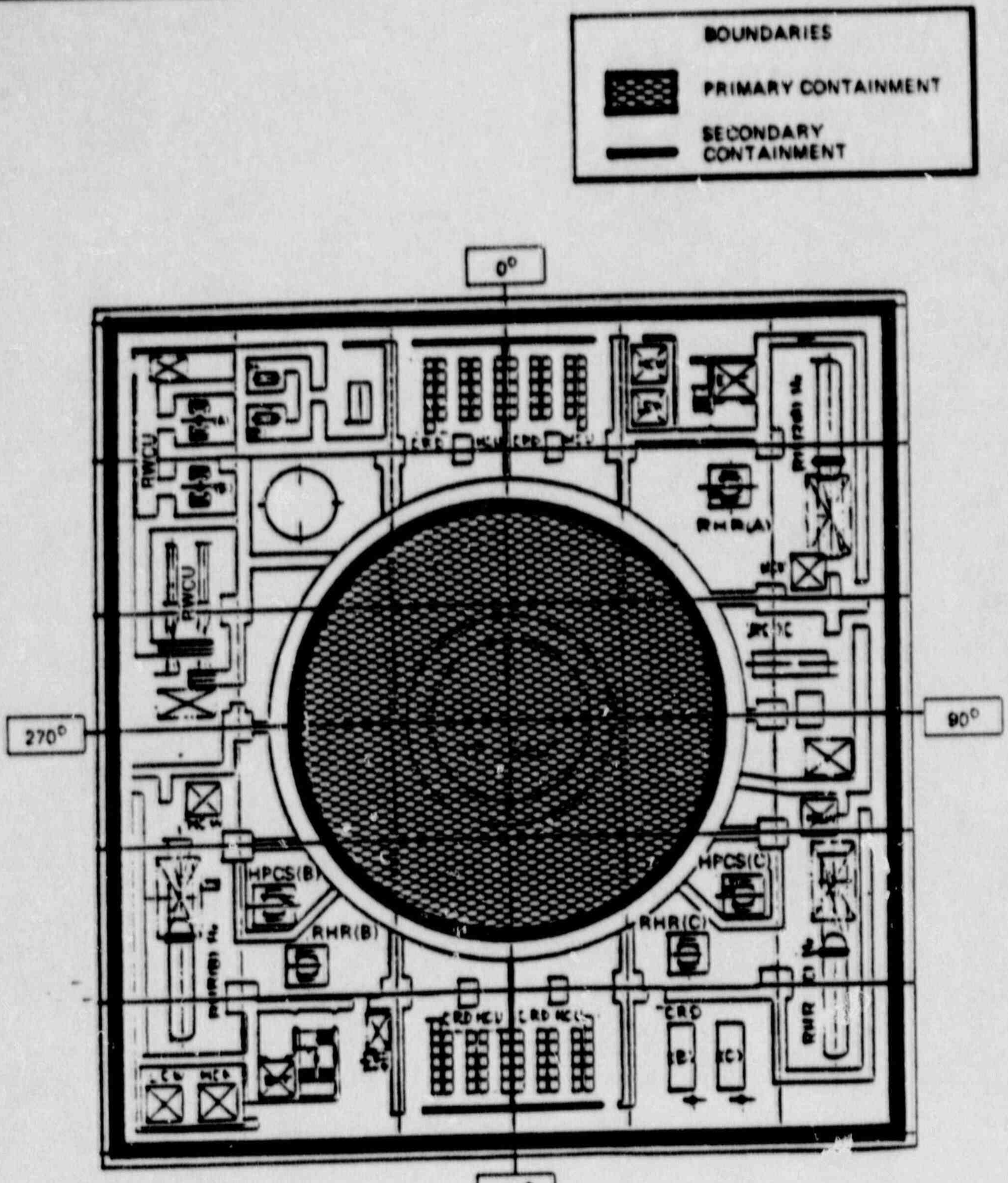


Figure 6.2−29 CONTAINMENT BOUNDARIES IN THE REACTOR BUILDING − PLAN SECTION B−B (90° − 270°)



87-265-32

Figure 6.2-30 CONTAINMENT BOUNDARIES IN THE REACTOR BUILDING – PLAN AT ELEV (–) 13200 mm

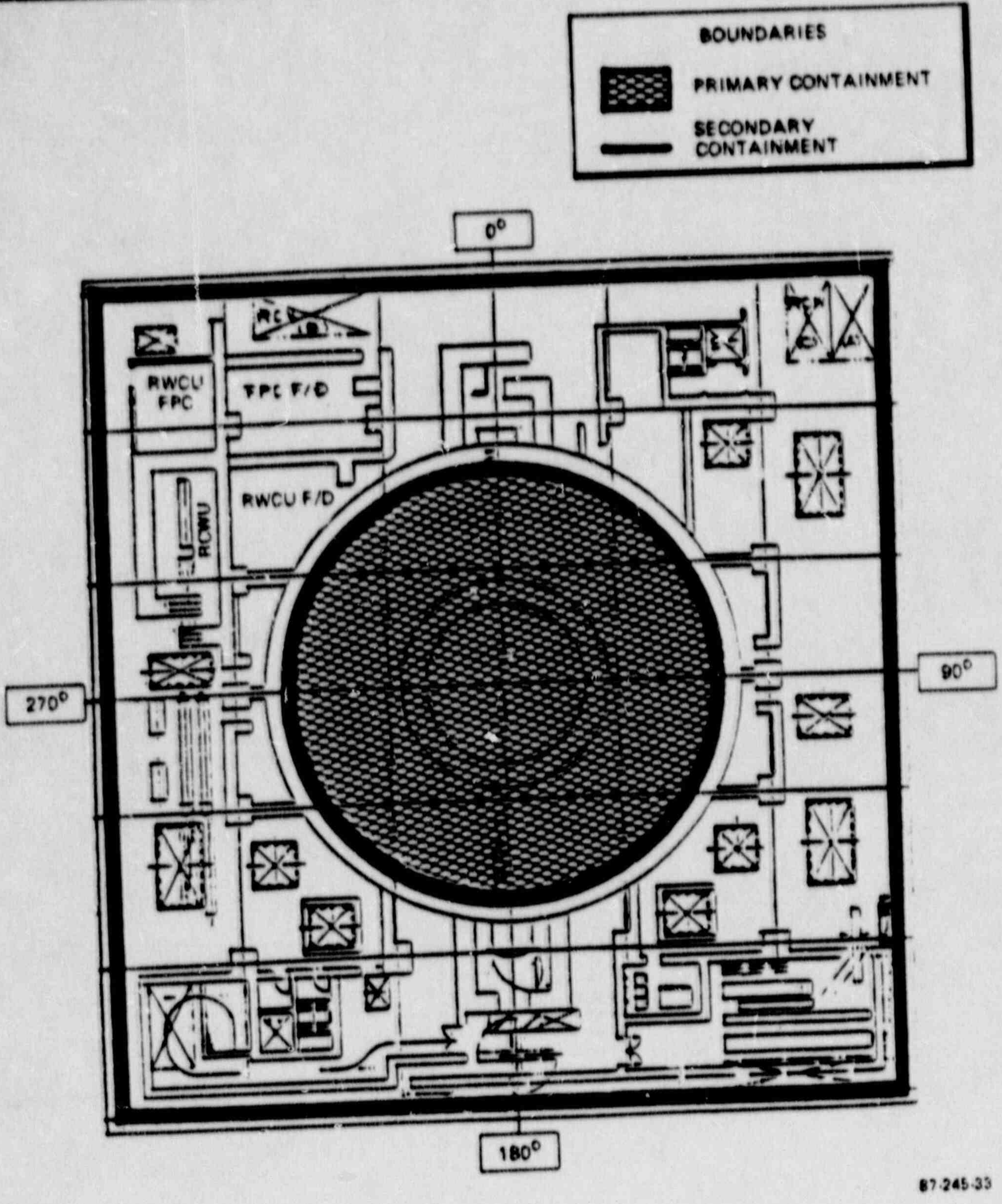


Figure 6.2-31 CONTAINMENT BOUNDARIES IN THE REACTOR BUILDING – PLAN AT ELEV (–) 6700 mm

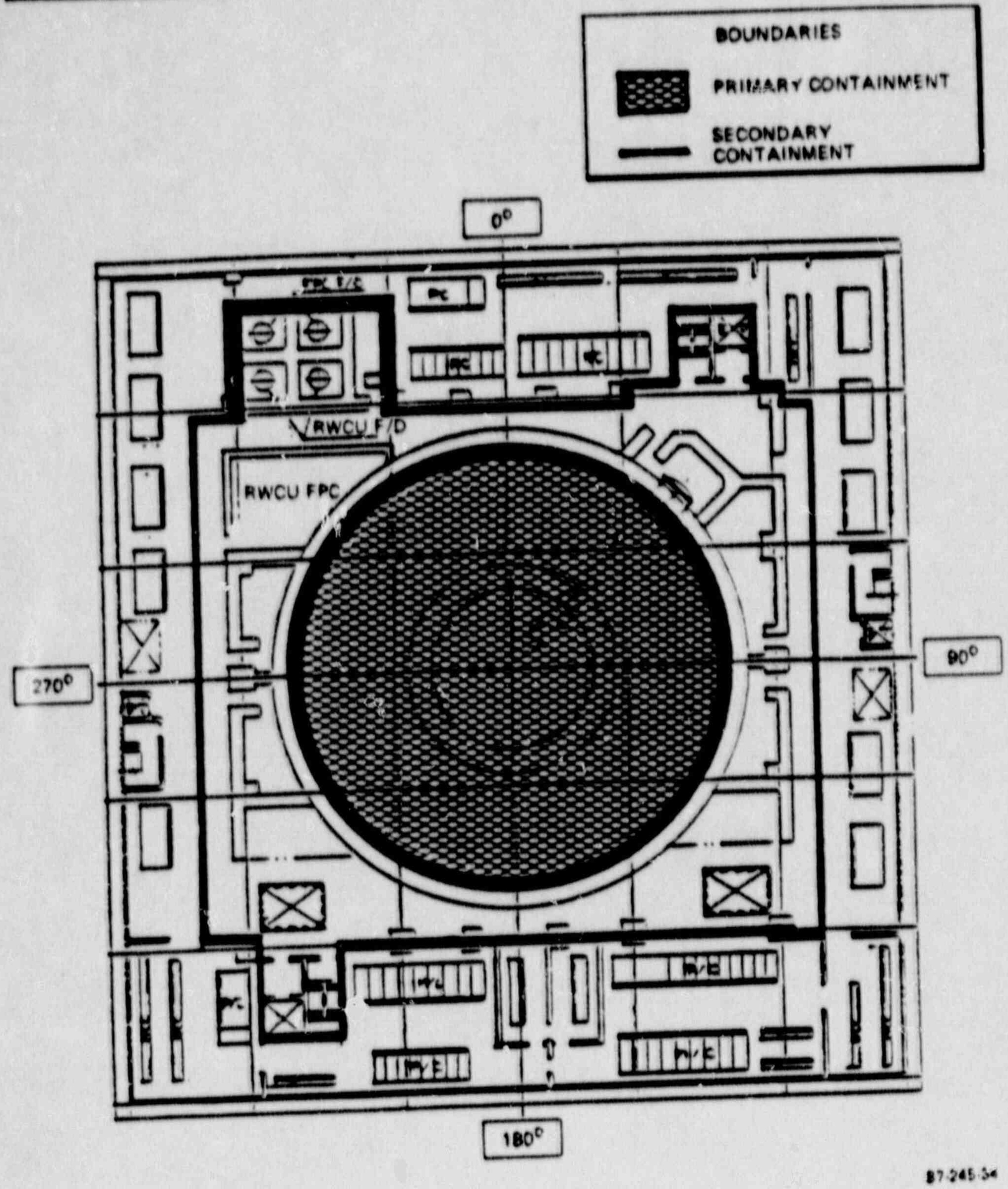


Figure 6.2-32 CONTAINMENT BOUNDARIES IN THE REACTOR BUILDING – PLAN AT ELEV (–) 200 mm

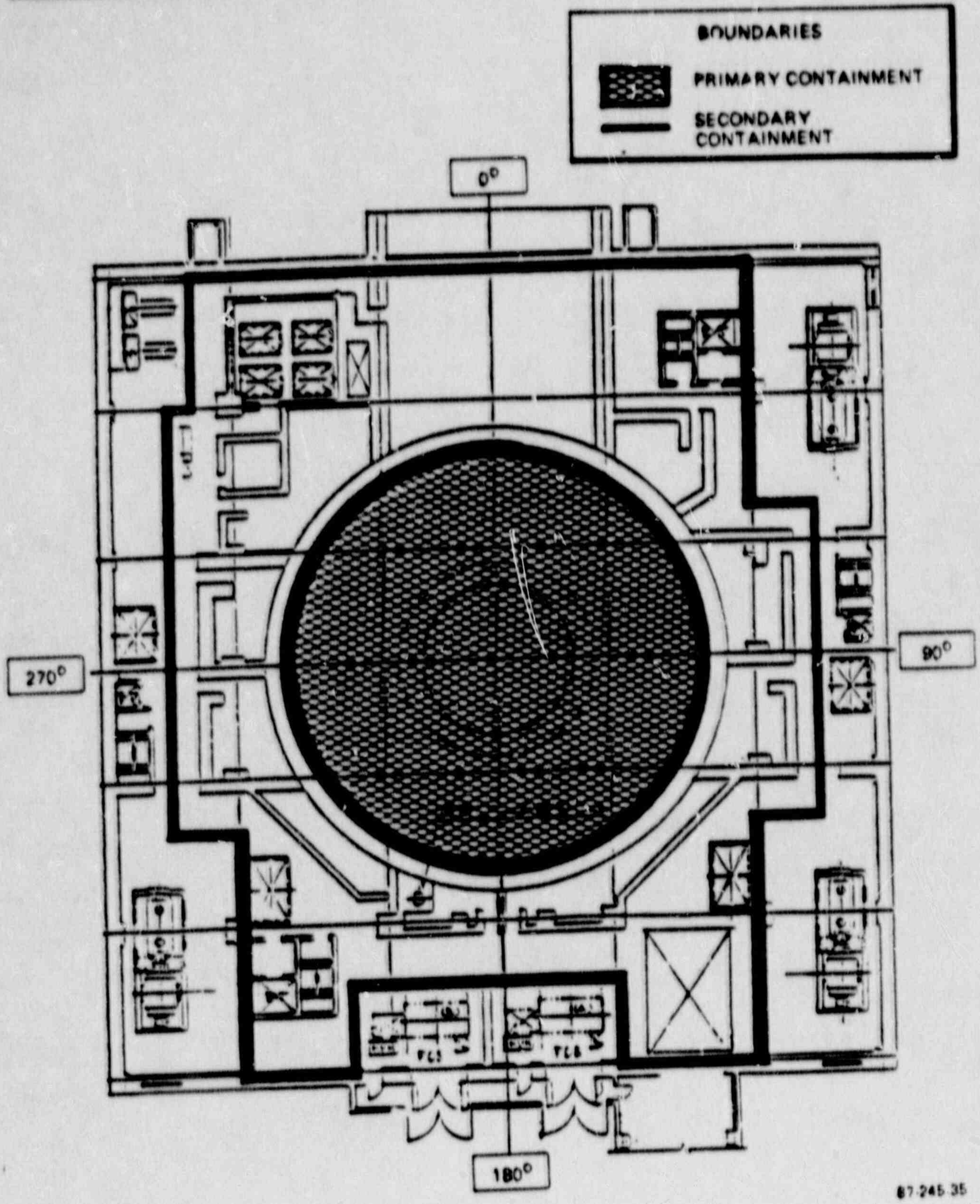


Figure 6.2–33 CONTAINMENT BOUNDARIES IN THE REACTOR BUILDING – PLAN AT ELEV 7300 mm

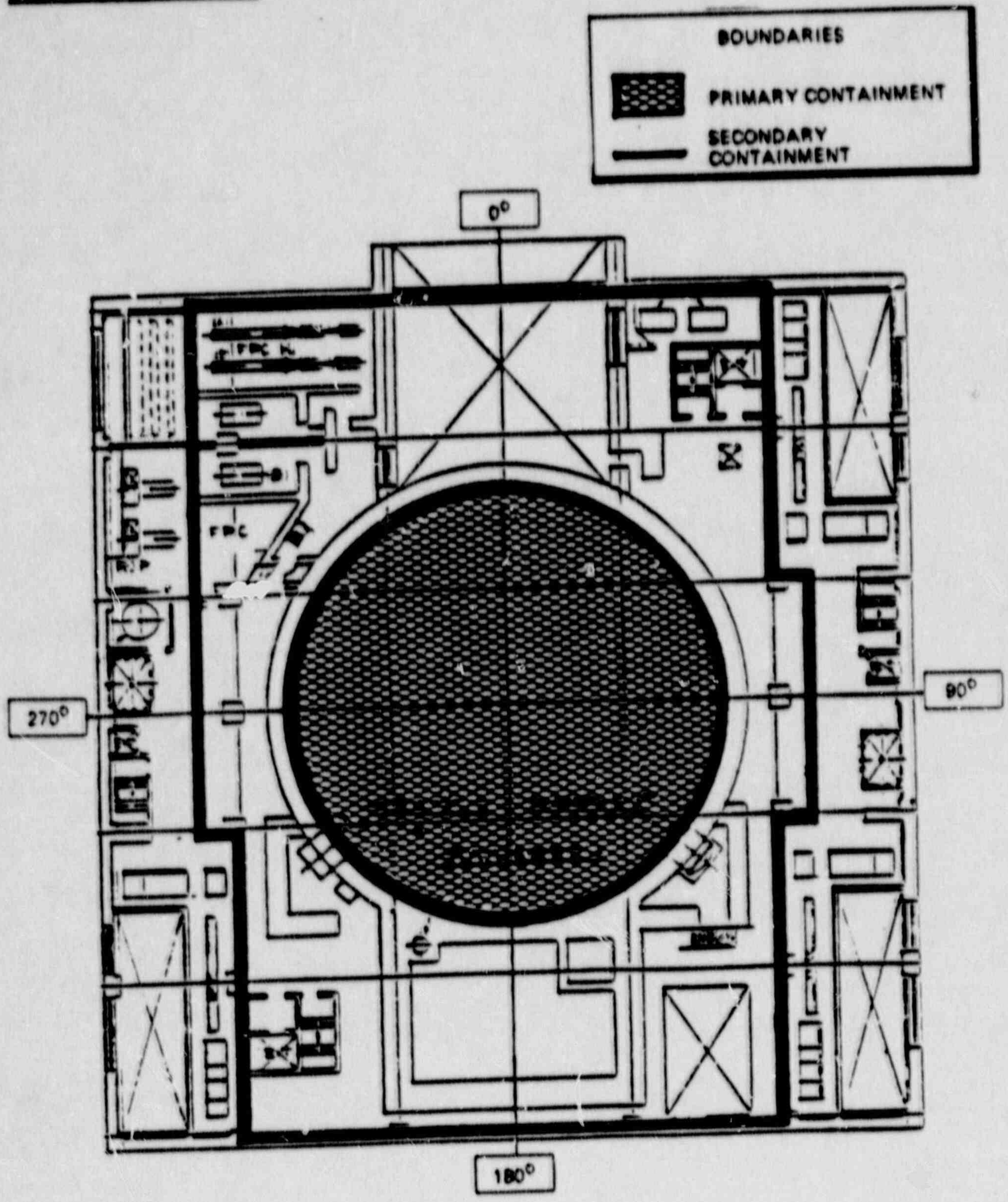


Figure 6.2–34 CONTAINMENT BOUNDARIES IN THE REACTOR BUILDING – PLAN AT ELEV 13100 mm

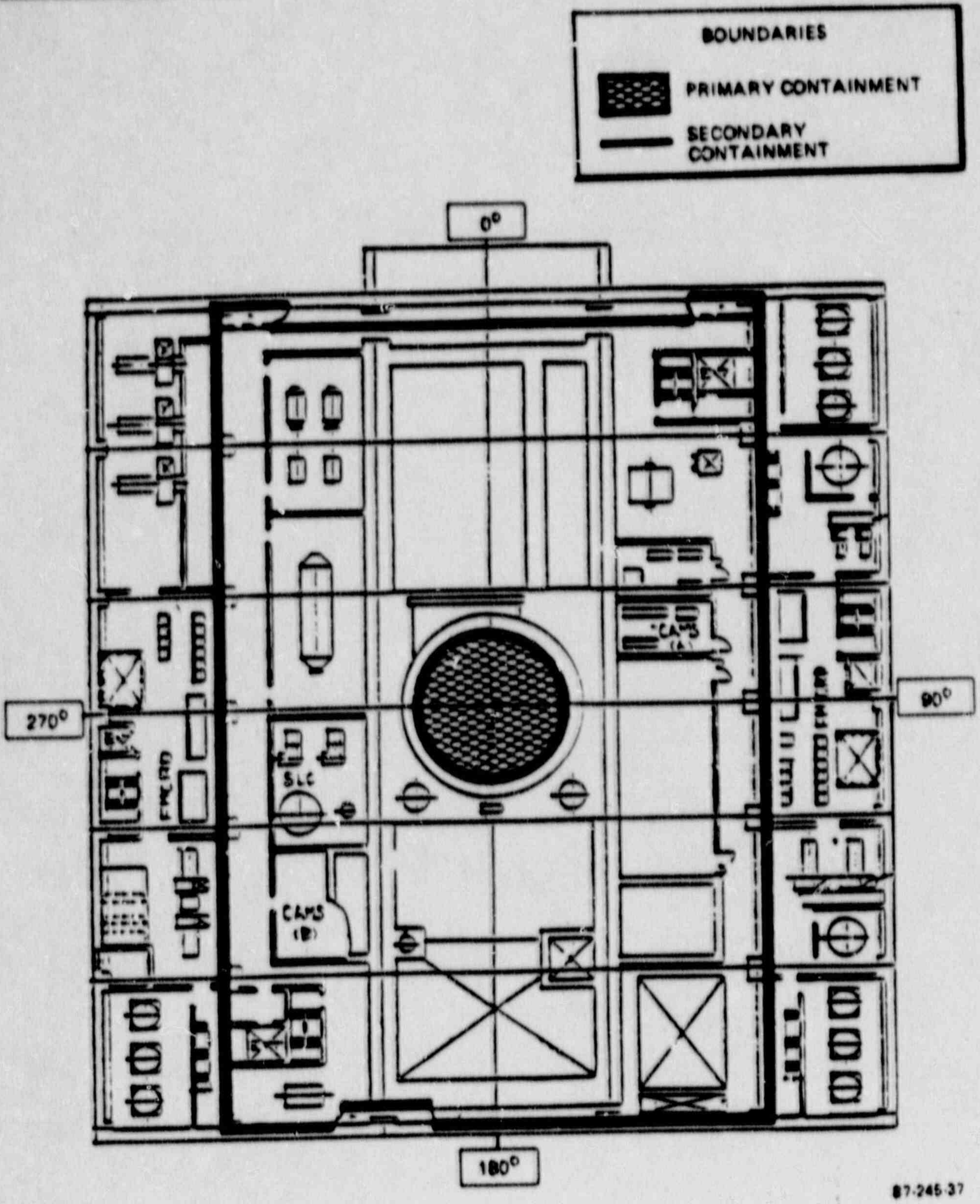


Figure 6.2–35 CONTAINMENT BOUNDARIES IN THE REACTOR BUILDING – PLAN AT ELEV 18500 mm

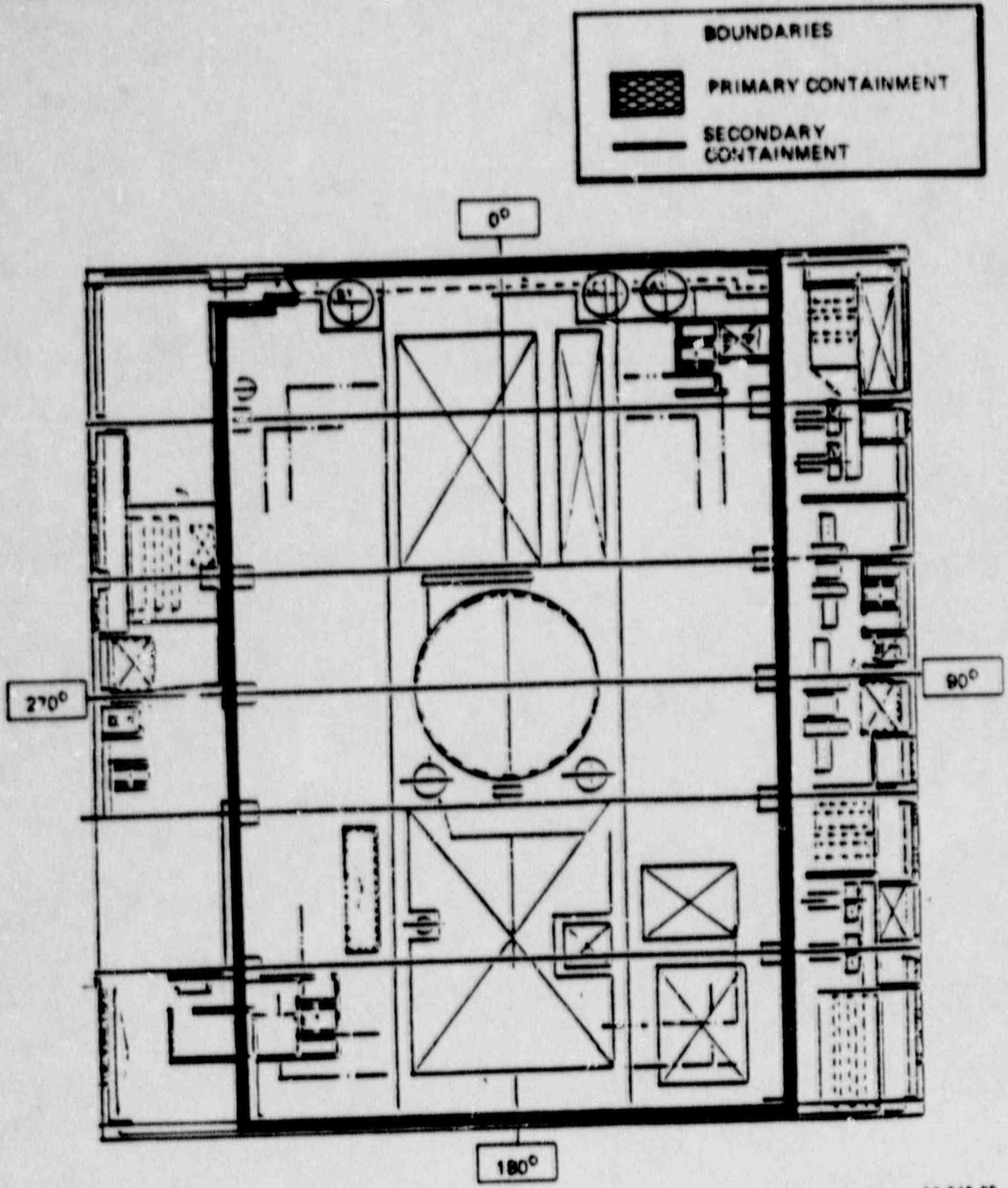
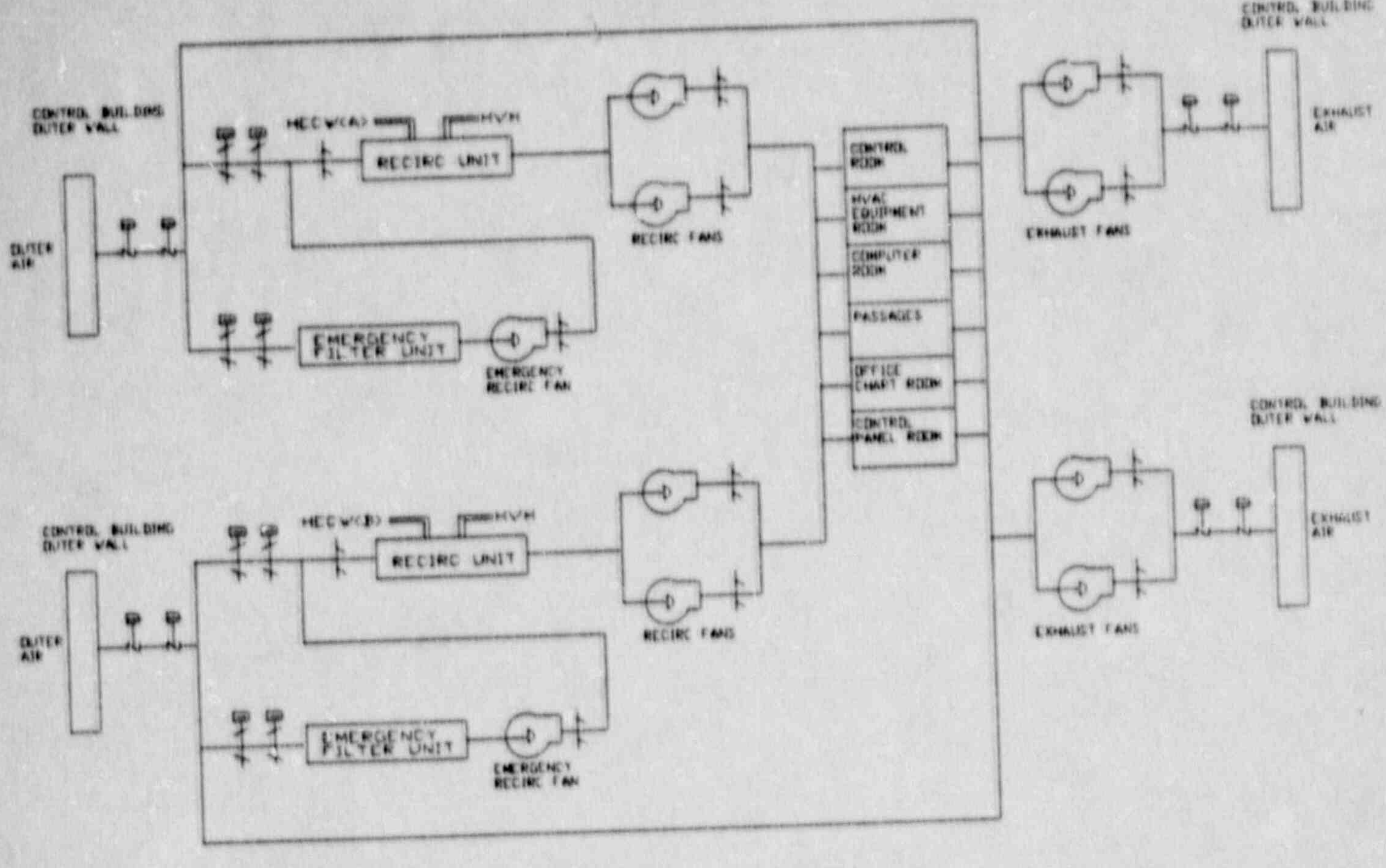


Figure 6.2–36 CONTAINMENT BOUNDARIES IN THE REACTOR BUILDING – PLAN AT ELEV 26700 mm

HABITABILITY SYSTEM

IS PROVIDED IN A SEISMIC CATEGORY I BUILDING THAT PROVIDES:

- o MISSILE PROTECTION,
- o RADIATION SHIELDING,
- o AIR FILTRATION AND VENTILATION,
- o EMERGENCY LIGHTING,
- o PERSONNEL AND ADMINISTRATIVE SUPPORT,
- o FIRE PROTECTION WITH SMOKE REMOVAL,
- o CONTROL BUILDING HVAC
  - LOCATED WITHIN A SEISMIC CATEGORY I BUILDING,
  - TWO 100% REDUNDANT HVAC SYSTEMS WITH DUAL INLETS AND EXHAUSTS
  - AUTOMATICALLY TRANSFERS TO ISOLATION MODE,
  - USES ESF GRADE DUCTWORK,
  - BACKUP POWER SOURCE PROVIDED
  - MAINTAINS TEMPERATURE AND HUMIDITY
  - PROVIDES SMOKE REMOVAL
  - PROVIDES PRIMARY FILTER
  - EMERGENCY FILTER SUBSYSTEM
    - AUTOMATIC AND MANUAL STARTUP
    - INCLUDES CHARCOAL & HEPA FILTERS



CONTROL BUILDING OUTER WALL
OUTER AIR
HECW(A)
HVH
RECIRC UNIT
RECIRC FANS
EMERGENCY FILTER UNIT
EMERGENCY RECIRC FAN
CONTROL ROOM
HVAC EQUIPMENT ROOM
COMPUTER ROOM
PASSAGES
OFFICE CHART ROOM
CONTROL PANEL ROOM
EXHAUST FANS
EXHAUST AIR
HECW(B)

ADVANCED BOILING WATER REACTOR

SUBCOMMITTEE

OCTOBER 31, 1989

THYAGARAJA CHANDRASEKARAN (CHANDRA)
PLANT SYSTEMS BRANCH
DIVISION OF SYSTEMS TECHNOLOGY
OFFICE OF NUCLEAR REACTOR REGULATION

REACTOR COOLANT PRESSURE BOUNDARY
LEAKAGE DETECTION SYSTEM

- o GDC 2 "Design Basis for Protection Against Natural Phenomena," and

  GDC 30 "Quality of Reactor Coolant Pressure Boundary"

Leakage is Categorized as Follows:

- o Identified Leakage

  - Identified Leakage Within Drywell Includes: Leakage From Reactor Vessel Head Flange, Inner Seal, Stem Inner Packing for Large Remote Power Operated Valves, and SRV Leakage

  - Identified Leakage is Limited to 25 GPM

  - Detection Methods: Equipment Drain Sump Pump Activity and Sump Level Changes

REACTOR COOLANT PRESSURE BOUNDARY LEAKAGE DETECTION SYSTEM (Continued)

- Unidentified Leakage

  - Unidentified Leakage Within Drywell Includes: Control Rod Drives, Valve Flanges, Closed Cooling Water for Reactor Services

  - Unidentified Leakage is Limited to 5 GPM

  - Detection Methods: Drywell Floor Drain Sump, Noble Gas and Airborne Particulate Monitoring, Condensate From Drywell Atmosphere Coolers

- Intersystem Leakage

  - Potential Intersystem Leakage Would be Into Closed System (Normally Filled with Water) or the RBCW System

  - Other Intersystem Leakages are Highly Unlikely Due to Closed Check Valves or Closed Containment

REACTOR COOLANT PRESSURE BOUNDARY
LEAKAGE DETECTION SYSTEM (Continued)

o Leakages Outside Drywell

- Include: Reactor Building Equipment Areas, Main Steam Tunnel, Turbine Building

- Detection Methods: Reactor Building Equipment and Floor Drain Sumps, Area Temperature Monitoring, Radiation Monitoring, Main Steam Line Pressure, Main Condenser Vacuum

o ABWR Will be Limited to a Total Leakage of 25 GPM

o Features of the RCPB-LDS

- Drywell Airborne Particulate Radioactivity Monitoring System is Designed to Seismic Category I Standard

- Indicators and Alarms are Provided for the Leakage Detection System

- Testing of LDS: Methods Include Simulation of Signals into Trip Units, Comparison of Methods, and Comparison of Channels

REACTOR COOLANT PRESSURE BOUNDARY
LEAKAGE DETECTION SYSTEM (Continued)

o **Conclusion**

- RCIC With 800 GPM Flow Rate is Adequate for Providing RCS Makeup

- RCPB LDS Complies With SRP 5.2.5 Requirements

CONTROL ROOM HABITABILITY SYSTEMS

- o GDC 4 "Environmental and Dynamic Effects Design Bases"
  - Protection Against Moderate-Energy Pipe Crack Effects
  - Concern About Steam Tunnel Through Control Building
- o GDC 19 "Control Room"
  - Two Physically Separated and Redundant Supply Air Intakes for Emergency Area Pressurization
  - Intake Automatic Selection Features
  - Redundant Radiation Monitors for Each Intake
  - Protection for Outside Airborne Radioactivity and Direct Shine

CONTROL ROOM HABITABILITY SYSTEMS
(Continued)

- No Assurance of Minimum 0.25" Water Gauge Positive Pressure During Pressurization Following LOCA

- No Piping and Instrumentation Diagrams for Control Room HVAC

- No Table on Treatment System Component Description

- Ambiguity About Redundancy of Filter Train Which May Not Comply With SRP Section 6.4 Acceptance Criterion II.2.b.

- Compliance With RG 1.52 Positions Not Discussed

- Minimum Instrumentation Requirements (SRP Table 6.5.1-1) Not Discussed

STANDBY GAS TREATMENT SYSTEM (SGTS)

o GDC 41 "Containment Atmosphere Cleanup,"

GDC 42 "Inspection of Containment Atmospheric Cleanup Systems,"

GDC 43 " Testing of Containment Atmospheric Cleanup Systems,"

GDC 61 " Fuel Storage and Handling and Radioactivity Control," and

GDC 64 " Monitoring Radioactivity Releases"

- Single Filter Train Does Not Comply With GDC 43
- Other Active Components (Fan, Demister, Pump, Heater, Valve, Damper) are Redundant
- Radiation Monitors at SGTS and Fuel Area Exhaust Ducts
- Concern Over Charcoal Adsorber Sizing

STANDBY GAS TREATMENT SYSTEM (SGTS) (Continued)

- No Piping and Instrumentation Diagrams

- No Failure Modes and Effects Analysis (FMEA)

- System Use During Inerting, Deinerting, Pressure Control and Primary Containment Purge and its Effect on System's Functional Capability During LOCA Not Analyzed

- No Discussion of All SGTS Actuating Instrumentation

- No Discussion of Compliance With RG 1.52 Positions

- Lacks Information on Minimum Instrumentation Requirements

FISSION PRODUCT CONTROL SYSTEMS AND STRUCTURES

o GDC 41 "Containment Atmosphere Cleanup,"

GDC 42 "Inspection of Containment Atmospheric Cleanup Systems," and

GDC 43 "Testing of Containment Atmospheric Cleanup Systems"

- Suppression Pool DF for Iodine Complies With SRP Section 6.5.5
- Iodine Chemical Composition Complies With RG 1.3
- Primary Containment (PC) Leak Rate 0.5% Per Day of PC Volume for 0-24 HRS; Thereafter 0.25% Per Day, Existing BWR Leakage Constant
- Pool Bypass Area 0.05 Ft^2 Low, Not an Advanced Feature
- Fission Product Release From Core 1 Hour After Accident Initiation Does Not Comply With RG 1.3
- SGTS Drawdown Time for Negative Pressure 20 Minutes, Not an Advanced Feature

ADVANCED BOILING WATER REACTOR

SUBCOMMITTEE

OCTOBER 31, 1989

JOHN TSAO
MATERIALS AND CHEMICAL ENGINEERING BRANCH
DIVISION OF ENGINEERING TECHNOLOGY
OFFICE OF NUCLEAR REACTOR REGULATION

4.5.1 CONTROL ROD DRIVE STRUCTURAL MATERIALS

- SRP 4.5.1 "CONTROL ROD DRIVE STRUCTURAL MATERIALS"
  - MATERIAL SPECIFICATIONS
    - USE MATERIALS EQUIVALENT TO ASME CODE SECTION III, APPENDIX I; SECTION II, PART A AND B; OR REG. GUIDE 1.85.
    - COMPATIBLE WITH REACTOR COOLANT - ASME CODE SECTION III, ARTICLES NB-2160 AND NB-3120
- AUSTENITIC STAINLESS STEEL COMPONENTS
  - COLD WORKED AUSTENITIC STAINLESS STEEL HAS YIELD STRENGTH LESS THAN 90,000 PSI
  - REG. GUIDE 1.44 - PREVENT IGSCC
  - REG. GUIDE 1.31 - PREVENT MICRO FISSURES IN WELDS
- PARTS ARE ACCESSIBLE FOR INSPECTION AND REPLACEMENT

4.5.2 REACTOR INTERNAL MATERIALS

- SRP 4.5.2 "REACTOR INTERNAL AND CORE SUPPORT MATERIALS"
  - MATERIAL SPECIFICATIONS
    - CORE SUPPORT STRUCTURES - ASME SPECIFIED MATERIALS; DESIGNED TO SECTION III, NG-2000
    - OTHER INTERNAL MATERIALS - ASME CODE OR ASTM
    - COMPATIBLE WITH REACTOR COOLANT - ASME CODE, SECTION III, NG-2160 AND NG-3120
- CONTROL ON WELDING - ASME CODE, SEC III, NG-4000 AND NG-5000
  - REG. GUIDE 1.44
- AUSTENITIC STAINLESS STEELS
  - REG. GUIDE 1.31 - PREVENT MICRO FISSURES IN WELDS
  - REG. GUIDE 1.44 - PREVENT IGSCC

5.3.3 REACTOR VESSEL INTEGRITY

- SRP 5.3.3 "REACTOR VESSEL INTEGRITY"
    - MATERIAL SPECIFICATIONS - LOW ALLOY, HIGH STRENGTH STEEL PLATES: ASME SA-533 AND FORGINGS SA-508.
    - ASME CODE, SECTION III, APPENDIX I AND 10 CFR 50, APPENDIX G
    - FABRICATION - ASME, SECTIONS III AND IX
    - INSERVICE INSPECTION - ASME CODE, SECTION XI
- FRACTURE TOUGHNESS
    - SATISFIED 10 CFR 50, APPENDIX G
    - IRRADIATION EMBRITTLEMENT - NOT A PROBLEM PEAK FLUENCE AT 1/4 T LESS 4×10^{17} N/CM^2
    - RT_{NDT} SHIFT - 28°F FOR WELDS, 8°F FOR BASE PLATES
    - UPPER SHELF ENERGY - ABOVE 50 FT-LB
- IGSCC
    - USE IGSCC RESISTANCE MATERIALS, E.G., TYPE 316
    - FOLLOW REG. GUIDE 1.44
    - NO SENSITIZED STAINLESS STEEL

ADVANCED BOILING WATER REACTOR

SUBCOMMITTEE

OCTOBER 31, 1989

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COMPLIANCE WITH CODE AND CODE CASES

I COMPLIANCE WITH 10 CFR 50.55a

1. REQUIREMENTS

- COMPONENTS IN RCPB MUST MEET REQUIREMENTS FOR ASME CLASS 1 COMPONENTS IN ACCEPTABLE EDITIONS OF ASME CODE, SECT. III

- ASME CLASS 2 & 3 COMPONENTS MUST MEET REQUIREMENTS IN ACCEPTABLE EDITIONS OF ASME CODE, SECT. III

2. EVALUATION CONCLUSIONS

- THE SSAR HAS DEFINED RCPB IN ACCORDANCE WITH 10 CFR 50.2

- ALL APPLICABLE COMPONENTS IN RCPB ARE PROPERLY CLASSIFIED AS ASME CLASS 1 AND WILL BE CONSTRUCTED IN ACCORDANCE WITH ASME SECT. III, SUBSECT. NB.

- ASME CLASS 2 AND 3 COMPONENTS WILL BE CONSTRUCTED IN ACCORDANCE WITH ASME SECTION III, SUBSECT. NC AND ND. QUALITY GROUP AND SEISMIC CLASSIFICATION OF THESE COMPONENTS WILL BE DISCUSSED IN SER SECT. 3.2

- SSAR CONTAINS ACCEPTABLE COMMITMENTS TO ASME CODE EDITION AND AGENDA DATES

II APPLICABLE ASME CODE CASES

1. STAFF REVIEW GUIDELINES

   - CODE CASES TO BE USED IN PLANT DESIGN MUST BE LISTED IN EITHER R.G.1.84, "DESIGN AND FABRICATION CODE CASE ACCEPTABILITY" OR R.G.1.85, "MATERIALS CODE CASE ACCEPTABILITY"

2. EVALUATION CONCLUSIONS

   - 16 OF THE 17 CODE CASES LISTED IN SSAR TABLE 5.2-1 HAVE BEEN ACCEPTED BY THE STAFF IN EITHER R.G.1.84 OR 1.85

   - CODE CASE N-451, "ALTERNATIVE RULES FOR ANALYSIS OF CLASS 1 PIPING UNDER SEISMIC LOADING" HAS NOT BEEN ENDORSED BY THE STAFF

ABWR STANDARD PLANT

CHAPTER 5: REACTOR COOLANT SYSTEM

PRESENTED TO

ACRS SUBCOMMITTEE ON THE

ADVANCED BOILING WATER REACTOR

OCTOBER 31, 1989

BETHESDA, MARYLAND

GE NUCLEAR ENERGY

ACRS ABWR SUBCOMMITTEE
10/31/89 REVIEW OF STAFF SER

AGENDA

- OVERVIEW OF ABWR REACTOR COOLANT SYSTEM (SECTION 5.1)
- INTEGRITY OF REACTOR COOLANT PRESSURE BOUNDARY (SECTION 5.2)
- REACTOR VESSEL AND INTERNALS (SECTION 5.3)
- COMPONENTS AND SUBSYSTEMS (SECTION 5.4)

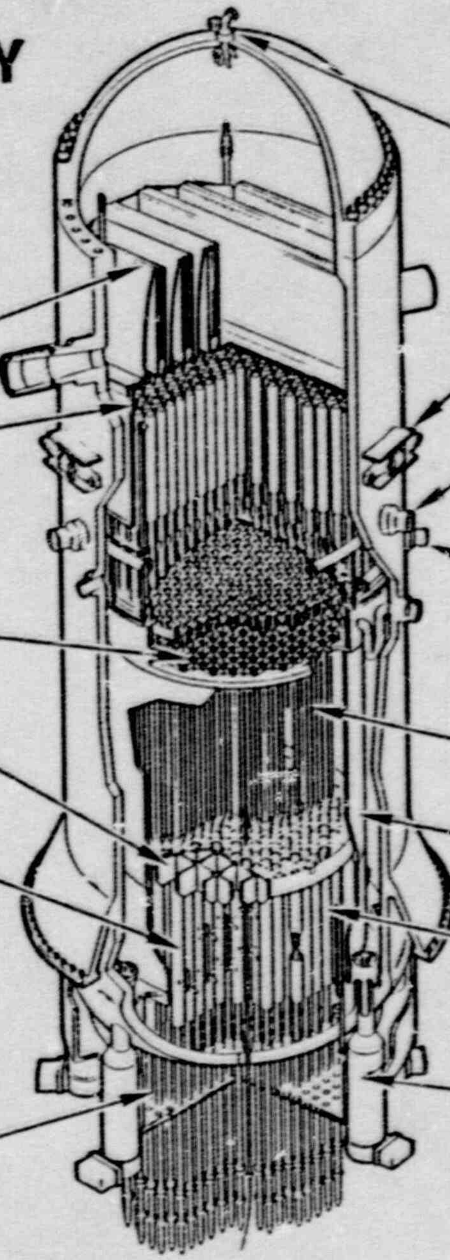
OVERVIEW OF ABWR REACTOR COOLANT SYSTEM

FEATURE	ABWR APPROACH
o REACTOR VESSEL AND INTERNALS	278 INCH VESSEL USING ESTABLISHED BWR TECHNOLOGY. MAXIMUM UTILIZATION OF EVOLUTIONARY DESIGN ENHANCEMENTS
o CORE HEAT REMOVAL	FORCED CIRCULATION USING TEN REACTOR INTERNAL PUMPS WITH ADJUSTABLE SPEED MOTORS (NO LARGE PIPING)
o REACTOR COOLANT PIPING AND REACTOR OVERPRESSURE CONTROL	FOUR 28-INCH STEAM LINES, TWO 22-INCH FEEDWATER LINES. EIGHT MAINSTEAM ISOLATION VALVES AND 18 SAFETY/RELIEF VALVES
o CONTROL OF REACTOR WATER QUALITY	CLOSED LOOP, HIGH PRESSURE REACTOR WATER CLEANUP SYSTEM (RWCU). TWO PUMPS, TOTAL FLOW CAPACITY EQUAL TO 2% OF REACTOR FEEDWATER FLOW.
o MAIN STEAM LINE FLOW RESTRICTION	FLOW RESTRICTORS LOCATED IN REACTOR VESSEL NOZZLE. REDUCES SEVERITY OF REACTOR BLOWDOWN FOLLOWING A STEAM LINE RUPTURE.

OVERVIEW OF ABWR REACTOR COOLANT SYSTEM (CONTINUED)

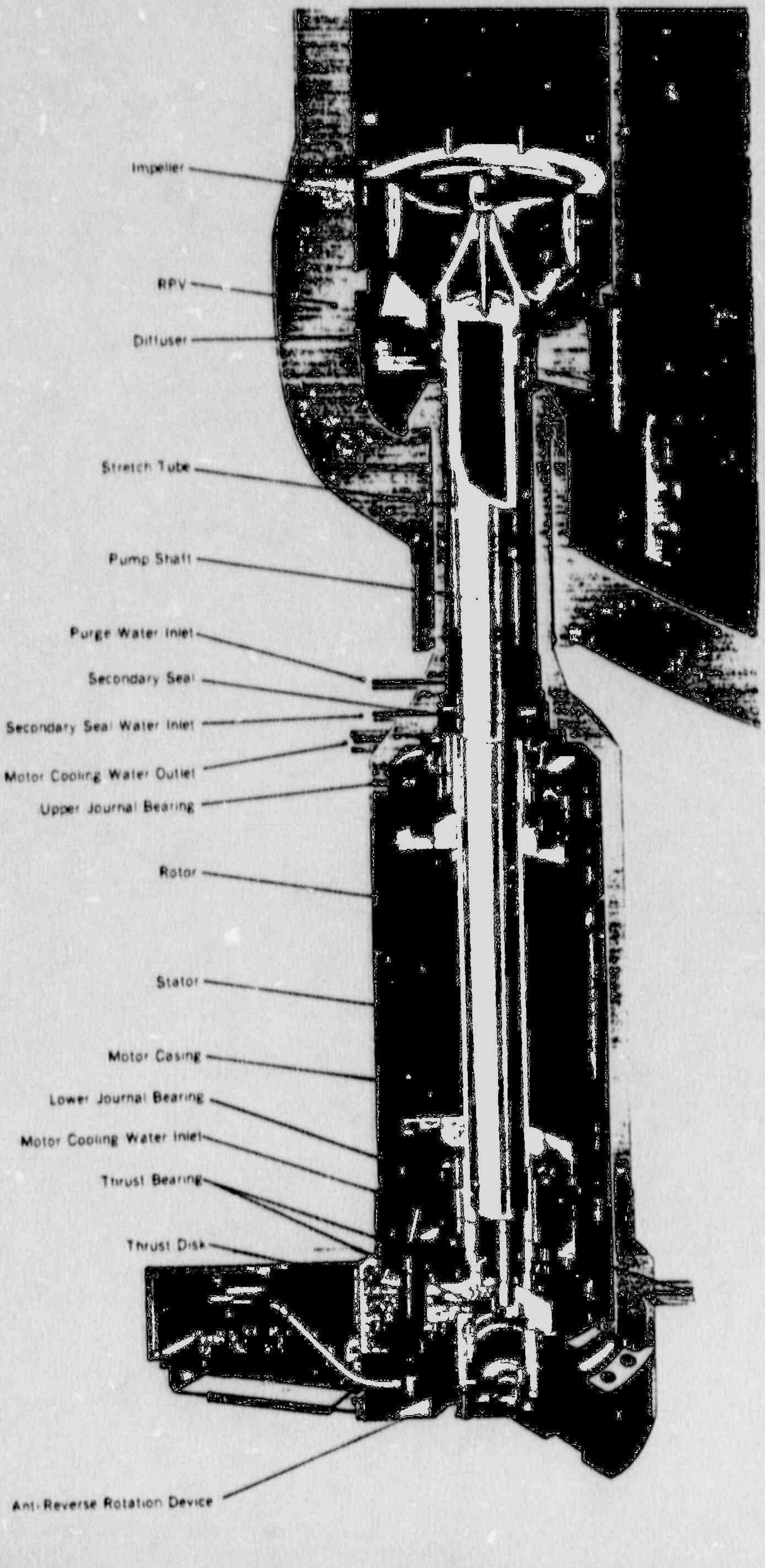
FEATURE	ABWR APPROACH
o REACTOR CORE ISOLATION COOLING	IF MAIN FEEDWATER FLOW IS UNAVAILABLE, REACTOR COOLANT INVENTORY IS PROVIDED BY A SMALL TURBOME-DRIVEN PUMP. SUCTION FROM EITHER CONDENSATE STORAGE OR SUPPRESSION POOL.
o RESIDUAL HEAT REMOVAL (RHR SYSTEM)	THREE INDEPENDENT LOOPS WHICH ARE CLASSIFIED AS ENGINEERED SAFETY EQUIPMENT. HEAT REJECTED TO THE ULTIMATE HEAT SINK VIA THE REACTOR BUILDING CLOSED COOLING WATER (RBCCW) SYSTEM.

REACTOR ASSEMBLY KEY DESIGN FEATURES



ACRS ABWR REVIEW 10/31/89

REACTOR INTERNAL PUMP



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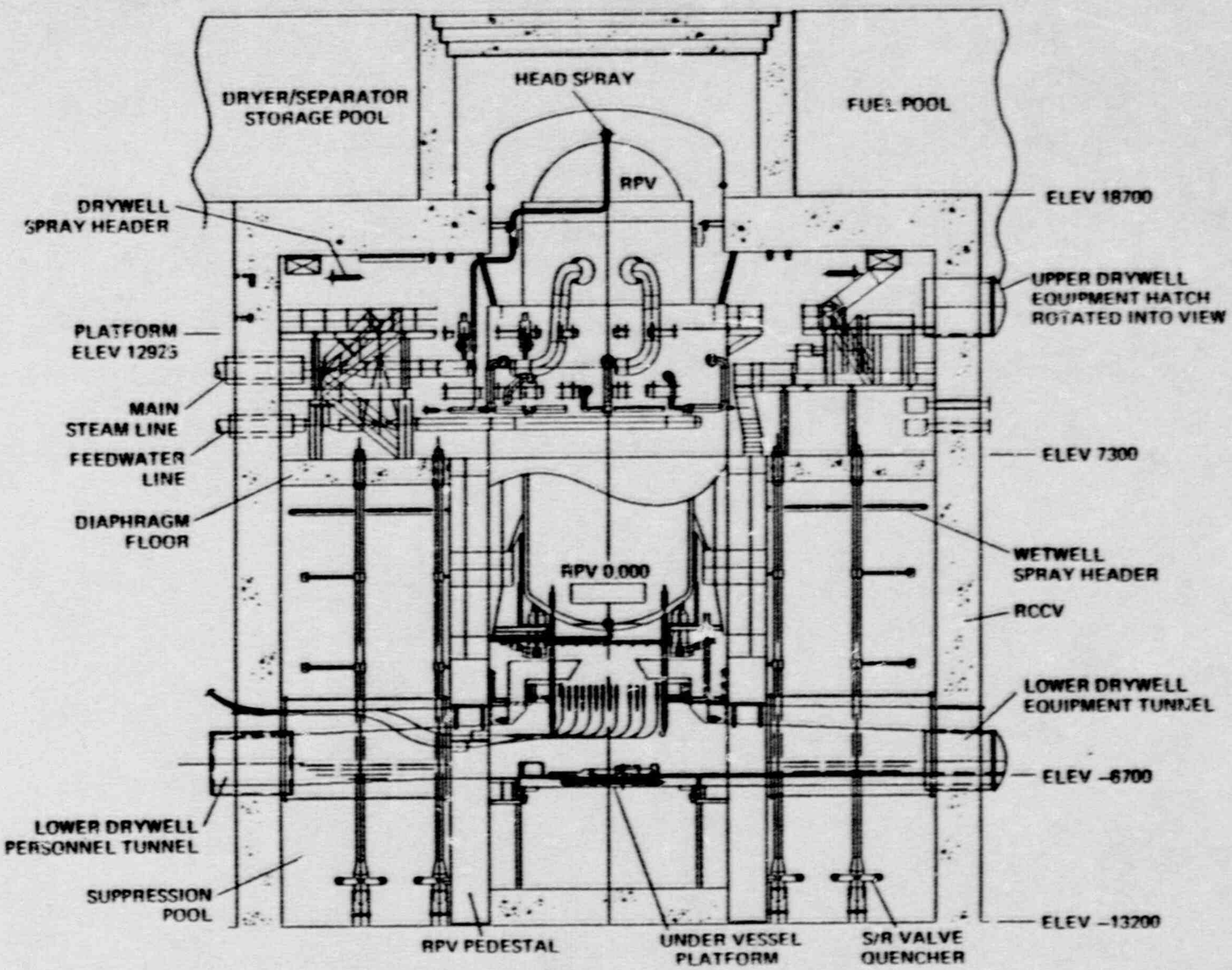

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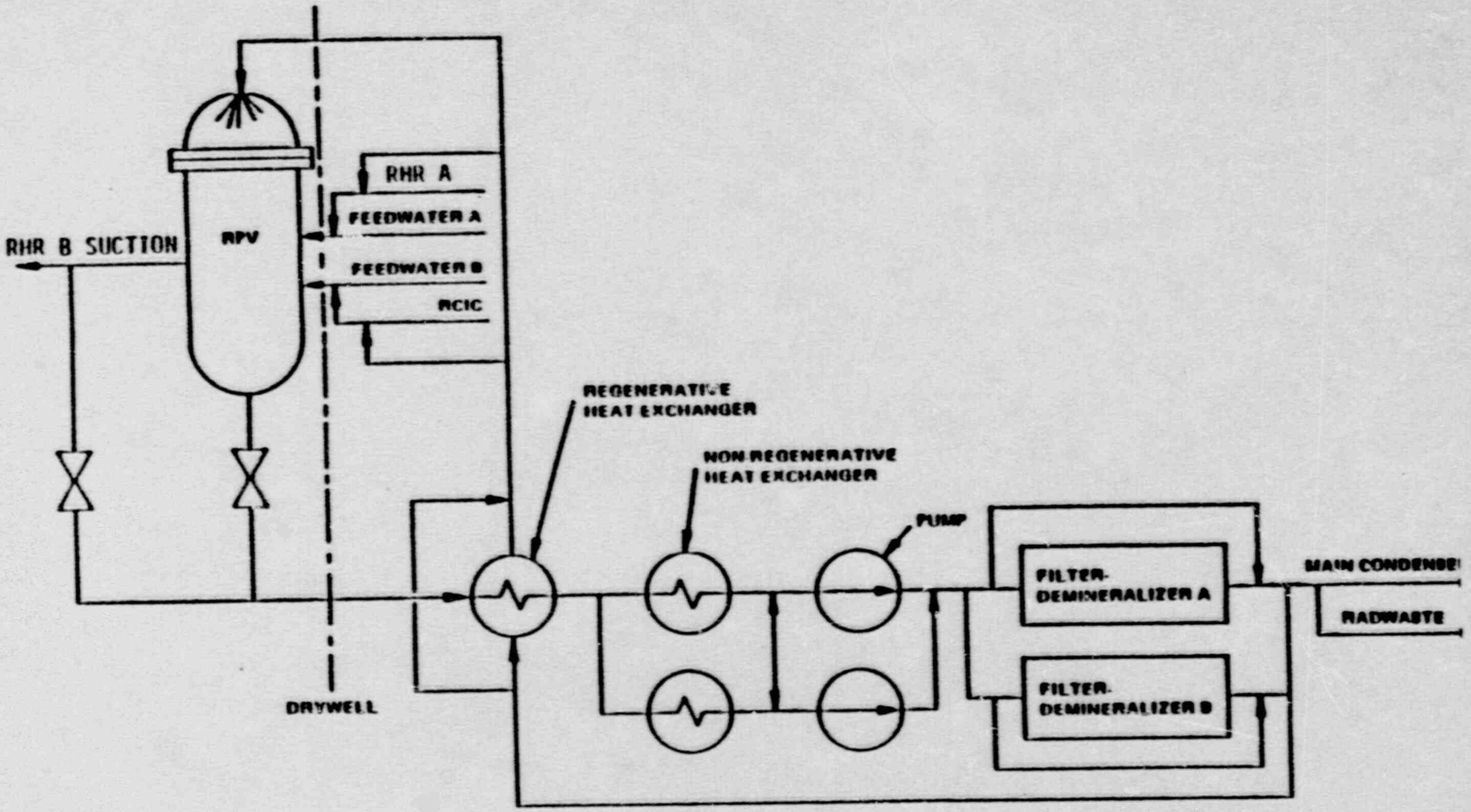
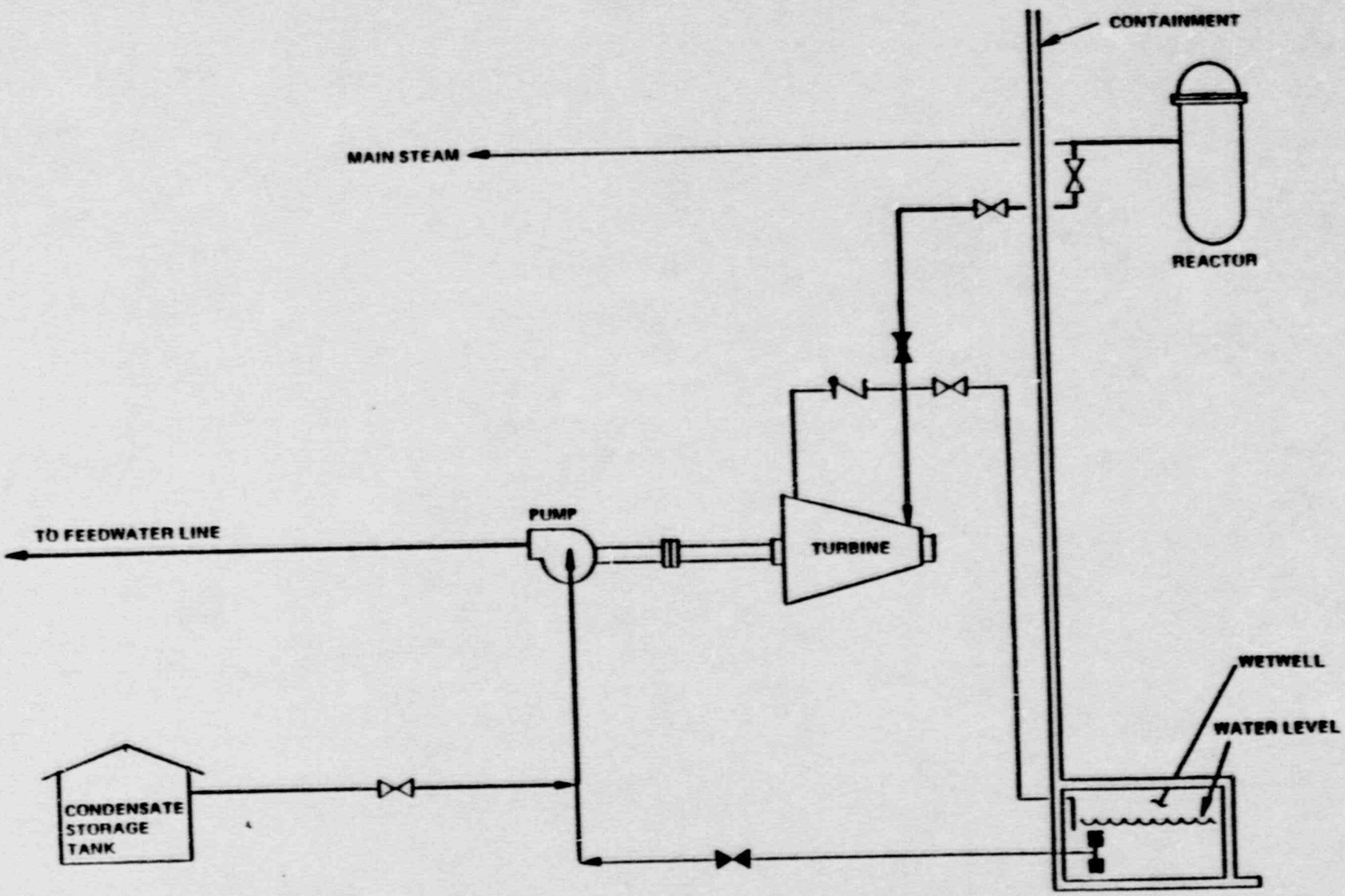
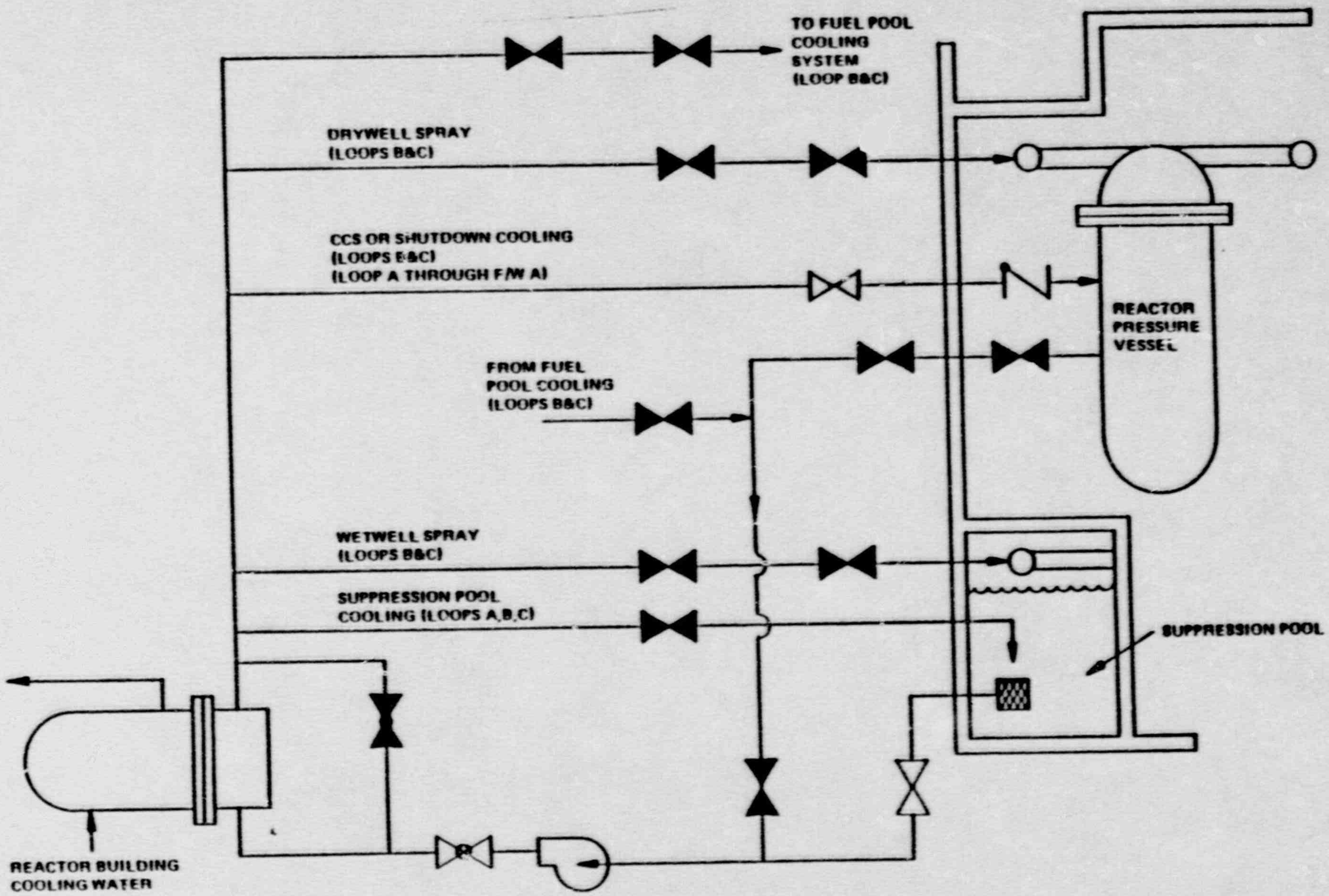
10/89

BWR REACTOR WATER CLEANUP (RWCU) SYSTEM - SCHEMATIC





Reactor Core Isolation Cooling (RCIC) Schematic Flow Diagram



Residual Heat Removal System (RHR)

INTEGRITY OF REACTOR COOLANT PRESSURE BOUNDARY (SECTION 5.2)

- RCPB COMPLIES WITH 10CFR50, SECTION 55A, CODE REQUIREMENTS INCLUDING CODE CASE APPROVAL OF CLASS 1, 2 AND 3 COMPONENTS

- OVERPRESSURE PROTECTION CONFORMS TO 10CFR50, APPENDIX A, GDC15

- AUTOMATIC DEPRESSURIZATION SYSTEM (ADS) INCLUDED WITH THREE LOW PRESSURE FLOODER SYSTEMS AND THREE HIGH PRESSURE FLOODER/FEED SYSTEMS (RCIC + TWO HPCF'S)

- THE ADS MAKES USE OF EIGHT OF 18 SAFETY RELIEF VALVES (SRV'S) OPERATED BY PNEUMATIC ACTUATORS

- SRV'S ARE DUAL FUNCTION:
  - -SAFETY FUNCTION - LIFT AGAINST A SPRING FORCE
  - -RELIEF FUNCTION - OPENED ON SIGNAL USING PNEUMATIC ACTUATOR

- SRV'S LIMIT REACTOR PRESSURE TO 110% DESIGN PRESSURE PER ASME CODE SECTION III FOR MSIV CLOSURE WITH HIGH FLUX SCRAM

INTEGRITY OF REACTOR COOLANT PRESSURE BOUNDARY (SECTION 5.2) (CONTINUED)

RCPB MATERIAL AND WATER CHEMISTRY

- o ABWR MATERIALS SELECTION "MUSTS"
  - HAVE SUCCESSFUL OPERATING EXPERIENCE
  - BE FULLY QUALIFIED IGSCC RESISTANT
  - INCLUDE KNOWN METALLURGICAL IMPROVEMENTS
- o ENVIRONMENTAL CONTROLS INTEGRATED WITH MATERIAL SELECTION
  - EPRI BWR OWNERS WATER CHEMISTRY GUIDELINES
  - HYDROGEN WATER CHEMISTRY TO PROVIDE ADDITIONAL MARGIN AGAINST SCC
  - UTILIZE PROVEN MATERIALS AND PROCESSES

ACRS ABWR REVIEW 10/31/89

REACTOR VESSEL AND INTERNALS
(SECTION 5.3)

- ELIMINATION OF LARGE RECIRCULATION FLOW PIPING BELOW THE CORE BY USING INTERNAL PUMPS IMPROVES CORE FLOODING AND SAFETY PERFORMANCE

- REACTOR INTERNAL STEAM SEPARATION USING PROVEN BWR AXIAL FLOW SEPARATORS

- EXTERNAL RECIRCULATION PIPING AND VALVES ELIMINATED

- LARGE RPV DIAMETER PLACES THE PRESSURE BOUNDARY MATERIAL WELL AWAY FROM THE CORE: THIS REDUCES NEUTRON FLUENCE TO VERY LOW VALUES, THUS GIVING LONG LIFE WITH GOOD PROTECTION AGAINST BRITTLE FRACTURE

- INTERNAL PUMP INERTIA PROVIDES SLOW FLOW COASTDOWN TO KEEP FUEL WITHIN THERMAL LIMITS

- FLOW RESTRICTORS ARE IN RPV STEAM OUTLET NOZZLE

- FLOW RESTRICTORS IN NOZZLE AND NO EXTERNAL LOOP REDUCE LOSS-OF-COOLANT ACCIDENT LOADS ON REACTOR INTERNALS AND CONTAINMENT

- NO WELDS IN CORE BELTLINE

COMPONENT AND SUBSYSTEM DESIGN (SECTION 5.4)

ITEM	BRIEF OVERVIEW
5.4.1 REACTOR RECIRCULATION	-TEN REACTOR INTERNAL PUMPS -WET MOTOR, SEALLESS DESIGN -SOLID STATE ADJUSTABLE FREQUENCY SPEED CONTROL -PURGE SYSTEM -BLOWOUT RESTRAINT
5.4.3 REACTOR COOLANT PIPING	-NO LARGE PIPING BELOW THE TOP OF THE CORE. CONTINUOUS CORE COOLING FOLLOWING A LOCA
5.4.4 MAIN STEAMLINE FLOW RESTRICTORS	-200% CAPACITY. LOCATED IN RPV NOZZLE TO FURTHER LIMIT ACCIDENT FLOW RATES
5.4.5 MAIN STEAMLINE ISOLATION SYSTEM	-TWO ISOLATION VALVES IN EACH STEAMLINE -CONVENTIONAL BWR TECHNOLOGY
5.4.6 REACTOR CORE ISOLATION COOLING SYSTEM (RCIC)	-800 GPM SAFETY SYSTEM TURBINE DRIVEN; PUMP SUCTION FROM CST OR SUPPRESSION POOL -SYSTEM CAPACITY SUFFICIENT TO PREVENT EMERGENCY SYSTEM INITIATION DURING ISOLATION EVENTS -SYSTEM OPERATION INDEPENDENT OF AC POWER -DESIGN REFLECTS "LESSONS LEARNED" FROM FIELD EXPERIENCE

COMPONENT AND SUBSYSTEM DESIGN (SECTION 5.4)
(CONTINUED)

ITEM	BRIEF OVERVIEW
5.4.7 RESIDUAL HEAT REMOVAL SYSTEM (RHR)	THREE COMPLETELY SEPARATE LOOPS PART OF THE PLANT ENGINEERED SAFEGUARDS EQUIPMENT. FURTHER DISCUSSION IN CHAPTER 6
5.4.8 REACTOR WATER CLEANUP SYSTEM (RWCU)	CONVENTIONAL RWCU CONFIGURATION WITH ENHANCED CAPACITY: - TWO 50% SEAMLESS PUMPS IN THE COLD LEG - FLOW EQUIVALENT TO 2% FEEDWATER - MEETS EPRI WATER QUALITY GUIDELINES
5.4.9 MAINSTEAM AND FEEDWATER PIPING	4 X 28 INCH STEAMLINES, 2 X 22 INCH FEEDWATER LINES STEAM DISCHARGE FROM RPV PRESSURE RELIEF VALVES IS PIPED TO THE SUPPRESSION POOL (10/12 INCH SRVDL)
5.4.12 VALVES 5.4.13 SAFETY/RELIEF VALVES 5.4.14 COMPONENT SUPPORTS	ABWR UTILIZES ESTABLISHED DESIGN PRACTICES AND EQUIPMENT TECHNOLOGY

ADVANCED BOILING WATER REACTOR

SUBCOMMITTEE

OCTOBER 31, 1989

DINO SCALETTI
STANDARDIZATION AND LIFE EXTENSION
PROJECT DIRECTORATE
OFFICE OF NUCLEAR REACTOR REGULATION

ABWR REVIEW - OUTSTANDING ISSUES

o APPROXIMATLY 30 ISSUES OPEN AT THIS TIME

- 14 RELATED TO THE UNREVIEWED SSAR CHAPTERS

- 16 SPECIFLY RELATED TO SSAR CHAPTER 4, 5, & 6

- NO OPEN ITEMS FROM CHAPTER 17 REVIEW

SER SECTION 1.8

UNREVIEWED SSAR CHAPTERS

- o SER MODULE 2
  - (1) SITE CHARACTERISTICS (2)
  - (2) DESIGN CRITERIA FOR STRUCTURES, SYSTEMS, AND COMPONENTS (3)

UNREVIEWED SSAR CHAPTERS (CONT'D)

o SER MODULE 3

(19) INSTRUMENTATION AND CONTROLS (7)

(20) ELECTRICAL POWER SYSTEMS (8)

(21) AUXILIARY SYSTEMS (9)

(22) STEAM AND POWER CONVERSION SYSTEM (10)

(23) RADIOACTIVE WASTE MANAGEMENT (11)

(24) RADIATION PROTECTION (12)

(25) CONDUCT OF OPERATIONS (13)

(26) INITIAL TEST PROGRAM (14)

UNREVIEWED SSAR CHAPTERS (CONT'D)

- SER MODULE 4
  - (27) TRANSIENT AND ACCIDENT ANALYSIS (15)
  - (28) TECHNICAL SPECIFICATIONS (16)
  - (29) CONTROL ROOM DESIGN REVIEW (18)
  - (30) SEVERE ACCIDENT DESIGN CONSIDERATIONS (19)

o OUTSTANDING ISSUES RELATED TO SSAR CHAPTERS 4, 5, AND 6

(3) FUEL SYSTEM DESIGN (4.2)

(4) NUCLEAR DESIGN (4.3)

(5) THERMAL-HYDRAULIC DESIGN (4.4)

UNDER REVIEW BY THE STAFF, COMPLETION EXPECTED SHORTLY

(6) STANDBY LIQUID CONTROL SYSTEM RELIABILITY ANALYSIS (4.6)

INFORMATION RECEIVED IN SSAR AMENDMENT 8 o OUTSTANDING ISSUES RELATED TO SSAR CHAPTERS 4, 5, AND 6 (CONT'D)

(7) FINAL REPORT ON FINE MOTION CONTROL ROD DRIVE SYSTEM IN-PLANT TEST PROGRAM (4.6)

INFORMATION RECEIVED

(8) ASME CODE CASES N-433 AND N-451 (5.2.1.2)

GE TO DROP THE REQUEST

(9) TMI-2 ACTION ITEMS RELATED TO SAFETY/RELIEF VALVES (5.2.2)

INFORMATION RECEIVED

o OUTSTANDING ISSUES RELATED TO SSAR CHAPTERS 4, 5, AND 6 (CONT'D)

(9A) PREVIOUSLY UNIDENTIFIED ITEM - COMPLIANCE WITH NUREG-0313, REV. 2 (5.2.3)

GE WILL COMPLY

(10) INSERVICE INSPECTION AND TESTING (5.2.4)

(11) PRESERVICE INSPECTION (5.2.4)

UNDER EVALUATION BY GE

(12) CLEANING OF STAINLESS STEEL COMPONENTS (5.3.1)

WILL RESPOND IN AMENDMENT 9

- OUTSTANDING ISSUES RELATED TO SSAR CHAPTERS 4, 5, AND 6 (CONT'D)

  (13) TMI-2 ACTION ITEMS RELATED TO EMERGENCY CORE COOLING SYSTEMS (5.4.6)

  INFORMATION PROVIDED

  (14) CONTAINMENT SYSTEMS (6.2)

  STAFF ACTION

  (15) CONTAINMENT LEAK TESTING (6.2.4)

  REMAINING INFORMATION TO BE PROVIDED IN AMENDMENT 9

  (16) CONTROL ROOM HABITABILITY (6.4)

  INFORMATION PROVIDED IN AMENDMENT 8

- o OUTSTANDING ISSUES RELATED TO SSAR CHAPTERS 4, 5, AND 6 (CONT'D)

  (17) ATMOSPHERE CLEANUP SYSTEMS (6.5)

  INFORMATION TO BE PROVIDED IN A FUTURE SSAR AMENDMENT

  (18) MAIN STEAM ISOLATION VALVE LEAKAGE CONTROL (6.7)

  STAFF ACTION

ADVANCED BOILING WATER REACTOR

PRESENTATION TO ACRS
SUBCOMMITTEE MEETING
OCTOBER 31, 1989

GEORGE THOMAS
REACTOR SYSTEMS BRANCH
DIVISION OF SYSTEMS TECHNOLOGY
OFFICE OF NUCLEAR REACTOR REGULATION

FINE MOTION CONTROL ROD DRIVE SYSTEM

- HYDRAULIC AND ELECTRIC INSERTION
- ROD INSERTION IN 0.7 "STEPS VS 6" STEPS
- TWO DRIVES PER ACCUMULATOR
- NO SCRAM DISCHARGE VOLUME

OVERPRESSURE PROTECTION

- NO DIFFERENCE FROM CURRENT DESIGN
- MEETS ASME B& P.V. CODE SECTION III
- CREDIT IS TAKEN ONLY FOR SAFETY/RELIEF VALVE SAFETY MODE NOT FOR POWER-OPERATED MODE
- CREDIT IS TAKEN ONLY FOR THE SECOND SCRAM, HIGH FLUX SCRAM
- PEAK VESSEL PRESSURE IS 1274 PSIG $<$ 1375 PSIG

REACTOR RECIRCULATION SYSTEM

- TEN REACTOR INTERNAL PUMPS (RIPS) REPLACED THE EXTERNAL PUMPS
- RUPTURE OF LARGE-BORE EXTERNAL PIPE ELIMINATED AS DBA
- ONLY 2" OR SMALLER LINES BELOW TAF
- NO CORE UNCOVERY
- LESS ECCS CAPACITY
- RIP OPERATING EXPERIENCE IN EUROPE
- IMPROVES PLANT SAFETY

REACTOR CORE ISOLATION COOLING

* PART OF ECCS SYSTEM
* START ON REACTOR LOW LEVEL AND DRYWELL HIGH PRESSURE (DIVERSITY)
* INCLUDE A STEAM INLET BYPASS START FEATURE
* FULL FLOW TEST CAPABILITY FROM SUPPRESSION POOL
* MEET THE ECCS CRITERIA

RESIDUAL HEAT REMOVAL

- THREE ELECTRICALLY AND MECHANICAL INDEPENDENT DIVISIONS
- SHUTDOWN COOLING MODE: THREE SUCTION LINES FROM REACTOR
- LOW PRESSURE FLOODER MODE
- SUPPRESSION POOL COOLING
- WETWELL AND DRYWELL SPRAY COOLING
- FUEL POOL COOLING

EMERGENCY CORE COOLING SYSTEMS

- REACTOR CORE ISOLATION COOLING
- HIGH PRESSURE CORE FLOODER LOOPS-2
- LOW PRESSURE FLOODER MODE OF RHR-3
- AUTOMATIC DEPRESSURIZATION SYSTEM
- CORE FLOODER SPARGER OUTSIDE SHROUD. MOUNTED ABOVE CORE

ECCS TESTING AND PERFORMANCE

- PRE-OPERATIONAL TESTING ACCORDING TO REG-GUIDE 1.68
- FULL FLOW PERIODIC TESTS
- NO CORE UNCOVERY
- USE APPROVED LOCA ANALYSIS METHODS
- COMPLIES WITH 10CFR50.46, APPENDIX K
- PCT 1149°F $<$ 2200°F

ABWR STANDARD PLANT

CHAPTER 4: REACTOR

PRESENTED TO

ACRS SUBCOMMITTEE ON THE

ADVANCED BOILING WATER REACTOR

OCTOBER 31, 1989

BETHESDA, MARYLAND

GE NUCLEAR ENERGY

CHAPTER 4 REACTOR

CHAPTER 4 OVERVIEW

CONSISTENT WITH SRP CHAPTER 4 INCLUDES

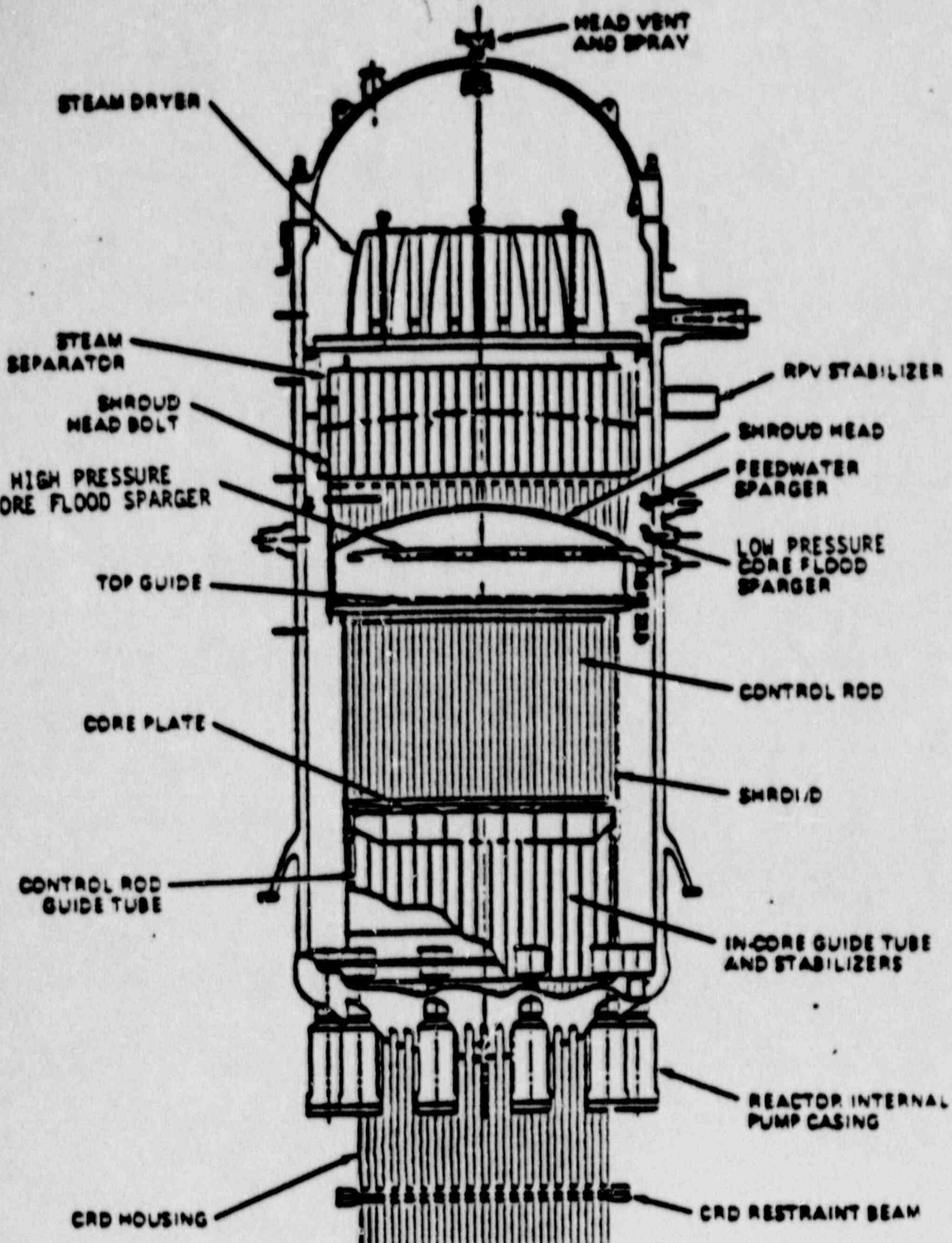
- REACTOR ASSEMBLY (RPV & INTERNALS)
- FUEL SYSTEM DESIGN
- REACTOR THERMAL HYDRAULIC DESIGN
- REACTOR MATERIALS
- REACTIVITY CONTROL SYSTEMS

REACTOR PRESSURE VESSEL

- COMPARED TO EARLIER BWRS ABWR USES REDUCED RADIUS CLOSURE HEAD AND FLANGES
- TEN PENETRATIONS IN BOTTOM HEAD FOR INTERNAL RECIRCULATION PUMPS
  - STUB TUBES ARE MACHINED FROM FORGING
- CONICAL SUPPORT SKIRT

REACTOR INTERNALS

- BWR 6 TYPE STEAM DRYER AND STEAM SEPARATORS
- BORON CARBIDE CONTROL ROD WITHOUT VELOCITY LIMITER
- BWR 6 TYPE CORE STRUCTURE
  - TOP GUIDE MACHINED FROM THICK PLATE
  - CORE PLATE STIFFENERS IN TWO DIRECTIONS
- SEPARATE LOW PRESSURE AND HIGH PRESSURE FLOODERS
  - HIGH PRESSURE SPARGER INSIDE TOP GUIDE
  - LOW PRESSURE SPARGER ON VESSEL WALL
- STAINLESS STEEL IN CORE HOUSING AND GUIDE TUBE STABILIZER CONNECTED TO SHROUD AND SHROUD SUPPORT
- CONTROL ROD GUIDE TUBE PROVIDES FMCRD BLOW OUT SUPPORT



REACTOR ASSEMBLY KEY DESIGN FEATURES

FUEL SYSTEM AND THERMAL HYDRAULIC DESIGN

ARE AS DESCRIBED IN NRC APPROVED GENERAL ELECTRIC STANDARD APPLICATION FOR REACTOR FUEL NEDE 24011

C LATTICE 8 X 8 FUEL

NEW DESIGNS WILL BE USED WHEN APPROVED-PLANT DESIGN PROVIDES MARGIN FOR THIS

NEW CONTROL ROD FEATURE IS ELIMINATION OF VELOCITY LIMITER

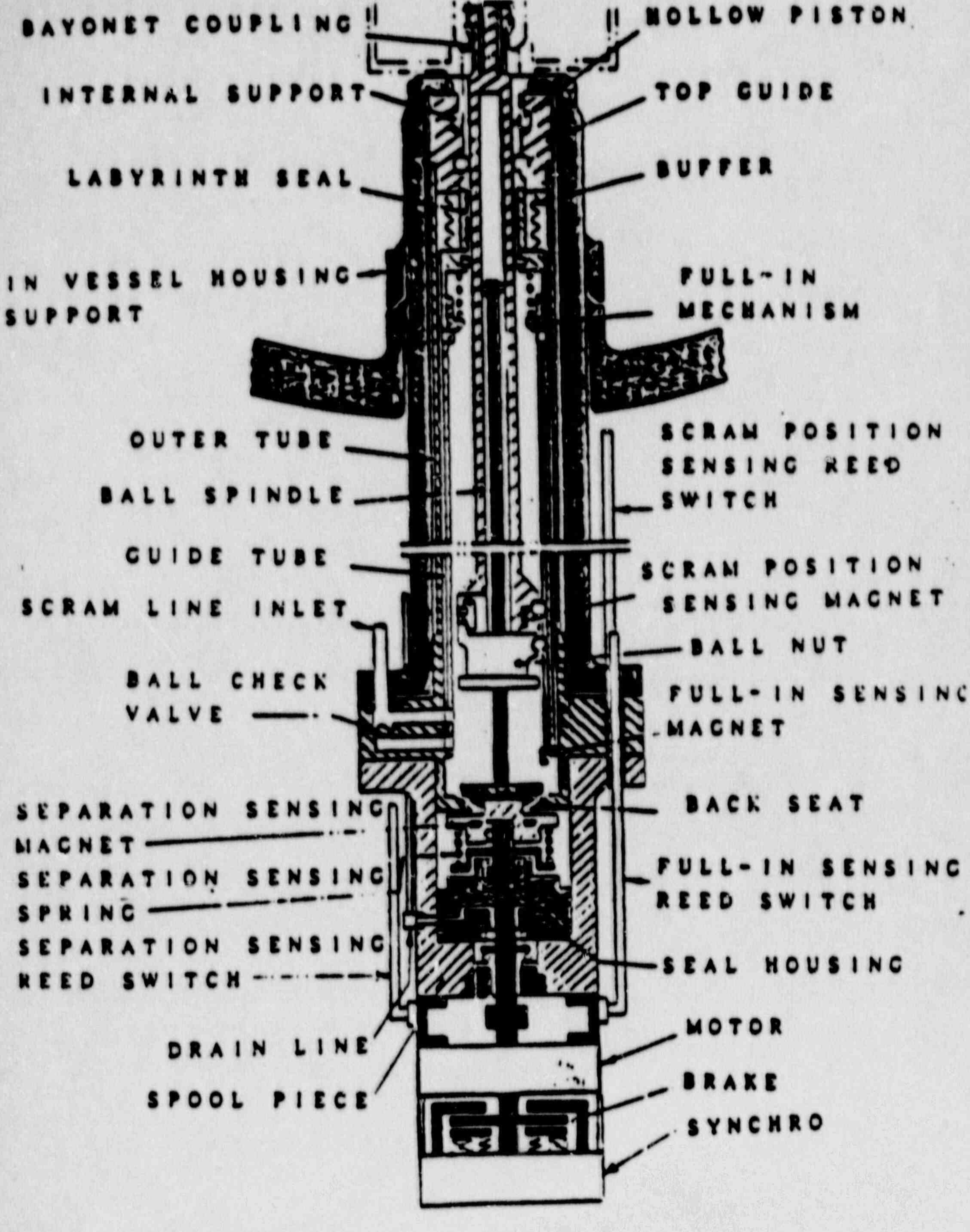
DISCUSSION LATER

REACTOR INTERNAL MATERIALS

- INTERNALS PRIMARILY AUSTENITIC STAINLESS STEEL
  - SHROUD SUPPORT STRUCTURE IS NICKEL-CHROME-IRON (ALLOY 600) AS ARE SHROUD HEAD BOLTS
- WELDING PER ASME SECTION III-WELDERS QUALIFIED TO SECTION IX
- MATERIAL INCORPORATES LATEST TECHNOLOGY AND COMPLIES WITH REGULATORY GUIDES 1.31,1.37 AND 1.44
  - BASE MATERIAL SOLUTION ANNEALED
  - COLD FORMING CONTROLLED AND AVOIDED WHERE POSSIBLE
  - DELTA FERRITE REQUIRED TO BE SHOWN BY TEST TO BE 8 AVERAGE/5 MIN
  - COMPONENTS SOLUTION ANNEALED AFTER WELDING WHERE STRESS IS HIGH OR PROBLEMS HAVE BEEN EXPERIENCED
  - MATERIALS ARE LOW CARBON
  - WELD HEAT INPUT IS CONTROLLED
  - CONTROL IMPOSED ON MATERIALS USED IN FABRICATION AND ASSEMBLY TO AVOID CONTAMINATION WITH DELETERIOUS SUBSTANCES
- STABILIZED NICKEL CHROME IRON ALLOY USED
- DETAILED MATERIALS PRESENTATION TO SUBCOMMITTEE 11/88

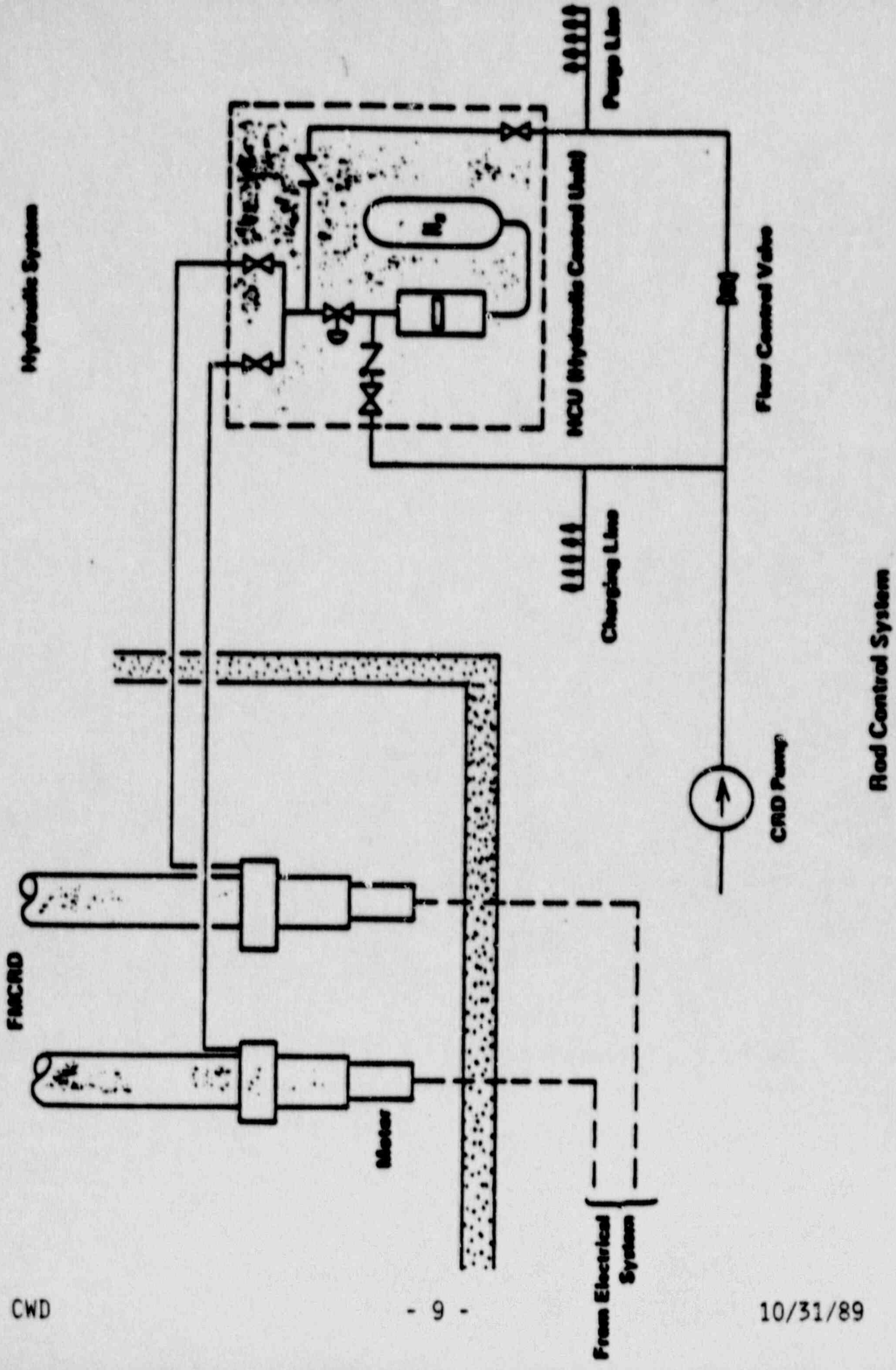
FMCRD

- KEY NEW FEATURE OF ABWR
- BASED ON SUCCESSFUL EXPERIENCE IN EUROPE
- DIVERSE MEANS OF INSERTION
  - HYDRAULIC SCRAM
  - ELECTRIC RUN-IN
- ELIMINATES SCRAM DISCHARGE VOLUME
  - REMOVES RADIATION SOURCE
  - ELIMINATES CONCERN ABOUT COMMON MODE FAILURE
- CONTROL ROD POSITIVELY COUPLED TO DRIVE-SEPARATION SWITCH DETECTS FAILURE OF ROD TO WITHDRAW
  - ELIMINATES CONCERN FOR ROD DROP
  - SEPARATION SWITCHES REDUNDANT AND CLASS 1E
  - ALLOWS ELIMINATION OF VELOCITY LIMITER
- FINE MOTION CAPABILITY ENHANCES OPERATION
  - ALLOWS PLANT AUTOMATION REDUCING STARTUP TIME
  - COMPLIMENTS CORE FLOW LOAD FOLLOWING
- PROVEN TO REDUCE MAINTENANCE AND EXPOSURE
  - DRIVE CONTAMINATION LOW
  - NO PISTON SEALS REQUIRING REMOVAL FOR MAINTENANCE
- ELECTROMECHANICAL BRAKE PREVENTS ROD WITHDRAWAL IF SCRAM LINE BREAKS
- NEARLY 2700 DRIVES IN SERVICE IN EUROPE
  - OVER 15000 DRIVE YEARS OF EXPERIENCE


BAYONET COUPLING
HOLLOW PISTON
INTERNAL SUPPORT
TOP GUIDE
LABYRINTH SEAL
BUFFER
IN VESSEL HOUSING SUPPORT
FULL-IN MECHANISM
OUTER TUBE
SCRAM POSITION SENSING REED SWITCH
BALL SPINDLE
GUIDE TUBE
SCRAM POSITION SENSING MAGNET
SCRAM LINE INLET
BALL NUT
BALL CHECK VALVE
FULL-IN SENSING MAGNET
SEPARATION SENSING MAGNET
BACK SEAT
SEPARATION SENSING SPRING
FULL-IN SENSING REED SWITCH
SEPARATION SENSING REED SWITCH
SEAL HOUSING
DRAIN LINE
MOTOR
SPOOL PIECE
BRAKE
SYNCHRO

FMCRD SYSTEM

- THE FMCRD SYSTEM IS BASED ON USE OF PROVEN COMPONENTS AND DESIGNS
    - TWO DRIVES PER HYDRAULIC CONTROL UNIT
        - ALLOWS USE OF EQUIPMENT PROVEN IN US BWR APPLICATIONS
        - DRIVES ON ONE HCU ARE SEPARATED
- SYSTEM INCLUDES BACKUP SCRAM VALVES AS USED ON US BWRS
- ALSO INCLUDES SELECTED CONTROL ROD RUN IN (SCCRI)
    - USES THE ELECTRIC INSERTION
- AUTOMATIC ELECTRIC RUN IN AFTER SCRAM
- HYDRAULIC SYSTEM INCLUDES REDUNDANT CHARGING PUMPS
    - AVAILABILITY FEATURE-PUMPS NOT REQUIRED FOR SCRAM
- LOW PRESSURE ALARMS ON ACCUMULATORS AND ON CHARGING HEADER LOW CHARGING HEADER PRESSURE CAUSES SCRAM
- FAILURE MODES AND EFFECTS REVIEWED WITH SUBCOMMITTE 11/88


Hydraulic System
Purge Line
HCU (Hydraulic Control Unit)
Flow Control Valve
Charging Line
Rod Control System
CRD Pump
FMCRD
Motor
From Electrical System

SUMMARY OF CHAPTER 4

RPV AND INTERNALS BASED ON PROVEN BWR 6 DESIGN WITH MODIFICATIONS TO ACCOMODATE INTERNAL RECIRCULATION PUMPS

FUEL AND THERMAL-HYDRAULIC DESIGN BASED ON GE STANDARD FUEL APPLICATION NEDE 24011

MATERIALS BASED ON THE LATEST DEVELOPMENTS IN MATERIAL COMPATIBILITY WITH BWR ENVIRONMENT AND FULLY COMPLY WITH APPLICABLE REG GUIDES

FMCRD BASED ON PROVEN EUROPEAN EXPERIENCE

PROVIDES ENHANCED OPERABILITY

PROVIDES REDUCED MAINTENANCE

PROVIDES REDUCED EXPOSURE

FMCRD SYSTEM COMBINES PROVEN COMPONENTS AND INCREASED SAFETY