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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

DATE: January 26, 1994

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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Advanced Boiling Water Reactors Subcommittee

Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland
Wednesday, January 26, 1994

The meeting convened at 8:30 a.m., Caryle Michelson, Chairman of the Subcommittee, presiding.

PRESENT FOR THE SUBCOMMITTEE:

Carlyle Michelson
Thomas Kress
Peter Davis
William Lindblad
Robert Seale
William Shack
Charles Wylie

ALSO PRESENT:

Robert Costner, ACRS Consultant
Medhat El-Zeftawy, Cognizant ACRS Staff Member

P R O C E E D I N G S

[8:30 a.m.]

MR. MICHELSON: This will be the second day of the meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Advanced Boiling Water Reactors.

Yesterday, we heard a number of presentations from the staff. Today, we intend to hear presentations by GE. I believe the staff will come in right after lunch to finish up on some questions that were raised yesterday for which we want to hear a few more words. After the staff has finished this afternoon GE will complete its presentation. We will have to adjourn at 4:00 o'clock, to meet people's schedules.

That's where we are at. Without further ado, I would like to get started with GE, if you will.

MR. POWER: Good morning. My name is John Power. I thought I would give a short prologue to today's presentation. Roughly three years ago, the ACRS expressed a number of concerns related to divisional separation, equipment qualification, clean up system, design basis, break out site containment, and severe accident aspects. Over the last three years we have exchanged information.

In June of last year, in San Jose, we had a relatively comprehensive evaluation and discussion and presentation to you, relative to the clean up system break, the divisional separation, the barriers, the significance of the clean up system break out site containment relative to total risk on the plant, and the impact on environmental equipment.

At that time, you indicated to us that there was some need for some additional considerations, examinations, and review. In the last six months we have put together a relatively top notch team, that has put this subject under intense microscope and evaluation. What we are here today for is to present the findings that they have concluded as a result of this six month study.

Without much ado, I would introduce Craig Sawyer, Senior GE Management, with the introduction.

MR. SAWYER: My name is Craig Sawyer. I am Manager of ABWR Engineering for General Electric. I am not going to stay up very long, except to make a few points. The first one is the agenda process that we are going to use for presenting the information to you this morning. I am, of course, leading off with the introduction.

We are going to take you through the design basis that we are using for the divisional separation criteria for how we are treating outside line breaks, fires, floods and so forth. We are going to carry you through some general safety evaluations that were done, as well as some very specific safety evaluations that have been done. Finally, wrap up with a summary.

What we are here to do today, hopefully, is to close the issues regarding outside line breaks and reactor water clean up system that have been lingering these many months. We want to place these issues in proper perspective. We are going to present to you, both deterministic analyses and probabilistic analyses that have looked at the various aspects of accommodating outside line breaks.

We have present today, a multi-disciplinary team involving structural people, thermal hydraulicists, PRA folks and so forth, to answer your questions as you present them.

Before we kick off though, I thought I would bring you up to date on the reactor water clean up system. This is a chart that I presented last June, I believe, when we had a session with you on the reactor water clean up system, follow up to an ACRS staff study on the reactor water clean up system that raised a number of questions.

At that time we told you about a decision that we had made to provide some additional capability shown here at the bottom, to be able to remotely manually isolate the flow from the bottom of the vessel, should the normal isolation process not take place. We have done some more thinking about that, particularly the interaction of what we want to do with the emergency procedure guidelines, and what kind of difficulties the plant operator would be faced with in diagnosing this event and taking actions.

As a result of those deliberations we have made some minor changes to the clean up system, which we think will improve the process. First of all, let me dispose of one other issue that you should be aware of. That is, to answer some of the ACRS concerns about having a sufficient number of check valves to prevent reverse flow of feedwater, we interchanged the location of the check valve and the isolation valve in the steam tunnel area so that there would be at least two check valves inside the steam tunnel, to prevent the reverse flow into the reactor water clean up room.

MR. MICHELSON: Will those valves be on the ISI list for periodic inspection?

MR. SAWYER: Yes. With regard to the emergency procedure guidelines we ended up deciding that rather than protect only against the bottom drain line it would be better to protect against both of the line additions, by introducing a third valve in the process, so that we don't require a more or less non-symptom based emergency procedure guideline which would require the operator to diagnose this event and control the water level below the RHR line.

What we had in place before was good, but this is better. Now, the operator doesn't have to make a decision about exactly how far above the core to keep the water.

MR. MICHELSON: That's purely a manual --

MR. SAWYER: It's a remote manual valve.

MR. MICHELSON: The one at the bottom.

MR. SAWYER: It's gone back to standard --

MR. MICHELSON: It's a whole in the bottom --

MR. SAWYER: It's a standard maintenance valve at this point, right. There are two maintenance valves shown here and here, and we have basically added a valve here to give the control room operator an opportunity to close off the system if the main isolation valves fail.

MR. MICHELSON: That valve would not be qualified for the blowdown flow, but rather for the --

MR. SAWYER: That's correct. The situation would be, the reactor will have been blown down by the operator because of his diagnosis that there is energy being delivered to the reactor building that can't be terminated. He will take the emergency actions per the EPG's to blow the plant down. At that time this valve would then be exercised, to try to terminate the flow.

MR. MICHELSON: That's the valve that we have been needing all along.

MR. SAWYER: Yes.

MR. MICHELSON: That will take care of much of the problem.

MR. SAWYER: It will make the operator's life a lot easier, in terms of control of water level and so forth after the event. I wanted you to be aware of that, because I think it will flavor a lot of what you are going to hear from the team with regard to the analyses, particularly the PRA analysis of this event.

MR. MICHELSON: The change back to a purely manual valve at the bottom drain of the vessel, you have introduced a little larger hazard now, in the sense that there's quite a few feet of pipe that could rupture that represented a leak in the bottom of the vessel as opposed to putting that valve in remote manual and very close to the drain point.

MR. SAWYER: Yes, but that's an --

MR. MICHELSON: It's not a significant point. I think what you have there is a significant improvement.

MR. SAWYER: We did reviews not only of maintaining -- of controlling the water level for the operator for what's going on inside the vessel but also the ability of the operating crew to access the reactor building to effect termination of the event. Because of the severe environment that will occur if you don't isolate, it's necessary to be able to close off things from inside.

MR. MICHELSON: Yes.

MR. SAWYER: That's one of the other reasons why we did what we did.

MR. DAVIS: Do you stroke that valve per tech specs every shutdown?

MR. SAWYER: We don't plan to have this valve part of the tech specs. That valve will be -- surveillance will be done on that valve during regular maintenance outages.

MR. MICHELSON: By that valve, you mean which valve?

MR. SAWYER: This one, the new one.

MR. DAVIS: The old manual one, is what I was referring to.

MR. SAWYER: We don't plan to stroke it during normal operation. It will be checked during refueling outages for operability.

MR. MICHELSON: There's no significant problem with stroking it during normal operation. You just stroke it whenever you operate the RWCU system, which is not always continuous by any means?

MR. SAWYER: That's true. If, for some reason, the reactor water clean up system were to go down, there wouldn't be a problem.

MR. MICHELSON: It would be wise to stroke that valve when the system is down, to make sure that it's still operable.

MR. SAWYER: Yes.

MR. MICHELSON: But it's a secondary effect, primarily.

MR. SAWYER: Right.

MR. MICHELSON: Its presence, alone, is a significant improvement.

MR. SAWYER: Yes. With that, let me put John Power back up to start you through the process of the design basis considerations.

MR. MICHELSON: I guess when you did all your pressurization calculations and everything, you have now gone back and taken credit for this new valve that was added. It should help you to keep from pumping up the building any further, and going on into a third division.

MR. SAWYER: The answer is yes and no. Why don't you revisit that after we have done that.

MR. MICHELSON: You are going to tell us about that, okay. Thank you.

MR. POWER: First of all, I would like to indicate to you that you have heard of station blackout. I am a human station blackout today. I am operating on RCIC and batteries only.

[Laughter.]

MR. POWER: If I fall down and not do so well, you will understand why. I had a long night. The purpose of my being here is to set the stage for some evaluations that are going to come after me, and to maybe clarify some things that in the past have been unclear because maybe we didn't sufficiently document them in the SAR.

I am going to spend a few rough moments talking about the ABWR's and the truly integrated plant design and evaluation. The reason I want to bring that up is, we are going to talk a little bit about barriers in one case that must perform their function, and the same barrier under another set of conditions that is not expected to. The second thing is, I want to talk a little bit about the defense in depth that we have on the ABWR that may not be recognized.

I will then quickly walk through the various containment systems we have, to maybe give some insights that weren't previously there. The last point down on the bottom, I will briefly walk through the design bases that we had put into the SAR in the last amendment, which are specific statements relative to design basis for a whole series of events.

[Slides.]

MR. POWER: What do I mean by ABWR being truly an integrated plant design? Most other plants in the past have had various significant regulations imposed upon them after the original design basis, like Appendix R, flooding analysis, and PRA's came a lot later. This is one of the first plants, the evolutionary design of a plant, that took these into account as the design was being developed, analyzed and portrayed.

We are not just looking at those items in a discreet manner, we are looking at them in an integrated manner. What we are also talking about here is, we are talking about operational as well as design. Previous plants were design basis, and the operational data came later. We have spent a great deal of time looking at operational events, to find out if those operational events do indeed have an impact on the design that we currently have. We talked about that a little bit yesterday, when we were identifying some of those items, the information notices.

The third area is, the design that we are looking at which is somewhat confusing from time to time is, there is the design basis events and then there are events that are parallel to them that turn out to be beyond design basis like ATWS and SBO, where there is sometimes confusion about carrying requirements from one to the next one. Finally, there is the severe accident aspects, where you numerically plug numbers in. In some cases those simplifying assumptions you made in deterministic are no longer valid for putting into the PRA aspect. We ran across a couple of those.

We looked at fire, flood, breaks and harsh environments in an integrated manner. Finally, we looked at internal and external events, again, in a first principle manner of rather than later on as a remedial action aspect.

The defense in depth. The ABWR, I think in some respects, there are a number of barriers that we have that are not necessarily given as much credit as they could be and the diversity of those structures, such as the reactor building analysis of the secondary containment which surrounds the divisional separation zones which surrounds the primary containment, and that a great deal of the equipment that used to be in reactor buildings has now been move into another building in the control building such as the service water and clean up systems.

Therefore, you have a great deal of what I would say a spreading out of risk around the plant, in addition to having three separate divisional arrangements relative to the ECCS systems and four divisions relative to the instrumentation and control.

The I&C systems. We initially started out as being digital systems, and we have now supplemented those systems under special events by hardwiring the high pressure coolant injection systems, putting the remote shutdown rooms, hardwiring those different from the control room, putting a large diversity of power supplies including the CTG in a different area than the diesel generators are in, with the capability of connecting with any one of the loads.

The primary containment. If you want to put it under a little microscope here, we have reduced the piping systems inside the primary containment, the break sources. We had on the BWR, an extremely diverse redundant leak detection and break detection system --

MR. MICHELSON: Excuse me. Before you go ahead, you had skipped over your figure of the ABWR. Is that really the ABWR now, that slide called advanced boiling water.

MR. SAWYER: This one?

MR. MICHELSON: That one. Is that reflecting now, the layouts that you have presently?

MR. POWER: It's probably as close as we can get right now.

MR. MICHELSON: Could you send us a copy of that? We don't have one.

MR. POWER: I will send you a nice color one.

MR. MICHELSON: Yes. The nice understandable ones are always helpful. If you could send us a few copies we will give them to the members.

MR. POWER: Absolutely.

MR. MICHELSON: That's the first time I have seen it laid out in a nice way that it's easy to understand.

MR. POWER: In the color presentation -- you can't see it here -- it's an excellent cutaway.

MR. MICHELSON: If you could send us some copies.

MR. POWER: We could have done that today.

MR. POWER: Absolutely.

MR. MICHELSON: I think it would be helpful for the members to have it in front of them.

MR. POWER: We have redundant and diverse isolation systems on the containment. We have extended the containment capabilities beyond what we currently or previously had, by putting in the COPS system. We have, again, provided conservative break analysis and effects, of where we have taken every single solitary combination of ECCS that you can think about, where its division is, its break size or it's by ECCS type, and provided the analysis in Chapter 6.

The secondary containment, again, we have a limited number of sources in the secondary containment, such as high energy lines associated with the RCIC. In the clean up system we have moderate energy lines associated with the RHR. We have put in the divisional zones which are in there, and those zones are basically hardened for fire and flood and harsh environments.

What we are going to talk to you about today about those zones being somewhat softened for a couple of very, what we refer to as improbable breaks outside containment.

Again, we have done fire, flood, adverse environments, protection. We have gone through all of those and, as I said, predominantly hardened barriers.

On the ABWR there's a very unique situation. It really provides you with protection from the outside site environments to the secondary containment that we never had before in some respects. It also provides accessible areas for providing clean or what we call diminished environmental effect areas for electrical equipment, where we can have easy access to it, where we don't have to go down into the equipment rooms, where we can make adjustments to the system even if an event were to be occurring in the individual compartments and we can get access to the electrical rooms.

We put a number of operational enhancements in. That building is accessible to provide us with access to the clean up system, to the spent fuel cooling systems, to the various ECCS systems, while it operates. It provides easy access, not hard access.

Divisional separation zones. As I said, we have three ECCS zones, and they are basically self contained. We have other zones which are tiered in the fourth quadrant. We have some non-divisional areas. We have separate drains and sumps inside divisional compartments. In many cases we provide subcompartmentizational protection from components to another.

The last area is the one that I think was the one that you are most interested in, the definition and discussion relative to the barriers between the divisional separation zones -- between the zones -- between other parts of the secondary containment, between that and the reactor building.

What I thought I would do is, run down briefly -- as a result of your request for us to define more clearly the specific design basis of each one of these systems and barriers and containments, we put together Section 313. That went out of here in Amendment 33. What you see in this presentation are excerpts from that section. I am only going to touch on a few of them, and briefly review them again. I am going to walk through the litany of the rector building secondary containment and on through, down to the barriers themselves.

There are a couple of items that are very important. The primary/secondary containment are there basically for pipe breaks that occur inside the primary containment. In many cases those breaks are un-isolatable and they give you the greatest possible core damage throughout. They possibly result in radiological consequences. Therefore, they are inside the secondary containment, and in order to provide a filter release of any leakage from the primary containment we may take secondary containment.

However, for potential breaks outside where we have put upon ourselves a rather severe design basis, the design basis that we limit core uncovery, that we require automatic action for isolation, where we in essence don't have fuel failures, where we have coolant releases, we do not require the secondary containment to exist.

In the case of both the primary and secondary containment, if a steam line break were to occur which is outside the primary containment but also outside the secondary containment, we don't require either the primary or secondary containment to be required.

That leads me to look into a couple of other items. The reactor building, itself, is a safety related structure. It provides a safe haven for equipment, as I said, the more sensitive equipment, the equipment that you were concerned about, the micro electronics, the various digital instrumentation and such. That reactor building also has a divisional separation criteria, where we spread the power sources and the support sources into different rooms and provide quite a bit of separation in that building.

MR. DAVIS: Excuse me, Mr. Power. The third item from the bottom confuses me a little bit. Reactor buildings are relatively friendly environments, although it provides controlled access to important safety equipment.

MR. POWER: It's not a building that is under -- it's a building where you can have access to it. You don't have to go through two entry ports, as an example. I am not sure that the word "although" is correct.

MR. DAVIS: That's the one that threw me.

MR. MICHELSON: Change it to "and" and I think you have a fairly good statement.

MR. DAVIS: Thank you. That's good.

MR. POWER: There was a couple of typos in there. The secondary containment, again, a couple of important items on it. It provides radiological barrier to releases from the primary containment. Finally, under design basis accidents outside, in the tunnel it may be subject to isolation. The standby gas treatment system may be used. Since we have no fuel failure, the need for standby gas in secondary containment isn't required for breaks in the steam tunnel.

The divisional separation zones gets a little more complicated. There are more bullets and more lines. Essentially, what I had done through there is walk through and attempted to identify and highlight that under fire/flood cases in most cases, those divisional separation zones and barriers are maintained.

When you get to the case of harsh environments they are also maintained, because they have separate ventilation systems for the individual rooms and coolers. The only case which is different is when you have this small low probability set of breaks that may occur outside there. You attempt not to maintain those barriers and structures in a hardened sense.

We spent a great deal of time looking at hardening of the barriers for breaks outside. One of the major problems you have is, the energy from the break, clean up system and such, it is relatively instantaneous. Therefore, the isolation valve closure doesn't do it. Detection doesn't do it. The barriers themselves, in order to evaluate and put in ventilation barriers, you would end up with subjecting them to single failure. We are ending up with things like 100-some, et cetera.

What we looked at and found is that when you look at the risks associated with this break -- that will be part of this discussion -- that risk seems to be such a small part of the total risk to the plant and the consequences of that risk with the isolation valving we are going to talk about, indicate that that's an acceptable risk to have that blowdown in that building for a short period of time.

MR. MICHELSON: Now, you are going to explain later what does happen if you experience these peaks?

MR. POWER: Yes. We are going to walk through the scenarios, the isolation closures, the temperatures, the effect on the equipment, the impact, the pressurization, the time and temperature. We are going to walk through the operator actions, the whole thing.

MR. MICHELSON: The point is, I have great sympathy for not spending as much effort on low probability events. However, there are numerous regulations that require that structures now be effective and so forth. Unless we change the regulations, you still have to do it.

MR. POWER: You will find that the evaluation that we are going to discuss with you, you will find the effect for the deterministic analysis is minimal. The effect from a delayed opening and a closure of the new valve over some period of time is also acceptable. You will find that those would take care of the case that I think you are talking about here.

MR. MICHELSON: Just to get ahead of you anyway, are you still going to environmentally qualify for the 15 pounds and --

MR. POWER: Those are numbers that will come out.

MR. MICHELSON: Okay.

MR. DAVIS: Mr. Power, I meant to ask you this earlier. What fraction of the time is the RWCU on line during operation?

MR. POWER: Quite bit.

MR. MICHELSON: Virtually, 100 percent.

MR. DAVIS: Somebody mentioned --

MR. POWER: A very large percent.

MR. MICHELSON: It should be 100 percent.

MR. POWER: It's an on line system. It has redundant components to be able to switch out and move to a different pump. Again, its basis for being in operation, of course, is meeting water quality standards inside the vessel. If that vessel water quality were being met, you could take the system out of service for periods of time if you wanted to.

The barriers were of concern to you, for us to identify those barriers and indicate to you that we were give each one of those attention. We have listed them here. Finally, we have a little critique about breaks outside of containment relative to barriers, allowing those barriers to be somewhat affected. I have a few line numbers on those. I am not really going to go over them.

The last three items is, we wrote down basically in shorthand what we thought were the first principle effects on the systems from the barriers and from the event that we are going to talk about. Gary is going to go through each and every one of those and talk about the barriers, and explain why they are the basis.

We not only did the doors and we did the penetrations, but we also included the structural aspects. Finally, I guess the punch line out of this is, is that the structures and systems and barriers provide adequate protection for a wide variety of design basis. The only design basis in severe accident events that the individual containment structures, systems and barriers -- they comply with a wide spectrum of design basis requirements, that the plant containment structures will maintain their structural integrity for all design basis events.

The secondary containment in divisional zones will maintain their design basis barrier for all radiologically significant design basis breaks inside containment that involve core integrity in refueling accidents as well as breaks.

MR. MICHELSON: Are you later today, planning on going a little more into the discussion on that common ventilation system?

MR. POWER: Yes, that will be covered.

MR. MICHELSON: Okay.

MR. POWER: That, briefly, is it. We will move on to the next item.

MR. MICHELSON: I think that was a very nice, comprehensive view of the system. Now, we just have to hear the details on it.

MR. POWER: That's correct. As Craig pointed out, the next presentation is, we are going to give you now a safety evaluation. At the end of that, we are going to go right into the clean up system breaks and give you 90 minutes of specific analysis from three different individuals.

MR. MICHELSON: All right. I am hopefully correctly assuming that everything you tell us here today is reflected in the SSAR.

MR. POWER: Yes.

MR. MICHELSON: We are going to depend heavily upon your handouts and written documents as a basis for our final report. We can't possibly go back and check every chapter and verse in SSAR to see that it is carried through.

MR. McSHERRY: My name is Art McSherry. I will be making a relatively short presentation on general safety evaluations. These are studies that have been completed that are currently in the SAR, both deterministic and probabilistic for fire, flood and LOCA. Also, we will just point out that we have a reactor water clean up line break analysis in the SAR now, which we will be giving a presentation today of the new analysis on that. I won't touch on that analysis at all.

MR. MICHELSON: What revision will contain the new analysis?

MR. McSHERRY: It's 34, I believe.

MR. MICHELSON: It will appear in 34.

MR. EHLERT: Yes. You have pretty much a lot of it. The result summary basically is in this chart. It's basically going to be some text and figure changes, but the results from the previous analysis -- at least for the subcompartment's, themselves -- is still going to be the design basis.

MR. MICHELSON: All right.

MR. McSHERRY: For the deterministic analysis we have completed a LOCA analysis. We have looked at all the possible break sizes, taken the worst case single failure, and only took credit for ECCS systems to mitigate the break. The results have shown that there is no core uncovery, and the peak cladding temperature is well below the 2,200 degree F criterion of Appendix K.

[Slides.]

MR. McSHERRY: As was discussed yesterday by the staff, we have completed a fire hazards analysis also. All fire areas were looked at, and all postulated fires met the ASTM-E119 limits.

MR. MICHELSON: What does that mean? Do you mean you are just using the standard curve out of 119 as your temperature profile?

MR. McSHERRY: Right. Change in temperature on the side of the barrier.

MR. MICHELSON: Right, thank you.

MR. McSHERRY: It was shown that fire detection and alarm systems are provided in all fire areas, a fire in any area without recovery will not prevent the plant from being safely shut down. Effective smoke removal has been provided, and there have been standpipes and hoses throughout the plant in all areas that are needed to get to the fire. The bottom line for the FHA is, the ABWR fire protection program is adequate for safe operation of the plant.

MR. LINBLAD: Mr. McSherry, a fire in any fire area without recovery, there was a question earlier about whether efforts to suppress fire with fire brigades would defeat some of the separation by opening access. Has that been looked at?

MR. McSHERRY: Open access, to other divisions?

MR. LINBLAD: Yes.

MR. McSHERRY: We have three divisions, so if there's a fire in one we could have access to the other divisions. We will still have a third division for safe shutdown. We don't see any area where we lose all three divisions. We possibly could lose two due to access but not all three.

MR. LINBLAD: Where you say without recovery, you do not mean that it's intended that the fire not be attempted to be suppressed.

MR. McSHERRY: No. The assumption is that we lose that division that has the fire in it. We don't take any credit for the equipment in that division.

MR. LINBLAD: You have also looked at the activities in suppressing a fire, that might generate safety issues.

MP. EHLERT: I would like to step in here real quick. In the fire hazards analysis and in the smoke removal and in the flooding analysis, taking into account the fire suppression activities and for both the water and access through the doorways, the fire hazard analysis accounts for allowing access into a division by opening -- through the hallways, so you can enter the division that's on fire from the neighboring divisions and not affect the smoke removal.

Basically, it allows smoke removal from the division that's on fire and still have enough differential pressure across the division to keep the two clean divisions relatively clean of smoke.

MR. LINBLAD: Thank you.

MR. KRESS: I am not quite sure I understood your answer to Carl's question on the second bullet. Does that mean you went into each area and postulated fires could happen to the materials that are in there, and calculated the temperature transient due to those fires.

MR. McSHERRY: Yes.

MR. KRESS: That it's enveloped by the ASTM curve?

MR. McSHERRY: Yes. Based on the combustible loading in that fire area.

MR. KRESS: Based on the combustible loading.

MR. MICHELSON: It's not clear in reading Appendix 9-A, that you went through that process. Perhaps you did. I didn't gather that from looking at Appendix 9-A. Maybe it's somewhere else.

MR. EHLERT: Appendix 9-A, I didn't write it. At least from my own interaction with the author, a lot of it we assumed a combustible loading in a given area. That assumed combustible loading was basically in line with the ASTM-E119 curve.

MR. MICHELSON: I don't think you did that. You can't relate those two. If you are going to do it that way, you have to model the fire and the combustibles available and all that. I don't think you did that. I don't think you necessarily need to do that.

MR. EHLERT: We based an assumption based on a given flow area, how much combustibles was in a room.

MR. MICHELSON: What 9-A did, if I understand 9-A -- maybe I don't -- you went in and inventoried each fire area.

MR. EHLERT: Correct.

MR. MICHELSON: And determined thereby, the number of combustibles and the time duration during which those combustibles could combust. Then, from there, you arrived at a speculation or an observation that there isn't enough in there to burn to do much anyway and it's a non-problem area. I didn't have any problem with that.

I don't think you went in and modeled the fire, calculated its rate of rise, and looked at its temperature rise and said okay, it's under the E119 curve. I don't think you did that, but you might have.

MR. EHLERT: What you could do to get to the ASTM-E119 curve is, there's a bases based on what is burning, as to how fast you can rise time based on combustible loading.

MR. MICHELSON: I don't think you did that.

MR. EHLERT: As long as you aren't talking about oil fire, you can usually meet the ASTM-E119 curve with the types of loadings that we have.

MR. MICHELSON: I think those are all correct statements. I just don't think you actually did the -- I think Dr. Kress was asking you if you modeled the fire and determined it was under that curve. I don't think you did.

MR. EHLERT: We did some checks, to make sure that our assumptions on combustible loadings fell in line with our curve. We did not model every single room to verify the assumption.

MR. KRESS: I guess the follow up question is, did you then go ahead and use the ASTM curve for your basis for the environmental effects as opposed to a real --

MR. EHLERT: Yes. We had to use our qualification for three hour fire barriers, yes.

MR. MICHELSON: Just for the edification of the Committee, one has to be very careful in using this on doors. If you go back and look at the door spec -- I think that is the E119. That's the wall spec.

MR. EHLERT: I think E119 is the wall spec.

MR. MICHELSON: The door spec is E152. If you go back and look at it, it uses the same time temperature profile. The difficulty is, you start reading the fine print and you find that the back side of the door, its temperature can vary, all the way from being within the limits of E119 to rising to very large values after 30 minutes. E119 only goes out to 30 minutes. Three hours of so-called arbitrary qualification time, you can have temperatures as high as 650 degrees. It says right in the standard. You can have temperatures up to 650 degrees on the back side of the door at the end of three hours.

Then, it cautions you, if this is a problem then you have to do something about it. It's a problem, when people try to get out of a building and you depend upon a fire door and it's too hot to walk by it.

There's a lot more to it. I don't think that for ABWR we should even get into it. Ivan is aware of it, and he's going to look into it later. There's more to it, than just the temperature time profile, a lot more to it. For walls it's pretty good. For doors, it isn't good at all. I guess they did it differently for doors, because they couldn't qualify a door to stay under 250 for three hours.

MR. EHLERT: Doors, you still want leakage. If you don't have leakage you are not going to be able to open the door.

MR. MICHELSON: There's all kinds of problems with doors.

MR. EHLERT: Yes.

MR. MICHELSON: In trying to qualify them. For walls, it's straightforward. At any rate, enough said. I don't think we pushed that point further on ABWR.

MR. McSHERRY: The next deterministic analysis we completed was a flood. ANS 56.11 line break in lines greater than one inch, with no credit for sump pumps or credit for operator action to terminate the flood. High energy line breaks were terminated by automatic action within one minute. Single active failure was assumed, the worst case single active failure.

All the buildings were evaluated, and it was determined that all potential floods could be terminated with no loss of more than one safety division.

MR. MICHELSON: You might want to check that bullet that says you terminate within one minute, unless you have changed reactor water clean up.

MR. EHLERT: It's 76 seconds.

MR. MICHELSON: You have 45 seconds to begin with, and then it takes about 30 seconds to close, so you are well over a minute. It's roughly a minute.

MR. EHLERT: It's 76 seconds, total, to closure.

MR. MICHELSON: That's a little more than a minute.

MR. McSHERRY: That's the worst case. If it closes on high temperature it may close sooner. If it closes on high flow it would take 76 seconds.

MR. MICHELSON: I don't think you built time delays into any other isolation except reactor water clean up.

MR. EHLERT: No.

MR. McSHERRY: Only for high flow. For high temperature, the time delay is not built in.

MR. MICHELSON: No, but the high temperature has its own inherent instrumentation delays that might be that significant, depending on where the break is relative to where the thermal couples are.

MR. POWER: Now, with the kind of blowdowns that we are going see into that steam tunnel let me tell you, there's four levels of temperature sensors and four different systems that are going to close those valves.

MR. MICHELSON: I am referring to clean up, not to main steam tunnel.

MR. POWER: Once they close the main steam, they are indirect closures on the clean up system.

MR. MICHELSON: I was talking about the break on the reactor water clean up to begin with. The steam tunnel has nothing to do with it then. The steam tunnel sees it, but it sees it very late in the game, as that last blowout panel opens to relieve in that direction.

MR. McSHERRY: Late in the game as you will find out later, is very quickly, within seconds. It's not that late. We will go through that later on.

MR. MICHELSON: Okay.

MR. McSHERRY: It sees it very quickly.

MR. MICHELSON: All right.

[Slides.]

MR. McSHERRY: The probabilistic analysis that has been completed, we have completed a level one PRA using standard fault tree and event tree methodology. That has shown that for all postulated accidents or all potential accidents, LOCA, transients, including ATWS, that the core damage frequency is very low. It's 1.6 E to the minus seventh per year.

This meets the NRC goal of 1 E to the minus four, as well as the EPRI goal of 1 E to the minus five, by a large margin.

The largest contributor to this core damage frequency is station blackout. Station blackout is approximately 70 percent of the total core damage frequency.

MR. DAVIS: Excuse me. That figure at the top, 1.6 E to the minus seven excludes any contribution from seismic, fire or flood.

MR. McSHERRY: Yes, that's true.

MR. DAVIS: Which, from the numbers I have seen elsewhere would be significantly larger than that.

MR. McSHERRY: We don't believe so, no.

MR. DAVIS: At one time in Appendix 19 there was a fire CDF quoted at 1.4 times E to the minus six.

MR. McSHERRY: As we will show in the next slide, we believe that the core damage frequency due to fire is much less than ten to the minus six.

MR. DAVIS: The original seismic number was considerably larger than that also.

MR. McSHERRY: Right.

MR. DAVIS: Anyway, that's just internal events.

MR. McSHERRY: Internal events, yes.

MR. MICHELSON: What is the situation now on doing the external events since they have become much more site specific? Is that a COL action item, for the PRA to incorporate external events?

MR. McSHERRY: We have done some external events, but it's COL applicant item to confirm based on site specific information.

MR. MICHELSON: Would that be a level one PRA again, or are they required to go all the way to level three? Does that even specify it anywhere. It would have to be in the SER if it was going to be a requirement. What is the requirement for updating the PRA?

MR. POSLUSNY: I don't think we have specified it in the SER currently. Probably in the -- I think we have a paper that Jerry has been writing on the application for the combined license, and there might be something in there. I can't recall.

MR. DAVIS: I thought he said there was some SECY paper that's up for a Commission approval that specifies the requirement.

MR. MICHELSON: I thought it had been settled, but perhaps it hadn't.

MR. DAVIS: I think that even if the SECY paper is approved, the COL is only obliged to confirm the seismic margins assessment and the five methodology work that was done. He did not do a whole PRA on the external events.

MR. MICHELSON: The PRA that we have now is based on best knowledge of conceptual designs. It isn't based on actual design. Is there going to be a requirement to bring the PRA up to actual design.

MR. POSLUSNY: Let me check on that. I will get an answer.

MR. MICHELSON: Unless it's specified, it isn't required.

MR. McSHERRY: The next probabilistic analysis was the fire PRA study. As discussed yesterday through discussions with the NRC, we have used the EPRI Five methodology. Five provides procedures for determining what the loading in each fire area is. It's basically a screening analysis, in combination of using fault trees in the level one PRA.

It was determined from that analysis that all the fires were screened out, and that the CDF for fire is much less than 1 E to the minus six, although there is no actual number on that since it's just a screening analysis.

MR. MICHELSON: The assumption is, I guess, if everything screens out under Five, then it's apparent that the CDF must be much less than ten to the minus sixth.

MR. McSHERRY: Yes.

MR. MICHELSON: That connection I don't think was ever made in the five methodology was it, that if you follow my prescription it is guaranteed you are going to be much below ten to the minus sixth? Is that made in the Five methodology.

MR. MCCRACKEN: The screening criteria for five is ten to the minus six. So, the only way you can screen any event out in any area is, it has to be less than ten to the minus six. What they are saying is, if they went through and they all screened out, then they are saying it must be.

MR. MICHELSON: One of them could have been just a tad under ten to the minus six and screen everything out. But that doesn't mean much, much less.

MR. MCCRACKEN: Right. As I recall, when they went through the Five methodology everything did screen out the first time through. They went through the Five methodology and made some modification to their design. Once they made the modification to the design, then they screened out.

MR. McSHERRY: Yes, that's true.

MR. MICHELSON: I think the only conclusion you can reach is that you are equal to or less than ten to the minus six, not much less. I don't know what that margin is from the Five methodology. I just know that that screening criteria was passed on an individual examination basis. Therefore, it must be passed in total.

MR. MCCRACKEN: I, personally, wouldn't put a lot of reliability in any number less than ten to the minus six. That's a matter of personal opinion.

MR. MICHELSON: I am going to quibble slightly with it being as big a margin suggested by that double there.

MR. McSHERRY: The last probabilistic analysis that we completed was the flooding PRA.

MR. MICHELSON: To follow up on that same point, since the total is coming out ten to the minus seven, this is a significant point if the fire is ten to the minus six. They are claiming 1.6 E minus seven for the total.

MR. McSHERRY: The Five methodology is conservative.

MR. MICHELSON: Everything we do is conservative. I don't know quantitatively how conservative and I am not sure that you do either, unless you have done something more than just Five.

MR. McSHERRY: We haven't.

MR. MICHELSON: With Five, I think you are bounded to say it's less than ten to the minus six, which could be then a major contributor or a significant contributor.

MR. DAVIS: Still, way below the --

MR. MICHELSON: But all below the goal.

MR. KRESS: The only way to answer that question is to actually go ahead and do a full PRA.

MR. MICHELSON: Yes, that's right.

MR. LINBLAD: Mr. Chairman, when you speak of below the goal is the goal limited to internal events?

MR. KRESS: I don't think the goal ever specified just internal events. It meant the full spectrum.

MR. LINBLAD: Because the analysis is silent on external events, we really don't know if the design meets the goal; is that right?

MR. MICHELSON: That's right. We do though --

MR. KRESS: We have a good idea.

MR. MICHELSON: We have a good idea. From the Five methodology, at least we feel it's in the ten to the minus six range for fire. If the rest of it is 1.6 ten to the minus seven, then fire is a contributor to that.

MR. KRESS: We are not sure about the seismic, though.

MR. MICHELSON: Yes.

MR. DAVIS: I think it's worth saying that if you look at the PRA methodology for fires in seismic it's hard to fulfill the intent without having the plant. Both of them require significant walk down and inspection to look for combustibles and look for ignition sources and so forth. I think in retrospect, trying to do a PRA with a plant that doesn't exist for fires and seismic is very difficult. It would be hard to defend, because you don't have as-built information and know where all these things.

MR. MICHELSON: But, on the other hand, you shouldn't oversell it as to how low it might be.

MR. DAVIS: I agree.

MR. MICHELSON: Or high, for that matter. We know it's somewhere below ten to the minus six.

MR. POSLUSNY: Let me give you a quick feedback. In our SECY paper we really didn't talk as far as the COL application, that it will require full PRA. It's our belief -- and when we revise the paper -- we will be asking for the so-called living PRA to reflect site specifics and as-built.

MR. MICHELSON: In our final report to the Commission, Pete, I think you probably should say some more words about our recommendation concerning the need for upgrading of the PRA for internal and external events as well, if that's the way you see it. Then, we can discuss it.

MR. DAVIS: I agree.

MR. McSHERRY: As far as the flooding PRA, we looked at all potential sources. We did not take for a design basis crack, we assumed the worst case double-ended shear. We determined that the building of concern were the reactor control and the turbine buildings. As in the case of the deterministic analysis, we did not credit the sump pumps.

Operator actions to terminate the floods were modeled. We looked at some common cause failures, mostly opening of water tight doors due to maintenance or operator errors. There was a bounding analysis. We did not do the level of flooding PRA that was done in the level one PRA. We have a total CDF that was less than two times ten to the minus eight per year for all floods.

MR. MICHELSON: Your flooding analysis, at least the one that read, seemed to be dealing with water on the floor and what its elevation might reach and what equipment you might lose. It didn't deal with the spraying of the water or the cascading down on the equipment. The reason it didn't is, you didn't know where the equipment is for sure yet.

MR. McSHERRY: Also, we have stated that the equipment will have spray shields on it, and the motor control centers will be NEMA type 4. We did not look at spray, you are right.

MR. MICHELSON: It probably, if you take the adequate precautionary design measures such as the adequate specification of the panels and so forth, it's probably a non-problem. We will look at the adequacy of your words on how well you are going to protect the equipment. The words always got a little fuzzy when you started to read t[illegible] as to what was meant. Splash shields are one thing. Splash shields, alone, won't take care of -- drip shields alone won't take care of water.

You don't even have to spray. You can spray from the side and get into the equipment. Drip shields only handle things directly from above.

MR. McSHERRY: That's true.

MR. MICHELSON: Even in big quantities.

MR. McSHERRY: That's true, yes.

MR. MICHELSON: It gets a little flaky, but it's a good precautionary measure to at least have drip shields on the equipment. That seemed to be provided. Flood is more than just water rising on the floor.

You have eliminated, I think, the curbing from most areas. Is it clear from the SER or will be from the SAR, where you still have curbs. Will the drawings be revised to show which doors are curbed and which aren't curved?

MR. EHLERT: The drawings may not be revised. I am not sure how much more further revision they will do for the SAR.

MR. MICHELSON: How do we know where we still have curbs?

MR. EHLERT: In the flooding analysis right now, we are assuming we will have it very specifically called out where we require curbs to meet the protection requirements for the equipment.

MR. MICHELSON: In other words, I can't go to the drawings anymore to know where the curbs are. I would have to go to the flooding analysis.

MR. EHLERT: Correct. It is our belief that the owner/operator, when he installs equipment, may put in additional curbs for investment protection.

MR. MICHELSON: It's been a little difficult for me to determine how in an ITAAC for instance, the inspector knows whether there's supposed to be a curb on the door or not. Are you going to upgrade the ITAAC drawings at least, to make sure that the doors that are curbed are indicated on those drawings?

MR. EHLERT: The curb requirements on the ITAAC drawings are in place. There are no curbs required to meet the requirements.

MR. McSHERRY: The only doors that were assumed were the --

MR. MICHELSON: One simple way to do it is, just say we haven't got curbs anymore, anywhere.

MR. EHLERT: As far as the safety evaluation, you are correct.

MR. MICHELSON: That's going to be a little bit of a difficulty.

MR. EHLERT: There's only one area, per se, where curbs are required. One is in the bottom floor of the basement where we use water tight doors to protect ECCS compartments. Then, we have a requirement both for -- basically water tight door and penetrations above the floor.

MR. MICHELSON: You are going to -- I will have to see what your final answers are. Flooding in that control building from the higher elevations -- those big water lines going to the chillers, if one of those breaks --

MR. EHLERT: That issue, we have proposed. The other curb that we have is basically the computer floor. The computer floor will be curbed off.

MR. POSLUSNY: We are going to need those drawings consistent with the analysis.

MR. MICHELSON: I would hope so.

MR. POSLUSNY: In the final amendment.

MR. MICHELSON: There's always a point in time where do you quit. I would be a little disturbed. The quality of the control building drawings is not very good to begin with. It's not getting any better when you start changing things, and you can't tell from the drawings anymore what's there.

MR. MICHELSON: It's really something that should be fixed. I don't know if the Committee will feel strongly enough to say it in a letter. The drawing quality is very poor in some areas and particularly the control building. It's downright unprofessional.

MR. LINBLAD: That's part of an artifact, that we aren't dealing with an actual plant. We have some specifications for a future plant that is not realized yet.

MR. MICHELSON: I would have sympathy with that argument, except you go to the reactor building and those are very good drawings. It's very well indicated. The Japanese drew the reactor building and GE has done the control building, and they just haven't done the same level of professional control.

MR. EHLERT: The other thing is, the Japanese are building that reactor building.

MR. MICHELSON: That's all right. But that's no excuse for turning out an unprofessional drawing. We will get to it later today, but I have some real troubles even reading the drawings. If I can't read them, then there has to be something wrong. They don't even use conventional architectural symbols in it. They don't even tell you what their symbols mean.

It just is a little sloppy, at best. At any rate, I would agree with the staff. At this stage, what do we do. It bothers me, that I go to the security drawings and see one thing and go to the fire protection drawings and see something else, and go to Chapter 1 drawings and see something else. They just aren't consistent, and they ought to be consistent. It's all the same drawing.

Obviously, different stages or something -- people have been going in and even marking them up, in the case of fire protection. I don't know where they are at.

MR. LINBLAD: Aren't we going to lie on the textual statements?

MR. MICHELSON: Yes, I guess so. Except that, there's a whole lot of things in the drawings that aren't necessarily described in the text well enough to tell you. The text doesn't describe where a door is. It doesn't tell you whether the door is curbed or not. You look at a drawing and you see a door. You don't need to describe it.

MR. LINBLAD: Doesn't that suggest then, that the location is not fixed, if it's not shown in the text as being fixed?

MR. MICHELSON: No. I don't think anybody has proposed that drawings are for information only, and only the text counts as a design basis. If that's true, that would be a nice statement to know.

MR. LINBLAD: I guess that's my assumption.

MR. MICHELSON: It hasn't been my assumption. I have been relying on the drawings to convey the information that's needed for evaluation. If it's for information only, I can't evaluate safety from it.

MR. POSLUSNY: More importantly, the information we pull to the DCD which will include drawings.

MR. MICHELSON: The ITAAC drawings don't correspond with the Chapter 1 drawings necessarily, either. It's a clean up job that just isn't finished, I think is the problem. It must be that the manpower or whatever problems are just keeping them from cleaning the documentation up. I think the staff is experiencing the same kinds of difficulties, and they look at it in much greater detail than we do, obviously. They have 100 people that look at it.

If the staff disagrees that they are in fine shape, they should speak up.

MR. MCCRACKEN: I think this is one where we fully agree with the Committee, that we have to have consistency from Chapter to Chapter and tier to tier, because this is part of a rule. If you have inconsistencies in the rule when it comes time to build one, there's going to be a whole lot of disagreement and lawyers getting rich, based on whether you were supposed to do it this way or the other way based on the drawings.

MR. MICHELSON: I think you find the problem will come up when you try to get it certified. Lawyers will tear you apart with inconsistency. They will tell you the thing isn't ready, go back and do it again.

MR. MCCRACKEN: They are not as thorough as you are, Carl.

MR. MICHELSON: You might be surprised. At any rate, I have given up on that. We are at the end of the game.

MR. McSHERRY: That concludes our presentation on general evaluations. Now, we will get into the specifics of the reactor water clean up line break.

MR. SAXEMA: I am Umesh Saxema from General Electric. Under this specific evaluation I will be covering two analyses, one for the pressurization in the compartment due to the spray in the water. The second analysis that we have done and was not presented before is, what to be the cool down rate in each compartment in order to make sure that the temperature response of the compartment is within the temperature profile.

[Slides.]

MR. SAXEMA: First, will be the pressurization analysis. As John Power mentioned it is not all together a new analysis. It is basically an updated revision of existing analysis. This is wrong. This is the design basis compartment pressure temperature analysis. What we have done in the revised analysis is, we have taken credit for some opening in volumes in pressure calculations. That is, by taking credit for some of the natural paths which were ignored in the previous analysis.

We have maintained the same break blowdown both respect to the valve opening time and closure, et cetera. In addition to that, we have performed the analysis for the temperature response. In this analysis, our intent is not to model the phenomena as such, because that very complicated task. What we have done here is, we have taken a very simplified approach in order to get the bounding response temperature curve.

MR. MICHELSON: On that bullet you say you considered and modeled the structural heat sinks.

MR. SAXEMA: That's correct.

MR. MICHELSON: We are talking about transients that undergo -- that are so fast, that I am not sure heat sinks have much to do with the peak pressures and so forth.

MR. SAXEMA: In my pressure calculations we did not take any for the heat sinks.

MR. MICHELSON: Okay. It's just too fast to be significant.

MR. SAXEMA: That's correct. In addition to this, we have also evaluated about the beyond the design basis conditions, that one-eight of the valve does not close as designed, and see what kind of pressure and temperature should be expected.

MR. MICHELSON: That's not beyond the design basis for one valve to fail to close, but it is for two.

MR. SAXEMA: Exactly. Just to give you an idea, briefly, as we said earlier we took credit for some of the openings. As a result we expect some lower pressure in the compartments. Our assumption is the same double ended break, and the compartment doors open as the blowout happens. We are now taking credit for the entrances, the doors which open on pressurization. We also take credit for communication between other compartments.

As you saw earlier, we evaluated the two breaks as we did earlier. We are taking credit for some more openings. We analyzed both the clean water break and the RCIC break. For the clean water break we have taken the worst which is 76 seconds. For the RCIC break it is same as earlier, 41 seconds.

MR. MICHELSON: In doing your calculations, are they sufficiently sophisticated to do the transients within corridors, for instance?

MR. SAXEMA: Yes, sir.

MR. MICHELSON: The reason is, in some cases you have a divisional door in the corridor very near the door that blows out from the pressurization of the break. If you don't do a good enough calculation you may not be sure about the integrity of the barrier door between the divisions. Do you follow what I am saying?

MR. SAXEMA: Yes. We took it into our calculations.

MR. MICHELSON: You have done a true transient calculation in the corridor as well.

MR. SAXEMA: That's right. Wherever the door opens. Very briefly, the kind of blowdown for the clean water break. This is the time in seconds. This is the flow rate in time per second. The initial blowdown which you see up to eight seconds, is the contribution from both sides of the line from RPV side and BOP side. As we found out, most of the pressure damage is done in this timeframe. It's basically that the pressure starts leveling of.

MR. MICHELSON: This is all based on the isolation valves remaining fully open, these numbers on this chart. Is that including the valve closure, and this is a chart of what's happening with time?

MR. SAXEMA: That's correct.

MR. MICHELSON: This is with valve closure.

MR. SNYDER: As you can see over here --

MR. MICHELSON: I guess it has to be, because it goes to the --

MR. SAXEMA: The valve starts closing before. The valve starts affecting the flow when the valve is less than the --

MR. MICHELSON: In doing the calculation, have you taken account of the travel then, your orifice effect as the valve is closing.

MR. SAXEMA: Yes.

MR. MICHELSON: It seems to be too flat, if you are really doing that.

MR. SAXEMA: The valve area is much larger than the --

MR. MICHELSON: It's about a 3X, I assume.

MR. SNYDER: Yes, that's right. The valve effect you can see comes over here.

MR. MICHELSON: You are saying I am seeing the 3X along that flat portion.

MR. SAXEMA: That's right. Just to go quickly over modeling assumption. As I said earlier, we modeled each compartment and assumed the mixture of air is clean. As I said, this pressure analysis is short duration. We did not take credit for any heat transfer in the component walls, no kind of heat cooling or heat transfer.

In addition to that, since we are taking credit for the door opening, we also did some sensitivity analysis, what if the doors open at 1.5 psig and what if the doors open at 5 psig. All this is factored into our final calculations. As I said, about the calculation, the break flow is determined by the three components, the time of delay and closure time. For the blowout panels they are assuming to open at .5 psig.

MR. MICHELSON: Have you actually looked at typical doors at least, and tried to reach a conclusion as to what pressure a door is likely to blow out like a panel?

MR. EHLERT: The main compartment doors we are looking at, they open outward. When you go into the compartment you pull the door open toward you, and you walk into the room. What we are assuming is failing is the latch, basically, is the only thing that has to fail.

MR. MICHELSON: The differential pressure across the door uniformly distributed, does that latch unlatch?

MR. EHLERT: It doesn't have to be very high, because basically as soon as the door starts to warp you pop it.

MR. MICHELSON: Right. I was just wondering if you actually got any numbers on when the door opens.

MR. EHLERT: I know from construction experience you would take a cart with a valve on it and run into some of these doors and pop them open.

MR. MICHELSON: That's also -- actually, people have pressurized compartments with CO2 systems, they think at about a pound they blew open. You also at Quad Cities compressurized the compartment and blew the doors off. I don't know if anybody ever tried to back calculate to see what the pressure might have done there.

MR. EHLERT: The reason we did the sensitivity analysis was to make sure that if we go in and assume that a door is open at one psi and by some imagination somebody put in a strong door and it blows it -- the pressurization and calculations --

MR. MICHELSON: What I am really getting at is, does the door open before the blowout panels open.

MR. EHLERT: I would say not. Some rooms don't have blowup panels, they only have a door.

MR. MICHELSON: One-half pound loading on a door is already substantial loading.

MR. McSHERRY: As I understand, the door doesn't open for 1.5.

MR. EHLERT: Right.

MR. MICHELSON: That's why I asked him, does he have data that says the door will stay closed until 1.5. It makes a big difference on whether this thing propagates out through blowout panels or propagates out through the door into the corridor and spreads itself in the building faster than it goes through the blowout panels.

We may not even blow all the way to the main steam in this thing, depending on what assumptions you make in the calculations.

MR. EHLERT: Correct.

MR. MICHELSON: These doorways are very large.

MR. EHLERT: A lot of it depends on where the break occurs. In some rooms for instance, there is only the door. There are no blowout panels.

MR. MICHELSON: I think the conservative way to do this is to assume that the doors open instantaneously.

MR. EHLERT: If you look at the --

MR. MICHELSON: Then check to see if the blowout panels will relieve as well, or whether it all relieves into the building through the door.

MR. EHLERT: If you look at the time differential between rooms -- most of these compartments are from one-half psi to 1.5 psi -- you are talking about micro seconds.

MR. MICHELSON: Where the break is, I agree with you completely. I was more concerned with whether or not I ever got any relief to the main steam chase from a blowout in the basement of the building. I am not convinced that the main steam -- that steam ever gets to the main steam chase unless you convince me with the calculations.

MR. EHLERT: In some breaks it does not -- only a fraction of it gets there.

MR. MICHELSON: I think that it all blows into the building.

MR. EHLERT: Right.

MR. MICHELSON: That was the only reason that I pursued that.

MR. SAXEMA: The design pressure, the maximum pressure which I defined for the structure design are not differential pressure but the calculated absolute maximum pressure in each compartment, so also the temperature.

This gives you a typical of our nodalization scheme for our model. The model, what it does, it models each compartment. This is the compartment where the break is. This is the corridor that this bottoms out at the next corridor level. It is connecting to the refueling floor on the top.

As I was telling earlier, in a previous analysis we took only credit for the partial volume of this. In this new analysis we have extended the volume, over here. This is the case, which is communicating to different corridors. I tried to put this bar which will give you some relative locations of each box. So that, because you are talking about the corridor and this level and this bottom level, I tried to give some feel about this reactor position.

MR. MICHELSON: That's a new wrinkle on your calculation, using the staircase. That wasn't in your earlier calculations.

MR. SAXEMA: That's correct.

MR. MICHELSON: It looks like that might be a significant bypass and it might very well that that's the way the steam gets into the upper reaches and distributes in the building, and you never relieve to the main steam chase.

MR. SAXEMA: You are right.

MR. EHLERT: Depending on the break location, you are probably right.

MR. MICHELSON: Yes, depending on the break location.

MR. SAXEMA: The similar chart for this RCIC line break.

MR. MICHELSON: In your previous calculations on RCIC you had some fairly significant pressures. I don't remember the numbers now. They were almost as big as reactor water clean up in certain areas where the RCIC was located.

MR. SAXEMA: In some spaces, yes.

MR. MICHELSON: But they would not have the capability of pumping up the building the same way, because we are talking about much smaller lines and so forth. It was a big break for that area, even for reactor water clean up.

MR. SAXEMA: This is the same layout, showing the location for the clean up water break and RCIC break. This is showing common pipe --

MR. MICHELSON: Before you flip that one off, you can help me. Here's at typical case of where I couldn't read the drawings. In the lower left hand corner there's a funny little -- in the lower right hand corner there's a funny little mark on the corridor. Go the far right hand corner. What is that thing, that little barrier in the corridor.

MR. EHLERT: It's a sliding door.

MR. MICHELSON: It's not a door and it's not labeled, and I have no nomenclature. Is that a sliding door?

MR. EHLERT: Sliding door, motorized sliding door.

MR. MICHELSON: Is it a water tight sliding door?

MR. EHLERT: No. It's just a fire door.

MR. MICHELSON: Just a fire door, okay. How do I know that? Is there a nomenclature somewhere that tells me how to read this drawing, and does the future designer know what you intend it to be?

MR. EHLERT: This is taken from the tier one. The Appendix A of tier one there's a nomenclature list and a key index to the drawings.

MR. MICHELSON: I don't recall that -- I looked at it once, but I haven't had time to look at the latest edition. Is that defined, that symbol defined?

MR. EHLERT: Yes, it is.

MR. MICHELSON: In the ITAAC?

MR. EHLERT: Yes, it is. Back in the Appendix there's an index.

MR. MICHELSON: I will go back and look for it.

MR. DAVIS: Is that MSW on there for motorized sliding --

MR. MICHELSON: Mine doesn't have a MSW on it.

MR. DAVIS: I can't tell for sure what it is.

MR. MICHELSON: It's lower right hand corner, there's nothing on it.

MR. DAVIS: I thought you were talking about in that bar.

MR. EHLERT: It's HCW.

MR. DAVIS: Thank you.

MR. MICHELSON: This is one case where I was looking at it and could not -- the symbols didn't seem to match. That's true of the upper right hand corner too, that's a motorized door as opposed to a swinging door. Symbols would help a lot, nomenclature. If it's in there, I will look for it.

MR. SAXEMA: As a result of the analysis, taking credit for the corridor volumes, I will now calculate at peak pressure in the compartment of the rooms are well below the previously calculated 15 psig number, which is about in new calculations maybe five or six psig. However, the design of the room does not change. That means that the pressure which I used for the design, it's still 15 psig.

MR. LINBLAD: What does that mean, if the doors certainly can't take 15 psig. What are you saying the design pressure is, to contain a volume?

MR. SAXEMA: To contain a volume.

MR. LINBLAD: But it doesn't contain a volume if the doors spring open at perhaps one and one-half pounds.

MR. SAXEMA: What happens, it may take a little bit of time for the pressure to rise because the blowdown is coming into this -- it depends on how fast you need the pressure build up in that room where the break is.

MR. LINBLAD: I suggest that what you really mean is, the walls will resist at 15 psi differential pressure?

MR. SAXEMA: That's what I was coming at.

MR. LINBLAD: But it's not the room that resists it, it's the walls and floors.

MR. SAXEMA: The integrity of the walls of the rooms.

MR. LINBLAD: Thank you.

MR. SAXEMA: I was about to come to that. The pressure in the corridors at these two levels is below four psig, which is much better than originally what we were calculating 15 psig.

MR. MICHELSON: That's a peak pressure, just outside of the door that blew out.

MR. SAXEMA: That's right.

MR. MICHELSON: Is that where that is?

MR. SAXEMA: That's right. This is the peak pressure in the secondary containment which is about two psig.

MR. MICHELSON: In the drawing that you showed us for the minus 1,700 elevation, you show a double door in the corridor right outside the doors where the clean up systems are. Am I talking about that door designed for five pounds or is that one --

MR. EHLERT: No. That door is just a standard fire door. That door is not designed to take any pressure.

MR. MICHELSON: It isn't designed for anything. That's one of the barriers that will -- doors that will swing open.

MR. EHLERT: Right. The air is assumed to be going up the two stairwells in the upper left and lower right.

MR. MICHELSON: Depending on where the break is and so forth, I don't know where the air is going. It isn't always going up the stairwells. It's coming out the doors of the compartment that has the break in it first. Those double doors clearly, will not take much differential pressure before they open.

MR. EHLERT: Correct.

MR. MICHELSON: That is a divisional barrier.

MR. LINBLAD: Could I ask again, what was the goal, to protect the structural integrity of the building or to maintain separation?

MR. EHLERT: The objective is to come up with the correct EQ temperature and pressure for the equipment that is basically in the path of the blowdown, and to come up with a correct pressure and temperature and structural evaluation to make sure one, we don't cause a failure to the structure due to the break.

MR. LINBLAD: So, divisional separation is part of the issue; is that right?

MR. EHLERT: No. We allow divisional separation to fail. The only separate barriers that we protect are the ones between the secondary containment to the clean areas or electrical equipment areas outside.

MR. MICHELSON: Those doors you will design --

MR. EHLERT: There are no direct door connections. It's only pipe paths.

MR. MICHELSON: There are doors there as well.

MR. EHLERT: Not to the electrical areas.

MR. MICHELSON: No, but to the control building. You don't want to -- get this in the control room building either.

MR. EHLERT: Those are already double -- sliding, motorized doors.

MR. MICHELSON: Are they designed for whatever peak pressures you are calculating to be experienced inside of secondary containment at that location.

MR. EHLERT: Yes.

MR. MICHELSON: If they are, you are all set. That may be perhaps five pounds.

MR. EHLERT: It's two psi at the location.

MR. MICHELSON: Two, at those locations, okay. That's still pretty good.

MR. LINBLAD: That was an interesting question. I am not sure that I understood the answer. Are you saying that joiner doors will be designed for two pounds?

MR. EHLERT: Correct.

MR. MICHELSON: These are doors between the --

MR. EHLERT: Between the reactor building to the control building there is a --

MR. LINBLAD: Joiner doors look like that.

MR. MICHELSON: No.

MR. EHLERT: No. There is three passage ways between secondary containment back toward the service building, to the change areas. In those passage ways there's double motorized doors to provide an airlock, to go from the secondary containment negative pressure to atmospheric at the service building. These will be designed for two pounds.

MR. LINBLAD: Thank you.

MR. MICHELSON: As I understand it, those are the only doors that will be designed for a specific differential pressure; is that correct?

MR. EHLERT: Correct.

MR. MICHELSON: All other doors might swing open, depending on the break location.

MR. SAXEMA: This will show you the new pressure calculations. As you can see, the peak pressure in the room where the break is, is now about 19 psia. That shows major pressure values.

MR. MICHELSON: These are a little higher than you have been calculating in the past, I thought.

MR. SAXEMA: These numbers.

MR. EHLERT: In the past, we were up around 21 and 22 psia.

MR. MICHELSON: I thought we were up around 15 or even less.

MR. EHLERT: That's gage, 15 gage, which would be 30 psia.

MR. MICHELSON: I am sorry. I am just slow today.

MR. SAXEMA: That gives you kind of a temperature time history in each compartment. As a result, when peak temperature is about 221 or so which is well below the earlier peak temperature, and similar occurs, let me go through it quickly. For the RCIC line break -- and you can see the pressure is much smaller. The temperatures for the RCIC line break are kind of little bit higher.

In the RCIC room where the steam is super heated because of steam break, we see much higher temperature. These are the temperatures curves which were used in specifying or designing what we call the EQ temperature profiles.

What we did, we calculated the peak temperature which will be seen and we took that temperature and let it continue for six hours before we give any relief. After six hours we allow the temperature to drop to 66 degrees C. What we did here we said okay, this will equal temperature profile. The temperature analysis which we will be discussing later on was also to confirm that indeed my EQ profile is realistic and bounding what the real temperature response I can see.

My next presentation will be dealing with not pressurization but giving the same kind of break scenario, same kind of compartment nodalization. What will happen to my temperature in the compartment, as I allow or take credit for my cooling effect. As a function of time my temperature will change in the compartment and that, I will compare with my EQ temperature profile.

MR. MICHELSON: This is all just to arrive at a temperature profile for equipment qualification purposes?

MR. SAXEMA: That's right. I would like to make it clear here, that my temperature analysis, if I look from realistic point of view, it will be a very complicated phenomena. It will be the pressure difference and the temperature difference, and how the temperature will be adjusting from room to room.

What we have done here, we have taken a very simplistic approach to simplify my model. I will discuss the rationale for that. I said in this analysis we are taking credit for the heat sinks. Where the heat sinks are concerned, there are many sources. We have limited analysis to heat sinks, which are primarily concrete surfaces. There is the floors, walls, ceilings and internal walls.

We have not taken any credit for the equipment in the building like pumps, motors, et cetera. We also have not taken any credit in the analysis for the coolers which are in the room. Also, we have not taken any credit --

MR. MICHELSON: The coolers won't do you any good at the temperatures you are talking about. They are just being loaded up. They might trip out the chillers and whatever from overloading the chillers.

MR. SAXEMA: That's right.

MR. MICHELSON: It's just not going to help you a bit. Furthermore, taking credit for the heat sinks and the walls is fine, but you now have to also add back in the heat sources in the room.

MR. SAXEMA: I agree.

MR. MICHELSON: The coolers are not going to be able to do anything about the heat sources in the room. In fact, I think you are -- if you want to get a little more sophisticated you better go back and start looking at how chillers respond when you suddenly heavily overload them by putting this high temperature steam onto the air handling units and watch the water temperatures go. The chillers will trip out. They won't handle those high overloads.

MR. MCCRACKEN: I agree.

MR. MICHELSON: That's very high overload on the chillers. They want to become big condensers, and they weren't put in there to become big condensers.

MR. SAXEMA: For this analysis, we considered a break at the bottom floor. We considered two cases, what we call the design basis case, that the isolation valves close automatically as designed, 76 seconds. In the second case we considered the design basis conditions, what if isolation valves do not close. Then, we take into account whatever the operator actions will be taken.

As I said, again, it is simplified and conservative. Let's see what I have more to say.

MR. MICHELSON: On the operator action then, at what point in time did you consider the operator closed this new valve?

MR. SAXEMA: As a matter of fact, I ignored that operator action in my analysis.

MR. MICHELSON: You did.

MR. SAXEMA: You will see that.

MR. MICHELSON: Okay.

MR. SAXEMA: As a start, the whole secondary containment building, rather than taking each and every individual route and cubicle, I have divided it into three major interconnecting compartments, taking the volume from bottom floor to the next floor. When we did the case for the isolated case, the design basis event, it should have taken credit for the secondary containment building volume. I have limited my break flow, all energy flow into the bottom compartment.

For un-isolated case, which is where the valve does not close as designed, I have taken credit for the entire containment volume, on the understanding that once the break is established and I do not take credit for any operator action, I will have a situation -- my break is coming from the broken pipe. The entire flow will be going to the top of the building. Very soon, you will have a quasi-steady state condition.

For that reason I assumed my entire containment volume is included. Coming back to the structural heat sink model as I said, we took only boundary walls at this floor and internal walls, and we neglected any internal walls from the down level all the way to the top. Once again, you will see here, no credit for the pool in the refueling floor or other equipment.

In terms of the heat transfer mechanism between the compartment volume and the structural heat sinks, I have limited my calculation to convection heat transfer only. That means, we have not taken any credit for the steam condensation effect because of the cold surface. My heat transfer mechanism is purely based on natural convection and what effect I had.

This is one more kind of conservatism which I believe everybody agrees is a very conservative assumption.

MR. KRESS: Your natural convection heat transfer coefficients need a length and Delta T.

MR. SAXEMA: Yes, correct.

MR. KRESS: The Delta T, of course, is transient.

MR. SAXEMA: We calculate this convection based on the Delta T. As the time goes by the heat transfer rate will decrease.

MR. KRESS: You keep changing it as Delta T changes.

MR. SAXEMA: That's correct.

MR. KRESS: Your length parameter was what, the height of each compartment?

MR. SAXEMA: That's right.

MR. MICHELSON: Did you do this on a compartment by compartment basis, or did you kind of go back and homogenize and take some square footage and make a hypothetical compartment.

MR. SAXEMA: In fact, we built on the compartment basis also. Then, we said since the doors are all open, if we have a cooling in one compartment the pressure will go down. Then, the other compartment will feed into it. It's going to be a kind of isolated event.

MR. MICHELSON: It's not going to be a homogeneous situation either in the building. There's going to be hotter spots and cooler spots, depending on how well connected they are.

MR. SAXEMA: I admit that. We have not made attempt to duplicate a realistic situation.

MR. MICHELSON: I don't think you are going to use any of this anyhow, when you get done.

MR. SAXEMA: No.

MR. MICHELSON: It's the peaks, that are going to be the qualification problem.

MR. SAXEMA: That's correct. As I said, my model for the reactor building, we have divided into three major volumes. This is the bottom flow, and there will be communication path. This is up to the negative 1,700. This is the entire rest of the building and the structural heat sinks.

Now, the heat sinks are modeled in such a way, that they are all semi-infinite. The other side of the heat sink you assume is insulated surface. For the internal heat sink which are the internal walls in the structure, they are modeled as a slab, on both side.

MR. KRESS: You included conduction into those, then?

MR. SAXEMA: Pardon me?

MR. KRESS: I presume from that statement, that you included conduction equations into those?

MR. SAXEMA: That's right.

MR. MICHELSON: In the concrete.

MR. SAXEMA: There were deterministic analyses. Coming back to this we are going to include both from the pipe side and this is same about 76 seconds, same as in this first edition analysis. As far as the venting is concerned, we have not taken any credit for the vessel pressure reduction through the make up water that is coming in. We also have not taken any credit in calculation, as the vessel depressurization that is based upon the operator action to terminate the break if they de-pressure the vessel.

In that situation most of the analogy will not go into the outside the containment, it will go to thee suppression pool. We have neglected and ignored that kind of direction. In our calculation the analogy which is coming into the rule is kind of constant energy and constant flow.

In terms of the duration which it is same as earlier. For the design basis event I have considered two cases. Number one is, the operator is able to take action to close the valve in half an hour. For my temperature calculations I have a constant flow into the room, constant for half an hour. Then, I terminate my flow. In the second case I assume the one hour duration for the operator and see how fast my temperature will cool down.

MR. MICHELSON: Before you leave that slide, there's always this little problem of breaks that occur down stream on the return side, back to the feedwater. The flow instrument at one time was located quite a distance from the wall.

Now, have you moved that flow instrument. If it breaks down stream of that flow instrument you don't have any differential. The only way you ever pick it up is with temperature sensors. The instruments both see the same flow. The break is down stream of the last flow instrument but still in the compartment, and those are not isolated under differential flow. Those have to be isolated by some kind of temperature isolation.

MR. SAXEMA: I agree.

MR. MICHELSON: I just wonder, did you move that flow instrument to the boundary? We pointed this out to you a long time ago, that you had that problem.

MR. POWER: We had one set up in the penetration into the secondary containment.

MR. MICHELSON: For those breaks though, then we depend upon that temperature and that has -- if the temperature is in the room then it should be 10 seconds or so.

MR. POWER: Yes, it's very fast.

MR. MICHELSON: It will be longer than 76 seconds, but maybe by no more than ten seconds.

MR. POWER: I would think it would be a lot shorter.

MR. MICHELSON: No. It can't be shorter than the -- okay, you are saying because it doesn't have the built-in.

MR. POWER: That's absolutely right.

MR. MICHELSON: It may be shorter, all right. I take it back. You did get the temperature moved in at least.

MR. POWER: That's correct.

MR. SAXEMA: That gives you a brief schematic how the flow is coming into the room from the reactor side and the BOP side. On the BOP side will be adding the cool water and have depleted all this from this side. From the vessel side after this depletion, it is full pressure coming into the break.

MR. DAVIS: This drawing doesn't show the manual isolation valve that you have added, is that right?

MR. SAXEMA: Mine is very simple. It does not reflect the actual.

MR. MICHELSON: It's downstream of the flow restrictor yet, isn't it, the new valve is. The third valve is still downstream of the -- the flow restrictor is on the vessel almost, isn't it?

MR. SAXEMA: Yes.

MR. MICHELSON: This is just one break that you showed on your picture. There's numerous other potential break locations in compartments, some of which may be more or less confining than the compartment housing the inlet side isolation valves. Have you found the worst compartment, or do you determine that that is indeed after calculation.

MR. SAXEMA: In my view, that is the worst compartment at the bottom. Any compartment break about high elevation will have sufficient path to go up.

MR. MICHELSON: I am thinking now the structures again. These other compartments may be more confining and therefore the peak pressure in the compartment before everything gets blown out could be --

MR. EHLERT: The worst case from a break is in the heat exchanger rooms.

MR. MICHELSON: What did you get there?

MR. EHLERT: That was around the -- still way below the 15 pounds that the room is designed for. It's around ten pounds.

MR. MICHELSON: Those rooms have that stacked block wall for shielding.

MR. EHLERT: That's correct.

MR. MICHELSON: Is that block wall going to be designed for the peak pressure you calculated?

MR. EHLERT: Yes. It's already been evaluated and reviewed by the NRR for 15 pounds

MR. SAXEMA: Just to tell you briefly what goes in my transient cooling analysis. This solid line is what was used in pressure analysis. I simplified this as dotted line. This is the break of the flow into the compartment. I let it continue. This is for the deterministic analysis.

The difference will come for the un-isolated case, which it goes beyond 76 seconds I let it continue for one-half hour and one hour. That is my input source in my calculation.

MR. MICHELSON: You didn't calculate that dashed line, did you?

MR. SAXEMA: Yes.

MR. MICHELSON: Why does that come out higher at the beginning than the --

MR. SAXEMA: As I said what we did, we assumed that it is kind of saturated blowdown at full pressure for the vessel.

MR. MICHELSON: No, the first few seconds, up at the top.

MR. SAXEMA: This one?

MR. MICHELSON: Yes. Why does that come flat across.

MR. SAXEMA: I think we took the same value. It just looked like difference over here.

MR. MICHELSON: One has a drop and the other doesn't. I thought that was a result of the calculation.

MR. SAXEMA: This curve --

MR. KRESS: The dash line is just what he --

MR. MICHELSON: I thought that was after he did it, the cooling analysis, and then this is what he got.

MR. SAXEMA: The point I am trying to make here for my transient cooling analysis, I am taking a worst input condition.

MR. MICHELSON: Okay. Based on this simplistic model for my isolated case which I am calling the design basis case, we assumed initial conditions over here. We calculated peak temperature is about 212, which is way below the 248, is my qualification temperature. Not only that, my temperature drops to 150 degree F in less than six hours, showing which is in the qualification profile.

MR. MICHELSON: What are you going to qualify it to?

MR. SAXEMA: Yes.

MR. MICHELSON: I say, what are you going to qualify it to, 212 or 248?

MR. SAXEMA: Two forty-eight, yes.

MR. MICHELSON: Okay. What pressure?

MR. SAXEMA: Fifteen psig, depending upon the equipment location.

MR. MICHELSON: You haven't changed that any from your earlier reports. You are just showing that it's a very conservative number, but you are still going to use the original number.

MR. SAXEMA: That's right. As I was showing, this is the model for the cooling analysis for the isolated case. I assume my bottom flow is 8,200 up to 1,700 is like one closed compartment.

[Slides.]

MR. SAXEMA: This is my temperature response curve, which is based on the design basis assumption. Valve closes in 76 seconds. You can see that the temperature peaks out and this is the cooling. This solid line indicates that equal temperature profile for six hour is this temperature, then it goes to 150. This confirms that my temperature profile will be within my profile.

The same for the un-isolated case. The difference is, I assumed for one hour and one-half hour. Once again, my temperature profile they showed within the equal profile, and the temperature drops to 150 in less than six hours. Let's look at the picture here.

Once again, this is the model that I used for my calculations for the un-isolated case. Once again, this is open to the atmosphere. Any cooling effect will have tried to bring the air from the outside. The internal heat sinks -- again, the same is for outer walls and internal structures. This is my temperature time history, which considered the one-half hour and one kind of valve closure.

MR. MICHELSON: Let me stop you for just a moment, and go back to something that came up at previous meetings. That is, it appears that a considerable amount of the effluent from the reactor water clean up break may very well end up in the upper structure of the building quickly, in fact, into the cooling area. Then it came to pass that gee, blow out panels on the refueling floors will blow out.

Is that still what you believe will happen?

MR. EHLERT: Yes.

MR. MICHELSON: Again, of course, the argument that it ends up in the steam chase gets even weaker. You start venting in that direction and you will never get pressure build up enough to go out the steam chase.

MR. EHLERT: There is no specific requirement to go out the steam chase.

MR. MICHELSON: No, but in reading your analyses though, it always ends up that we are really venting this out through the steam chase in the turbine building and it's a no-never mind.

MR. EHLERT: Venting atmosphere is the end product.

MR. MICHELSON: The end product will be venting to atmosphere and very likely venting out of the refueling floor blowout panels, as I understood --

MR. EHLERT: Depending on where the break is, yes.

MR. MICHELSON: Yes, depending on where the break is.

MR. SAXEMA: This is a comparison of my calculated temperature response with my profile. This is the line for the half hour valve closure. Both these transient curves in the profile. What I am concluding from here is that I can take for one-half hour or one hour, I can still remain within my profile for the temperature qualification.

Once again in summary, this transient calculation in the very simplistic model in a conservative manner, and the results show the profile was good.

MR. MICHELSON: In view of all these revelations, I would like to ask the third valve that you have added to perform the ultimate isolation, was it put in there on the basis of these kinds of calculations or is it just to make sure that we don't have any further problems. What prompted you to decide to add the third valve?

MR. SAWYER: Basically, the analysis that Dr. Saxema showed you doesn't take any credit for operator action to depressurize. Even if we didn't have the third valve we always have the assumption that the operating crew would depressurize. That, itself, would limit the enthalpy flow to that compartment.

The main reason why we added the third valve was to ease the operator's job of controlling water level after to the blowdown to within a narrow band above the top of the fuel to keep questions about long term flooding of the reactor building down.

MR. MICHELSON: It's really, it's just to put the thing to bed for sure. I don't want to talk you out of it or anything. I like it, but I was trying to determine -- I didn't see anything in here that drove you. It had to be something else that drove you. I think I understand. Thank you.

That was a very good analysis, probably more than what was needed to justify your position. It was a very fine analysis. I think Dr. Catton would have enjoyed listening to that one. He might have had a few questions. Thank you.

MR. LINBLAD: I have a question, Mr. Chairman. The question relates to ventilation ductwork. What is the external and internal design pressure for ventilation ductwork that appears in the 15 pound room design pressure?

MR. EHLERT: In what aspects are you worried about. Basically, all the ductwork in the building is non-safety. It's not required for any purpose after the accident.

MR. LINBLAD: So, in this analysis has the assumption been made that the ventilation collapses closed?

MR. EHLERT: No. The supply ducting is basically concrete imbedded ductwork that drops it down from the upper levels down to the basement levels. It basically uses the corridors as a plenum, with openings in the walls to pressurize the rooms.

MR. MICHELSON: I didn't gather it was concrete embedded. It's in concrete chases, if that's what you mean.

MR. EHLERT: Yes, it's in concrete chases.

MR. MICHELSON: There's a big difference in the capability of the duct, to whether it's embedded or just in a chase. The chase is also vented in both directions, so it's an open duct.

MR. LINBLAD: Does the duct do any ducts past through one of these rooms? Not terminate within the room, but transits the room?

MR. EHLERT: No. There's only exhaust pick up in the room.

MR. MICHELSON: You mean, none of the ductwork in the process of going through the building goes through any area where these breaks are being postulated?

MR. EHLERT: Right. They basically go from the room to the outside corridor, and it's transferred to the main vertical duct which carries it up

MR. LINBLAD: The outside corridor in some cases it sees a two psig.

MR. EHLERT: Yes, at the upper levels it's two psi. At the lower levels it's five psi.

MR. MICHELSON: That's enough to collapse sheet metal ducts.

MR. EHLERT: Yes.

MR. LINBLAD: The ducts are intended to resist that, or to collapse under that?

MR. EHLERT: It depends for the most part, the steel transfer ducts which is most of the sheet metal ducts, there is no credit taken in the analysis for their abilities. The main duct that we take credit for is for the transfer ducts which are basically in the walls to transfer air from the -- basically what the room is, you have a room with access to the corridor or the door.

We put a cutout in the wall to allow air to transfer from the normally -- corridor into the room for air flow. The exhaust system takes suction on the room and basically pulls air from the corridor into the room. That way, we are always taking the most contaminated out of the room and pulling clean air from the corridor in, from the HVAC.

MR. POWER: Gary is going to walk through the barriers next.

MR. MICHELSON: I was saving all my heating and ventilating for then, too. I thought maybe we passed it up and you were catching it. There are quite a few questions there.

If I understand it, the equipment qualification now, the entire secondary containment is designed to remain functional under 15 pounds, 248 fahrenheit conditions. Is that a correct statement.

MR. EHLERT: Could you repeat that.

MR. MICHELSON: Presently it appears that the equipment qualification is for 15 pounds, 248 degrees. Does that mean that the equipment can remain functional at 15 pounds, 248 degrees. Is that what EQ means in this case?

MR. EHLERT: Yes. When we are talking about EQ, the EQ pressure temperature is what the equipment is qualified at.

MR. MICHELSON: Is it functional at those conditions.

MR. EHLERT: It's capable of functioning. It's does not necessarily --

MR. MICHELSON: The problem that I am getting into -- and I don't know whether to press the issue. It's something that somebody ought to at least think about. That is, if you postulate that you pressurize a secondary containment to these kind of conditions and you say that everything remains functional, I have to assume that the room cooling capabilities remain functional.

I am not worried about cooling the room below these conditions. What I am worried about is the same room cooler that is cooling these areas might be cooling other areas that are no longer going to get cooled because the pressures will trip out. They won't handle overloads.

MR. EHLERT: The systems inside secondary containment are not -- do not use chilled water for their cooling.

MR. MICHELSON: You say that --

MR. EHLERT: They are off the RCW heat exchangers.

MR. MICHELSON: The ones in the basement are but how about those up in the instrument rooms inside secondary containment, none of those have chill water?

MR. EHLERT: Those are, but those are outside of secondary containment.

MR. MICHELSON: The instrument rooms are inside of secondary containment. The electrical rooms are outside.

MR. EHLERT: Those don't have room coolers inside of them.

MR. MICHELSON: You are saying that we don't provide any chilled water.

MR. EHLERT: Correct. There's no chilled water inside secondary containment except for some push button on/off air conditioners for when you are doing personnel maintenance.

MR. MICHELSON: I thought that there was environmental control to keep those instruments a little cooler.

MR. EHLERT: There's RCW water used which is cooling water.

MR. MICHELSON: Just normal cooling water, not chilled. There's no chilled water inside of secondary containment.

MR. EHLERT: As we mentioned yesterday, the only chilled water -- emergency chilled water that is used is for the control room, the control building, and the three clean electrical areas.

MR. MICHELSON: And, the diesel.

MR. EHLERT: And, the diesel. It's basically those three zones outside secondary containment.

MR. MICHELSON: But not -- if there's none inside, then we don't worry about that aspect. If the equipment is functional, then it's a non-problem.

MR. POWER: The last presentation that Art will give, he has looked at all kinds of things about extended life, et cetera, relative to the numbers that we used.

MR. MICHELSON: Why don't we take a break right now and come back at 20 minutes to.

[Brief recess.]

MR. MICHELSON: Let's go back on the record.

MR. SEALE: Mr. Chairman, I have a question. I think this is probably a good time to ask it. How much does this 15 pound capability cost? The problem that I see is that you now apparently have demonstrated that there's actually a fairly large margin embedded in that, and that's a pretty -- I think it would be pretty expensive.

What are the down side consequences for a COL holder if they say hey, I am being forced to cut costs everywhere. Why don't I build a ten pound design or something like that. What does that do to the status of this whole process?

MR. EHLERT: The main thing it's designed for the 15 pounds -- at least for increasing it above 15 -- is the structure. The structure fails, you have -- the structure is valid for the 15 based on the wall thicknesses provided and the beam sizes, floor slabs, and so on.

MR. SEALE: Apparently, ten --

MR. SHACK: It's more the equipment qualifications.

MR. EHLERT: Right. It's mostly the electrical connections, the boxes.

MR. MICHELSON: You better think about this carefully though. You are really qualifying it for that condition, you are going to have to use hermetically sealed boxes to qualify it.

MR. EHLERT: Some of the instruments are --

MR. MICHELSON: You are going to have to design the boxes much heavier to take 15 pounds external pressure. You can't vent the boxes and get through the EQ very easily, although some people think they can do it anyway. You really -- it's really kind of tough to pass the EQ test if you vent the steam inside the box while you are doing the EQ test.

MR. SAWYER: Gary, I don't want to put words in your mouth, but I thought that when we did the analysis for the 15 pounds, that we didn't actually commit to increase the structure to meet the 15 pounds over what it was anyway.

MR. EHLERT: Right. The structure didn't have to change to meet the 15 pounds.

MR. SEALE: Okay, so there are other considerations that established those designs.

MR. EHLERT: For the civil part, the shielding and radiation hazard --

MR. SEALE: My question is --

MR. MICHELSON: Your question is a good one, though. The 15 pounds is going to cost them quite a bit of money. I was quite surprised. I am not going to argue with it. I think you can get by with less than 15 pounds. It would finally sharpen the pencil and come in with something less.

If you stick to 15 pounds it just gets tougher to build the equipment for 15 pound differentials. Most of this stuff is probably build for depressurization of three pounds or something. In fact, not all of us have to even do that. But 15 pounds is a substantial differential on an instrument. You have to build a hermetically sealed instrument that will handle it. It has been done.

Inside of containment it's understandable, and there they do it. But it's a little more expensive of an instrument, I suspect. Maybe you can tell us it doesn't make any difference we would do 15 pounds.

MR. LYONS: I guess one of the things that you have to remember though is, when we are talking about an EQ profile, that only applies to the equipment that needs to be qualified under 50.49. It's a limited number and set of equipment.

MR. MICHELSON: What do you think it's limited to? It's all the ECCS equipment.

MR. LYONS: That's right.

MR. MICHELSON: That's most of what's inside secondary containment. There isn't much else in there, is there?

MR. LYONS: That's true. All the equipment that is inside the secondary containment does not have to be qualified to those temperatures and pressures.

MR. EHLERT: All the reactor water clean up does not have to be, the pressure pool clean up does not have to be.

MR. MICHELSON: The RCIC, high pressure core flooder, all this equipment has to be qualified, including it's instrumentations. You have rooms full of them inside secondary containment.

MR. EHLERT: It's mostly just the instrument connections.

MR. MICHELSON: It's the instruments where you get the toughest problems.

MR. MICHELSON: Yes. The pumps, the 15 pounds is a no-never mind.

MR. MICHELSON: You start to really get subtle and ask some of these instruments require differential pressure operation. Are you going to design now so that they remain operable with a 15 pound differential pressure between the outside the bellows and what's going on inside the bellows in order to remain accurate.

These things don't work at 15 pounds like they did with an atmosphere on the outside. I think the misbehave. Normally, you vent the instrument to atmosphere, and that's your reference point.

MR. LINBLAD: Which instrument would that be?

MR. MICHELSON: Any instrument that -- it depends upon a bellows movement for instance.

MR. LINBLAD: Certainly, an air operated --

MR. MICHELSON: Yes. The pressure is on the outside.

MR. LINBLAD: I assumed that they are electronic transmitters.

MR. MICHELSON: If they are all electronic and unaffected by atmosphere, you are okay. I haven't seen that stated anywhere, that's what they will use.

MR. LINBLAD: If they have a 15 pound design, I bet they will.

MR. MICHELSON: They will have to use instrumentation, which is independent of the atmosphere in which it's operated in.

MR. KRESS: You are not going to get a low lower. You may get down to ten psi by sharpening your pen and pencil, and you are going to have the same problems.

MR. SEALE: But still, everything that you read about the emphasis on economics and cost reduction in the industry right now suggests that anything that smacks of overkill is on the list for review. I think we ought to be very sensitive to what the implications of what appears to be an over design might be in terms of downstream corrections or re-design.

MR. MICHELSON: Just for my own edification, and I have asked it before and am going to ask it again. What are the Japanese doing about the reactor water clean up line break, if anything. Are they postulating it and are they designing for it, or do they just ignore it.

MR. EHLERT: We don't have any of that information.

MR. MICHELSON: It would be interesting to ask sometime.

MR. SAWYER: They are not dealing with the un-isolated case. In other words, their basis for EQ for the building is based on the design basis.

MR. MICHELSON: They still have to deal then with the several pounds and 212 degree kind of thing.

MR. SAWYER: Oh, yes.

MR. MICHELSON: Are they doing an EQ for that condition?

MR. SAWYER: Yes, they are.

MR. MICHELSON: Are they doing it throughout secondary containment?

MR. SAWYER: Yes, they are.

MR. MICHELSON: Then, they are dealing with the problem.

MR. EHLERT: That's their normal design basis. The first topic that I am going to swing through is some questions that were alluded to earlier was, the parameter study on the effects of door opening pressure.

Basically, there are two types of doors that were assumed to fail. One was the normal stair case door which is for personnel access. Usually it's a light weight door, three hour fire barriers, in the only requirement on the door. It's for personnel entrance and egress from a given floor to move up and down, vertically, through the plant.

MR. MICHELSON: Are all stairwells divisionalized?

MR. EHLERT: No. There are only two stairwells in the secondary containment.

MR. MICHELSON: They share common divisions.

MR. EHLERT: Yes. There's one in the --

MR. MICHELSON: Those are divisional barrier doors at the stairway.

MR. EHLERT: No. The stairway itself resides in a division.

MR. MICHELSON: But it has to have doors to another division.

MR. EHLERT: You go down the corridor and then through a divisional door.

MR. MICHELSON: You never go from a stairwell into another division.

MR. EHLERT: Correct. You may, on an above at a different elevation.

MR. MICHELSON: The elevation goes all the way to the top of the pool --

MR. EHLERT: That's what I am trying to get out. On some floors you may change divisions. The stairway may change divisions.

MR. MICHELSON: As you go up the stairs.

MR. EHLERT: That's why you have -- one reason why you have a three hour fire barrier at the stairwell.

MR. MICHELSON: Indeed, there are divisional barrier doors at the stairwells.

MR. EHLERT: Yes. They assume they are failed.

MR. MICHELSON: I am just trying to clarify a point.

MR. EHLERT: These doors normally are opening outward, away from the staircase. They are failing basically in the opposite direction of their opening. Normally, they set those at a higher failure pressure than a door that would be basically being over pressured in the direction that it normally opens.

That's mostly because -- the obvious reason, you have to bow the door sufficiently enough to fail the frame. Whereas, in the other direction, you only have to fail the latch.

MR. MICHELSON: In the case of Quad Cities were their doors seeing reverse flow?

MR. EHLERT: Both. They saw everything. The results basically came in that for stairway doors, if we set the pressure high enough, the doors never open. We communicated normally through the steam tunnel and met our design or pressure goals.

For compartments it just changed the opening time. It didn't really change the -- it increased the peak pressure slightly in the compartment. The main effect was the delay is when peak pressure occurred because the door would stay closed a fraction of a second longer.

MR. MICHELSON: What does that minimum pressure mean. What are you telling me, that's the lowest pressure at which a door will open?

MR. EHLERT: For the large compartment doors, the heavy compartment doors.

MR. MICHELSON: For the divisional barrier doors?

MR. EHLERT: No. Subcompartment doors, like the heat exchanger room.

MR. MICHELSON: Is that going to be a design requirement to have the capability of opening only above one and one-half differential?

MR. EHLERT: No. When you go below one and one-half differential we saw -- basically it will have no effect.

MR. MICHELSON: Some of these are double doors, of course. Are they also one and one-half?

MR. EHLERT: None of these doors right here that we are talking about are EQ qualified. These aren't barriers that are design basis.

MR. MICHELSON: Are we going to know which doors are EQ qualified and which ones aren't by looking at some words or drawings or something?

MR. EHLERT: It will be words, or markings on the tier one.

MR. MICHELSON: Will I have to wait for amendment 34?

MR. EHLERT: Wait for 34.

MR. LINBLAD: So, can we say that the minimum pressure is zero and gives the same results, or is there something that happens between zero and 1.5 psi.

MR. EHLERT: The odds are that if they open at zero, the pressures go down in the room.

MR. MICHELSON: And, go up in the corridors.

MR. EHLERT: You will vent into the corridors faster, yes. It may go up slightly.

MR. SAWYER: Gary, those numbers -- some people are mislead to believe that they are some kind of design spec from GE, that we have minimums and maximums. That is just a parameter study, to see what effect it would have on peak pressure.

MR. EHLERT: That's correct.

MR. SAWYER: We are not specifying the doors to have a minimum opening pressure of one and one-half.

MR. MICHELSON: None of the doors except those going to the control building are going to be spec --

MR. SAWYER: Correct.

MR. LINBLAD: Do I understand that the direction of swing is not specified either, that either swing can --

MR. EHLERT: In the tier one they are not specified.

MR. MICHELSON: The direction of door swings are specified on your tier one drawings.

MR. EHLERT: There's also a statement that it's for information only.

MR. MICHELSON: That's -- where do I find that statement?

MR. EHLERT: It's in the appendix.

MR. MICHELSON: Is that in the introduction?

MR. EHLERT: General provisions.

MR. MICHELSON: Is there another general provision that says I can move boundary -- can move doors around and can move doors around on an ITAAC without getting a new rule?

MR. EHLERT: I believe so. This is basically --

MR. LYONS: If you look in the general provisions there's a discussion about the figures in general. I don't remember the exact words.

MR. MICHELSON: We didn't review ITAAC and didn't realize those words were in there. I would like to read those words.

MR. LYONS: There's basically statements to the effect that the figures are representational and for information only, and that -- I am trying to remember the exact words -- whether it's minor changes or changes to the -- they are basically functional drawings.

MR. MICHELSON: What does that mean?

MR. LYONS: If a door is moved from one corner of a room to another corner of the room but along the same corridor, that would fall within an acceptable --

MR. MICHELSON: If a door was eliminated, then it would be a new rule?

MR. LYONS: Yes.

MR. MICHELSON: You didn't like the door there and didn't want to move it -- I didn't need it, and would have to go to rulemaking to remove it?

MR. LYONS: That's right.

MR. MICHELSON: It will clarify how much you can do without going to rulemaking. I will read those words.

MR. EHLERT: The next area is basically the flood effects. When you are talking about the reactor water clean up you are talking about a large quantity of water that can come out. Basically, we are trying to assure everybody that it's not the governing flood event.

Basically what we did was assume 60 percent of the break flow is water. The rest of it is steam and it disappears. We assume the floor spread, to make sure the water --

MR. KRESS: That 60 percent is based on the constant enthalpy from the blowdown to the --

MR. EHLERT: Roughly, yes. It's actually a little higher than 60. We just use 60 to give us a bound. Actually, I take that back. It's a little lower than 60.

MR. KRESS: It is constant enthalpy.

MR. EHLERT: Yes. Basically the two major floors where you have water problems will be the elevation minus 1,700 and the basement, minus 8,200. That's where most of the reactor water clean up system is located, where you have doorways, where you can get entrance into the general area of the building, or it's in the basement floor where you are collecting all the water from a break.

The provisions that are put forth at least in the basement floor where you have large accumulation of water from any type of break, that all the penetrations from the outside corridor into the ECCS rooms is kept at least two and one-half meters off the floor to prevent any flooding effects from the reactor water clean up break going into the ECCS compartments.

Basically it's keep ECCS dry. At least from my standpoint they will be steam to atmosphere.

MR. MICHELSON: Before we leave this point of the drawing -- because I think the staff ought to go back and look at this interpretation of figures. For some reason you restricted the whole paragraph only to Section 2. I think it ought to apply to Section 3, because that's where all those control building drawings are.

MR. EHLERT: The only thing in Section 3 should be the radiation hazard drawings.

MR. MICHELSON: Section 3, of the certified design material. The drawing is in there. You say that they will have to be adhered to strictly then, as opposed to interpretation and all the other good words. I would think that you would like to include Section 3, just in case.

MR. EHLERT: Yes.

MR. MICHELSON: You may want to move these boundaries around or whatever. I don't know what you might want to do. It should have been Section 3 and 2.

[Slides.]

MR. EHLERT: This is a basic summary on how the high energy line break affects the ECCS room's availability. It basically is, the penetrations are assumed to fail, to allow the steam into the ECCS rooms. That's where we get the 15 pound design pressure.

As was mentioned earlier, the short term EQ pressure and temperature numbers are bound -- I shouldn't say bound -- the high energy line break results.

MR. MICHELSON: One of the things I guess I missed when the previous presentation was made is, we have kind of at least always made intuitive arguments, so what, the boundary door is open. We still got a third division whose boundary doors don't open. Maybe that's not true.

Do the calculations show that all three divisions have open doors from a break in the reactor water clean up?

MR. EHLERT: We assumed all the --

MR. MICHELSON: You are assuming it. Do the calculations verify that you get into the third division? I think we have been making intuitive arguments that really we really don't think it will get to the third division. It will be protected anyway.

MR. SAXEMA: In my calculations, I think my other flow path you will be communicating with the other divisions.

MR. MICHELSON: All three?

MR. SAXEMA: Yes.

MR. MICHELSON: Then, the argument is that it spreads --

MR EHLERT: The pressure will decrease as you move away from the break location.

MR. MICHELSON: But it will still open all the doors, because you have sufficient differentials.

MR. LINBLAD: Is that first statement one sentence or two sentences, without a period?

MR. EHLERT: It should be two sentences. It should be period there and a new sentence.

MR. LINBLAD: Thank you.

MR. MICHELSON: We don't really care about the HVAC ducting. It's spreading through the doors anyway.

MR. EHLERT: The only concern with HVAC ducting is whether it collapses on top of safety related equipment.

MR. MICHELSON: One other concern, where it penetrates secondary containment, what will be its design qualification, since that reactor building cooling system is outside of secondary containment.

MR. EHLERT: Correct.

MR. MICHELSON: It has some penetrations with some valves or dampers, or whatever you want to call them.

MR. EHLERT: That's the next topic.

MR. MICHELSON: All right.

MR. EHLERT: It's one chart away. This is basically a summary that was mentioned earlier. Pressure from both breaks are below the 15 psig compartment design pressure. The 8,200 and minus 1,700 corridor pressures are below five psig. The balance of the secondary containment above the minus 1,700 elevation is basically below two psig.

Because of the HVAC openings and cable tray openings through the ECCS walls, those walls aren't seeing any large Delta P's, at least long term. It's very brief until you get equalization across the walls because of the openings.

The pour pressure from water outside the building is around ten to 15 pounds. The only effect you are going to have by a break on the RBCW penetrations is the seal will have to work the opposite direction. That's assuming if the water disappears on the back side.

MR. MICHELSON: This is a seal where it penetrates the --

MR. EHLERT: Where the pipe penetrates the reactor building wall.

MR. MICHELSON: That is secondary containment down at those elevations.

MR. EHLERT: Correct.

MR. MICHELSON: Those seals are going to be designed for at least the 15 pounds.

MR. EHLERT: They have to be designed at least for the pour pressure if the tunnel that they cross over from the control building to the reactor building fails, and that's like 25 meters below grade which is basically at 75 meter ahead of water.

MR. MICHELSON: It's a big hydrostatic pressure.

MR. EHLERT: Yes.

MR. MICHELSON: The tunnel fills with water, that's the postulation.

MR. EHLERT: Right.

MR. MICHELSON: Then, you have an enormous -- in the other direction. Now, you have to design the seal for both ways now.

MR. EHLERT: Correct. If you could take the 15 or 20 pounds going this way, it's the back pressure -- you are not going to use something you stuff in a hole.

MR. MICHELSON: That will be specified, that it has to take both the internal pressure of 15 pounds or the external pressure of full hydrostatic head to a ground elevation.

MR. EHLERT: Correct.

MR. MICHELSON: Is that going to be stated somewhere in amendment 34?

MR. EHLERT: The penetration back pressure from the ground into the building, I believe, has been put in. John, do you remember. I think we put it into the --

MR. MICHELSON: Amendment 33?

MR. EHLERT: I am trying to think if it's in 33 or just in the mark up that we have been discussing.

MR. MICHELSON: There's two problems with the tunnel. One, of course, is pure hydrostatic. You get that from the site flood or whatever.

MR. EHLERT: Right.

MR. MICHELSON: The other one is if you thrust a low energy pipe in there, there are some additional contribution from the --

MR. EHLERT: Right. You could have a higher than the hydrostatic head.

MR. MICHELSON: It could be a little higher. I wouldn't argue too much unless you trim the margins real tight. Then, you might ask if it's capable of doing both. Hopefully, these are fairly slow leaks, and the hydrostatic to ground is probably good enough. That's a pretty tough requirement already.

MR. LINBLAD: I would like to understand that fourth statement better. What large differential pressure are you speaking of. What is the design of the pump room walls?

MR. EHLERT: This is the tier one drawing for the reactor building. In cases of heat exchanger pipe break or pump room pipe break, this corridor is going to get basically all the way around highly pressurized, fairly rapidly.

MR. LINBLAD: What is highly pressurized?

MR. EHLERT: It's the five pounds.

MR. LINBLAD: Thank you.

MR. EHLERT: These rooms basically, are -- because of the water tight doors, these doors are assumed not to fail. We do have cable tray and HVAC duct and cooling water piping that has to penetrate from this corridor into the

ECCS rooms.

MR. MICHELSON: At what elevation?

MR. EHLERT: Based on the ITAAC, it's at least two and one-half meters off the floor.

MR. MICHELSON: That means that when you get the flood on the inside you have a real good problem on those ducts and penetrations, because they have to take about 19 feet of hydrostatic or something like that from the flooding of the compartment itself -- suppression pool flooding into the --

MR. EHLERT: From suppression pool flooding --

MR. MICHELSON: That took it up how many feet? That certainly is the design basis then for that penetration, part of it, at least. That's several pounds pressure.

MR. EHLERT: If I remember right, it's like four meters of water.

MR. MICHELSON: Yes, something like that. That gets a little higher than five pounds per square inch from hydrostatic. You have to design for both, to make sure at least --

MR. EHLERT: Yes, but that's --

MR. MICHELSON: This, again, I expect to read in Amendment 34 if it isn't already in there.

MR. LINBLAD: Returning to my question, what is the design pressure of the pump room walls?

MR. EHLERT: It's the five pounds. The main area is 15 pounds for the structure or the main compartment walls that surrounds high energy pipe. RHR, this division is designed for 15 pounds because of the RCIC line break scenario.

MR. LINBLAD: My question is, are you actually relying on the HVAC openings between the pump rooms and the surrounding corridor to limit the differential pressure on the pump room wall, or will the pump room walls be designed for the pressure regardless of the size of the HVAC opening?

MR. EHLERT: The walls will be designed for the five pounds, which is neglecting the opening in those walls. We know the walls will actually cause us to have margin in those five pound numbers.

MR. LINBLAD: Thank you.

MR. MICHELSON: Don't you think the hydrostatic head of 13 or 14 feet in the compartment will set the walls and not --

MR. EHLERT: The opposite direction though. The steel will have to move from the front face to the back face.

MR. MICHELSON: The wall thicknesses or whatever.

MR. EHLERT: Mostly, the wall thickness is set by shielding requirements.

MR. MICHELSON: Yes, if that becomes more controlling then that --

MR. EHLERT: It is for all the walls, at least so far.

MR. MICHELSON: This ventilation opening isn't being -- I don't know what to do about shielding. I never worry about that on it. It's clearly -- it has a very large pressure differential that has to withstand. We said we wouldn't let the water -- that is the reason for the water tight doors. That water will not get out of the room.

MR. EHLERT: The main purpose of these water tight doors is to keep the large quantities that's in this corridor from damaging the equipment.

MR. MICHELSON: In or out, either way.

MR. EHLERT: It's mostly for going in, not for getting out.

MR. MICHELSON: We are not claiming that it won't get out. These ventilation ducts might be the way by which it gets out, unless you put them up above --

MR. EHLERT: We are mostly worried about the suppression pool clean up failure, which will basically dump the -- fill the whole corridor.

MR. MICHELSON: Why are the ventilation ducts so low?

MR. EHLERT: It's not that they are low. That is a minimum level.

MR. MICHELSON: Why do we allow them to be that low?

MR. EHLERT: They probably will not be. The HVAC may be high --

MR. MICHELSON: Why didn't you simply put them above the water line and you won't worry about them?

MR. EHLERT: In ITAAC, you have to put a number to specify.

MR. MICHELSON: You put a number in ITAAC, and then you won't worry about the flooding -- designing these ventilation ducts for the flood because it's above the flood line.

MR. EHLERT: The main concern for ITAAC for the design was for the water getting from the corridor into the ECCS compartments.

MR. MICHELSON: Okay.

MR. EHLERT: That was set at the maximum water depth in the corridor, which is two and one-half meters.

MR. MICHELSON: That was about the two and one-half meters, that direction. I don't want to read stories about if you get a break in that room the water floods up to 12 meters or whatever it was, and that the water is confined to the room because you have water tight doors.

Don't give me that story, if you haven't done it on the ventilation duct as well. You see what I am saying?

MR. EHLERT: Yes.

MR. MICHELSON: It's an inconsistency in the design. You can do it two ways. Keep the ventilation duct out of the water or design it for the water pressure. You have your choice.

MR. EHLERT: There's no way to design the holes to the wall to close fast enough on a break unless you have a manual type of isolation valve.

MR. MICHELSON: I think you just put the hole in the wall above the water line. It's a simple as that. We are past the stage where we argue about how you ought to design a plant. The staff is expected to evaluate whatever you do finally propose, and I will ask the staff why that's okay. That's how we get our answer.

MR. EHLERT: For the temperature effects we are going to qualify all three RHR divisions for the same pressure and temperature, mostly because we are afraid of RHR A being placed in RHR B and vice versa. From an insulation perspective it causes you a nightmare if you have different qualification temperatures for the same piece of equipment in different divisions.

MR. MICHELSON: Are we still claiming the reactor water clean up is in division two, and that's where the worst of the event will be experienced.

MR. EHLERT: Yes.

MR. MICHELSON: Are we claiming that that division two equipment will continue to function because of the EQ?

MR. EHLERT: Yes.

MR. MICHELSON: You are taking credit for all three divisions for that event.

MR. EHLERT: We can still, based on previous analysis, we don't need -- we only need one division for this break. If one of the three divisions is operable we will achieve safe shutdown.

MR. MICHELSON: Yes, all right.

MR. EHLERT: Based on the RHR A design temperature for RHR, RHR's B and C basically have more margin because of the differential HPCF is basically based on the CUW line break, the EQ numbers, which gives you a lower temperature number. I believe it's 220 degrees F, whereas RCIC I believe is 240.

That's basically all I had, unless somebody has some specific questions on the buildings.

MR. MICHELSON: Now, maybe I missed it, but did you tell us about where it penetrates the wall out of secondary containment. Is that in the next discussion? Heating and ventilating -- the reactor building heating and ventilating system is outside of secondary containment.

MR. EHLERT: Yes.

MR. MICHELSON: It has to penetrate it. How are those penetrations being handled. What are they being designed for, and why are we assured that they don't blow out and thereby get into the rest of the reactor building.

MR. EHLERT: The one, they are above the rest of the reactor building.

MR. MICHELSON: Above means nothing when steam is flowing. It means something if it's only water we are dealing with.

MR. EHLERT: The secondary containment HVAC penetrations are up, way up high in the reactor building.

MR. MICHELSON: Yes, they are fairly high. I think they are 14,000 --

MR. EHLERT: One is at the refueling floor elevation and the other one is on the floor below. It's like 18 meters.

MR. MICHELSON: Those fans are a little lower in the building than that.

MR. EHLERT: That's where the entrances are for secondary containment HVAC. There's a supply penetration and an exhaust penetration.

MR. MICHELSON: Even though the fans are lower, you come up the duct and come down.

MR. EHLERT: The fans are -- we are talking secondary containment HVAC?

MR. MICHELSON: Yes.

MR. EHLERT: Secondary containment HVAC, the supply and exhaust fans are located in the turbine hall.

MR. MICHELSON: Yes, and that's at a lower elevation.

MR. EHLERT: Yes.

MR. MICHELSON: They must be coming up -

MR. EHLERT: They duct and come up across the top of the --

MR. MICHELSON: You are essentially at the refueling floor with the entrance and exits?

MR. EHLERT: Yes.

MR. MICHELSON: The entrance fans are also in the turbine building.

MR. EHLERT: Yes.

MR. MICHELSON: So, we have two sets of ducts, a supply and return.

MR. EHLERT: Yes.

MR. MICHELSON: Those are very large ducts.

MR. EHLERT: Yes. They are 1.2 meter diameter.

MR. MICHELSON: At least. Those come over the control building then.

MR. EHLERT: Yes.

MR. LINBLAD: There's a standby gas treatment system in the reactor building?

MR. EHLERT: Yes, two divisions.

MR. LINBLAD: When we were talking about these line breaks outside containment, what pressures do the filters and the standby gas treatment system --

MR. EHLERT: They are not designed to operate under this accident. Standby gas is only for handling refueling accidents and accidents inside containment.

MR. LINBLAD: Nonetheless, they accumulate a load of fission products perhaps or radioactivity systems. What pressures do they see and what might we be blowing out the system.

MR. EHLERT: The floor itself, is going to see two pounds.

MR. LINBLAD: What do the filters see? Will the filters fail under --

MR. EHLERT: The system should not be operating in this scenario.

MR. MICHELSON: Yes, it is operating.

MR. LINBLAD: When you say it's not operating, do you say it will not communicate to the internal volume of the reactor building.

MR. EHLERT: I am not quite following the question.

MR. LINBLAD: When you say it is not operating, do you mean that the ducts are shut off?

MR. EHLERT: Yes. The system is -- basically what happens is, on the radiation signal when it finally reaches the HVAC and it gets a signal that we have a radiation problem in secondary containment, the HVAC will attempt to isolate and standby gas will begin to start -- it will basically come on and attempt to draw the building.

Because of the blowout panels that have opened up already, the only thing that standby gas most likely will draw down is outside of atmosphere. The refueling floor will be open directly to the outside by this time.

MR. MICHELSON: Standby gas will see whatever the building pressure is at the intake to the standby gas treatment system.

MR. EHLERT: Yes.

MR. MICHELSON: You are saying that's --

MR. EHLERT: There's one operator action to that.

MR. MICHELSON: That's trying to then create a draft, so to speak, though the system. That's going to create differential pressure. I thought the question was, is that going to be enough of a differential pressure to blow the filters out of the standby gas treatment --

MR. LINBLAD: That is my question, yes.

MR. MICHELSON: I haven't heard the answer I don't think yet.

MR. EHLERT: I don't think I know the answer to that specific question. I don't think it's --

MR. MICHELSON: Nor, does it make any difference. That would be impossible to answer.

MR. LINBLAD: Why wouldn't it make a difference if the filters are loaded with previous activity.

MR. MICHELSON: It will then blow some activity out into the --

MR. POWER: That's the point. We are not assuming a loss of coolant action inside containment immediately followed by an accident outside containment. They will not be loaded, in any way, shape or form. They may have residuals from something, but there is a very -- they receive very loving care not to be operated when there isn't an accident.

MR. EHLERT: The only time it will be used is for inerting and actually for de-inerting.

MR. MICHELSON: You are not counting on them after the event.

MR. EHLERT: That's correct.

MR. POWER: No.

MR. MICHELSON: You are saying that you are even willing for them to puff out whatever might be there.

MR. EHLERT: Secondary containment is violated and we don't count on it.

MR. MICHELSON: We violated it up at the refueling floor, for sure.

MR. LINBLAD: The carbon seems to accumulate over a period of time, regardless of your best efforts.

MR. MICHELSON: It will have some hot stuff on it. I think you will find that what's coming out of the resin beds by the backflow from the reactor water clean up and so forth, is just going to overwhelm these other worries.

MR. LINBLAD: Yes.

MR. MICHELSON: We haven't even addressed what is the real activity level resulting from this kind of a break. We are just trying to assure survivability of the equipment, so that something even bigger doesn't happen. I am still a little unclear when you isolate the reactor building heating and ventilation, that damper probably is not designed for the differential.

MR. EHLERT: No. It will not close.

MR. MICHELSON: It might blow out, you are conceding.

MR. EHLERT: Yes.

MR. MICHELSON: Further now, is the ducting -- what is that going to be, a spiral --

MR. EHLERT: It's already a pipe.

MR. MICHELSON: It won't blow out either. This pressure wave will just move on out into the turbine building where the fans are and just kind of puff around the room and go out --

MR. EHLERT: Yes. It's going to go out to the turbine building. It will meet what's coming down the steam tunnel.

MR. MICHELSON: It will be kept encapsulated though, so it can't escape locally along the route.

MR. EHLERT: From the external perspective, I don't think there will be enough that will make it down that pipe versus out the reactor building floor.

MR. MICHELSON: I think it's going to go out the refueling floor, myself.

MR. EHLERT: Yes.

MR. MICHELSON: Speculation.

MR. EHLERT: Based on just area ratio, most of it's going out the refueling floor.

MR. MICHELSON: It's likely to go right out to atmosphere that way. Any other questions on this?

[No response.]

MR. MICHELSON: I think we have heard all we probably all we need to know on this subject by now.

MR. SAWYER: We have one last presentation to give you now. We did a PRA evaluation which further convinced ourselves that the process that we used previously to justify not dealing with bypass events is valid, even considering the reactor water clean up outside line break.

MR. MICHELSON: We arrive at the same conclusion, but we would like to hear your presentation.

MR. McSHERRY: This is Art McSherry again, and I will be going through the PRA that we completed to determine what the core damage frequency would be for a CUW line break, both isolated and un-isolated cases.

I'll first go over a description of the CUW system that's been described a couple of times, at least a new feature, the new valve we've added. I'll also touch on the normal operation of the system and how the system is isolated, what kind of signals isolate the system.

I'll then describe how we computed the line break frequency, the methodology we used to determine what the initiating event will be, what the frequency of the event will be, and then, in response to concerns of the Committee, we will evaluate how the ECCS and other equipment that's in the harsh environment will operate; that is, what is the unavailability of systems that need to start given the event and what is the reliability of systems that are already running to continue running.

We'll finally then have a calculation of what the core damage frequency will be.

Now, prior to going into the details, I'd like to first, very quickly, give you the results, where we're going. This the event tree that I'll end up with in my presentation, and I will give more details on this.

What I'm going to try and present will be some of the bases for these numbers -- the frequency, the isolation, un-availability, various operator actions depending on which systems fail and which systems don't fail, the ability of the operator to close the manual -- remote manual shut-off valve.

So, we're going to end up back here. I just wanted to give you the overall view before we went into the details.

MR. MICHELSON: Are you going to discuss the details of the numbers shown on that overall view?

MR. McSHERRY: Yes.

The main function of the clean-up system is to maintain parity of the reactor coolant in accordance with Reg Guide 1.56.

It also has other functions for start-up and shut-down, for inventory control, to maintain the correct water volume in the system, RPV head spray for a fast reactor cool-down, and the bottom head drain valve is there to minimize RPV temperature gradients.

The system isolates on several signals. The one that we're using or taking credit for, which is the slowest closure signal, is a high system flow rate. There is a 45-second time delay, as already mentioned, on the high flow rate, but it also isolates on other signals -- low level in the RPV, high steam tunnel, and high CUW equipment room temperatures, as well as actuation of stand-by liquid control, so you don't take the boron out of solution during an ATWS or post-ATWS.

MR. DAVIS: I thought I read somewhere, one of the functions of the system, it could be used for decay heat removal?

MR. SAWYER: We take credit for that in the PRA, and that was an early discussion we had with the ACRS regarding whether or not the system could really do that, but that's not a design basis.

MR. DAVIS: No, I realize that, but it is a function that you're taking credit for.

MR. SAWYER: It's a capability that we made possible by being able to bypass the regenerative heat exchanger under some conditions.

MR. DAVIS: I just wanted to clarify that, because it wasn't on the slide.

MR. McSHERRY: Okay.

The CUW isolation valves -- that's the normal isolation valves, the ones that automatically close -- are safety-related, and they are designed to close under full break flow.

In fact, there is a requirement that the manufacturer of the valve do a test to verify that the valve will close under actual conditions.

Piping for the CUW system inside the primary containment is ASME Section 3, Class 1, and outside secondary containment, it's ASME Section 3, Class 3.

The material both inside and outside secondary containment are the same, SA-333, Grade 6, and the loading or the design basis for the piping is the same inside and outside secondary containment except for seismic.

For outside secondary -- or outside primary containment, it's just uniform building code seismic, whereas inside it's Seismic Category 1.

MR. MICHELSON: Just to be sure we're all together, I think you're taking Class 1 out through the second --

MR. McSHERRY: Yes.

MR. MICHELSON: -- the first isolation valve outside of primary containment.

MR. McSHERRY: Yes.

MR. MICHELSON: It's Class 1 outside of primary containment, and that's going to be seismic up to that point.

MR. McSHERRY: Yes. Yes.

Also, to minimize the number of welds in the system, we will be using induction bending of the piping.

If the pipe diameter or the pipe radius is greater than one-and-a-half pipe diameters, you can induction bend the pipe to minimize the number of welds.

MR. MICHELSON: That's just for the Class 1 portion.

MR. McSHERRY: No.

MR. MICHELSON: Throughout the Class 3 portion, as well?

MR. McSHERRY: Yes.

MR. MICHELSON: That's nice. Okay.

MR. LINDBLAD: I guess I'm not familiar with the term "induction bending."

MR. McSHERRY: You just heat the pipe up and you bend it, just like glass blowers bend, the same thing, bend the pipe.

MR. DAVIS: The induction process doesn't bend it.

MR. McSHERRY: No. You heat it up so it's get soft and you bend it.

MR. DAVIS: I had a question on the isolation valves. Just remind me -- they have a 45-second closure delay. Is that right?

MR. McSHERRY: Only for high flow. On the other signals, they close when they -- when they get the signal, the high flows due to -- we don't have isolation for normal operation when we get changes in flow with the system. So, it's only on the high flow that we have a time delay of 45 seconds.

MR. DAVIS: Okay. But here we're talking about a rupture of the pipe.

MR. McSHERRY: But the temperature could close it sooner. If the temperature is sensed in the room, it could close sooner.

Now, we're assuming it's going to take 76 seconds to close, but that will give us the worst conditions. For the isolated case, it will give us the highest temperatures in the building.

MR. DAVIS: Well, I'm trying to get at the fact that if -- if they have this delay, will you still have equipment failure problems due to the steam?

MR. McSHERRY: We're going to get to that.

MR. DAVIS: Okay.

MR. McSHERRY: We will address that.

MR. MICHELSON: The problem with the temperature instrumentation -- I don't think there is any commitment to protect it against jet impingement and so forth from the breaks which it's trying to assess.

So, we're really not sure temperature even works, but we do know differential works, providing that it isn't a break downstream of the second flow measurement, and nearly all the breaks would be upstream, but you can't count on temperature if you're talking about the room where the break is. It would be awfully difficult, if not impossible, to protect against the break, which has different EQs than the 50-pound and so forth.

MR. McSHERRY: But it also does isolate on low RPD level and high temperature.

MR. MICHELSON: Other things will catch it eventually.

MR. POWER: I'd like to remind the Chairman that the leak detection system in there is a safety-grade system, and it's qualified for those temperatures and pressures that we're talking about.

MR. MICHELSON: But it's not qualified for the jet impingement from the break.

MR. POWER: I understand that, and you're making the assumption that jet impingements will wipe out something like six different sets of temperature monitors all the way out.

MR. MICHELSON: They're all in the same room. Yes, it will wipe them all out.

MR. POWER: They're -- they're in three different rooms.

MR. MICHELSON: No -- but the ones you're counting on for this fast response are in the room where the break is.

MR. POWER: Well, yes, but there are three different rooms that we have sets of --

MR. MICHELSON: That's right, but they're physically pretty far apart. Some are further down in the basement and some are way up at the top. That was a problem with the location to begin with.

MR. McSHERRY: Here is a piping schematic similar to the one that Craig put up earlier, and again, we have this remote manual shut-off valve that we've added to the system, and we've taken out the operator off the bottom head drain valve. So, I won't spend too much time on this.

The frequency -- what we have done to calculate the initiating event frequency is use the WASH-1400 methodology, where we've -- where it states in there that, for pipes greater than three inches, the frequency is 1E to the minus 10 per hour per pipe segment, where a pipe segment is defined as the length between major components in the system, such as pumps and valves.

So, we've gone through the P&ID for the clean-up system, and we calculated that it had 50 segments, based on this methodology, and that calculates to a frequency of 3.7E to the minus 4 per year.

MR. MICHELSON: Now, other PRAs that have been done -- sometimes they do it on a per-foot basis. Have there been ones done on a per-segment basis, and how do they define segments?

MR. DAVIS: The more recent ones are doing it on a per-foot basis, but the numbers don't change a whole lot.

MR. MICHELSON: It may not. I'm just trying to determine how to -- whether it has any important relationship, because they are -- I thought they used to use, also, welds as a discontinuity, so they did it on how many segments separated by welds and not necessarily by major pieces of equipment. There are various ways of doing it.

MR. McSHERRY: At this point, we don't know how many welds are in the plant, but we do know that we're going to minimize the welds, as I mentioned before, by pipe bending, and also, we're going to be using modularization techniques to put in large sections of pipe that are not going to be welded.

MR. MICHELSON: But philosophically, the idea was we thought breaks would occur at discontinuities, and a weld is a discontinuity. Usually it's welds when you have equipment or valves. Also, pipe segments are welded together, and that was what I was trying to find out. Are you counting -- you're not, apparently, counting from weld to weld, but rather from a piece of equipment to a piece of equipment.

MR. McSHERRY: That's correct, yes.

MR. LINDBLAD: Are these 50 segments for the entire system or just outside containment?

MR. McSHERRY: These are outside containment.

MR. LINDBLAD: So, there's additional segments inside containment.

MR. McSHERRY: Very few, yes.

Now, this number -- we also know that, currently, using both BWR and PWR history -- in PWRs, they have a system called the chemical volume control system, which is very similar to the clean-up system, and there's approximately 1,500 reactor years of operation of these clean-up-type systems without major breaks. There have been some cracks and leaking but no major breaks that we're analyzing here.

So, doing a chi square on 1,500, we get a number of 2.4E to the minus 4, which should be a bounding number, and yet we're using a higher number that even you would get with a chi square.

So, we believe this is a reasonable break frequency for this analysis, and the reason we're doing this analysis was from the Committee's concerns --

MR. MICHELSON: Have you looked at other PRAs to see, for their pipe contribution, if it comes out in this neighborhood?

MR. McSHERRY: Some PRAs claim this is nil. They don't even give a number for it. They say it's a very, very low number. I don't know of any other PRAs that have done --

MR. MICHELSON: I've seen some that do, indeed, claim that the -- in doing their analysis -- the probability of a pipe failure is in the neighborhood of 10 to the minus 4. So, it's kind of nearer the number you came up -- measuring segments and whatever. I just wondered if you had checked to see how you compared with other ones.

MR. McSHERRY: Other people write this break off, because they have core damage frequencies at 10 to the minus 5, and a 10 to the minus 4 initiating event, by definition, is going to be a low frequency for them.

MR. MICHELSON: They assume that they got such good isolation valves, which indeed you might have but the present-day plants don't necessarily have -- we haven't even qualified the valves in present-day plants, in most cases, yet. EPRI is trying to figure out how to do it.

But for this plant, with the rules now set down for how good the valves have to be, then the probability of closure is very high, and therefore, these breaks should go away, but the break probability to begin with does look like -- in the right range, at least from what I've seen.

MR. LINDBLAD: If you had no events in 1,500 reactor years of experience, wouldn't your chi square give you a less-than number rather than a equal number?

MR. DAVIS: It does, doesn't it?

MR. LINDBLAD: But it doesn't say that. Did you mean to say that it was less than 2.4E to the minus 4?

MR. McSHERRY: Exactly. It's a bounding number. The number should be lower than that.

MR. LINDBLAD: Your slide didn't say that.

MR. McSHERRY: I'm sorry. That's the intent.

MR. DAVIS: I think that's the 95-percent confidence.

MR. MICHELSON: There's another small factor that maybe you're going to tell us about, and that is the material construction being carbon steel in this case, and in most all other cases, it's stainless.

Now, that affects the probability of a pipe rupture, because now you've got to talk erosion/corrosion, perhaps, or other mechanisms when all of this goes out the window.

Are you going to tell us why erosion/corrosion or other mechanisms are a non-problem?

MR. POWER: You recall we submitted an answer relative to clean-up system materials, and it turns out that 40 percent of those materials are carbon steel, and about 60 percent are stainless steel, and each one of them has a little different twist on it, erosion/corrosion on one and

IGSEC on the other.

MR. MICHELSON: But on the pipe -- it was that much carbon steel pipe?

MR. POWER: Yes, it was.

MR. MICHELSON: I'm talking about components or tanks.

MR. POWER: It's carbon steel. We did a very sophisticated analysis evaluation in 1988.

MR. MICHELSON: No, no, no, no, no. ABWR -- how much of it's carbon steel?

MR. POWER: It's carbon steel.

MR. MICHELSON: Throughout.

MR. POWER: Outside. Inside, it's --

MR. MICHELSON: No, no, outside only.

MR. EHLERT: The reactor water clean-up is carbon steel, and we looked at existing BWRs.

MR. MICHELSON: This is a PRA for ABWR only.

MR. EHLERT: Yes, but we looked at existing CUW systems, and it's a mixed bag, about 50/50, between stainless and carbon steel.

MR. MICHELSON: Some of them have nearly all stainless, some have a large amount of carbon.

MR. EHLERT: It's all carbon.

MR. MICHELSON: Yes. That's for somebody else to worry about.

MR. POWER: Well, there's a commitment on erosion/corrosion here, on CHECKMATE, and all the other things for the co-applicant to look at this material constantly.

MR. MICHELSON: Has any of the ABWR owners now applied CHECKMATE to reactor water clean-up? I'm now aware of any, but I thought maybe in the last year or so, since the last time I checked with the staff in some detail, that some people would start looking at it.

I don't know what the situation is out there, and erosion/corrosion sometimes takes longer, depending on how bad the situation is. It doesn't take a few months, it may take 10 years or 20 years, and maybe we haven't seen it happen yet because it's just now coming down the road.

We don't know unless you go in and inspect the piping, and we don't do that either, or at least apply CHECKMATE, and I don't know that we're doing that either.

I don't know that we know any of that, but for this place, it is carbon steel, and the probably of failures dealing with the carbon steel pipe -- I am raising the issue that we don't know erosion/corrosion, unless you have some good argument for it, so that kind of just makes it a little less conservative of an analysis that the way it first appeared.

MR. DAVIS: I don't think they were trying to do a conservative analysis.

MR. MICHELSON: No, but it's less conservative -- unless you take erosion/corrosion into account, you can't play the probability game quite as well.

MR. McSHERRY: I think you'll see as we go through that there are uncertainties associated with all these numbers, but even factoring in the uncertainties, the core damage frequency, it's still going to be quite low.

MR. MICHELSON: The real saving grace is you've got good valves now.

MR. McSHERRY: Right. They've proven that they can handle that environment.

MR. EHLERT: We have committed the COL applicant to use CHECKMATE. He has to use CHECKMATE.

MR. MICHELSON: That will also help.

MR. EHLERT: That should solve the erosion/corrosion problem.

MR. MICHELSON: That will start monitoring early on.

MR. EHLERT: Yes.

MR. MICHELSON: Yes. I was just trying to plant a seed for the staff to think about, because there are a lot of plants out there that aren't doing any of this, don't have good valves either.

MR. McSHERRY: Okay.

Given that we have this break, there was a concern raised by the Committee that the numbers that we had presented earlier on the operability of the equipment given this environment -- we know there is very little data on operation at this high temperatures. We haven't had accidents in this system. We haven't had actual operation of ECCS components at high temperatures.

Environmental qualification gives you information on capability -- that is, it addresses common cause failure or capability of the equipment to operate -- but it doesn't give you any information on reliability or un-availability for many of these that are operating.

So, to qualify a component for EQ, you need one successful test, and then it's qualified.

Also, when you do EQ, you age it, but still there are people that challenge the aging mechanisms, and the equipment is relatively new, and the existing PRA databases do not treat these high temperatures. So, the numbers you get from the KAG -- the Key Assumptions and Ground Rules database -- are not applicable to these harsh environments.

So, what we've done -- we did a review of the literature to find out what other people think of operability of ECCS-type equipment at high temperatures, and we found that, in support of NUREG-1150, there was a group of people that got together and did a DELPHI analysis, four experts in the EQ area, and they looked at -- based on their EQ experience and other judgements -- what would happen to the equipment if you had to operate it at these higher temperatures, and there was a consensus from the group that, as the temperatures increased, there would be an increase in the failure probability or failure rates.

There was some disagreement on how high these changes would be and at what point. They felt that, at the qualification limit, there would be a fast change or even a function change in the un-availability of the equipment. At lower temperatures, the further you got from the qualification temperature, the less impact there was on the reliability.

In their opinion, most of the components that would be in the harsh environment would have the same type of failure mode -- that is, valves and motors have connector boxes -- and it was their judgement that the predominant failure mode would be moisture intrusion into the connector boxes, causing short-circuits, and so, since most of the boxes -- most of the equipment has the same box, the same failure mode could apply to the valves, as well as the motors.

MR. LINDBLAD: May I ask a question about that?

MR. McSHERRY: Sure.

MR. LINDBLAD: The moisture intrusion was the result of high temperature?

MR. McSHERRY: And humidity, steam.

MR. LINDBLAD: Steam and humidity.

MR. McSHERRY: Steam and temperature.

MR. LINDBLAD: Rather than the high temperature.

MR. McSHERRY: It's a combination of both. It was high temperature and steam causing failure of the seals and moisture getting through the seals into the connector boxes causing short-circuits.

MR. MICHELSON: Steam will go through the seals, of course, not moisture.

MR. McSHERRY: Steam, yes.

MR. MICHELSON: It's highly pressurized relative to the box. It's highly pressurized steam, and it just penetrates through the seal, and then it condenses inside the box, and that's when the problem starts.

MR. McSHERRY: One of the main conclusions that we've used in our modeling is that, if the equipment is qualified for the environment, it is not totally common-mode.

That is, there would be a common mode for components in the same system, but between systems, there are other modes that could cause the seals to fail. It could be maintenance or design of the seals themselves.

MR. MICHELSON: So, it wasn't all the components in all three systems that were exposed to the environment --

MR. McSHERRY: That's true.

MR. MICHELSON: -- at the same time, roughly.

MR. McSHERRY: Right. What we're saying is that things like the RHR motors would have a different failure rate than the high-pressure core flooders --

MR. MICHELSON: Sure.

MR. McSHERRY: -- if they're qualified for the environment.

MR. MICHELSON: For the same environment, yes.

MR. McSHERRY: Right. But if they are not qualified for the environment -- and as we show for some of these breaks, there's time periods when we're outside of the EQ envelope -- then it is totally common mode, and we have a certain failure rate that we apply to all the motors then that are not qualified for that environment.

Contrary to the quite pessimistic opinion of the DELPHI group, we found some data from IEEE in support of IEEE-275, -323, and -383 that shows that motors can run for quite long periods of time -- in some cases, up to 100 days; I've said three weeks here, but there were some over 100 days -- at 250 C and 100-percent steam.

So, there's a mixed bag, if you like, of people thinking things will fail at the limit, or components, and these tests were done for more than one component. In some cases, there were 100 to 150 motors or, as they call them, motorettes, pieces of motors that they would test.

MR. MICHELSON: You're using the number of 100-percent humidity. That doesn't mean steam.

MR. McSHERRY: Correct.

MR. MICHELSON: That means a relative humidity of 100 percent in air. Steam is a whole different actor. When it gets in, it condenses, and it's a different qualification. That's the problem. People think 100-percent humidity means, gee, I can operate in a steam environment. That's simply not true. That's a different qualification entirely.

So, I don't buy the 100 percent as telling me much. If you told me it was in a steam environment at 100 degrees centigrade, it would have told me a little more.

MR. McSHERRY: It's just data that shows that, at a very high temperature, 250 C, that these motors can run for a long period of time, but yes, it's not the exact same --

MR. MICHELSON: It's not running in steam.

MR. McSHERRY: Not running in steam, that's right.

MR. LINDBLAD: Excuse me. Could you explain why 100-percent humidity is not steam?

MR. MICHELSON: Because the moisture doesn't condense out at 100 percent. If it's a cold surface, it will, but if it's a surface at the same temperature, the moisture won't condense out.

MR. SEALE: But he said 100 degrees centigrade.

MR. MICHELSON: 100 centigrade, right.

MR. LINDBLAD: Greater than 100 centigrade.

MR. MICHELSON: As you go up higher than that with the steam part, it will condense out on those surfaces to some extent, depending on the heat transfer rates.

MR. LINDBLAD: But this was over a long period of time. So, presumably things were coming to equilibrium at some time.

So, why isn't 100-percent humidity considered to be water that is at vapor pressure?

MR. MICHELSON: The problem the motor is going to get into -- it's going to be cold when you start.

Now, if you do a test where you start with a cold motor and shoot 100-degrees-centigrade, 100-percent-humidity air onto the motor, that water will condense moisture for quite a while, until it gets up to equilibrium, and that's the moisture now that gets into the terminals or whatever that may not be qualified.

MR. LINDBLAD: So, you suspect that these tests that are referred to here were running hot to start with?

MR. MICHELSON: It they put them in an autoclave and bring everything up together, they're running hot. If they put them into a chamber with the motor running cold -- it also depends on whether the motor just started or has been running at equilibrium.

MR. LINDBLAD: So, we really don't know.

MR. MICHELSON: You don't know. We just don't know. That number alone doesn't tell me enough, anywhere near enough.

MR. SEALE: Could you tell me, is there a cleanliness requirement on these junction boxes?

MR. McSHERRY: Not that aware of.

MR. SEALE: It seems to me, actually, if you think about it, that if you kept the junction boxes clean and you saturated them with steam, that doesn't necessarily mean you've got a problem.

MR. MICHELSON: That's ght. It depends on whether the steam is coming from a nice clean water supply, like a de-mineralized water source, and if there is absolutely no contamination on the surfaces, it probably won't conduct, but that's not true, because of simply the way we have to build plants to begin with and the source of the steam.

In this case, this ought to be pretty clean, but I don't know. It might be coming out of the de-mineralizers, and I don't know what its conductivity is.

MR. McSHERRY: Now, there is something that I didn't mention -- and I probably should have -- is that we found that, for some equipment, if you use what's called shrink tubing to connect the cables together, even if these seals do fail, if it's bolted and has shrink tubing on it, it will help, also, from failing at higher temperatures and steam.

MR. MICHELSON: That's how you pass qualification tests in some cases.

MR. McSHERRY: Right.

MR. MICHELSON: Now, are these going to be all -- in the case of instruments, are they going to -- will it be vented instrument casings, or will be it be hermetically sealed?

Some people even put this nice seal on the door and stick a hole in the bottom of the box because they couldn't stand the differential pressure to pass their test, and it kind of makes a different qualification problem.

MR. McSHERRY: I'm not sure which components you're talking about now.

MR. MICHELSON: The pressure transmitter that's located a little bit remote from the pipe but it has to be inside of secondary containment. Is that pressure transmitter in a box that is sealed to withstand 15 pounds external pressure on the box? If you have a vent hole in it, I don't have to take 15 pounds pressure on the box.

MR. McSHERRY: The level transmitters are temperature-compensated, and they are qualified for these environments.

MR. MICHELSON: This is not the level transmitters that -- these are not inside of containment. These are outside of containment. This is reactor water clean-up instrumentation associated with RHR and HPSI, the works that are presumably still operable with the reactor water clean-up.

MR. McSHERRY: Yes.

MR. MICHELSON: Are those instruments going to be hermetically sealed so that the boxes then have to withstand the 15 pounds?

MR. McSHERRY: For CUW? No.

MR. MICHELSON: Are you going to vent the boxes?

MR. McSHERRY: That's a level of detail I don't think we have yet.

MR. MICHELSON: It can be done both ways. If you vent the boxes, you've got to be very careful about all the internal sleeving and protection and everything, just like with the motor. Usually, it's the terminal box that gets you, not the windings of the motor, which are generally in pretty good shape.

MR. McSHERRY: For this analysis, we're not taking any credit for those sensors. We don't really care if those sensors fail or not.

MR. MICHELSON: All right. That's a part of what's doing the isolation and so forth, you know.

MR. McSHERRY: Maybe it's doing the isolation.

MR. MICHELSON: There have got to be transmitters associated with that differential pressure device that's measuring the differential flow, and those transmitters are in the environment that we're talking about.

MR. McSHERRY: There are several sensors that can cause isolation of the system.

As I already mentioned, the temperature profiles for the auto-isolator case is that we get the break and the valve closes within 76 seconds. The temperature starts out in the ECCS rooms at 100 degrees C and decreases to 66 degrees C within two hours. So, it's down to 150 F within two to three hours.

For the manual isolator case -- that's the cut-off valve that we've added -- or if the operator chooses to try and close the main isolation valves, if he completes that action within one hour, again it's within the qualification limits, because the temperature drops down to roughly 100 degrees C and gets down to 66 C within five hours. So, with a one-hour delayed case, we are within the EQ envelope of the equipment.

MR. MICHELSON: For this instrument qualification, are any of these instruments going to be solid-state-type devices, or are they all going to be pure mechanical, because solid state getting up to 212 fahrenheit is beginning to get marginal on the solid state components for steady -- you know, to operate for several hours, and you're talking, I think, six hours or something into that.

MR. McSHERRY: We have specs on the Rosemont transmitters that show they will operate beyond these temperatures that we have.

MR. MICHELSON: The old Rosemonts perhaps would, but I think -- I'm not that much of an instrument technician anymore to know how they changed those things out, but I know there is a great deal of solid-state transmitting capability built into these transmitters, so that I don't know if they will withstand 212 or not, but presumably they will.

MR. POWER: We have made a commitment for those systems to meet the environmental qualifications.

MR. MICHELSON: They're qualified to operate at these conditions.

MR. McSHERRY: Yes.

MR. MICHELSON: Not just survive these conditions.

MR. POWER: Operate.

MR. MICHELSON: Okay. That's a very important point. It's not intended to be subtle.

MR. McSHERRY: Okay.

So, for the first two cases, for the auto-isolator case and for the manual isolator case, all the equipment that's being credited for this scenario that's in the harsh environment is within the EQ envelope.

For the un-isolated case, the temperature stays at 100 degrees C indefinitely, until it's isolated, and after six hours, the equipment is no longer qualified. So, as I will show in the event tree, we will give different un-availabilities for those components.

The harsh environment will be contained within secondary containment. That is, the steam will not get outside secondary containment into the essential electrical rooms. So, the remote control centers that operate -- that give power to this equipment will not be affected.

Also in the analysis, we are not taking credit for RCIC. Even though RCIC is qualified for this environment, RCIC has a high room temperature shut-off that's somewhere around 150 F. So, we are not crediting RCIC for mitigation of this event.

For the auto-isolation case, we have taken the ECCS network -- in this case, it's the two high-pressure flooders and the three RHR trains -- and have increased the un-availability of the whole network by a factor of over

200. Even though it's qualified for the environment, it's at the elevated temperatures.

MR. MICHELSON: Let me ask another question on your environmental qualification for motors. The motors are apparently going to be capable of running with an atmosphere surrounding them of 100 degree centigrade and 15 pounds.

Now, those motors in themselves, when they start operating, are going to generate large amounts of heat, which is normally removed by forced draft coolant on the motor and whatever.

It's not clear that any of that equipment will even do any cooling with 100-degrees, 100-percent humidity atmosphere in the room. All they will be is condensers. They don't cool the air. They will just condense moisture out of the air.

Will these motors operate then? Is it claimed they will operate?

MR. EHLERT: There is no credit in the EQ limits for the coolers operating.

MR. MICHELSON: No, no, no. The coolers are gone. Will the pump motors operate in a 100-degrees-centigrade atmosphere for six hours without cooling?

MR. EHLERT: That's the EQ requirements on those motors.

MR. MICHELSON: Those are going to be interesting motors.

How about it, Charlie?

MR. WYLIE: We always use water for the motors.

MR. MICHELSON: Yes, they're water-cooled motors, because you knew there was a tough problem when you remove the heat from the motors, and the higher the temperature in the room, the tougher the problem, and here it's 100 centigrade that you start out with.

MR. McSHERRY: These motors are water-cooled.

MR. MICHELSON: No, they're not. I haven't found that. Are they water-cooled motors, or are they air-cooled motors with an air-handling unit in the corner to cool the motors?

MR. EHLERT: The seals, I believe, are cooled by water.

MR. MICHELSON: Yes.

MR. EHLERT: The pump seals.

MR. MICHELSON: We're not talking about pump seals. We're talking about the motor.

MR. McSHERRY: Oh, the motor. No. The pumps are cooled by RCW.

MR. MICHELSON: The pumps I'm not worried about.

MR. McSHERRY: Okay.

MR. MICHELSON: They'll survive this with no problem. The pump motor, the electric motor, is it direct water-cooled, or is it going to be cooled by an air-handling unit in the corner, which I think is what you've got?

MR. EHLERT: It's an air handler.

MR. McSHERRY: Right.

MR. MICHELSON: So, that doesn't work anymore.

MR. McSHERRY: That's correct.

MR. MICHELSON: It can't cool the motor. If the atmosphere is 100 degrees centigrade and 100-percent humidity, all that cooler can do is remove moisture from the atmosphere. It's a big condenser.

MR. EHLERT: It's not used to reduce the temperature in the room.

MR. MICHELSON: Right. So, now the motor is putting heat into the room, and the room is already 100 centigrade by your postulation.

MR. EHLERT: The EQ would keep the room at 100 degrees C for six hours.

MR. MICHELSON: There's insulation and everything to survive six hours with in excess of 100 centigrade.

MR. WYLIE: Well, you could design a motor using Class H insulation.

MR. MICHELSON: It's a different motor than I think I read about.

MR. POWER: I think you will also hear in the discussion that we do not need all those motors running under those conditions. We only need a small portion of make-up, and he'll discuss that.

MR. MICHELSON: That's true, but the motor you need is in a room that is not going to be cooled, and it's going to be a hot room to begin with. I don't believe it's going to be 100 centigrade all this time, but I'm trying to point out -- your PRA people have to think about this, and the probability of cooling that motor is zero. I think everybody conceded that, and therefore, you've got to look at what the motor temperature is for six hours, what the room goes to, and whether the motor survives and what that probability is, if you're going to do a PRA that's meaningful.

MR. McSHERRY: And that's what we have done. We have said that the motors will be qualified for this environment, and we have raised the failure rate by over a factor of 200 to take account for this higher temperature.

MR. MICHELSON: And the motors will be designed for this environment, to operate for six hours without cooling.

MR. McSHERRY: Yes.

MR. MICHELSON: Okay. Good. That will take care of it.

MR. McSHERRY: Now, for the manually isolated case -- this is either the operator closes the main isolation valves or the remote manual shut-off valve -- the un-availability of that is dominated by operator error. We say that to keep the equipment within the EQ envelope, the operator must act within one hour.

Now, the valve we're putting in will be a motor-operated valve, and it should have a better un-availability than 1E to the minus 2. Based on KAG values, it should be more like 2E to the minus 3, but we're going to be limited in the PRA by the operator error to use the valve, to figure out the scenario and manually close the valve.

In the un-isolated case, we said that it is totally common mode. Back up here, I mentioned that this 6.6E to the minus 5 takes credit for the fact that it is not totally common mode, and the high-pressure flooders and the RHR pumps and motors of the trains have different seal designs.

MR. MICHELSON: What is the probability for the two valves in series? Is that that 3E to the minus 7?

MR. DAVIS: No, 2E to the minus 4.

MR. MICHELSON: Per valve or two in series?

MR. McSHERRY: Two in series.

MR. MICHELSON: That's probably a little bit conservative.

MR. DAVIS: Yes. If they're, indeed, designed for this --

MR. MICHELSON: If they're designed right, this should be a non-problem.

MR. McSHERRY: One valve is in the harsh environment and one valve is not, but it would be in the harsh environment for a very short period of time, and it's up on the second or third floor.

MR. MICHELSON: It's all over with before it sees the environmental condition.

MR. McSHERRY: Right.

So, for the un-isolated case, we have raised the ECCS network failure to .03. So, it would be beyond its qualification limits.

MR. MICHELSON: Now, you are assuming that the outboard isolation valve is protected against steam jets and so forth for the duration of time needed to shut it.

MR. McSHERRY: Yes.

MR. MICHELSON: The wiring, in particular, is the vulnerable point, and it will have to be glass-shielded so that it survives the initial blast and can get the valve closed.

MR. EHLERT: That's a standard requirement for all safety-related valves.

MR. MICHELSON: Yes.

MR. DAVIS: Is there a reason you didn't consider the AC-independent injection system?

MR. McSHERRY: Yes, because of the harsh environment. There are two valves that have to be opened inside the secondary containment.

MR. DAVIS: I knew the pump and the engine is outside the --

MR. McSHERRY: They're valved inside. At these temperatures, the operator could not get in that room.

So, the scenario for the isolated case is that we did a break on the first floor. We're taking that as the worst break as far as the conditions in the building.

As mentioned previously, the blow-out panels and doors open, and the pressure is as was presented by Umesh. The steam stays within secondary containment. ECCS rooms heat up very quickly to 100 degrees C, in about 10 seconds.

Isolation valves are directed to close based on various signals. We assume a closure time of 76 seconds. And feedwater condensate continue to run and maintain -- or they are capable of continuing to run and maintain normal water level, and ECCS can be used as a back-up if feed and condensate fails.

For the manually isolated case, up to one hour, the operator can either close the main isolation valves that did not close automatically, or after the blowdown, either the blowdown through the break or the operator blows down manually, will then open -- or close this new valve, the manual shut-off valve.

Again, feed and condensate are capable of keeping up with this break, and they could maintain level without ECCS even being challenged.

Now, we assume that the reactor has scrammed on either high temperature in the steam tunnel or by manual scram. The operator is directed by procedure to scram the plant for this break. That is an event-specific procedure for this break. If he does it within an hour, the equipment stays within EQ limits.

If the operator fails to isolate the break, then he is directed to blow down and to control RPV level below the level of the break, and then it will depend on where the break is. It could be from one foot above the core to a meter-and-a-half.

Then, to close out, once the building is cooled down, after maintaining levels so we don't lose make-up capability, then we just enter the building and close the valve manually and recover from the event.

Now, I'll go over the event tree again, this time in more detail, and I'll mention some of the operator actions and couplings and what we assume is available and not available and what it means as far as time for operator actions.

Initiating event, break, at 3.7E to the minus 4.

If the operator -- if the break does not isolate -- well, let's say the break does isolate. Then you can either use condensate at 10 to the minus 3 that we've already mentioned, and that would be success, or ECCS at 6E to the minus 5 would also be success, and that would give us a core damage frequency of 2.4E to the minus 11.

MR. KRESS: Could you elaborate on how you calculated the 3.7 times 10 to the minus 4?

MR. McSHERRY: Yes. I already did. That's the WASH-1400 methodology.

MR. KRESS: I know. You start out with 1 times 10 to the minus 10 per segment --

MR. McSHERRY: Right. We get 50 segments.

MR. KRESS: -- per year. You multiply that by 50.

MR. McSHERRY: Right.

MR. KRESS: You multiply that by the number of hours in the year?

MR. McSHERRY: Right. Exactly. And then we convert from median to mean.

MR. KRESS: Oh, you convert from median to mean.

MR. McSHERRY: Right.

MR. KRESS: Okay.

MR. McSHERRY: That's the standard form of converting.

MR. KRESS: That's what I didn't do was convert from median to mean. I was trying to reproduce the number.

MR. McSHERRY: Okay. That WASH-1400 is a median value, and you must convert E to the minus sigma over 2 squared where sigma is the uncertainty.

MR. KRESS: Okay. That would explain it.

MR. McSHERRY: Okay. So, for the isolated case, we get 2.4E to the minus 11.

Now, if the valves do not automatically isolate, then the operator can manually close either the main isolation valves or the new valve, and we are assuming an operator error of 1E to the minus 2, and this is from Swaine and Gutman for a procedure. We're assuming the operator has correctly diagnosed the event, and this number can be substantiated by analysis done by Swaine and Gutman methodology.

Now, if the operator does isolate, it would go back to the same case. We now have an isolated event, and the same numbers for condensate and ECCS apply. We get a much lower core damage frequency, of course, because of the failure probability of the valves.

This number, 2E to the minus 4, assumes that the valves are qualified and designed properly. This is a KAG number that does not take into account any harsh environment, because the valves will not see the harsh environment. On the inside of containment, they won't see it at all. On the outside, they'll see it for a very, very short period of time.

Now, if we cannot manually isolate, then we get to the point that we have to then determine how much water is left depending on which systems fail.

It gets a little complicated here depending on -- if condensate is success, the operator then must control the level, otherwise he will run out of water in about four hours. So, within four hours, he must diagnose the event and lower level or he is going to run out of water.

If he runs out of water, he can still use ECCS, because there will be water -- and the pool could be used for ECCS if he blows down or if he uses the high-pressure core flooder, which will shift suction from condensate storage to the pool, and again, we're going to get very low numbers for core damage frequency, 10 to the minus 12.

Now, we have -- the operator error to not control level is a relatively high number, because we felt there was coupling. If the operator failed to diagnose the event and tried to manually isolate, we then say with a relatively high probability he will not lower the level.

He has an hour-and-a-half to two hours to complete this, but we're saying there's a coupling, that in the timeframe of two hours, that the failure of the operator is on the order of 10 to the minus 3. So, we have taken account for coupling into the short time.

Now, if condensate fails, then we have to rely on ECCS. Depending on if he blows down or not or if he uses the high-pressure core flooders, he could have between 7 and 11 hours of make-up water available, and we're saying, over that period of time, that there is a de-coupling of the operator error between his inability to diagnose the event and his very long-term to figure out that he has to lower the level before he runs out of make-up.

MR. DAVIS: In the top sequence, you've made the assumption that, for that case --

MR. McSHERRY: The isolated? Automatic isolation?

MR. DAVIS: Yes. The condensate will be available indefinitely.

MR. McSHERRY: No. It will be available for 24 hours. It is isolated, and so, condensate -- you should not run out of inventory.

MR. DAVIS: Right. That's what I said.

Now, that may be okay, but that assumes that the MSIVs won't close for this accident. Is that right?

MR. McSHERRY: The MSIVs will close.

MR. DAVIS: Okay. Then how do you get continued supply of condensate?

MR. McSHERRY: From the condensate storage tank by gravity drain.

MR. DAVIS: There is enough of that to provide enough --

MR. McSHERRY: Yes. Condensate storage has 557,000 gallons.

MR. MICHELSON: You must have depressurized, then, I guess.

MR. McSHERRY: In this case, you keep it on the feed pumps. Feed and condensate would be available.

MR. MICHELSON: Okay. These are all motor-driven feedwater systems.

MR. DAVIS: If you've lost condensate vacuum, you can still get enough gravity flow.

MR. McSHERRY: Sure.

MR. SAWYER: Once you isolate, the only flow you have to make up for is decay heat.

MR. McSHERRY: Right.

MR. MICHELSON: Let me just try to look at this thing in a little different perspective. It appears that the break probability is in the neighborhood of 3.7 to 10 to the minus 4. That's the event probability, right?

MR. McSHERRY: Frequency per year, right.

MR. MICHELSON: Frequency, yes. That is a fixed number that we can do nothing about. What we're talking about thereafter in all these trains are we've already got the bad atmosphere in the building and so forth. The question is how do we get out of it?

So, it looks like the frequency of getting the bad atmosphere in the building is roughly 3 to 10 minus 4, right?

MR. McSHERRY: Correct.

MR. MICHELSON: Okay. And all of the good things we do don't change that situation. So, we really have to go to the full careful environmental qualification of the equipment, because we've got too high a frequency here to tolerate it otherwise. We must have a high assurance that this equipment is going to survive the event.

MR. McSHERRY: Feed and condensate will not see the harsh environment, of course.

MR. MICHELSON: Beg pardon?

MR. McSHERRY: Feed and condensate --

MR. MICHELSON: That's true. The feed and condensate arrangement will not see the harsh environment, and therefore, you could argue that we don't need any of the ECCS. Is that what you're saying?

MR. McSHERRY: No. I'm just saying that the condensate and feed are not qualified but don't have to be and they don't see the harsh environment.

We still need -- to get these numbers -- to get the low numbers that we think are appropriate, we still need qualification of ECCS.

MR. MICHELSON: You don't think this event could be carried out with no ECCS?

MR. McSHERRY: If feed and condensate is --

MR. MICHELSON: Assuming that we got the isolation and everything -- in other words, I just got the event. I got the break all right, but everything else worked right.

MR. McSHERRY: ECCS would not be challenged if feed and condensate --

MR. MICHELSON: No, no, no. Let me ask my question again.

MR. McSHERRY: Okay.

MR. MICHELSON: If we do get the break but everything works right --

MR. McSHERRY: It isolates. Okay.

MR. MICHELSON: The isolation is the big thing that's got to work right.

MR. McSHERRY: Right.

MR. MICHELSON: After that isolation, could we survive on the feedwater system only? We don't even need depressurization, because it can be brought on up to full pressure.

MR. McSHERRY: Sure. Now, you wouldn't do that forever.

MR. MICHELSON: You're sure now. We don't need, then, ECCS to survive this break provided we get the break isolation.

MR. McSHERRY: That's correct.

MR. MICHELSON: Is that a correct observation?

MR. McSHERRY: That's correct.

MR. MICHELSON: That's an important observation, in fact, because then I have to put less reliance on the environmental qualification. I might almost ask, of course, if you made your numbers good enough and your proof look good enough, why do you need the environmental qualification if you can survive without it?

MR. McSHERRY: For this break, we're showing the risk as very, very low, but there are other breaks or other times when you do need the ECCS for different --

MR. MICHELSON: Just for reactor water clean-up. That's all we're talking about here.

MR. McSHERRY: Reactor water clean-up --

MR. MICHELSON: That's what that first-line probability is.

MR. McSHERRY: That's right.

MR. MICHELSON: It's only reactor water clean-up, and for that break, the question in my mind is do we need environmental qualification? I think we do for regulatory purposes.

MR. SEALE: In fact, if the condensate is available, you don't even use ECCS.

MR. McSHERRY: That's right.

MR. MICHELSON: That's what I'm saying. I don't need any of it.

MR. SEALE: That's right.

MR. MICHELSON: That was the point, and that's an important point which I haven't heard pushed too hard in the past, but I think it's a very important point. I, for some reason, forgot that these are not steam-driven feedwaters.

MR. McSHERRY: No.

MR. MICHELSON: If you had steam-driven feedwater, then you've got a different problem, because you've got to get the pressure down and you've got a whole lot of other things before you can start talking about getting water back to the reactor, but with full feedwater pressure available, independent of the event, it becomes of much less concern in this plant. Okay. I think, if my observation is correct, then it certainly looks even better.

So, fixing the valves was the key. You had to get the isolation. Once you've got the isolation, then I think you can fly without ECCS, and the environmental qualification gets a little less sticky.

MR. POWER: You can also use the AC-independent system.

MR. MICHELSON: Yes. Yes. So, why are we spending -- if I were doing a cost-benefit analysis, I'd have a hard time justifying the environmental qualification of the ECCS equipment for this event, you know, this 15 pounds and 248 fahrenheit. It's getting less and less clear that that's needed provided you do have a fully-qualified, although not safety-grade, feedwater system, because there you've got redundancy and so forth, too. You're not depending on one pump.

MR. DAVIS: Carl, one thing I would be concerned about is a seismic event. This is not a seismic qualified system.

MR. MICHELSON: This is not a seismically qualified system. Aren't you doing a seismic qualification on this, in part?

MR. SAWYER: On the feedwater system?

MR. MICHELSON: No, no, no, on the reactor water clean-up. I think they're doing some pseudo-seismic qualification. Is that correct?

MR. EHLERT: We're meeting the seismic criteria as specified in the -- basically, it would be considered the California piping code, B-31.

MR. MICHELSON: You've got assure it will stay and place and so forth. There's some seismic but not a lot.

MR. DAVIS: Well, what I was worried about more was you'd lose the ability to get the condensate, very likely.

MR. MICHELSON: You might lose the water box and the condenser.

MR. DAVIS: Well, you'd lose power.

MR. MICHELSON: And you'd lose power.

MR. DAVIS: You'd definitely lose offsite power.

MR. SAWYER: Why am I losing offsite power?

MR. DAVIS: Well, for any seismic event --

MR. SAWYER: Oh, for seismic events. Okay.

MR. DAVIS: If it goes above .3 g, you have lost --

MR. SAWYER: I was going to make another comment, which is I think we're -- in this latest discussion in the last couple of minutes, we're crossing the line once again between deterministic and probabilistic.

It would be nice if we could use PRA with the staff to argue the qualify of everything in the plant. I think we would have a much lower burden. But unfortunately, in the deterministic world, the feedwater isn't there. So, that's why we have to do the EQ.

MR. MICHELSON: I think you'd better stick with the plan you've got. I just think, though, that it does somewhat take the pressure off the pureness of the environmental qualification. That's my only observation.

MR. SEALE: Puts it in perspective.

MR. MICHELSON: Put it in perspective, yes. It doesn't have to be quite as rigorous as it would otherwise be.

MR. McSHERRY: Okay.

Now, in summary, for the isolated case, we're getting 2.4E to the minus 11, but more importantly, for the un-isolated case, which could be a bypass sequence, the number is less.

Now, of course, there are uncertainties associated with all the numbers that I've put in the event tree, but the point is that the same uncertainty and methodology and the database has been used to do the Level 1 PRA, and relative to the other analyses or relative to other scenarios, this break is a low number.

So, even if you argue that our numbers are very, very low and could have large uncertainties, the point is it's still relatively small compared to other breaks that we have analyzed with the same methodology.

MR. MICHELSON: Now, the un-isolated, does that take credit for the third valve?

MR. McSHERRY: Yes.

MR. MICHELSON: Okay. Because without the third valve, the un-isolated case has got to be way up there.

MR. McSHERRY: It goes up by two orders of magnitude. It would be higher, right.

MR. MICHELSON: It's probably a lot higher than that because of all the uncertainties on how valves behave under these conditions.

MR. SAWYER: Well, we're not entirely depending on that third valve. The 10 to the minus 2 number is operator action, and if all the operator does is depressurize, the burden goes way down, but he also has to control the water level within the vessel within a narrow bound for the longer term to avoid running out of water sources.

So, although the third valve is very helpful, the PRA was done based on operator error, not on the presence of the valve.

MR. MICHELSON: That was the controlling factor, yes.

MR. McSHERRY: It dominated.

MR. MICHELSON: It won't start that feedwater system either, but that's a pretty small probability.

MR. McSHERRY: It's already running. Feedwater continues to run.

MR. MICHELSON: Well, it continues to run, but I'm not sure you can say that it continues to run for these events. If you get a little water in the reactor vessel, I think you'll get isolation. The system is available, it's not affected, but I think it's isolated, isn't it?

MR. EHLERT: It never gets to that point.

MR. MICHELSON: Oh, it doesn't get you to that point. Oh, okay. Then you're still okay. All right.

MR. DAVIS: I think your conclusion is probably valid. I would point out, however, that for this accident, this core damage accident, you will, it seems to me, always get a large release, because you've bypassed the containment boundary.

MR. McSHERRY: Yes.

MR. DAVIS: And that's not the case for the core damage frequency you're talking about, that you're comparing it with.

MR. McSHERRY: That's true, but even for bypass, even for other bypass events, this is relatively small.

MR. DAVIS: Okay.

MR. SAWYER: That's one of the reasons why we prefer to have this event which leads to core damage be significantly lower than the internal events that release the fission products inside the containment.

The bottom line here is we wanted to make sure that we basically were consistent with the previous studies that were done, which dealt with this mode and other modes of bypassing containment and fission product release events.

MR. DAVIS: Okay. I just wanted to point out there's more to it than just comparing core damage frequency, because in this case you have a more risk-significant sequence than most of the other --

MR. McSHERRY: But it is relatively small compared to other bypass events.

MR. DAVIS: Thank you.

MR. MICHELSON: I'd like to ask Steve Mays if he has any further questions. He looked quite a bit at the PRA in the past. Have you got anything you'd like to get cleared up?

MR. MAYS: This is Steve Mays, Senior ACRS Fellow.

In looking at the event tree, this is a significant improvement over what was originally put forth on this analysis, and I'd like to say that the construction and logic of the event tree is exactly the kind of stuff we had been looking for initially, and so, I have no problems in that.

My only concerns were about where the numbers were coming from for the branch points in the event tree -- for example, the condensate system, this 10 to the minus 3 probability of failure, whereas in the normal reactor trip tree in the PRA, the probability of feedwater failure after just a generic reactor trip is taken is .05. I'm a little curious as to how this system suddenly got 50 times better than the one that was assumed in the normal trip tree.

So, I have questions along that nature, but I have to agree that, if the valves are capable of isolating with the probabilities associated here and the addition of the isolation valve that can be subsequently isolated by the operator, I think that dramatically reduces the risk scenario in terms of core damage frequency.

So, I have less problem with the overall conclusion, but I still have some reservations about where the individual numbers came from.

MR. MICHELSON: That one particular number, could that be related to the fact that this is all electric feedwater, as opposed to most people using steam-driven?

MR. MAYS: No. What I'm saying is that, in the Level 1 PRA, for this plant, a normal plant trip, the probability of feedwater failure is taken as .05, and out here it comes to 10 to the minus 3.

MR. McSHERRY: That was a conservative number in Level 1. This is a more realistic number for this break. In the Level 1 PRA --

MR. MAYS: Excuse me, but if I have a normal plant trip, it would seem to me that the probability of losing feedwater following a generic plant trip would not be 50 times higher than the probability of losing feedwater from a reactor water clean-up system break.

MR. McSHERRY: I agree. What I'm saying is that, for the Level 1 PRA, that number is very conservative. We did not do a detailed fault tree on the feed system in the Level 1 PRA. This is a more realistic number.

MR. MICHELSON: It's more than the feed system, of course. It's the electric power system and so forth.

MR. MAYS: I think, yes, that's part of the answer. Some of the trips that were considered before included failure of this as the cause of the trip.

MR. MICHELSON: That would make a difference.

MR. MAYS: But I'm not sure.

MR. MICHELSON: It does depend upon the reliability of the power source as to how reliable this condensate system will be.

MR. MAYS: So, even taking into account those issues, I still think that the construction of the logic that they're using and the overall conclusion relative to core damage frequency to other events is probably appropriate, even if you were to change those numbers, and I share Pete's conclusion about the radiological consequences of a failure of isolation, with the core damage in this sequence being significantly higher than the other ones. So, that's the only comments I have.

MR. MICHELSON: This is, indeed, quite -- this is a real PRA, as opposed to some of the earlier material, which certainly didn't have a semblance of a real PRA. It didn't have a fault tree with it or an event tree, either one.

Any other questions on it?

[No response.]

MR. MICHELSON: That finishes your discussion, I guess.

MR. McSHERRY: Yes.

MR. SHACK: What's the oxygen level in this water? I mean it's relatively high-oxygen water, right?

MR. SAWYER: Very low. It's about 50 ppb.

MR. SHACK: Yes, but 50 ppb from erosion/corrosion is a lot of oxygen. Low oxygen in an erosion/corrosion sense is less than 5 ppb or 10 ppb.

MR. SAWYER: I know it's a very low number.

MR. SHACK: It's higher than 20, right?

MR. SAWYER: I don't know. I know it's a real low number, and I know that we're requiring -- erosion/corrosion is an important consideration.

MR. SHACK: If somebody chunks 30 or 40 ppb into CHECKMATE, he's going to get corrosion.

MR. MICHELSON: The velocities are fairly low in this system, as far as I can tell. They should be quite low. That helps, too, but there are some restricting devices and throttling devices and whatever to make the system work, and that's the areas where you have the greater problem with erosion/corrosion.

MR. POWER: Three members of the team would like to have an opportunity to head to the airport, if you have no further questions for them.

I'd like to make one other observation. This team here was backed up by a lot of other people back in San Jose like Carol Buchholz and Jack Duncan and Sid Smith and Barry Simon and a lot of other people. This is a fairly large effort to respond to your concerns, and I think maybe we've accomplished that today.

MR. MICHELSON: I think you've given us a very good response. I guess the Subcommittee shares that view. It's certainly as comprehensive as I think we need.

This is the final meeting, final discussion of all of this material. Are there any other things that we need to bring up? The staff is going to come back with a few replies to questions we've raised. Of course, somebody from GE will probably be around.

MR. POWER: We're coming back for the normal questions from the last meeting and other meetings, yes.

MR. MICHELSON: I thought you were wanting to leave.

MR. POWER: No, just some of us.

MR. MICHELSON: Oh, okay. That's no problem.

MR. LINDBLAD: Mr. Chairman, I do have a question when you're finished.

MR. MICHELSON: Go ahead.

MR. LINDBLAD: I'm sure you told us this before, but the bottom drain out of the reactor vessel shows two-and-a-half-inch pipe, but what is actually the minimum restriction in the bottom drain?

MR. SAWYER: Two inch.

MR. LINDBLAD: Two inch.

MR. SAWYER: This is Craig Sawyer from GE.

There is a flow restriction right at the vessel which limits the break flow to equivalent two-inch.

MR. LINDBLAD: Two-inch internal diameter or two-inch pipe?

MR. SAWYER: Two-inch internal diameter.

MR. MICHELSON: There's a flow restriction.

MR. SAWYER: Going through the vessel, the inside diameter for water flow is two inches.

MR. LINDBLAD: Don't I see two-and-a-half-inch pipe leading up to it?

MR. SAWYER: Yes.

MR. LINDBLAD: And what is the internal diameter of two-and-a-half-inch pipe? I thought it was even smaller than two-inch.

MR. MICHELSON: It might be. I thought, at one time, I check and it looked like the valve matched.

MR. SAWYER: I don't know if that answers your question, but I know we've looked at this, and the piping is slightly larger than the restriction of the vessel.

MR. MICHELSON: Slightly larger. Okay. Is that a Schedule 80 pipe?

MR. SAWYER: Yes.

MR. LINDBLAD: All right. I agree. It's 2.323 inches. Thank you.

MR. MICHELSON: This is not two-and-a-half-inch pipe.

MR. EHLERT: It's 65 millimeters. Japan -- their standard pipe sizes are the same as U.S. pipe sizes, except rounded off.

MR. MICHELSON: Okay. Can we cut this off so we can come back from lunch at 1:15? And then we'll just trade the difference with the staff.

[Whereupon, at 12:35 p.m., the meeting recessed for lunch, to reconvene this same day, Wednesday, January 26, 1994, at 1:15 p.m.]

AFTERNOON SESSION

[1:15 p.m.]

MR. MICHELSON: If the staff is ready, then we can go ahead and get started and cover the points that they came to give us today.

MR. BURTON: This is Butch Burton from the Plant Systems Branch. I just wanted to come back on a couple of things that I promised to follow up on yesterday.

One of the ones had to do with exactly whether the radioactive drains were headered and, if so, where? I went back and checked, and yes, they are headered downstream of the individual sumps. They all are headered and then go to either the low-conductivity waste or the high-conductivity waste collector tanks.

MR. MICHELSON: They're headered inside the tunnel or inside the reactor building?

MR. BURTON: You cannot tell specifically from the diagrams, but I was told by GE that they are inside the tunnel.

MR. MICHELSON: Those diagrams, I guess, don't even show where the lines penetrate the building. Sometimes they stick a little symbol on that says I'm going now from the reactor building into the tunnel. They don't put that symbol on those drawings.

MR. BURTON: The only clear boundary you get is for the drywell pump.

MR. MICHELSON: Is there a single check valve, then, to isolate?

MR. BURTON: What you have is, on the discharge of each of the drywell sumps -- and there are a number of sumps, both high and low conductivity --

MR. MICHELSON: This is outside of containment, what the questions related to, not the drywell.

MR. BURTON: Right. But I'm saying it applies to all of them, and it talks -- in the drain section of the SSAR, it talks about the safety-related back-flow check valves, and yes, these check valves are on the discharge of each of sump pumps.

MR. MICHELSON: There's one or two?

MR. BURTON: There are two pumps per sump, and there is one on each of those discharges.

MR. MICHELSON: One check valve, though, is all that prevents the back-flow --

MR. BURTON: Right.

MR. MICHELSON: -- through a given pump.

MR. BURTON: Right. So, I wanted to clarify that.

MR. MICHELSON: Okay.

MR. BURTON: The second thing --

MR. MICHELSON: Now, do we know for sure that those will be a part of the inspection program?

MR. BURTON: I went back and checked the in-service testing table in Chapter 3, 3.9-8, and I did not see them there. So, that is one thing on my to-do list to straighten out with GE.

MR. MICHELSON: Whether or not -- you know, you have to think about these. [illegible] have a strong feeling, but on the other hand, I [illegible] want to believe that they'd go for 20 years wi[illegible]g checked and then have the flood occur and find out they don't work.

MR. BURTON: Right. And they are designated safety-related, but everything needs to be consistent.

MR. MICHELSON: I guess, experience-wise, we should know if they aren't working pretty quick, because you'll stir up a given sump pump and the water will end up filling another sump somewhere if the checks aren't working.

MR. BURTON: Right.

MR. MICHELSON: So, I guess we do get kind of an operational check every time the pump cycles. So, maybe it's not too critical. I was just asking whether it was in the program or not.

MR. BURTON: The second issue had to do with the effect of flooding out the instrument air compressors in the turbine building. I went back and checked on that, and there are several safety-related components that are served by instrument air. They are the isolation valves on secondary containment HVAC, some of the pressure and temperature control valves on emergency chilled water, and the isolation valves which separate the safety-related portion of the reactor building cooling water system from the non-safety-related portions of the system.

MR. MICHELSON: Those all fail safe?

MR. BURTON: They do fail safe. GE has looked at that, and actually, they stated that in Section 9.3.6.3, that they have looked at loss of power, loss of air, and the effect on those instruments, and yes, they do fail safe.

The other thing that I wanted to talk about was the --

MR. MICHELSON: If you're leaving this particular subject, the other question I think we were alluding to -- so you have lost all your air and you also flooded the building. Clearly, you're not going to get the equipment back quickly.

MR. BURTON: Right.

MR. MICHELSON: Even after you de-water the building, there might be a site flood that goes on for months --

MR. BURTON: Right.

MR. MICHELSON: -- a month or two before you can get it de-watered again.

MR. BURTON: Right.

MR. MICHELSON: Was there any reason to believe that we could not continue to do everything we needed to do to maintain reactor cooling?

MR. BURTON: That was part of that question, and there is no long-term effect from that flooding.

MR. MICHELSON: So, you've looked at it enough to think that there doesn't seem to be any suspicion there.

MR. BURTON: No, no, not at all.

MR. MICHELSON: Okay. Thank you.

MR. BURTON: The final thing had to do with some of the changes to the ITAAC, a couple of things. Specifically, I think we're pretty much agreed that we're going to need to add a tunnel ITAAC to clarify exactly what the higher order Tier 1 verifications need to be for those tunnels.

MR. MICHELSON: Okay.

MR. BURTON: So, we are going to see about adding that.

The other thing is that there have been some words proposed for how we're going to reconcile the as-built plant with what was assumed for flood analysis, pipe failure analysis, fire, things like that.

We've got some proposed words. We've looked at them. We got them yesterday, but we looked at the words, and the words that are there, they look pretty good, but there is still an issue regarding exactly what, if anything, we need in the turbine building.

MR. MICHELSON: Are these the words that --

MR. BURTON: The ones we discussed with you.

MR. MICHELSON: I have a copy, and any member who wants to see those words -- I think Medhat has got the original now and can make a copy.

MR. BURTON: Right.

MR. MICHELSON: I haven't had a chance to examine them in detail yet, but in principle, at least in flipping pages alone, it appeared to be -- what you were doing is the right thing to do.

MR. BURTON: Yes.

MR. MICHELSON: It's a question now of whether the words are the right words.

MR. BURTON: I think, at this point, the only issue may be whether or not we've really treated adequately protection of some of the safety-related instrumentation that's in the turbine building.

MR. MICHELSON: Clearly, of course, the tunnels were omitted.

MR. BURTON: As I said, we're going to have --

MR. MICHELSON: You're saying you're going back to pick those up?

MR. BURTON: Right.

MR. MICHELSON: The turbine building was omitted, but I'm not sure there's any strong feeling either way on that one.

MR. BURTON: What I'm proposing is that we would see a separate -- we have various building ITAACs, and we will have a new ITAAC that will deal specifically with the tunnels. So, the wording in there would be very similar to what you see in some of the other building ITAACs.

That's pretty much all I wanted to bring out, unless there were some other things, something I was forgetting from yesterday.

MR. MICHELSON: Anyone have any recollection of what might have been omitted? I didn't make notes of what we were going to hear. These are the three I recognize. I was thinking there was something else you were going to come back to, but it escapes me now.

MR. BURTON: I wasn't writing when I was up there either. What I'll do -- if you come up with it, I'm going to be here.

MR. MICHELSON: You'll be here a while.

MR. BURTON: Yes.

MR. MICHELSON: Okay. Thank you very much. Appreciate it.

MS. MALLOY: This is Melinda Malloy again from yesterday. I wanted to pick up on a couple of questions that I believe Mr. Davis asked yesterday from Chapter 20.

In the interest of getting some of our folks back to the office, we wanted to cover any questions that you may have had on item 2.B.1, which is discussed beginning on page 20-116 of the FSER. It's also called 50.34(f)(2)(iv), Consideration of Degraded or Melted Cores in Safety Reviewed Reactor Coolant System Vents.

As I recall, yesterday you had a concern about the staff's acceptance of the main steam line break as bounding in regards to this -- the reactor coolant system vents, and with us today we do have George Thomas from the Reactor Systems Branch, who would be happy to entertain your specific concerns.

MR. MICHELSON: What was your question, Pete?

MR. DAVIS: Well, she characterized it correctly. I just was concerned that use of a single MSIV break as a bounding accident to cover all vents in the reactor system -- it gives me a little bit of concern, because some of these are unique locations and unique breaks that can possibly impose some additional problems on the core cooling capability, such as a break in the RCIC steam line or the reactor vessel vent steam line -- or vent line.

You're convinced that this main steam line isolation thing covers all of these other possibilities. Is that the position of the staff?

MR. THOMAS: Yes. This is George Thomas from Reactor Systems Branch.

What we are talking about is the safety relief valve on the line going to the suppression pool. When you compare the main steam line break, the line break is bounded by the big break, a break in the steam line.

MR. DAVIS: Well, a smaller line would -- in some respects, might be more challenging, because the primary system pressure is maintained at a higher level, and if you have to go through an ADS if the high-pressure injection systems don't work, and you have fewer options for ECCS, but that's not a problem here.

MR. THOMAS: There are three high-pressure systems.

MR. DAVIS: Right.

MR. THOMAS: Then they've got the ADS. We don't see it as a big concern.

MR. DAVIS: Okay. Well. small breaks are still analyzed, I guess, as part of the Chapter 15 analysis.

MR. THOMAS: Right. We did a complete break spectrum analysis. They look at small break, intermediate break. So, they did a complete analysis.

MR. DAVIS: Okay. I think I'm satisfied, Mr. Chairman.

MR. MICHELSON: Okay. Thank you.

What's the next one?

MS. MALLOY: The second item that we needed to get back with you on was 50.34(f)(1)(i), which our evaluation begins on page 20-94 of the FSER.

I think Mr. Davis directed some initial comments towards some statements that appeared at the top of 20-95 on how the Probabilistic Risk Assessment was revised, and he had a bottom-line concern -- I guess I would prefer if he could articulate that for the staff.

We have with us Dino Scaletti, who works in the Advanced Reactor Division, who actually served as the Project Manager working with our Probabilistic Safety Assessment folks to develop the safety evaluation, and we also have Bob Palla and Glenn Kelly of the Probabilistic Safety Assessment Branch to back up with any specifics, as need be.

MR. DAVIS: If you'd like, I'll try to explain it again.

As you know, GE did a cost-benefit analysis for several potential improvements to the plant. Their results are summarized in your Table 20.5.1-4 on page 20-156, and of course, all of the results show exceedingly low numbers on the benefit side of the equation, but as is pointed out in the discussion, the staff used a different analysis to check the risk numbers and came up with higher source terms for the containment vent sequences, came up with a large increase in the overall risk -- I think about a factor of five -- and then there is an unstated increase based on the source term that you got, I suppose, using MELCOR versus MAPP, and then the seismic contribution is not included in the cost-benefit analysis, which is almost a factor of 10, at least on the core damage frequency, based on the original PRA.

I'm just wondering if the staff is still convinced that none of these improvements are cost beneficial, and I have a particular interest in the filtration system on the containment over-pressure protection system.

MR. PALLA: Let me try to address that.

MR. DAVIS: Okay.

MR. PALLA: I'm Bob Palla, with the Probabilistic Safety Assessment Branch.

Basically, the risk for this plant is extremely low, in large part because of the extremely low core damage frequency, and I'll say that strictly speaking for internal events. The numbers are very low. There was an estimate on the order of -- it's like 2/10ths of a person-rem over a 60-year life. That's a GE estimate, and we did come up with a higher estimate, because the GE number did not include LOCAs outside containment as risk contributors. We added them in. We took a higher probability of containment failure for DCH events. The combination of those two -- there may have been one other or two in the minor adjustments, but we were talking still on the order of one person-rem over a 60-year life.

Now, if you just constraint yourself to the internal events, one person-rem and using $1,000 per person-rem criteria, there's essentially -- you couldn't do anything to speak of. Even procedural changes do cost money. Things that have to be maintained cost real dollars, and I would say, if we can accept the core damage frequency and if we base our decisions on $1,000 per person-rem, I feel quite comfortable that there wouldn't be anything that would be a risk-significant reduction that would meet risk reduction criteria.

Filter vents have been installed in Europe. They've been installed not for -- not using cost-benefit as the criteria but making more political decisions. Their costs are -- they range from several million to tens of millions of dollars.

We had a proposal back when Shoreham was still being considered for licensing, when they were pursuing it. They were going to build philtra-type containment, which is really the gravel bed within a seismic-type structure, and they had estimated $60 million for that.

Now, some of that may be due to the high costs in that particular area of the country, and I'm not sure what exactly when into it, but they claimed $60 million was the number. We've seen numbers on the order of several million.

MR. DAVIS: GE's estimate is $3 million.

MR. PALLA: Yes. That seemed to be -- that could even be conceived to be low.

MR. DAVIS: Okay. I think that's a good answer. On page 20-96, though, the staff states that you got much higher doses for the vented cases.

MR. PALLA: We did do, as you indicated, a calculation using MAX, and we also had assumed a larger source term to begin with, because we did not give as much credit for suppression pool scrubbing.

There was a sensitivity analysis that was done back when the original PRA review was in the Office of Research. Calculations were done at Brookhaven using some of the uncertainty-type codes and the Latin hyper-cube sampling technique and so on. They came up with a range of source terms for a vented case.

We used -- I believe it was the mean value, and then, subsequently, Sandia ran some calculations. This is -- I guess the Sandia report has -- is in the process of being finalized, is nearly final now, but those were done using the MELCOR code, and those calculations are very close to what we had actually used. The source terms were a lot higher. The consequences were higher because we used MAX. That might be a factor of two or three just from going from CRACK over to MAX.

The releases for the vented case were, as a result, higher in our situation, but those releases were still not what dominated the total person-rem. If you looked at the -- it's a table that I don't believe ended up in the short version of the SER, the final version of the SER, but it was approximately 17 percent of our risk estimate, and we estimated one person-rem, and 17 percent of that came from the vented case.

MR. DAVIS: Okay. I couldn't tell how much higher you got, because that's not in the --

MR. PALLA: The bulk of our one person-rem estimate came from early containment failures and bypass of the containment.

MR. DAVIS: And I guess, right now, we don't have any way of telling how much more seismic would add without having a site.

MR. PALLA: In looking at the robustness of the conclusions, we just did a what-if, and again, there is no updated PRA, as stated in this Chapter 20 write-up. If you just based it on the original PRA review, again not the GE numbers but the review numbers, you could have risk estimates for seismic on the order of 200 person-rem for a

60-year life, and again, if you used $1,000 per person-rem, you're still not going to be even close to entertaining a filtered vent.

The way I look at it -- I kind of back it up -- just pulling back and saying, well, would it make sense to support a filtered vent on this design? Well, the core damage frequencies here are a factor of 10 less. Containment performance has been deliberately considered for severe accidents in this plant.

If you can justify it on cost-benefit with this plant, you'd be back-fitting every plant that we have in the country now. So, it doesn't pass that kind of test in my mind, but we didn't base it on that either. We did base it on the numbers.

MR. DAVIS: I guess one of the things that inspired my interest was the fact that they've eliminated one of the valves in the vacuum breaker line over some of the existing designs, which suggests that there might be an increased probability of a vacuum breaker bypass in the suppression pool, which does two bad things. It eliminates the energy absorption capability of the suppression pool and also the source term reduction for the suppression pool. I think GE gave us a fairly good argument that it's still not a high-probability event, but it did trigger my interest in looking at this. We have a deliberate vent of the containment that's not filtered.

MR. PALLA: That is the one area that this design does not seem to be an improvement over operating plants, in the reduction of the redundancy there.

There is an event in the containment event tree to deal with that. There is a contribution to risk from that particular event, and there was a design alternative considered, and I think that the cost estimate for that design alternative was reasonably low, and again, driven by the core damage frequencies, it didn't pass the cost-benefit test.

So, even that, which, you know, just on a judgement basis, seems like a good idea still, to stick with the two valves, it just -- if we use the PRA and the cost-benefit, the $1,000 per person-rem, as our criteria, we have no rationale for even requiring that kind of a change.

MR. DAVIS: Okay. I think that takes care of it, Mr. Chairman.

I'd like to see this table you referred to of the risk profile and contribution. Would that be possible to get? Are you going to include that in the final version of the FSER or have you decided yet?

MR. PALLA: It's Table 20.5.1-1.

MR. DAVIS: What page?

MR. PALLA: Page 153 of Chapter 20.

MR. DAVIS: Okay. I'll have to take a look at that. I'm sorry I missed that. Thank you.

That's all I have, I think, Mr. Chairman.

MR. MICHELSON: Thank you.

MR. POSLUSNY: Mr. Chairman, that's all we have in feedback from yesterday.

MR. MICHELSON: Before we get on to anything else, let me give you some feedback from today.

I'm not sure if this got back to you or not, but we received -- the NRC received Docket 52-002, which is the System 80+, received a letter from ABBC, Brown Beveri, in which they talked about certain things, and the one thing that bothered me was they talked about the fire protection for diesel generators, and they spent about a page or two pages or better talking about why foam was not acceptable. That's fine, that's their view, but it gives me a little bit of heartburn, because foam is what we're using for ABWR.

Now, the final concluding sentence in this whole letter says, "The use of foam suppression is not considered a viable option." Those are pretty strong words, because how come we think it's viable -- does the staff believe it's viable for ABWR?

MR. LYONS: This is Jim Lyons from Plant Systems Branch. Yes, we believe that foam is viable for the ABWR, and I guess we have -- I think, in this situation, with --

CU is trying to present why they did not want to use foam in their situation, and their discussion is an acceptable discussion of why they don't need to use foam.

MR. MICHELSON: Right.

MR. LYONS: The final statement that you read, I think we agree, is an awfully strong statement in the sense that it's not a viable option. It would certainly be a viable option if they wanted to use it.

MR. MICHELSON: They presented no arguments --

MR. DAVIS: Did they have any reason why they --

MR. MICHELSON: They gave a whole two pages or so here of all the reasons why you shouldn't use foam.

MR. WYLIE: What do they propose to use?

MR. MICHELSON: They're going to use water.

MR. DAVIS: For diesels?

MR. MICHELSON: Yes. It's a water spray.

MR. LYONS: If I may add, we discussed that statement with them, with ABBC, and they are going revise that.

MR. MICHELSON: Will they revise the letter?

MR. LYONS: Yes.

MR. MICHELSON: That would remove all my heartburn. I recognize that they have the right to have their own views on why they might not like to use foam, but it ought not to in any way indicate foam is unacceptable but just that their preference is to use something else.

MR. LYONS: We agree.

MR. MICHELSON: GE has the same right to indicate their preference, and their belief is foam.

I have pointed out to the staff many times -- I have visited a number of plants in the past, and I keep seeing these various kinds of diesel generator protection, and I keep asking how come you're doing this instead of that, and they say our experts told us that this is the only way to do it. You go to the next plant and it says their experts say this is the only way to do it.

MR. LYONS: Right.

MR. MICHELSON: And there's two different ways. I think we're running into another example of the same thing, except I don't like to see it here, because some intervenor is going to pick up on this and start saying, gee, these guys know what they're doing, how come you accepted it for ABWR? So, they will take it out of the letter, and that would remove --

MR. LYONS: Yes.

MR. MICHELSON: -- the concern I have. I think all the members got that letter, and the reasons there seem legitimate, but on the other hand, I'd like to hear GE's. I imagine they could make just as good sounding a story on why foam is okay, but CE should not have been quite so strong in their final conclusion as to embarrass us on ABWR, and I guess the staff is going to fix it so the letter gets retracted and reissued or something.

MR. WYLIE: Undoubtedly, they never went to Navy fire-fighter school.

MR. MICHELSON: I've heard so many arguments on why foam isn't any good and why it is good, but I don't know myself, and I imagine Conrad has heard all these same arguments and he probably doesn't even know, and depending on whose experts you get, your answer will vary.

MR. DAVIS: Well, I find it a little bit curious, because right at the start they say that foam systems have proven to be very effective at control and extinguishment of fires involving hydrocarbon-based layers.

MR. MICHELSON: But not in a nuclear plant, and they go on to give all the reasons why they don't want to do it in a nuclear plant. I didn't mind that part. They can leave all that in. I just minded that it says it's not even a viable option, that that was just a little stronger than -- I think they didn't make a case for saying that strong -- you know, to make that strong a case.

There's some interesting things in there, though, that I didn't fully appreciate about the environmental hazards of the foam and that sort of thing. I didn't know it had any environmental hazard, but apparently they think it does. I assume GE has access to that letter. It's a document, but I don't know if it's in the Public Document Room.

MR. POSLUSNY: I think it should be, yes.

MR. MICHELSON: They should read it just for their own edification, but I -- I found it an interesting letter, but I just think that they didn't make a case for saying it's the only way to go.

MR. POSLUSNY: What's the date on the letter, please?

MR. DAVIS: November 3, '93. It looks like their problems are all of the difficulties you have after actuating, cleaning things up.

MR. MICHELSON: Yes. It's the clean-up after you use it that's giving them enough problem to where they say it's not a viable option, and now an intervenor is going to come in and say I'm worried about my environment, and here these guys, hopefully, know what they're doing, and they say you can't even use foam, and now the ABWR is going to use foam, what's happening? It's just unnecessary.

MR. POSLUSNY: Okay. We've used up half-an-hour of GE's time.

MR. MICHELSON: All right. Let's go on to GE.

MR. POWER: What I have here is a review of 10 items that were identified at the last meeting where additional information was requested and which we're bringing forth this information. I'm going to quickly go over them. I don't think there are any big-ticket items. The breakdown is that I have roughly five of them, and I've asked -- since Alan Beard is not here, I'm going to ask Gary to talk about five of them, okay?

Those 10 items are roughly this: There was, long ago, an open issue relative to Charlie Wylie and relative to -- in regard to material control and in regard to electrical system operational aspects of breakers and protection.

There was some concern by Carl last week about the assumption of where the suppression pool break was -- inside, outside the rooms, or in the corridor -- and whether or not that would result in a loss of MPSH to the pumps or other ramifications.

There was a series of questions talking about the tunnel penetrations and the postulated failure, the ability to accommodate, the ability to pump out, take care of the fluid.

There was also a question relative to building sills. They were removed, and the question became one of whether or not they invalidated the current flooding analysis.

There has been a continuing set of questions relative to the SSAR about missing sections relative to the control building overviews and such.

There was a question on inter-system LOCA of whether or not the commitment was beyond the piping systems and what do you do about the flanges bonnets and such.

There was a question about high-, moderate-, low-energy line classifications of using the 2-percent number to go from one service to the other.

The control building internal flooding protection was also requested of us to provide some information, and finally, the clean-up system isolation valve test frequency came up of whether or not the particular valves are going to be subject to stroke testing and what's the frequency.

I'm going to run through five of these very quickly.

In regard to Charlie's first comment, I think it's a very good one. What are you doing about the material control relative to large structures, tanks, equipment associated with the environmental impacts on them for chemicals, etcetera.

The particular item was that cathodic protection was discussed in A.3 and should that not have been described in Chapter 3 and shouldn't other aspects like corrosion/erosion, chemical attack, and galvanic action be somewhere, and should there not be some kind of programmatic aspect relative to this?

I went back to the GE experts, and the feedback is this: Currently in the book there is -- GE recognizes the special attention that should be given to material controls, and they do that in the 60-year-life statements. They have statements relative to aging aspects, harsh environments, operating experience feedback, and maintenance rule considerations.

However, GE believes that those harsh environment concerns are fairly well-known from the operating plants, and they cover a very large spectrum of items, and GE believes that the focus of the SSAR is to talk about them in a broad spectrum of individual controls, and some of those controls are somewhat hidden in the various sections, such as water chemistry, radiation embrittlement, mechanical fatigue, and finally, GE believes that the current lifetime material control aspects are taken into account basically by industry standards of ASME code piping and vessels, aging aspects that the regulatory agency is putting together, and some other programmatic aspects that the co-applicant will supply.

The last thing really is that they also believe -- GE believes that EPRI and other programs are looking at things like the maintenance program compliance and that GE at the current time believes that no programmatic material or section should be added to the SSAR addressing these issues in a programmatic sense.

MR. WYLIE: I think that the main thrust of what I was trying to get at was that, in the design of a plant, unless the designer has the corrosion experts look at the total design before they start construction and make the necessary provisions for corrosion control, it's too late after you build the plant, and they need to plan that program from the start, up front, because -- take, for example, if you decide that you're going to use cathodic protection on the reactor liners, reactor building liners. You've got to design the plant so it will accommodate the cathodic protection. Otherwise, if you've got to try to backfit it, you'll destroy as much as you try to protect.

MR. POWER: We would agree with you. The Oyster Creek experience is a very good one with a sandbox. The first intention was to make it a galvanic action kind of mitigation, and it turned out that wasn't very successful. They ultimately ended up drilling holes, sucking out all the sand, and filling that area in at a controlled volume and a volume that's inspectable. I would agree with you. I attempted to solicit support --

MR. WYLIE: Somewhere it seems to me that it ought to say in the SSAR that they do that, that they will employ some corrosion control experts up front, as they start to design the plant. They don't do it.

MR. POWER: No, I would agree with you. In a lot of the ANS meetings recently on material control, they've talked about this, material conditioning, but right at the current time, relative to the organization, like GE, they believe that that's with each individual designer relative to codes and standards, rather than with some programmatic group that's going to look at it in a broader sense.

MR. WYLIE: Well, I disagree with that.

MR. POWER: I understand.

MR. WYLIE: I mean, you know, we're talking about a certified design. You're going to put your stamp on this and go out and build a plant, and unless there is a flag there and some interfacing requirement on the COL holder, this could go right through a crack.

MR. POWER: Do you have anything to add, Gary, relative to this, relative to liners and concrete outside and treatment?

MR. EHLERT: There's not much I can add. We have committed to galvanic protection for certain features, but to go beyond that, we're basically sticking to the codes and standard requirements.

MR. WYLIE: I'm not saying you need galvanic protection. All I'm saying is a corrosion expert is needed to determine that up front. I mean they've just thrown it in there. You know, EPRI threw it in there.

MR. EHLERT: That's one of the reasons why we have it.

MR. LINDBLAD: Are you suggesting that the site impact should have had some reference to it?

MR. WYLIE: I think that, up front, there should be a requirement, before you ever finish the design of the plant, that they do a corrosion survey and determine what kind of corrosion control they need, and if it means you're going to put galvanic protection in, then you'll accommodate it, because if you don't, then I know from experience you cannot impress that protective current on those liners unless you design for it and you design your reinforcing steel and everything else to accommodate it.

MR. MICHELSON: Could it be argued that it is a site-specific issue?

MR. WYLIE: It could be, yes. It is site-specific.

MR. MICHELSON: Why don't we have it in the site -- is there a site ITAAC?

MR. LINDBLAD: Yes, there's a site interface requirement.

MR. MICHELSON: Why can't it be put in there, since nobody seemed to disagree that it isn't -- you know, other than it's a good idea, why isn't it put in there as part of the ITAAC?

MR. POWER: I did not attempt to go through the ITAAC process.

MR. WYLIE: You've got a natural -- you have a natural corrosion mechanism set up on-site with the copper grounding system out in the switchyard and maybe even under your plant that sets up a cell between everything else that's grounded, such as the reactor liner, and the current flows off of the steel onto that copper, and that's what happened at Oyster Creek.

MR. POWER: The current -- the SSAR people have agreed to put in Section 3.8 references to really cathodic kind of protection. They would agree with you, but I have not talked to the ITAAC people, and I'd be glad to do that for you.

MR. MICHELSON: Does the staff have any view on this?

MR. POSLUSNY: It really sounds like a site-specific level of detail, that although, you know, you might have a COL action item to consider corrosion control, but putting this in as a site parameter, it's so really site-specific -- you know, we have other site parameters that say here is your flood level, you know, and that makes sense, but here it's so open.

MR. MICHELSON: So, you don't see any reason why it couldn't be added to an ITAAC.

MR. LINDBLAD: Charlie could have raised another issue and that's called ground resistivity to be used in relay and in lightning protection, but he doesn't because that can be resolved in the course of design, but he is pointing out that, in the initial stages, before the design is undertaken for the specific plant, some kind of study, an investigation needs to be made, that you lose the opportunity if you don't do it during the site interface period, which is true.

MR. WYLIE: Well, if you don't say something, how are you going to cover it?

MR. POWER: I guess they feel it's covered.

MR. WYLIE: Let me ask the staff. How is the staff going to do it?

MR. POSLUSNY: I think it's going beyond our review scope.

MR. SEALE: You have other ITAAC items in your review.

MR. POSLUSNY: I understand, but those are things that we reviewed as part of the scope of the Part 52 review. I think we're going to a level of detail and site specificity that's beyond the process right now.

MR. MICHELSON: Well, Charlie, we raised this issue in writing previously.

MR. WYLIE: We raised it a couple of years ago.

MR. MICHELSON: I'll put it on the list of blanks to be filled in when we write our final report, and depending upon what we hear by then, you will adjust what you fill in the blank with, because we are intending to address all issues that have been raised in our formal letters. So, at least we'll put in our recommendation at that time.

MR. WYLIE: Okay.

MR. POWER: The second set of issues that Charlie brought up were a number of ones relative to synchronization onto hot buses and whether or not the protective relaying was sufficient to take grounding faults in either direction when you're in that predicament and some other related items, and basically what I have done is talked to the electrical people, and they believe that, currently, we describe it sufficient in the SSAR, in the various sections that I have given to you. They talk about synchronization, coincidence, and etcetera.

I'm going to pass through the presentation on suppression pool and on tunnels and on sills and on drawings, and I'm going to end up with inter-system LOCA, and in the inter-system LOCA, the question came up whether or not the additional components on the system -- what was the design level they were going to be added to, and what we went back is that the current commitments are pretty well documented in Appendix 3-M relative to the resolution, acceptable resolution with the staff.

We also have a section in the generic issues that also affirms this position, and there is a discussion on inter-system LOCA in the draft or the advanced copy of the FSER, but in order to simply enlighten a little bit, I went back and identified those components that might need specific attention for in-line piping systems, used this as a checklist, went back and looked at these and the commitments relative to them, and except for the relieve valving, this statement is correct, that we will design them for 28 -- no, that's not correct -- 410 psi and that that commitment is cited in the SSAR, and the basis of that, the adequacy of the .4 is in a screening criteria in the NUREG out of Idaho and it's also in a BWR owners report.

MR. MICHELSON: My slide is not your slide. Which slide number was that supposed to be?

MR. POWER: 7-2.

MR. MICHELSON: All right. I've got it now.

MR. POWER: Okay. I'm going to leave 8 for Alan, and I'm going to wrap up here with -- and 9 for Alan, and I'm going to complete out here with the last item, which is the clean-up system isolation valving, what was the commitment relative to testing, and the basis of it is there was some confusion in the SSAR relative to -- when you looked in various tables like 3.9-8, you found it a little different than you found in the tech specs, and you found it a little different in other areas.

Finally, what has been agreed to with the staff and ourselves is that we recognize the importance of those isolation valves. We believe inspection and surveillance requirements should be done, and they should include stroking and leakage.

We did put the tech spec closing time -- closing time is really not an issue with that valve, because that valve can't close in time, but it in there under a 92-day stroking test, and that the actuation devices, like the logics, the trips, and the electrical testing and such, are identified also in the tech specs, and they have the frequency in there on the order of, I think, three months or so.

MR. MICHELSON: One of the important requirements, though, that I wasn't able to really pin down for sure was that, indeed, you're going to give either these particular valves or the prototype of these valves the full flow break isolation test.

MR. POWER: The commitment was that a test will be done at the manufacturer's facility under conditions of max flow and break configuration prior to the installation of those valves in place.

MR. MICHELSON: That's not said here.

MR. POWER: No. This is tech spec testing in operation.

MR. MICHELSON: Okay.

MR. POWER: The issue was that there was no stroking test before on these valves.

There are about five here that Alan will go through.

MR. BEARD: Good afternoon. I'm Alan Beard. As John alluded to, I'm going to address several of the items in this package we've just handed out. The first one we'll talk about is number 3 in your package, and it has to do with Mr. Michelson's concern, if we had a break in one of the pipes that connects to the suppression pool, what are the consequences of having an un-isolable break that drains the suppression pool down to some level?

GE's position is that we don't need the suppression pool to effect a normal safe shutdown in this scenario. We are talking about ECCS suction pipes and, in addition to that, the suppression pool clean-up pipe.

I'd like to point out that, during normal operation, only three -- well, the RHR lines are valved in and lined up to take suction off the suppression pool. RCIC and high-pressure core flooders are not, and then the suppression pool clean-up system, most of the time, we'll have to say is probably valved in and running to maintain suppression.

MR. MICHELSON: RCIC is going to be the room where we'll put the leak.

MR. BEARD: Excuse me?

MR. MICHELSON: RCIC is the room where we'll put the flooding. So, you can't count on flooding.

MR. BEARD: Okay. What I'm saying is, then, to drain into the RCIC room, you're going to have to fail the RHR suction line.

MR. MICHELSON: That's right.

MR. BEARD: And assume that the valve doesn't isolate. But again, I don't need RCIC to shut down my plant.

MR. MICHELSON: The valve is a significant distance from the penetration to the wetwell.

MR. BEARD: These suction valves are very close to the wetwell, but I'll grant you that the break is unisolable.

MR. MICHELSON: Okay. You haven't isolated it.

MR. BEARD: No. We're not going to assume that we have isolation.

The flow rates and analysis of the effects of these breaks are included in the SSAR, Section 3.4.1.2.1.1. Basically, the worst case break down there is an RHR line break, which gives us on the order of 1.5 meters cubed per minute or something along that line. Don't hold me fast on that number. And we say it's going to fill up that room, and then, when it reaches maximum flood level, it is possible it will find leakage paths out into the corridors.

So, in this case, we're going to affect the single division that the break is in and we're going to allow the rest of the water out in the corridors. However, the other two divisions are not affected.

MR. MICHELSON: I think the question to begin with, of course, was whether you not you had adequate MPSH on the unaffected divisions.

MR. BEARD: The bottom line is we don't need MPSH.

MR. MICHELSON: Okay.

MR. BEARD: We don't have it, but I can still shut down my plant without it.

MR. MICHELSON: Now, this scenario will have to be done, then, without the usual rule that says you've got to be able to do those things with loss of offsite power.

MR. BEARD: You're going to take a line break and give me loss of offsite power?

MR. MICHELSON: Usually these postulated pipe breaks assume that the mitigation must be achieved without depending upon offsite power. Now, if you change that rule, then you, indeed, will be okay.

MR. BEARD: If you're going to throw that wrinkle in it, my response to that is I'm in EPGs at that point, which are controlling things like suppression pool water level, suppression pool temperature, and they have a criteria that basically say at some point I've got to depressurize my vessel.

MR. MICHELSON: The only question -- and that is an important question -- is if you do not have access to offsite power, can you shut down safely in view of the MPSH remaining on whatever other pumps you have?

MR. EHLERT: In the design basis world, all of the breaks on the suction lines for the RHR or RCIC are isolatable. We do not have to take a break between the suction line in the wetwell to the isolation valve. That is a GDC exemption that we have.

MR. MICHELSON: How close is the isolation valve?

MR. EHLERT: The statement that's put into the SSAR is as close as possible to the wall.

MR. MICHELSON: That's right. I don't know how close that is, but if you have it right up to the wall and a high-quality pipe in between, you're all set.

MR. EHLERT: That's what's been declared, and you can see the write-up in Chapter 6 when we talk about GDCs 55 through 57.

MR. MICHELSON: Then, also, you have to make sure the flood does not affect the valve, since it's not an automatic isolation valve, as I recall, it's strictly a manual operation determined later in the game, and I only had a mild curiosity as to whether anybody had check the MPSH to see if any other pumps would even work after you've flooded one of these compartments and you lose a couple of meters of level in the suppression pool.

MR. EHLERT: If you can isolate, you're not going to take that much.

MR. MICHELSON: Well, the whole assumption is you don't isolate. That's how you got the flood, and that's how you got the concern. The question in my mind is what is the elevation, then, in the suppression pool after you equilibrate with the compartment?

MR. EHLERT: It's down to about, if I remember right, between two-and-a-half and three meters deep of water.

MR. MICHELSON: Okay. And then how high is the strainer above the bottom of the suppression pool?

MR. EHLERT: One meter.

MR. BEARD: One meter for the RHR.

MR. MICHELSON: So, you've got roughly two meters of head on the pumps then?

MR. EHLERT: Two meters of head on the strainer, plus the pump has its own casing submerged into the base mat by another two-and-a-half meters.

MR. MICHELSON: Well, it sits on a pedestal, probably, not on the base mat, but --

MR. EHLERT: But the pump is in a case that goes into the mat.

MR. MICHELSON: These are submerged pumps?

MR. EHLERT: They're vertical pumps.

MR. MICHELSON: Yes, they're vertical pumps, but I didn't think they were -- I thought they were centrifugal, vertical centrifugal, not a casing kind going down into a sump. I looked at the drawings. Admittedly, they're pretty sketchy. We don't have enough of the design to know, but I thought those were standard centrifugal pumps but vertical, as they are in most plants, and they are not buried in the floor. They're sitting up off the floor, that high.

MR. EHLERT: The motor is up that high.

MR. MICHELSON: No, no, the motor is way up in the air. It's been a seismic problem for a long time, because they're so high, but the pump sits down near the floor. It sits on a pedestal. Now, maybe this is a different design, and we don't --

MR. EHLERT: In the Mark II-type containments, the motor is about four or five feet off the ground and the suction goes down.

MR. MICHELSON: Let me ask Bob what kind of RHR pumps do they use? Do you recall? They're vertical pumps, but are they mounted on the floor?

MR. COSTNER: I think they're in sumps.

MR. MICHELSON: They're in sumps? Okay. I'll take it back. You sure don't get that from looking at the drawings we've got. I guess the staff knows this. I don't, from the information we've got. I'll go back and check it and give you the reason why -- if I have a problem with reading the SSAR later. These are the RHR pumps that I'm talking about. I've been around a lot of plants in the last 20 years, and I just hadn't seen that particular arrangement.

MR. BEARD: The point we'd like to drive home, though, is, as Gary alluded to, we're beyond design basis in this incident if you're going to assume an un-isolated break. Therefore, it's unreasonable to hold us to the station blackout, but to address your specific issue on station blackout --

MR. MICHELSON: Not station blackout, loss of offsite power. You've got all the on-site power you want. The pumps have got power. It's just a question do they have MPSH. That was the only question in this whole discussion.

MR. BEARD: Okay. Let me respond to that, then, and say that --

MR. MICHELSON: All you have to do is bring back the calculation of MPSH and show it's adequate.

MR. BEARD: I don't need MPSH, because the minute I depressurize the vessel, I can go into RHR decay heat removal.

MR. MICHELSON: Where are you going to dump it?

MR. BEARD: I'd like to address it, Mr. Michelson, but the minute I depressurize the vessel, I've cleared my interlock that allows me to go into RHR decay heat removal. The minute I put those systems in line, I can suck up all the heat that's there.

MR. MICHELSON: You've got plenty of MPSH.

MR. BEARD: I've got plenty of MPSH when I'm in that condition. So, I don't need to have the MPSH on the suppression pool.

MR. MICHELSON: You can probably ride through the event until you do get into recirculation mode.

MR. BEARD: Right.

MR. MICHELSON: Assuming you can't pump from the suppression pool, eventually you could get into the recirculation mode.

MR. BEARD: Well, if I'm in my EPGs, I'm going to hit a step that, when my suppression pool level is dropping, it's basically use or lose during emergency depressurization of the vessel. At that point, when I've depressurized the vessel, I can now go into RHR decay heat removal, and I have my MPSH back in my RHR pumps. Does that satisfactorily respond to your --

MR. MICHELSON: I think that would be a satisfactory response, sure.

MR. BEARD: Any other questions from the rest of the Subcommittee?

MR. MICHELSON: The question was also the clean-up system on the drywell where -- or in the wetwell where it was -- a different location in the building that kind of flooded a lot of corridor, and it wasn't clear how that one is isolated quickly and so forth.

MR. BEARD: Well, on the suppression pool clean-up line, we do have two safety-related isolation valves. The scenario you postulated, though, says we couldn't assume isolation.

MR. MICHELSON: How close are those valves?

MR. BEARD: One of them is very close to the containment wall again. The other is -- obviously, you want to have them removed somewhere so they're not wiped out by a common --

MR. MICHELSON: Both of those are safety-grade.

MR. BEARD: They're both safety-related, they're both containment isolation valves.

MR. MICHELSON: Okay. Then about the same argument pertains.

MR. BEARD: Yes. Actually, it's much less severe because it's .2 centimeters cubed per minute. So, it's a lot slower drain-down.

MR. MICHELSON: Yes, but if you don't isolate it, it's a lot more volume in which to flow and, therefore, a lot more drainage of the suppression pool.

MR. BEARD: If you'd like, I'll address that, because the requirement we have on the ECCS compartment for flooding is that they are protected up to the maximum flood level.

MR. MICHELSON: Yes.

MR. BEARD: Well, we may have penetrations in the walls above the maximum flood level. So, at some point we're going to reach a level in those rooms, if we're flooding inside those rooms, that we start dumping the water out in the corridor. So, you really don't have that much less volume for these other scenarios.

MR. MICHELSON: Maybe you're missing the point. If the volume available in which to fill the building is greater for the corridor area than it is for the room area, then the level in the suppression pool will be lower at the time it equilibrates.

MR. BEARD: I understand your concern, and what I'm trying to say is, at some point, when I get a water level up high enough in my room, I now start communicating with the corridor, which gives me that area.

MR. MICHELSON: The clean-up system for the wetwell is in the corridor.

MR. BEARD: I understand that.

MR. MICHELSON: Okay. That's where the water is going.

MR. BEARD: But if you postulate the RHR line case that you were talking about before, what I'm saying is, as the water level comes up in that room, at some point it starts to flow back out in the corridor and I still have the same area.

MR. MICHELSON: That wasn't the postulation. We're now postulating the break on the clean-up system, and it's a different area, and it's a different equilibrium elevation in the pool. I don't know what that number is. You should be able to tell me.

MR. BEARD: It's 2.1 meters.

MR. MICHELSON: So, it drops 2.1, and in the RHR case, how much was it?

MR. BEARD: In the RHR case, it's about 2.3.

MR. MICHELSON: So, actually, you're saying, in the RHR case, it drops a little more than it does in the case --

MR. BEARD: What we're saying is the remaining water in the pool is 2.3 meters.

MR. MICHELSON: Oh, that's the remaining water, not the drop. Okay. So, it does, indeed, drop a little lower in this case than it did in the RHR.

MR. BEARD: But just slightly. It's not significantly different.

MR. MICHELSON: I just wanted to know.

MR. BEARD: Okay.

Moving on to item number 4, again a concern was expressed by Mr. Michelson on the effect of, if we have a non-safety-related tunnel -- and we do have a rad waste tunnel that we're classifying in that category -- if you have a structural failure of that tunnel, what is possible damage on the seals?

GE has gone back -- we've marked up SSAR Sections 3.4 and 3.12 to address your concerns on this.

MR. MICHELSON: Okay.

MR. BEARD: We've provided those to the staff. I have not heard from the staff whether they find what we have put in there acceptable. I don't know if the staff wants to address that now or not.

MR. MICHELSON: Why don't you tell us how you addressed it first?

MR. BEARD: Okay.

Specifically, to address the concern about structural failure of non-safety-related tunnels, we've put in a requirement that says the design of the penetration shall include features such that, even in the event of a catastrophic failure of -- wrong one, I'm sorry.

MR. MICHELSON: No, that's the right one.

MR. BEARD: No, this one. The tunnel structures -- and this is a quote from what will be in the SSAR -- the tunnel structures shall be designed so that, in the unlikely event of structural failure of the tunnel -- I left out a word -- it will not result in unacceptable consequences to penetration seals at the interface of safety-related structures.

MR. MICHELSON: That takes care of it. Thank you.

MR. BEARD: Okay.

In addition to that, Mr. Michelson, you had also raised a concern regarding, if you did have a catastrophic failure of an individual seal, how do we cope with that?

MR. MICHELSON: Since there's only one of them, I gather. There's only one seal. They're not using two seals in series or anything like that.

MR. BEARD: We haven't decided one way or the other yet what it would be, but we're proposing to include is the statement that says the design of the penetration seals shall include features such that, even in the event of catastrophic failure of the seal, the flow rate through the penetration is less than 1.5 meters cubed per minute.

MR. MICHELSON: Okay.

MR. BEARD: Emergency procedures shall be developed to enable plant personnel to restrict the flow and begin recovery in two hours.

MR. MICHELSON: HOw does that compare, then, with sump pump rates?

MR. BEARD: We're not looking at that. We're saying that you would be able to do normal damage control procedures, very similar to what the Navy uses on their submarines and ships, to restrict the flow, and then we can either use existing sumps or we can install sump pumps to get rid of that water.

We looked briefly at restricting it to the sump flow rate. The problem was we felt we needed to get down there at some point and stop the flow, because we were going to run out of volume to pump this water to.

So, we felt the more logical way to address this is to limit the flow such that it's not overwhelming, and damage control procedures could be done to stop it and then to take the remedial actions that are needed, and at two hours at 1.5 meters cubed per minute, if we're flooding the corridor spaces down in the basement, we're going to have approximately six inches of water spread out on the floor. It takes 10 hours to get a meter deep of water at that flow rate.

MR. MICHELSON: Okay. It just puts a number on the seal designer, then, that he has to build a seal that doesn't leak too darn fast.

MR. BEARD: The concept is, if you're using a resilient-type seal, that you have restrictive radial clearances between the device penetrating and the sleeve.

MR. MICHELSON: That would do it. You just have to give some kind of a boundary condition to design for.

MR. BEARD: Okay.

MR. MICHELSON: Does 1.5 meters, cubic meters per minute, seem like a difficult problem for a seal?

MR. BEARD: No. In the rough calculations we did, we felt --

MR. MICHELSON: It looks like an awfully big number.

MR. BEARD: Well, with the 10-inch sleeve and an 8-inch pipe giving an inch radial clearance, we're looking at about that flow rate for the static-type heads.

MR. MICHELSON: Now, that's a static head up to ground elevation.

MR. BEARD: That's the assumption we used when we were trying to determine this number, yes.

The final item was to identify means by which tunnel fire or flooding conditions would be mitigated or accommodated. I didn't address fire in this, and I apologize for that, but --

MR. MICHELSON: What number is that?

MR. BEARD: We're still on item 4.

MR. MICHELSON: Oh, you're still on 4.

MR. BEARD: I'm doing the last bullet here, which is what our synopsis of your concern was.

MR. MICHELSON: Okay.

MR. BEARD: Fire, we feel, is only a concern to safety-related tunnels, and we have definite requirements that say, for safety-related tunnels, they will be mechanically and electrically separated such that, for all the design basis events, an event occurring in one division does not affect the other two, and that's how we're going to address the fire concern on this.

MR. MICHELSON: Now, the tunnel I had in mind, of course, is the one you're going to use to run all this fuel oil piping in, and if you break the fuel oil line and you get an ignition, I just wondered how you're going to handle it.

MR. BEARD: Well, if it's a tunnel, it's got restricted oxygen.

MR. MICHELSON: Yes. It depends on the design of this whole thing as to how restricted the oxygen is.

MR. BEARD: Okay. But again, it's divisionally -- each of these tunnels for the fuel oil are divisionally separated such that, in the event of a fire in that tunnel, if it's possible, it will only affect that particular division's worth of equipment.

MR. MICHELSON: Well, the problem I had in mind was that you've got an interface now with the reactor building for that tunnel, and if you have a fire in a tunnel and it burns the seal off, the oil now proceeds to enter the reactor building.

MR. BEARD: Inside the same division that it's feeding, though.

MR. MICHELSON: Yes. I just wanted to see what we had in mind.

MR. BEARD: Okay.

Now, to address your flooding conditions, Section 3.12.2 and 3.12.3 will now have requirements for tunnels to contain leak detection equipment and provisions for water removal. We don't necessarily construe that to mean that you have to have permanently installed sump pumps. What it is is a means to either drop a submergible pump down in there to periodically pump it out if you get rain water that accumulates or permanently installed or whatever.

MR. MICHELSON: If you ever sunk a 100-foot-deep shaft into the ground and expect to stay dry, you're a real dreamer.

MR. BEARD: It is a 60-meter-deep shaft.

MR. MICHELSON: I didn't envision this as that good of construction, but it could be.

MR. BEARD: Any other questions?

[No response.]

MR. BEARD: Item number 5 then -- and I'm sure there will be some discussion on this.

As we told you last time, the sills in the buildings have been removed to conform with the EPRI URD guidance to permit use of robotics and to also simplify the use of maintenance carts and things like that in the plant. You asked us to go back and confirm removal of floor sills does not violate the design basis, and our answer to that is no, it does not.

MR. MICHELSON: You've taken out all references, then, I guess, in flood analyses and whatever, to the presence of sills.

MR. BEARD: We have revised 3.4 to eliminate the references to sills except in those cases where they really do still exist; i.e., the emergency diesel generator day tank room, I believe, will still have a sill.

MR. MICHELSON: Yes.

MR. BEARD: But in general, we're not saying there are sills on passageway doors anymore.

The basic approach we're taking is we've elevated all safety-related water-sensitive equipment 200 millimeters off the floor, minimum, and we're going to allow this water, as it comes from whatever pipe break or whatever, to spread out over the floor. It's going to flow under corridor doors and all that.

The floors are required to be water-tight, and we feel that's a reasonable assumption. It's concrete poured on top of a steel decking. We don't think they're going to leak.

MR. MICHELSON: Your plugs and everything, then, are going to be water-tight plugs in the floor.

MR. BEARD: We have added additional requirements. There are now, I think, six requirements in the early part of Section 3.4 that have -- hatch plugs are required to be water-tight up to -- you know, to withstand the hydrostatic head at 200 millimeters.

Again, we put a caveat in there. We don't feel that's necessary on things like clean-up compartment demineralizer bed areas where radiation concerns on embrittlement of those seals may preclude the use of that.

MR. MICHELSON: Just as a passing question, when you calculate all the pressurizations from reactor water clean-up, did that lift any of the plugs, building and room compartment pressurization?

MR. EHLERT: This is Gary Ehlert, GE.

The differential across the slabs where these hatches were was not that great. There's 15 pounds basically on both sides of the hatch.

MR. MICHELSON: Not on both sides of the hatch. On one side of the hatch, when you get a break, there's 15 pounds. Later, there's something less than that.

MR. EHLERT: There's a slight delay, but once it gets --

MR. MICHELSON: A big delay.

MR. EHLERT: -- into the staircase and blows into the next floor above, it's --

MR. MICHELSON: I was thinking of compartments where you've got the ion beds and so forth, which are plugs directly on the compartment where the break occurs, and I just wondered, do those plugs lift? I just don't have any feel for how heavy they are.

MR. EHLERT: They probably will lift, but I don't think they'll go very far.

MR. MICHELSON: As long as they aren't a missile, you're all right.

MR. EHLERT: They're still in the CUW compartment area, and they've got to lift and put themselves through a concrete shielding wall to get anywhere.

MR. MICHELSON: Okay. Go ahead.

MR. BEARD: Okay. The six bullets are design requirements we've put in to address this. If there are any questions on that, I'll address them. If not, seeing that I'm boring Mr. Davis over here --

MR. MICHELSON: No, I don't think so. He's just not awake.

MR. BEARD: We have in conversations past agreed that there are some areas that we still don't have some things represented on the drawings. Specifically, what we have identified to date are revisions to four drawings.

The section view of the reactor building at elevation 4,800. We will clarify the personnel access corridor that comes across there.

The site layout drawing is going to be revised to show the typical routing of the emergency diesel generator fuel oil tunnels.

The radwaste tunnel location elevation 8,200 will be clarified in the reactor building/control building plan views.

MR. MICHELSON: I don't know if Medhat understood and asked for it, but I asked for a sheet showing the nomenclature that you are using for the control building, because it's not the same architectural nomenclature as used for the reactor building. I found the reactor building nomenclature. I didn't find any for the control building, and it's different. The doors are being shown differently, and so forth. It doesn't even show doors on many of the areas of the control building. It just shows an opening. I don't if it's a door, an opening, an archway or what.

MR. BEARD: You're talking about the general legend on the control building drawings?

MR. MICHELSON: Yes. I couldn't find one anywhere.

MR. EL-ZEFTAWY: We asked for the symbols for the control building rooms.

MR. MICHELSON: Yes, so we could read the drawings.

MR. BEARD: It may be our fault that we didn't understand.

MR. MICHELSON: Would you please sent Medhat a copy of the symbols. If the Staff understands it and they don't need the symbols, then I'll just look at it for my own edification. Otherwise I would expect it to be in the SSAR.

MR. BEARD: We will get to Med a copy of the symbols there and I think we will also take the action item to update the first of that set of drawings to include a reference table.

MR. MICHELSON: The simplest thing to do is go back and use the same nomenclature for the control building as you've used for the reactor building. A door is a door. A swinging door, there is a simple symbol for it. You aren't showing any symbols in some cases and therefore you have to guess as to whether it's an open archway or what it is.

MR. BEARD: We'll go back and look at that.

MR. MICHELSON: Sometimes you put a centerline down it. I guess that means there's a door. I don't know. It's sloppy at best.

MR. BEARD: We will provide it.

MR. MICHELSON: And it's so simple to fix.

MR. BEARD: The next item I have to address is item No. 8 in your package. It has to do with the classification of high and moderate energy lines.

You also asked us to clarify the use of the percentage time used in establishing the moderate energy classification and to identify all piping subject to the conditional allowance.

The design basis for identifying high and moderate energy line breaks is given in the SRP and GE conforms to that guidance. That is defined in the SSAR section 3.6.2.1 and 3.6.2.2, I believe.

The 2 percent exemption. GE is going on the historical interpretation of that. We have gone back and looked at the BWR-4s, the BWR-5s and BWR-6s. They are all interpreting that 2 percent exemption the way we are.

MR. MICHELSON: Which is?

MR. BEARD: We are saying even though the system may not be running, it's considered operable for tech specs and therefore is in that classification.

MR. MICHELSON: In other words, it's 2 percent of plant operating time, not system operating time.

MR. BEARD: Close to 2 percent of plant operating time.

MR. MICHELSON: Does the Staff accept that? That's not the way the regulations read. I'm wondering if you accepted it anyway.

MR. BRAMMER: This is Jim Brammer from NRR. We have accepted that in the past. It is maybe literally a slight deviation from the standard review plan.

MR. MICHELSON: It's not slight at all. It says clearly in the standard review plan it's 2 percent of system operating time.

MR. BRAMMER: I understand.

MR. MICHELSON: That's a whole lot different for RHR.

MR. BRAMMER: Our philosophy has been that if the system is sitting there year after year at a low pressure and is only exposed to the high pressure for a relatively short period of time. It's unfortunate that it was quantified in the standard review plan, but at any rate that has been sort of the philosophy for the Staff over the years.

MR. MICHELSON: You ought to fix your standard review plan if that is what you are using. That is what I've been going by and it clears says you don't use plant operating time. Some of these high pressure systems only operate a very short period of time but when they do they are at high pressure and the pipes can break. Pipes don't break just because they are sitting; they break because they have a challenge to them such as pressure. If they don't get challenged at all in a year, then clearly you can't use the idea of plant operating time. They won't break just sitting there. They'll break when you crank them up and you pressurize them.

MR. BRAMMER: We'll consider a standard review plan change.

MR. MICHELSON: I think you would have trouble logically justifying a change. It's an arbitrary change.

MR. BRAMMER: It would be arbitrary. It's not the only one.

MR. MICHELSON: There is no scientific justification that I'm aware of.

MR. BEARD: Just to finish off, tables 3, 4 and 5 in section 3.6 describe the different systems that are classified either high or moderate energy and by their location.

RHR vessel suction and return lines up to the outboard isolation valves fall into this category.

The high pressure core flooder pump discharge line up to the inboard isolation valve falls in this category.

The RCIC pump discharge line up to the inboard isolation valve also falls into that category.

MR. LINDBLAD: Could you explain to me again item 1? Is that for the RHR system reactor vessel suction?

MR. BEARD: It's decay heat removal, yes.

MR. LINDBLAD: Earlier Mr. Power was talking about 410 reactor vessel pressure. Are you saying that the 410 psi design pressure will be used with the 2 percent exemption?

MR. BEARD: The RHR piping itself is designed to the 410 psig.

MR. LINDBLAD: Without consideration of this?

MR. BEARD: Without consideration of this issue.

John, did you hear that statement? I just want to clarify that. The RHR piping is designed to 410 psig without consideration of whether it's a high or moderate energy line?

MR. POWER: That's correct.

MR. MICHELSON: The only place that this comes into account is what kind of breaks you are to postulate. That's all it's used for, the 2 percent. It has nothing to do with what you should be designing for. It only has to do with what you postulate in terms of breaks. The rule was that this normally is a system that only operates at high pressure 2 percent of the time it's operating. There are some systems that operate at a high pressure very shortly and then low pressure thereafter, and RHR is one of them.

MR. LINDBLAD: I was mixing that up with stress allowance on piping code, which is 1 percent.

MR. MICHELSON: That time was always thought to be in terms of total system operation, not plant operation. There's a big difference. It changes the postulated breaks considerably..

MR. BEARD: The final item I had to address is item 9 in your package. It deals with the control building internal flooding protection.

As I described earlier, the basic philosophy on internal flooding is we are raising water-sensitive equipment above the anticipated or design flood level on these things. We are letting the water spread out on the floor and seek its pathways down to the basement where it will be taken care of using stair towers, elevators, your normal drains.

The main control room and the computer room utilize elevated floors. That's to provide for cable routing and things like that.

I would like to point out there are no significant water sources located in either of those rooms. The fire protection hose standpipes are outside of those rooms. If you were to use them, they would be brought in for a specific purpose. There is really no credible flooding source in there to begin with.

The concern now becomes, I'm letting this water spread out on floors; I'm going to get standing water out in the corridor spaces; does that water get in to the subfloor area? The answer to that is, the stem walls -- and we've added this requirement in the SSAR -- separating the raised floor area from the surrounding corridors is required to be watertight.

MR. MICHELSON: What is a stem wall?

MR. BEARD: It's a term I used. Effectively it's the sidewall for the area bounded by the raised floor.

MR. LINDBLAD: It's the sides of the floor plenum.

MR. BEARD: That's a better description.

MR. MICHELSON: That will be watertight?

MR. BEARD: That will be watertight such that water in the corridor cannot get into that space.

MR. MICHELSON: This would be on the main control room floor particularly.

MR. BEARD: Correct.

MR. MICHELSON: All those doorways are at floor level.

MR. BEARD: All those doorways are at the control room floor level, which is elevated.

MR. MICHELSON: That, of course, I couldn't tell from the drawings since the drawings never showed that it was elevated to begin with. You're saying I step up one step.

MR. BEARD: You would take one step up into the control room through the passageway door.

MR. MICHELSON: Then there is a trench around for the water to accumulate and keep draining down to the lower elevations.

MR. BEARD: Correct.

MR. MICHELSON: That should take care of it as long as you have got a watertight so-called "stem wall."

MR. BEARD: To address the concern about if you did have a fire in that control room or computer room subfloor, you are going to pull manual hoses in and extinguish it. With an inch and a half hose you're probably delivering 100 gallons per minute. It's a large volume. You could accumulate a lot of water there. We don't think it's going to take more than ten minutes to put a fire out in there.

Anyway, to get rid of that water we're going to have floor drains in the control room subfloor area. Those floor drains will be routed to the divisional sumps. We'll have a requirement to include a loop seal to maintain the control room HVAC envelope.

I know the next question, Mr. Michelson, is, how do you maintain the loop seal? Though I am not going to specify it right now, the manner we probably have in mind is to terminate the pipe underneath the lowest level that you would draw the sump down to, and the sumps are receiving enough water that that would be --

MR. MICHELSON: The sumps won't be receiving any water, hopefully, under normal operations.

MR. BEARD: We're going to have equipment drains to the lake under there.

MR. MICHELSON: That's a dry floor.

MR. BEARD: Correct, but the V sumps will be receiving water from the equipment trains.

MR. MICHELSON: I thought you were talking about putting a sump in the subfloor.

MR. BEARD: No.

MR. MICHELSON: So the water seal is going to be down where the big sumps are.

MR. BEARD: Down where the sumps are located in the basement, yes. That's to maintain the control room HVAC envelope.

The significant flooding sources available for water in the control building are really three systems, reactor service water system, fire protection, reactor cooling water, and the HVAC emergency cooling water.

I think we have done a real good analysis of the RSW and there is no question there.

RCW and HECW systems are effectively closed volume systems. They do have a head tank that they share located at 31,700 millimeter elevation in the reactor building.

MR. MICHELSON: But they have got a big cooling water supply to them coming from the basement of the control building. You've got to cool that chiller system up in the higher elevations where the chiller system is, but it has got big water pipes from the basement up to it.

MR. BEARD: They have RCW water circulating through them.

MR. MICHELSON: I think it's 8 or 10 inch.

MR. EHLERT: Yes, but the total volume of each division of the whole RCW system is about 50,000 gallons.

MR. MICHELSON: That's a lot of water in a small room. I agree it's nothing for the basement. I'm not worried about the basement. Release in a small room is where the problem is. That's a lot of water.

MR. BEARD: The point I was trying to make was they are limited volume systems. We are satisfied that with the flow rates out of these breaks the maximum flood level you're going to create on the floor is underneath the 200 millimeters. It will flow down to the basement and that type of volume from this limited volume system is easily accommodated in the basement.

MR. MICHELSON: I think you no longer can talk about 8 inches of water on the floor because you took the sills off. That's the way you used to get the 8 inches. You said, okay, I'm going to put an 8-inch sill in the room and I'm going to keep 8 inches of water confined. It isn't confined anymore to anything like 8 inches.

MR. BEARD: Right. I'm allowing it to spread out but I'm still maintaining all my equipment above that elevation.

MR. MICHELSON: That's right.

MR. BEARD: I also want to point out that there are alarms on the surge tank. You may not detect this because of level switches that are installed in there. You're going to get an alarm in the control room saying you've got a low head tank level.

MR. MICHELSON: The head tank is not on the raw water side. The head tank is on the circulating water side.

MR. BEARD: There is a head tank that is common to both the RCW and the HECW systems.

MR. EHLERT: Both are vented to the atmosphere, to a surge tank which is used to maintain the system pressures.

MR. MICHELSON: Where is that located?

MR. EHLERT: It's 31,700.

MR. BEARD: It's 31,700 in the reactor building.

MR. MICHELSON: What elevation?

MR. BEARD: 31,700.

MR. MICHELSON: It's got to be real high.

MR. BEARD: They are very high up in the reactor building, yes.

MR. MICHELSON: You are monitoring that level.

MR. BEARD: We are monitoring the level in the surge tank.

MR. MICHELSON: It's the raw water side I'm worried about.

MR. BEARD: The RSW.

MR. MICHELSON: Yes.

MR. BEARD: So we have a tube failure.

MR. MICHELSON: No. I've got a pipe failure in that 10-inch pipe going up to that room.

MR. EHLERT: That still is part of a closed loop and they share a common surge tank.

MR. MICHELSON: No, it's not. Service water is coming from the ultimate heat sink.

MR. EHLERT: No. Service water ends in the basement and goes back out. What is pumped up to the refrigerators is reactor building cooling water.

MR. MICHELSON: It's on a closed loop already, you're saying.

MR. EHLERT: Yes. That is a closed loop unless the service water heat exchangers fail.

MR. MICHELSON: I see. I guess I'd better check the drawings then.

MR. BEARD: I'll pull the drawings and we can do that right now.

MR. MICHELSON: Usually you just have little arrows that say "service water."

MR. EHLERT: It's cooling water in this plant.

MR. MICHELSON: In this case it has to be the cooling water side.

MR. EHLERT: For service water to dumped into the refrigerators you'd have to have a service water heat exchanger failure.

MR. MICHELSON: The only service water is circulating in and out of the basement.

MR. EHLERT: That's correct.

MR. BEARD: That is correct.

MR. MICHELSON: Then you've got pumps in the basement to drive it up. Then the surge tanks is a good answer. I don't need to see it. I'm sure that's what it is.

MR. BEARD: That ends the prepared presentations we had. I do note that we have an hour and ten minutes before you said your absolute cutoff is. We are prepared to respond to any other questions you may have.

MR. LINDBLAD: That's confidence.

MR. BEARD: I didn't guarantee what the response would be.

MR. EHLERT: The answer may be we'll bring it back later.

MR. MICHELSON: Ask your questions if you have any others.

I do hope that you are going to make those control building drawings a little more clear before we're done. I think any reasonable individual who looks at the reactor building drawings and then looks at the control building drawings will wonder if they were even drawn by the same company.

MR. DAVIS: And they weren't.

MR. MICHELSON: In fact they weren't, but they should be a comparable quality of detail and definition with uniform symbolism and everything that goes into prudent engineering. If you see sloppy drawings, you wonder about the thought that went into them. Maybe it was a real good thought, just sloppy drafting. The drawings are very poor. There are still a number of errors in them. We tried to point out a number of errors but there are still a lot of them in there that they haven't fixed. Some of them have been copied into the ITAAC drawings even.

MR. BEARD: I would like to respond to at least one issue that came up yesterday and that was on the chillers. I don't know why it escaped me yesterday. I talked to San Jose after the fact. One of the things you were worried about, Mr. Michelson, was when we go to restart these chillers the possibility of an incredible inrush on the motors stalling out and causing a failure of the diesel generator.

MR. MICHELSON: They are stalled out.

MR. BEARD: The response to that is breaker coordination prevents that.

MR. MICHELSON: I wasn't worried about blowing the diesel generator. I'm sure you've got break protection. It just kicks everything out. It's useless to try to start a stalled compressor. It's useless. And yet we do it in the logic. It's not clear to me yet that you've taken it out of the diesel loading logic. You explained to me yesterday, well, if it tries to restart on a loss of power, then the logic knows that it's too high a pressure and everything and it won't load it.

MR. BEARD: Let me respond to that. It might help to put up the electrical diagram while we do it.

The HECW chillers are off of 480 volt feed. So they are obviously much smaller motors than some of the other ones we've got on the 1E buses that are fed from the 6.9 kv.

MR. MICHELSON: That's right.

MR. LINDBLAD: Do you know the rating of them?

MR. BEARD: Gary, to you know the cooling capacity?

MR. LINDBLAD: Big, little, 10 or 100 ton?

MR. EHLERT: If I remember right, they are either 130 or 230 ton each.

MR. MICHELSON: I'll look that one up too. I read numbers bigger than that.

MR. EHLERT: There are two chillers per division.

MR. MICHELSON: These are big chillers.

MR. EHLERT: In the normal system, if I remember right, you've got 5 500-ton chillers.

MR. MICHELSON: Oh, yes, even 700-ton chillers.

MR. EHLERT: Those are out in the turbine building on offsite power.

MR. MICHELSON: I thought the others were bigger than 130.

MR. EHLERT: I'm thinking they might be 230s.

MR. MICHELSON: That's a little closer to what I recall.

MR. BEARD: In the event of voltage loss on the 1E bus the sequence is -- and I don't know all the specific times; I'm sure Charlie will correct me if I'm wrong -- once we sense a reduced or loss of voltage in here we're going to open the breaker from the preferred power supply. We're going to start our diesel and we're going to close the breaker and supply the bus.

MR. MICHELSON: That's going to be done by a logic control?

MR. BEARD: That is done by a logic control.

Each safety-related system on that is also monitoring 1E bus voltage and it's going to sense that voltage is lost. If it was just a partial degradation when we do the connection, they all look to make sure that it drops off. Once it sees voltage restored to whatever its set point is they start throwing internal timers.

MR. MICHELSON: How do they coordinate with each other?

MR. BEARD: They do not coordinate with one another.

MR. MICHELSON: You mean they can all start at the same time?

MR. BEARD: If your set points for some reason were screwed up, yes, that would be a possibility.

MR. MICHELSON: What set points are you referring to?

MR. BEARD: Each one of these is looking to see if voltage is back up to, I'll just say arbitrarily, 6.8 kv, and it starts a timer. The timers are sequenced so that the loads come on at different times and they close the breaker.

MR. MICHELSON: That's the loading logic.

MR. BEARD: That's the loading logic. It's not done by a central sequencer. Each one controls itself. The HECW chillers are in the last block of stuff to come on.

MR. MICHELSON: That doesn't make them best necessarily, because it means now the diesel is already reaching it's nearly fully loaded condition and this is the last load you see.

MR. BEARD: Possibly, yes.

MR. MICHELSON: And if it's an unusually big inrush, that's the difficulty. You've got to make sure it's going to handle that inrush.

MR. BEARD: We say we either handle that inrush or we protect from tearing down the system by breaker coordination. And if I have an inrush, I'd better trip the breaker on that.

MR. MICHELSON: You always do that. That's electrical engineering, breaker coordination on all electrical loads.

MR. BEARD: I thought I heard yesterday that you were concerned that if these things started we could take down the class IE bus, and we say we don't think that's credible.

MR. MICHELSON: What I was saying was that if that inrush is more than the diesel is capable of it will open its breaker and it takes down the bus and you start all over. When that bus is lost everything sees a loss of voltage and it starts all over again. If you keep cycling through that, eventually you burn the motors up because you can't restart these big motors that frequently.

MR. BEARD: Being that this is the last one we sequence on, the generator is sized to handle the normal starting current for that.

MR. MICHELSON: For a stalled compressor? Not the normal starting current; the starting current for the stalled compressor.

MR. BEARD: Why are you postulating it's a stalled compressor?

MR. MICHELSON: Because you just shut it down 10 seconds earlier.

MR. BEARD: What we are saying is, we are going to restore power back to it; the microprocessors are looking to see is there a demand for me to turn on; if there is the demand, it starts through its starting sequence. As part of that starting sequence, if there is still pressure in the system it will do pressure relief and whatever and then it will start. You're not going to be trying to start a stalled compressor.

MR. MICHELSON: That's the explanation you gave yesterday and I bought that. I have no more problem with this issue. I'm trying to make sure you understood the issue, and the issue is you don't want to kill the diesel. It will open its breaker if it gets too much inrush.

MR. LINDBLAD: Carl, the starting current won't be any greater than a stopped rotor.

MR. MICHELSON: A locked rotor.

MR. LINDBLAD: A locked rotor torque. It won't be any greater than that.

MR. MICHELSON: It will not be greater than a locked rotor.

MR. LINDBLAD: It will just stay on longer.

MR. MICHELSON: It will stay on a lot longer.

MR. LINDBLAD: So it isn't a question of what is the starting current but the time that the current runs high.

MR. MICHELSON: Yes. And that's what the breakers are seeing.

MR. LINDBLAD: Yes.

MR. MICHELSON: And monitoring.

MR. LINDBLAD: On thermal overloads.

MR. MICHELSON: If it's too prolonged, they kick out.

MR. LINDBLAD: The magnetic won't trip it out.

MR. MICHELSON: Probably not. The thermal will.

MR. LINDBLAD: It may, yes, depending on its setting.

MR. WYLIE: I think the overcurrent relay will take it out. You basically match the curve above the starting current for starting one of these things. If it exceeds that, it will take it out.

MR. LINDBLAD: Will it exceed it, just the current itself?

MR. WYLIE: No. It will exceed it in time.

MR. LINDBLAD: Integrated over time.

MR. WYLIE: Yes.

MR. MICHELSON: All we area really saying is you've got to look at it and assume that it is stalled. Every 1E bus sees the same situation at the same time and all of them drop out. All of them recycle again. They did add this protection now. They are trying to monitor the condition of the chillers to make sure that they shouldn't be reloaded. That's the saving grace. They've taken care of the problem. Because then they won't start until they're ready.

In past practice has GE in the designing of their sequencers been using a master sequencer or have they been using these individual timers that don't monitor what is going on?

MR. BEARD: To the best of my knowledge, and that may be limited, the typical practice historically has been to use a master sequencer.

MR. MICHELSON: That's my understanding.

MR. BEARD: This is a new approach.

MR. MICHELSON: I'm not going to say it's any better or any worse. It's another way to do it. I can see some potential shortfalls. The old master sequencer made sure things didn't get out of sequence for whatever reason. If there's a failure of one of those timers on two big motors, then it will take that generator out unless it's capable of starting two big motors at the same time. But that's a small probability failure, and it will only affect one generator whereas this other affects all four, or all three in this case.

MR. POWER: I there are no more questions, I think that's it for us today.

MR. MICHELSON: You guys have done a fine job. We were just trying to find out where your breaking point might be.

[Laughter.]

MR. MICHELSON: The Committee now has to decide what they want to say in a report or how they want to finally come down. I think we have received a sufficient amount of information with which to make a reasonable decision. I think we have probably reviewed this as hard or harder than any project that I'm aware of having been through, but I think it was justified because of the first of the kind, and so forth. I think it has been thoroughly looked at by us. I think we have raised a number of questions. I think we see some improvements that were made as a consequence and by and large I think we can just develop a greater comfort level from the feeling that, yes, we really think we do understand this plant and therefore our decision is based on something other than a superficial look. That's all we are striving for.

MR. BEARD: I would like to make certain that you don't feel there are any issues that we still owe you a response on.

MR. MICHELSON: Not that I'm aware of. I am kind of curious to see how some of the responses got back into the SSAR, but I don't think the Committee is going to have much time to even look. We're going to depend heavily upon what you have told us and these written replies and handouts.

MR. BEARD: We fully expect that and we think that's reasonable.

MR. MICHELSON: From then on it's the Staff's problem if there are still inconsistencies.

Gentlemen, thank you very much.

[Whereupon at 3:00 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: ACRS ABWR

DOCKET NUMBER:

PLACE OF PROCEEDING: Bethesda, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Michael Paulus
Official Reporter
Ann Riley & Associates, Ltd.

GE RESPONSES

ACRS

REQUESTS FOR ADDITIONAL INFORMATION PREVIOUS MEETING ITEMS

ABWR ACRS SUBCOMMITTEE MEETING

WEDNESDAY, JANUARY 26, 1994

BETHESDA, MARYLAND

- DECEMBER 15, 1993 MEETING – 10 ITEMS

J. ALAN BEARD
JOHN WILLIAM POWER
1/25/94

ABWR-ACRS SUBCOMMITTEE
REQUEST FOR ADDITIONAL INFORMATION
DECEMBER 14 AND 15, 1993 MEETINGS

1) PLANT MATERIAL CONTROLS – PROGRAMS

2) PLANT ELECTRICAL SYSTEMS – OPERATIONAL ASPECTS

3) SUPPRESSION POOL PIPING – POSTULATED BREAK ANALYSES

4) PLANT TUNNEL PENETRATIONS – POSTULATED FAILURE ACCOMMODATION

5) PLANT BUILDING SILLS – REMOVAL ANALYSES

6) PLANT BUILDING – SSAR DRAWING UPGRADES

7) PLANT INTER-SYSTEM LOCA – REMEDIAL ACTION COMMITMENTS

8) HIGH/MODERATE/LOW ENERGY LINE – CLASSIFICATION RULES

9) CONTROL BUILDING – INTERNAL FLOODING PROTECTION

10) CUW ISOLATION VALVES – TESTING FREQUENCY

JAB
JWP
1/25/94

#1 PLANT MATERIALS CONTROLS – PROGRAMS

REQUESTS

- OPERATING EXPERIENCE INDICATES THAT SOME PLANT MATERIALS ARE SUBJECT TO AGING AND CONDITION-RELATED EFFECTS WHICH DEGRADE THEIR PERFORMANCE ESPECIALLY OVER AN EXPECTED 60 YEAR LIFETIME. THESE INCLUDE:
  - CONTAINMENT STRUCTURAL OR INTEGRITY MATERIALS (E.G., LINERS)
  - STORAGE TANKS
  - SERVICE WATER PIPING
- THEY ARE SUBJECT TO HARSH GALVANIC, CORROSION, EROSION AND CHEMICAL ATTACK.
- PROGRAMMATIC ASPECTS AND INFORMATION RELATIVE TO THEIR TREATMENT SHOULD BE DESCRIBED IN CHAPTER 3. TREATMENT OF ELECTRICAL EQUIPMENT AGING ASPECTS (E.G., CATHODIC, ULTRAVIOLET, ETC. ASPECTS) CAN REMAIN IN CHAPTER 8.

RESPONSES

- GE RECOGNIZES THE NEED FOR SPECIAL ATTENTION TO PLANT MATERIAL CONTROL ASPECTS
  - 60 YEAR LIFE
  - AGING ASPECTS
  - HARSH ENVIRONS EFFECTS
  - OPERATING EXPERIENCE FEEDBACK
  - MAINTENANCE RULE CONSIDERATIONS

#1	PLANT MATERIALS CONTROLS – PROGRAMS (CONTINUED)

- HARSH ENVIRONS CONCERNS
  - RADIATION DAMAGE -- EMBRITTLEMENT, CRUD, IRSCC
  - WATER CHEMISTRY – IGSCC
  - GALVANIC AND CATHODIC REACTIONS
  - CORROSION AND EROSION
  - CHEMICAL ATTACKS
  - LIFE TIME, DUTY, WEAR OUT
- SSAR FOCUS: BROAD SPECTRUM OF INDIVIDUAL MATERIAL CONTROLS CONCERNS
  - GENERAL PLANT LIFE TIME CRITERIA (E.G., SSAR SECTION 1.2.1.3)
  - WATER CHEMISTRY
  - CATHODIC PROTECTION
  - RADIATION EMBRITTLEMENTS
  - MECHANICAL FATIGUE
  - MATERIAL TOUGHNESS
  - WATER PROOFING
  - SURFACE TREATMENTS
- GE BELIEVES THAT CURRENT LIFE TIME MATERIAL CONTROL ASPECTS ARE TAKEN INTO ACCOUNT
  - INDUSTRY CODE AND STANDARDS
  - NRC REGULATORY AGING REQUIREMENTS
  - COL APPLICANT AREAS – QC, ORAP

#1	PLANT MATERIALS CONTROLS – PROGRAMS (CONTINUED)

  - MAINTENANCE RULE COMPLIANCE
  - OPERATING EXPERIENCE FEEDBACK
  - EPRI PROGRAMS
  - EQUIPMENT REPLACEMENT PROGRAMS
- NO SPECIFIC PROGRAMMATIC MATERIAL CONTROL SECTION IS PROVIDED IN SSAR
  - SOME NEW REFERENCES TO MATERIAL CONTROL ARE BEING INCLUDED FOR SSAR SECTION 3.

#2	PLANT ELECTRICAL SYSTEMS – OPERATIONAL ASPECTS

REQUESTS

- A NUMBER OF ELECTRICAL SYSTEM RELATED ASPECTS NEED FURTHER ATTENTION. THESE INCLUDE:
  - DESIGN BASIS OF ACTUALLY PERFORMING SYNCHRONIZATION OF STANDBY POWER SOURCES WITH THEIR ANTICIPATED LOADS WHILE THEY ARE ENERGIZED BY NORMAL POWER SOURCES DURING NORMAL OPERATION.
  - DESIGN BASIS OF ELECTRICAL SYSTEM PROTECTIVE RELAYING RELATIVE TO SYNCHRONIZED OPERATION OF DIESEL GENERATORS, RESERVE TRANSFORMER, AND CTG TO THE PLANT ELECTRICAL LOADS AND THEIR NORMAL POWER SOURCES DURING NORMAL OPERATION TESTING EXERCISES.
  - DESIGN AND OPERATIONAL BASIS OF SPECIFIED ALLOWABLE VOLTAGE AND CURRENT DROPS FOR BOTH ON-SITE AND OFF-SITE POWER SOURCES.

RESPONSES

- THE OPERATIONAL SYNCHRONIZING OR PARALLELING OF STANDBY POWER SOURCES WITH PREFERRED POWER SOURCES IS AN ACCEPTABLE AND NECESSARY PRACTICE AT NUCLEAR POWER PLANTS. STANDBY POWER SOURCES ARE REQUIRED TO BE TESTED UNDER A VARIETY OF CONFIGURATIONS TO DEMONSTRATE THE CAPABILITIES (E.G. TIME TO RATED FREQUENCY AND VOLTAGE, LOAD TESTING, LOAD SHEDDING TESTING, ETC). THESE TESTS MUST BE CONDUCTED WITHOUT SIGNIFICANTLY AFFECTING PLANT OPERATION OR SAFETY SYSTEM IMMEDIATE AVAILABILITY. PARALLEL OPERATION DURING SOME TEST IS THE ONLY WAY TO ASSURE OR COMPLY WITH THESE REQUIREMENTS. (REFER TO EDG TESTING DURING LOCA OR LOPP SECTION 8.3.1.1.7)

- THE PLANT ELECTRICAL PROTECTIVE RELAYING IS DISCUSSED THROUGHOUT SECTION 8 OF THE SSAR. THE DESIGN BASIS OF PROTECTIVE EQUIPMENT TO UNDER VOLTAGE, OVER VOLTAGE, OVER CURRENT, ETC PERTURBATIONS IS TREATED THROUGHOUT VARIOUS SYSTEM/EQUIPMENT SECTIONS (E.G. SECTION 8.3.1.0.6). SPECIFIC PROTECTIVE EQUIPMENT DESIGN BASIS PARAMETERS ARE ADDRESSED ALSO (E.G. TRANSFER SWITCHES, GROUND FAULT DEVICES, ETC). SYNCHRONIZATION INTERLOCKS ARE PROVIDED AND DISCUSSED IN SECTION 8.3.1.1.6.4.
- GE HAS REVIEWED THE VARIOUS DESIGN BASIS OPERATIONAL ALLOWABLES FOR VOLTAGE, CURRENT, FREQUENCY, ETC AND COMPARED THEM WITH THE EPRI-URD VALUES AND FEELS COMFORTABLE ABOUT THEIR APPLICABILITY TO RELIABILITY AND AVAILABILITY FOR PLANT OPERATIONS.

#3	SUPPRESSION POOL PIPING – POSTULATED BREAK ANALYSES

REQUESTS

- A NUMBER OF POSTULATED SUPPRESSION POOL PIPING BREAK EVENTS ARE CITED IN THE SSAR. MOST OF THESE EVENTS HAVE BEEN EVALUATED RELATIVE TO REACTOR BUILDING/SECONDARY CONTAINMENT/DIVISIONAL SEPARATION ZONE FLOODING CONSIDERATIONS. PLEASE CLARIFY THE PIPING BREAK BASES, THEIR LOCATION, AND THE FLOODING EFFECTS FOR EACH OF THE EVENTS CITED.
- PROVIDE FURTHER ANALYSIS AND INFORMATION RELATIVE TO THE CITED BREAKS WITH REGARDS TO ...
  - ECCS PUMP NPSH EFFECTS DUE TO LOWER WATER LEVEL OF SP, LOWER HEAT CAPACITY OF SP, FURTHER WATER LOSS, ETC.
  - MEANS AVAILABLE TO BRING REACTOR TO COLD SHUTDOWN
  - OPERATOR ACTIONS TO AFFECT A COLD SHUTDOWN

RESPONSES

THE PIPING BREAKS WITH THE POTENTIAL TO DRAIN WATER FROM THE SUPPRESSION POOL INCLUDE THE ECCS SUCTION LINES (RCIC, HPCF, AND RHR/LPFL) AND SPCU. DURING NORMAL OPERATION ONLY THE RHR/LPFL LINES (3) AND THE SPCU LINE ARE ALIGNED TO THE SUPPRESSION POOL. ALL SUCTION LINES PENETRATING THE SUPPRESSION POOL WALL HAVE AT LEAST 1 SAFETY-RELATED ISOLATION VALVE THAT CAN BE CLOSED TO ISOLATE THE BREAK IF NECESSARY.

THE FLOW RATES AND THE ANALYSIS OF THE EFFECTS OF THESE BREAKS ARE INCLUDED IN SSAR SECTION 3.4.1.1.2.1.1.

IF AN UNISOLATED BREAK WERE TO OCCUR, THE WATER IN THE SUPPRESSION POOL WILL FLOW OUT OF THE BREAK UNTIL THE LEVEL IN THE POOL IS EQUAL TO THE WATER IN THE ECCS COMPARTMENT OR THE CORRIDOR SPACES ON ELEVATION -8200 MM

IN EITHER OF THE CASES DISCUSSED ABOVE, THE SUPPRESSION POOL IS NOT REQUIRED AS A HEAT SINK OR A WATER SOURCE TO BRING THE PLANT TO COLD SHUTDOWN SINCE THE MAIN CONDENSER AND FEEDWATER SYSTEMS REMAIN AVAILABLE. IF THE SUPPRESSION POOL INVENTORY WERE TO BE LOST DUE TO AN UNISOLATED BREAK, TECHNICAL SPECIFICATION 3.6.2.2 WOULD REQUIRE THE PLANT TO RESTORE WATER LEVEL IN 2 HOURS OR TO SHUTDOWN THE PLANT.

#4	PLANT TUNNEL PENETRATIONS – POSTULATED FAILURE ACCOMMODATION

REQUESTS

- ADDITIONAL INFORMATION RELATIVE TO THE PLANT TUNNEL PENETRATION SEALS IS REQUESTED. THE FOLLOWING IS REQUESTED:
  - EVALUATION CONSEQUENCES AND REMEDIAL ACTIONS TO BE TAKEN ASSUMING A POSTULATED CATASTROPHIC SEAL FAILURE
  - IDENTIFY MEANS TO BE TAKEN TO AVOID PENETRATION AND SEAL FAILURES DUE TO CATASTROPHIC FAILURE OF THE TUNNEL STRUCTURES.
  - IDENTIFY MEANS BY WHICH TUNNEL FIRE OR FLOODING CONDITIONS WILL BE MITIGATED OR ACCOMMODATED.

RESPONSES

SSAR SECTION 3.4 AND 3.12 HAVE BEEN REVISED TO INCLUDE ADDITIONAL REQUIREMENTS RELATIVE TO THESE CONCERNS.

SECTION 3.4..3.4 WILL NOW INCLUDE THE FOLLOWING REQUIREMENT FOR PENETRATION SEALS. "THE DESIGN OF PENETRATION SEALS SHALL INCLUDE FEATURES SUCH THAT EVEN IN THE EVENT OF A CATASTROPHIC FAILURE OF THE SEAL THE FLOW RATE THROUGH THE PENETRATION IS LESS THAN 1.5 M^3/MIN. EMERGENCY PROCEDURES SHALL BE DEVELOPED TO ENABLE PLANT PERSONNEL TO RESTRICT THE FLOW AND BEGIN RECOVERY IN 2 HOURS." AT A FLOW RATE OF 1.5 M^3/MIN IT WILL TAKE 10 HOURS FOR WATER IN THE BASEMENT OF THE REACTOR BUILDING TO ACCUMULATE TO 1 METER IN DEPTH.

SECTION 3.12.3 WILL NOW INCLUDE THE FOLLOWING REQUIREMENT FOR NON-SAFETY RELATED TUNNELS. "THE TUNNEL STRUCTURES SHALL BE DESIGNED SO THAT IN THE UNLIKELY EVENT OF STRUCTURAL FAILURE OF A TUNNEL WILL NOT RESULT IN UNACCEPTABLE CONSEQUENCES TO PENETRATION SEALS AT THE INTERFACE WITH SAFETY-RELATED STRUCTURES."

SECTIONS 3.12.2 AND 3.12.3 WILL NOW INCLUDE REQUIREMENTS FOR TUNNELS TO "CONTAIN LEAK DETECTION EQUIPMENT AND PROVISIONS FOR WATER REMOVAL".

#5	PLANT BUILDING SILLS – REMOVAL ANALYSES

REQUESTS

- CONFIRM THE REMOVAL OF FLOOR SILLS FROM THE PLANT DESIGN BASIS.
- PROVIDE THE BASIS OF THEIR REMOVAL.
- EVALUATE THE EFFECTS OF THEIR REMOVAL RELATIVE TO THE CURRENT PLANT FIRE AND FLOODING ANALYSIS DOCUMENTED IN THE SSAR.

RESPONSES

THE SILLS WERE REMOVED FROM THE BUILDINGS TO CONFORM TO REQUIREMENTS IN THE EPRI UTILITY REQUIREMENTS DOCUMENT. THIS IS BASED ON THE DESIRE TO PERMIT THE USAGE OF THE ROBOTICS AND TO SIMPLIFY THE USE OF EQUIPMENT CARTS. THE REMOVAL OF THE SILLS DOES NOT CHANGE THE BASIC APPROACH TO THE HANDLING OF INTERNAL FLOODS.

THE BASIC ASSUMPTIONS USED IN ANALYZING INTERNAL FLOODING IS THAT WATER SENSITIVE EQUIPMENT IS RAISED A MINIMUM OF 200 MM ABOVE THE FLOOR AND THAT THE DESIGN FEATURES OF THE PLANT PREVENT WATER DAMAGE BY LIMITING THE ACCUMULATED DEPTH TO LESS THAN 200 MM AND BY CONFINING THE EFFECTS OF WATER SPRAY TO THE IMMEDIATE VICINITY. SECTION 3.4.1.1.2 HAS BEEN REVISED TO CLARIFY THE DESIGN REQUIREMENTS AND WILL INCLUDE THE FOLLOWING SPECIFIC REQUIREMENTS.

1. WATERTIGHT DOORS AND WALLS ARE PROVIDED IN THE BASEMENTS OF THE CONTROL AND REACTOR BUILDING AROUND THE DIVISIONAL EQUIPMENT ROOMS TO PROTECT SAFETY-RELATED EQUIPMENT FROM THE MAXIMUM FLOOD LEVEL.
2. FIRE DOORS AND PENETRATIONS PREVENT WATER SPRAY IN ONE DIVISION FROM EFFECTING THE OTHER DIVISIONS.
3. FLOORS PREVENT WATER SEEPAGE TO LOWER LEVELS.
4. PENETRATIONS THROUGH FLOORS WILL BE WATER TIGHT OR HAVE 200 MM CURBS.
5. EQUIPMENT HATCH SEALS WILL IN GENERAL PREVENT WATER SEEPAGE.
6. WATER FROM A PIPE BREAK WILL FLOW UNDER NON-WATERTIGHT DOORS AND SPREAD OUT OVER THE FLOOR AT THE EFFECTED ELEVATION. WATER IS DRAINED TO THE BASEMENT THROUGH THE FLOOR DRAINS AND ALSO VIA THE STAIR TOWERS AND ELEVATOR SHAFTS.

#6	PLANT BUILDINGS – SSAR DRAWING UPGRADES

REQUESTS

- RECENT REVIEW OF THE SSAR PLANT LAYOUT DRAWINGS UNCOVERED A NUMBER OF DISCREPANCIES. THESE INCLUDED:
  - MISSING REACTOR BUILDING/CONTROL BUILDING ACCESS CORRIDORS AND ACCESS DOORS
  - MIS-PLACED PHANTOM BUILDING OUTLINES
  - OMITTED MAJOR INTERCONNECTION TUNNELS
- PROVIDE A LIST OF DRAWINGS THAT WILL BE CHANGED IN THE NEXT SSAR AMENDMENT.

RESPONSES

SECTION VIEW OF THE REACTOR BUILDING IS BEING REVISED TO BETTER SHOW THE PERSONNEL ACCESS AT ELEVATION 4800 MM.

THE SITE LAYOUT DRAWING IS BEING REVISED TO SHOW THE LOCATION AND ROUTINGS OF THE EMERGENCY DIESEL FUEL OIL SUPPLY LINE TUNNELS.

RADWASTE TUNNEL LOCATION AT ELEVATION -8200 MM WILL BE CLARIFIED IN THE REACTOR BUILDING AND CONTROL BUILDING PLAN VIEWS.

PERSONNEL ACCESS WAYS AT ELEVATION 12,300 MM FROM THE CONTROL BUILDING TO THE REACTOR BUILDING WILL BE CLARIFIED.

#7	PLANT INTER-SYSTEM LOCA – REMEDIAL ACTION COMMITMENTS

REQUESTS

- THE ABWR HAS UPGRADED ITS PIPING SYSTEMS TO ADDRESS ISLOCA CONCERNS. PLEASE SPECIFY THE ISLOCA DESIGN BASIS CONSIDERATIONS TO IN-LINE COMPONENTS ASSOCIATED WITH THE PIPING SYSTEMS.
  - PIPING FLANGES
  - PUMPS (SEALS, PACKING, ETC.)
  - HEAT EXCHANGERS (ΔP ASPECTS, TUBES, BAFFLE PLATES, ETC.)
  - SYSTEM RELIEF VALVES (SET POINTS, CAPACITIES, DUTY RATINGS)
  - KEEP FILL SYSTEMS
  - VALVING (PACKINGS, VALVE BONNETS, VALVE STEMS SEALS, ETC.)
  - DRAIN & VENT LINES

RESPONSES

- ABWR ISLOCA DESIGN RELATIVE TO NRC-STAFF POSITION IS WELL DOCUMENTED AND DESCRIBED IN THE FOLLOWING DOCUMENTS
  - ABWR SSAR – APPENDIX 3M – RESOLUTION OF INTER SYSTEM LOCA FOR ABWR (AMENDMENT 32)
  - NRC-STAFF FSER – SECTION 20.2.19 (GENERIC ISSUE #105) (ADVANCED FSER)
  - NRC-STAFF FSER – SECTION 3.9.3.1.1 – INTER SYSTEM LOCA PIPING AND COMPONENTS (ADVANCED FSER)

#7	PLANT INTER-SYSTEM LOCA – REMEDIAL ACTION COMMITMENTS (CONTINUED)

- SPECIFIC ATTENTION WAS GIVEN TO IN-LINE PIPING SYSTEM COMPONENTS
  - FLANGES
  - CONNECTORS
  - VALVE PACKING
  - VALVE STEM SEALS
  - PUMP SEALS
  - HEAT EXCHANGER TUBES
  - VALVE BONNETS AND BOLTING
  - DRAINS, VENTS, FILL CONNECTIONS
  - RELIEF VALVING
- THESE COMPONENTS WILL BE DESIGNED TO A DESIGN PRESSURE OF 0.4 TIMES NORMAL OPERATING REACTOR PRESSURE (E.G., 28.2 atm = 410 psig)

  (SSAR SECTION 3.M.7 – APPLICABILITY OF URS NON-PIPING COMPONENTS)
- BASIS OF REQUIREMENT/COMPLIANCE
  - NUREG/CR-5862 – SCREENING METHODOLOGY – MAY, 1992
  - BWROG REPORT – ISLOCA – PIPING AND VALVE CAPABILITIES.

#8	HIGH/MODERATE/LOW ENERGY LINE – CLASSIFICATION RULES/APPLICATIONS

REQUESTS

- DESCRIBE THE BASIS OF IDENTIFYING HIGH AND MODERATE ENERGY LINES.
- CLARIFY THE USE OF "PERCENTAGE OF TIME" USED IN ESTABLISHING A MODERATE ENERGY CLASSIFICATION FOR A HIGH ENERGY LINE DUTY (E.G., 2%).
- IDENTIFY ALL PIPING SUBJECT TO THIS CONDITIONAL ALLOWANCE ARRANGEMENT (E.G., RHR, RCIC, ETC.).

RESPONSES

THE BASIS FOR IDENTIFYING HIGH AND MODERATE ENERGY LINES IS INCLUDED IN THE STANDARD REVIEW PLAN SECTION 3.6. AND SSAR SECTION 3.6.2.1. GE IS UTILIZING THE 2% EXEMPTION HISTORICALLY GRANTED TO PIPE THAT IS NORMALLY EXPOSED TO MODERATE ENERGY CONDITIONS AND ONLY IS EXPOSED TO HIGH ENERGY CONDITIONS FOR SHORT PERIODS. THE INTERPRETATION OF THIS EXEMPTION IS THE SAME AS THAT PREVIOUSLY USED FOR THE BWR 4, 5, AND 6'S. IN WHICH IT IS ASSUMED THAT A SYSTEM THAT IS "OPERABLE" PER TECH SPECS IS IN EFFECT IN AN OPERATIONAL STATE.

TABLES 3.6-3,4,5, AND 6 DESCRIBE THE CLASSIFICATION OF THE PIPING CLASSIFIED AS MODERATE OR HIGH ENERGY. SPECIFICALLY, LINES WHICH ARE CLASSIFIED AS MODERATE ENERGY ARE AS FOLLOWS:

1. RHR VESSEL SUCTION AND RETURN LINES OUTBOARD OF THE FIRST ISOLATION VALVE.
2. THE HPCF PUMP DISCHARGE LINE UP TO THE INBOARD ISOLATION VALVE.
3. THE RCIC PUMP DISCHARGE LINE UP TO THE INBOARD ISOLATION VALVE.

JAB
1/25/94

#9 CONTROL BUILDING – INTERNAL FLOODING PROTECTION

REQUESTS

- ADDITIONAL INFORMATION IS REQUESTED RELATIVE TO INTERNAL FLOODING EVENTS IN THE UPPER FLOORS OF THE CONTROL BUILDING:
  - IDENTIFY ALL POTENTIAL FLOODING SOURCES LOCATED BOTH INSIDE AND OUTSIDE THE BUILDING (E.G., NON-SAFETY CHILLER PIPING)
  - DESCRIBE THE FLOODING SOURCE PATHWAY DOWN OR THROUGHOUT THE BUILDING
  - EVALUATE POTENTIAL PATHWAY INTO COMPUTER ROOM AND MAIN CONTROL ROOM FROM ALL SOURCES (FIRE FIGHTING, LEAKAGE IN SOURCES, FLOODING VIA SOURCES, ETC.)
  - DESCRIBE THE ROLL PLAYED BY ELEVATED OR RECESSED FLOORING IN FLOODING EVALUATIONS
- DOES REMOVAL OF ROOM ENTRANCE SILLS REQUIRE A NEW CONTROL BUILDING FLOODING ANALYSIS?
- HOW IS FLOODING DETECTED?

RESPONSES

AS DESCRIBED IN THE RESPONSE TO QUESTION #5 (REMOVAL OF THE SILLS) WATER SENSITIVE SAFETY-RELATED EQUIPMENT IS PROTECTED FROM DAMAGE BY LIMITING THE DEPTH OF ACCUMULATED WATER BELOW 200 MM AND BY CONTAINING SPRAY TO THE IMMEDIATE VICINITY OF THE BREAK. THE REMOVAL OF THE SILLS DOES NOT EFFECT THE BASIC ASSUMPTIONS FOR CONTROL BUILDING FLOODING.

THE MAIN CONTROL ROOM AND COMPUTER ROOM UTILIZE ELEVATED FLOORS TO PROVIDE FOR CABLE ROUTING. THERE ARE NO SIGNIFICANT WATER SOURCES LOCATED INSIDE THESE ROOMS. THE "STEM WALL" SEPARATING THE RAISED FLOOR AREA FROM THE SURROUNDING CORRIDORS IS REQUIRED TO BE WATERTIGHT. FLOOR DRAINS IN THE CONTROL ROOM SUBFLOOR AREA ARE ALSO

REQUIRED AND WILL BE ROUTED TO THE DIVISIONAL SUMPS AND INCLUDE A LOOP SEAL TO MAINTAIN THE CONTROL ROOM HVAC ENVELOPE.

THE SOURCES OF SIGNIFICANT FLOODING WATER AVAILABLE FOR INTERNAL CONTROL BUILDING FLOODING ARE LIMITED TO 4 SYSTEMS:

REACTOR SERVICE WATER (RSW)
FIRE PROTECTION
REACTOR COOLING WATER (RCW)
HVAC EMERGENCY COOLING WATER (HECW)

FLOODING FROM THE RSW SYSTEM IS LIMITED TO THE -8200 MM ELEVATION. LEAKAGE FROM THE RSW SYSTEM IS DETECTED BY LEVEL SWITCHES IN EACH OF THE DIVISIONAL RSW/RCW HEAT EXCHANGER ROOMS WHICH PROVIDES AN ALARM IN THE MAIN CONTROL ROOM AND AN ISOLATION SIGNAL TO THE RSW SYSTEM.

THE RCW AND HECW SYSTEMS ARE CLOSED VOLUME SYSTEMS WHICH SHARE A COMMON SURGE TANK LOCATED AT ELEVATION 31,700 MM IN THE REACTOR BUILDING. A LARGE BREAK IN THE RCW PIPING WILL BE DETECTED EITHER BY AN ALARM RESULTING FROM LOW LEVEL IN THE RCW/HECW SURGE TANK, LEVEL ALARMS IN THE RSW/RCW HEAT EXCHANGER ROOMS, OR HIGH LEVEL ALARM FROM THE DIVISIONAL SUMPS. SMALLER PIPE BREAKS WITHIN THE MAKEUP CAPABILITY OF THE SURGE TANK WILL BE DETECTED EITHER BY PLANT PERSONNEL OR BY BUILDING SUMP ALARMS.

#10	CUW SYSTEM – ISOLATION VALVES – TESTING FREQUENCY

REQUESTS

- SOME CONFUSION EXIST RELATIVE TO THE TESTING (TYPE AND FREQUENCY) OF THE CUW SYSTEM ISOLATION VALVING
- CLARIFY SSAR, TECH SPEC, IST AND ORAP TESTING REQUIREMENTS RELATIVE TO EACH OF THE SUBJECT VALVES

RESPONSES

- GE RECOGNIZES IMPORTANCE OF CUW ISOLATION VALVE CLOSURE RELIABILITY
  - RELIABLE NORMAL OPERATION
  - DEMANDING ACCIDENT CLOSURE REQUIREMENTS
  - DEMONSTRATED ACCIDENT CLOSURE QUALIFICATIONS
  - REDUNDANT AND DIVERSE VALVING WITH ALTERNATIVE CLOSURE CAPABILITIES
  - STRICT INSPECTION, TEST AND SURVEILLANCE REQUIREMENTS
  - VALVES ARE PCIVs
- INSPECTION, TEST AND SURVEILLANCE REQUIREMENTS
  - VALVES – STROKE, LEAKAGE, POSITION TESTING
  - ACTUATION DEVICES – LOGIC, ELECTRICAL, TRIP TESTING
- TECH SPECS REQUIREMENTS
  - STROKE REQUIREMENTS – CLOSURE TIME TESTING – EVERY 92 DAYS (SECTION 3.6.1.3.6)
  - LEAKAGE AND POSITION – REFUELING OUTAGE (SECTION 3.6.1.6)

#10 CUW SYSTEM – ISOLATION VALVES – TESTING FREQUENCY (CONTINUED)

  - ACTUATION DEVICES – LOGIC, TRIP, ELECTRICAL TESTING (SECTION 3.3.1.4.2)
- SSAR – IST COMMITMENTS
  - LEAKAGE TESTING – RO
  - POSITIVE INDICATION – RO
  - STROKING – 3 MONTHS (TABLE 3.9-8)

GE PRESENTATION

REACTOR BUILDING – SECONDARY CONTAINMENT – DIVISIONAL SEPARATION ZONES

DESIGN BASES AND SAFETY ANALYSES

ABWR ACRS SUB-COMMITTEE MEETING
WEDNESDAY, JANUARY 26, 1994
BETHESDA, MARYLAND

C. SAWYER
JOHN WILLIAM POWER
G. ELHERT
A. McSHERRY
U. SAXENA

1/25/94

GE PRESENTATION
REACTOR BUILDING – SECONDARY CONTAINMENT – DIVISIONAL SEPARATION ZONES
DESIGN BASES AND SAFETY ANALYSES

INTRODUCTION – OVERVIEW	C. SAWYER – 15 MINUTES
GENERAL DESIGN BASIS CONSIDERATIONS	J. POWER – 30 MINUTES
GENERAL SAFETY EVALUATIONS	A. McSHERRY – 30 MINUTES
SPECIFIC SAFETY EVALUATIONS	U.SAXENA/G. ELHERT/A. McSHERRY – 90 MINUTES
SUMMARY CONCLUSIONS	C. SAWYER – 15 MINUTES

1/25/94

INTRODUCTION – OVERVIEW

GE Nuclear Energy

ABWR Reactor Water Cleanup System/Break Outside Containment

Introduction

Presentation to ACRS

C. D. Sawyer, Manager,
ABWR Engineering

January 26, 1994

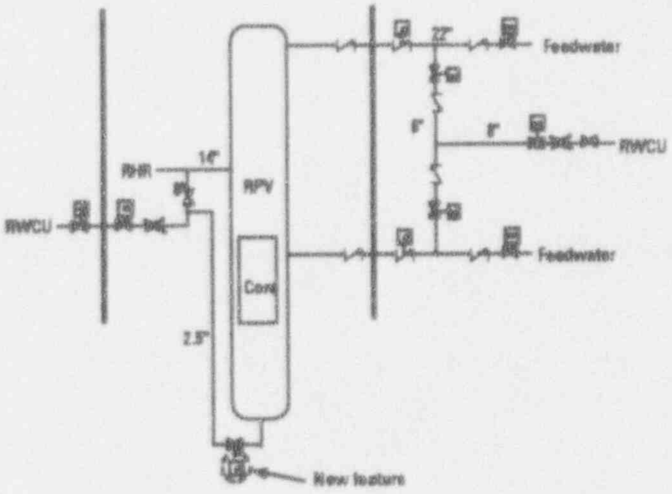
Agenda

- Introduction
- Design Basis Considerations
- General Safety Evaluations
- Specific Safety Evaluations
- Summary

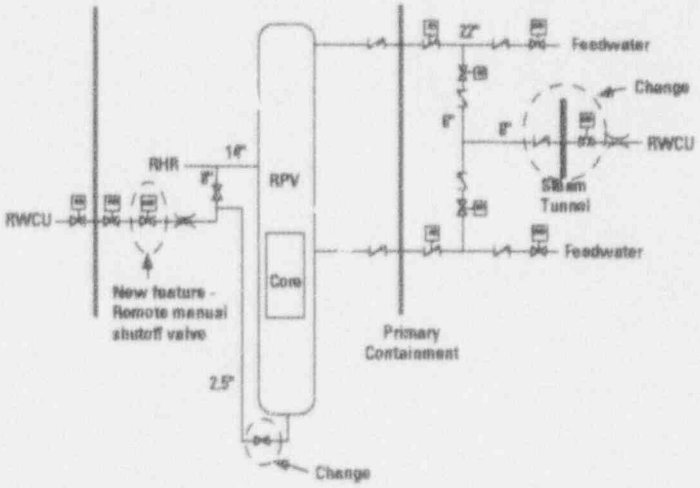
Purpose of Meeting

- Close RWCU/Outside line break issues
  - Place issues in perspective
  - Present deterministic and probabilistic analyses
  - Multidisciplinary team present to answer questions

RWCU Line Geometry - Previous



RWCU Line Geometry - Now



Change

New feature - Remote manual shutoff valve

Change

GENERAL DESIGN BASIS CONSIDERATIONS

1/25/94

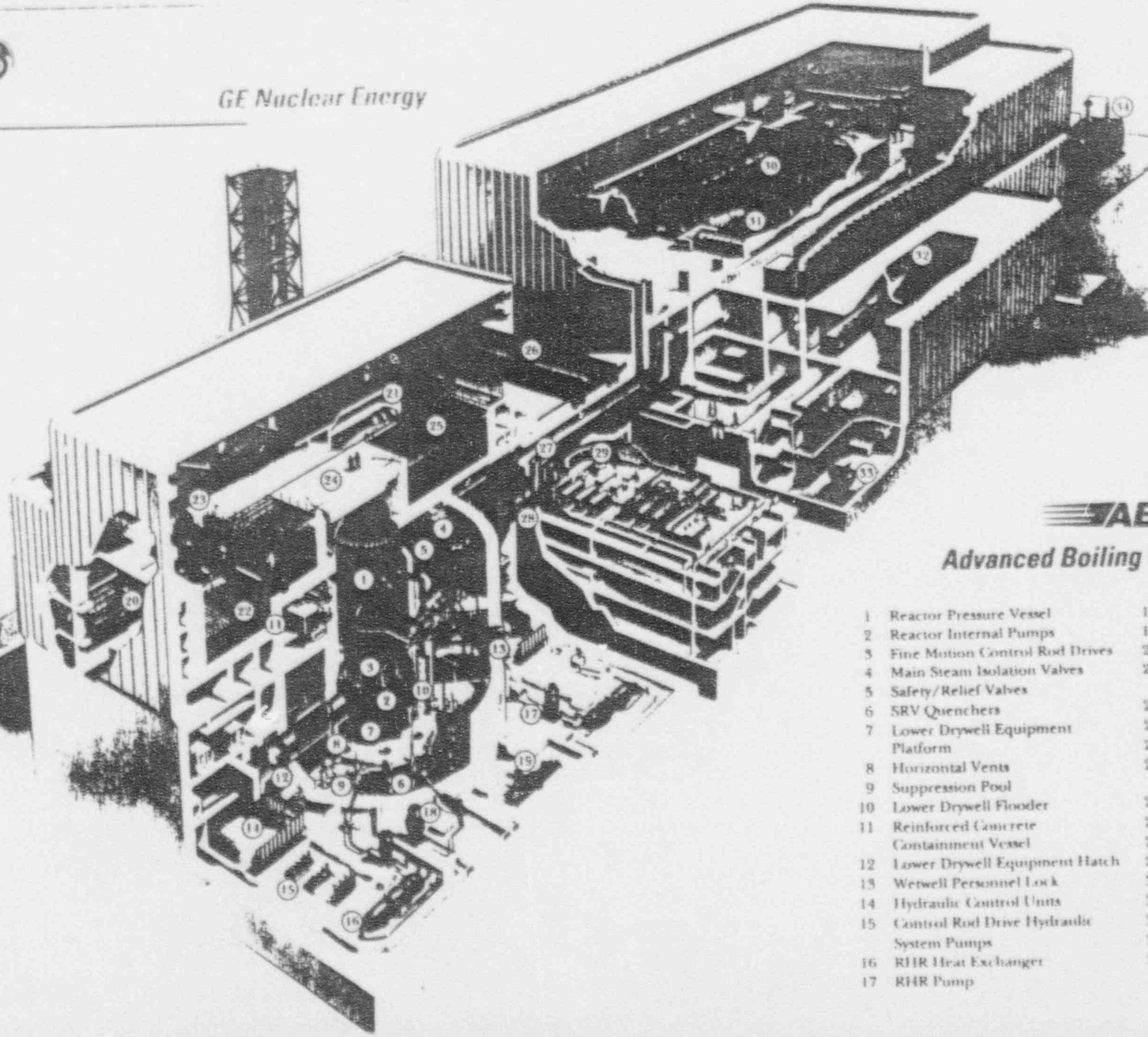
GENERAL DESIGN BASIS CONSIDERATIONS

- ABWR TRULY INTEGRATED PLANT DESIGN AND EVALUATION
- DEFENSE-IN-DEPTH APPROACH
- PRIMARY CONTAINMENT SYSTEM
- SECONDARY CONTAINMENT SYSTEM
- REACTOR BUILDING
- DIVISIONAL SEPARATION ZONES
- DSZ-BARRIERS
- DESIGN BASES

- ABWR TRULY INTEGRATED PLANT DESIGN AND EVALUATION
  - FULL SPECTRUM OF DESIGN AND OPERATIONAL CONSIDERATIONS
  - DESIGN BASIS, BEYOND DESIGN BASIS, AND SEVERE ACCIDENT EVENTS
  - FIRE, FLOOD, BREAKS, HARSH ENVIRONS
  - DETERMINISTIC AND PROBABILISTIC EVALUATION
  - INTERNAL AND EXTERNAL EVENT ASPECTS

- DEFENSE-IN-DEPTH APPROACH
  - PRIMARY COOLANT PRESSURE BOUNDARY AND REACTOR CORE
  - CONTAINMENT SYSTEMS
  - ENGINEERED SAFETY FEATURES
  - I&C SYSTEMS
  - POWER SOURCES

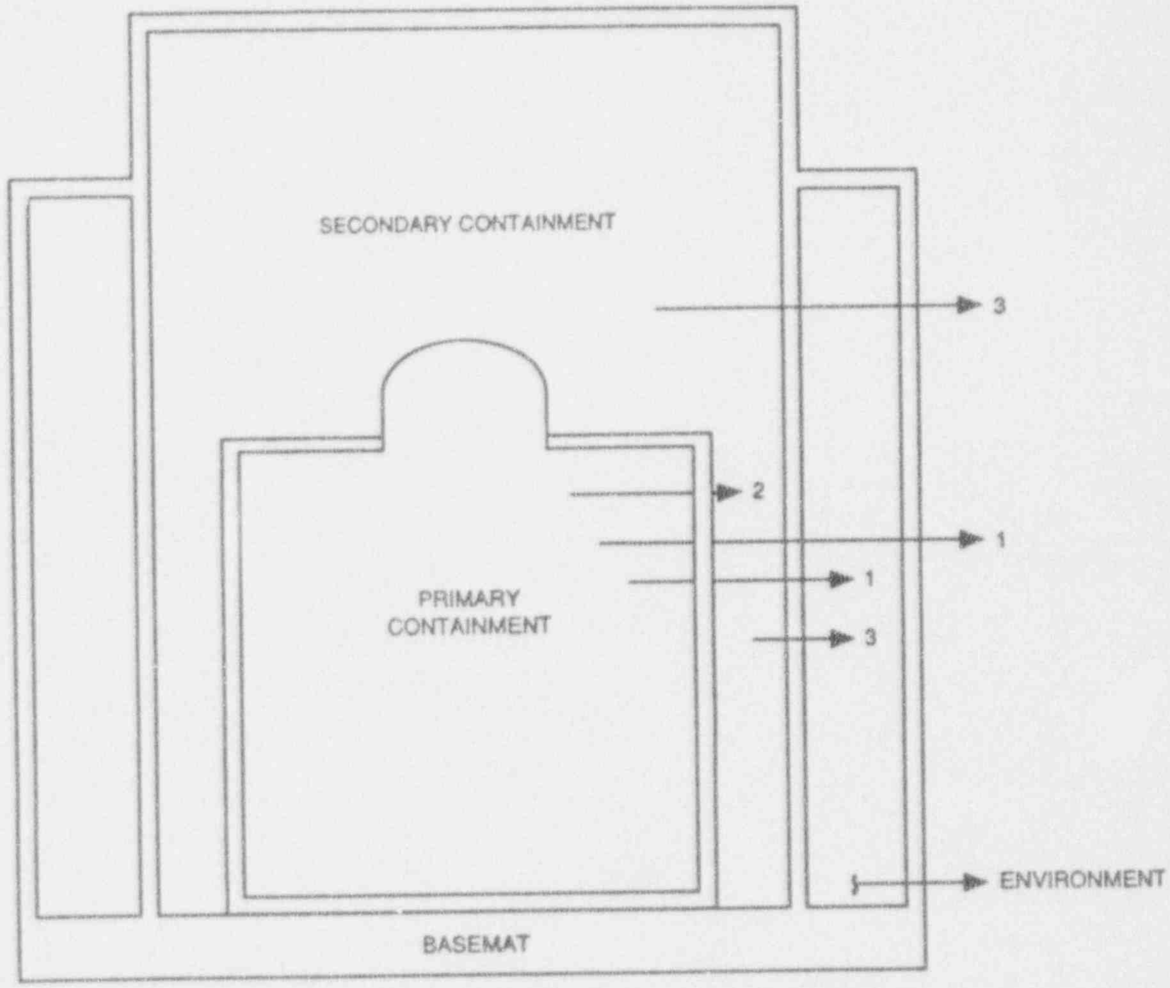
GE Nuclear Energy



ABWR

Advanced Boiling Water Reactor

1	Reactor Pressure Vessel
2	Reactor Internal Pumps
3	Fine Motion Control Rod Drives
4	Main Steam Isolation Valves
5	Safety/Relief Valves
6	SRV Quenchers
7	Lower Drywell Equipment Platform
8	Horizontal Vents
9	Suppression Pool
10	Lower Drywell Flooder
11	Reinforced Concrete Containment Vessel
12	Lower Drywell Equipment Hatch
13	Wetwell Personnel Lock
14	Hydraulic Control Units
15	Control Rod Drive Hydraulic System Pumps
16	RHR Heat Exchanger
17	RHR Pump
18	HPCF Pump
19	RCIC Steam Turbine and P
20	Diesel Generator
21	Standby Gas Treatment Fil and Fans
22	Spent Fuel Storage Pool
23	Refueling Platform
24	Shield Blocks
25	Steam Dryer and Separator Storage Pool
26	Bridge Crane
27	Main Steam Lines
28	Feedwater Lines
29	Main Control Room
30	Turbine-Generator
31	Moisture Separator Reheat
32	Combustion Turbine-Gene
33	Air Compressor and Dryers
34	Switchyard



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

- PRIMARY CONTAINMENT SYSTEM
  - LIMITED BREAK SOURCES
  - REDUNDANT AND DIVERSE LEAK AND BREAK DETECTION
  - REDUNDANT AND DIVERSE ISOLATION SYSTEM
  - EXTENDED CONTAINMENT CAPABILITIES
  - CONSERVATIVE BREAK ANALYSIS AND EFFECTS

- SECONDARY CONTAINMENT SYSTEM
  - LIMITED BREAK SOURCES
  - DIVISIONAL SEPARATION ZONES
  - FIRE/FLOOD/BREAK/ADVERSE ENVIRONS PROTECTION
  - PREDOMINANTLY HARDENED BARRIERS; SOME SOFTENED
  - CONSERVATIVE BREAK ANALYSIS AND EFFECTS

- REACTOR BUILDING
  - PLANT AND SITE ENVIRONMENTAL CONSIDERATIONS – EQUIPMENT PROTECTION
  - SO-CALLED THIRD CONTAINMENT ENVELOPE
  - INTEGRATED SAFETY SYSTEM SUPPORT AREAS
  - CLEAN/PROTECTED ESSENTIAL ELECTRICAL EQUIPMENT ZONES
  - OPERATIONAL ENHANCEMENTS – AT POWER ACCESSIBILITY, ETC.

- DIVISIONAL SEPARATION ZONES

  - ECCS ZONES – SELF-CONTAINED
  - OTHER ZONES – CUWS, FPCUS, SPCUS, CRDS, SLCS
  - NON-DIVISIONAL AREAS
  - DRAINS/SUMPS
  - SUB-COMPARTMENTS

- DSZ-BARRIERS
  - STRUCTURAL WALLS
  - CEILINGS AND FLOORS
  - ACCESS PATHWAYS
  - PENETRATIONS
  - AUXILIARY SERVICE SYSTEM CONNECTIONS

- DESIGN BASES
  - OVERALL
  - REACTOR BUILDING
  - SECONDARY CONTAINMENT
  - DIVISIONAL SEPARATION ZONES
  - SECONDARY CONTAINMENT AND DIVISIONAL SEPARATION BARRIERS
  - BREAKS OUTSIDE CONTAINMENT - BARRIER ASPECTS

Introduction - General Design Bases

- Primary and Secondary Containments are required for all DBA pipe breaks Occuring within primary containment and reactor fuel failure or damage events since the radiological consequences associated with core uncovery and for full cladding integrity loss considerations are usually severe and unacceptable without containment. Again, all of these events (e.g., LOCAs) occur inside primary containment.
- Potential breaks outside primary containment must isolate prior to fuel damage or core uncovery. Therefore, breaks outside primary containment do not result in fuel damage.
- Neither Primary or Secondary containment are required for DBA main stem line breaks outside primary containment.
- Secondary Containment is required for DBA refueling accident events since it serves as a primary containment function.
- Secondary Containment-Divisional Separation Zone integrities are required for DBA internal fires.
- ECCS Compartment/Divisional Separation is required for DBA flood events.
- Reactor Building-Divisional Separation Zone integrities are required for DB site related external events.

Reactor Building (RB) - General Design Bases

The general design basis considerations for the Reactor Building include:

- The Reactor Building is classified as a safety-related structure.
- The Reactor Building protects the equipment required safe and orderly shutdown equipment from adverse site-related environmental events (e.g., seismic, flood, storm, wind, snow, etc.).
- The Reactor Building encompasses the Secondary Containment and its ECCS Divisional Separation Zones.
- The Reactor Building also houses and provides spacial, physical and electrical separation to other Divisional Separation Equipment Zones or Compartments (e.g., Emergency DG Rooms, Emergency Electrical Equipment Rooms)
- The Reactor Building provides environmental controls to safety related equipment during normal operation and plant transients.
- The Reactor Building is devoid of HELB sources. It also contains only a limited number of fire, flood or radiological sources.
- The Reactor Building and the Secondary Containment share structural and barrier walls, and penetrations.
- Reactor Building is a relatively friendly environs although it provides controlled access to important safety equipment.
- Reactor Building's radiological barrier capabilities are not required for DBA events.
- Reactor Building's structural integrity is assured for DBA events.

Secondary Containment (SC) - General Design Bases

The general design basis considerations for the Secondary Containment include:

- The Secondary Containment provides an additional (secondary) radiological barrier to the Primary Containment. It provides a controlled collection, treatment and elevated release pathway for design basis LOCAs caused leakage from the primary containment. It also provides an environmentally controllable atmosphere for vital equipment required to safely shut the plant down under these conditions.

- The secondary containment provides primary containment during refueling or shutdown operations when postulated refueling pool or open primary coolant system accidents are assumed to occur.

- The Secondary Containment also provides a primary containment function for steam or liquid leaks from reactor coolant pathways outside the primary containment during normal or transient operations.

- The Reactor Building encloses the Secondary Containment and the lower portions of the secondary containment are situated below site ground level.

- Under design basis LOCA inside primary containment conditions, the Secondary Containment is subjected to isolation and standby gas treatment operation. Normal HVAC is terminated. Breaks inside primary containment are assumed to result in core uncoveries and fission product release although the ABWR design does not show this result. Divisional Separation Zone compartments will be relatively unaffected by the break effects.

- Under design bases LOCA outside containment breaks in the MS tunnel, the Secondary Containment may be subjected to isolation. The post event use of the Standby Gas Treatment System and need for secondary containment integrity is not required although they may be available. These breaks do not result in core uncovery or significant fission product releases. Therefore, Secondary Containment is radiological, controls are not needed. Primary containment is also not needed.

Divisional Separation Zones (DSZs) - General Design Bases

The general design basis considerations for the Divisional Separation Zones include:

- The three (3) special divisional separation zones or compartments are provided to independently house one of the three (3) ECCS/ESF divisions. A fourth but unique zone is set aside for non-safety-related equipment. The reactor, suppression pool and spent fuel cleanup systems are housed in this fourth quadrant or zone.
- The Divisional Separation Zone compartments also protect each division's equipment from any potential adverse effects of design basis breaks inside primary containment. Special individual DSZ HVAC systems provide heat removal service to the operating ECCS equipment and the surrounding rooms.
- The Divisional Separation Zone compartments provide limited protection from breaks outside the primary containments but, inside secondary containment (e.g., CUW System breaks and RCIC System breaks). The DSZ provide complete protection for breaks in the MS tunnel. The effects of this event do not adversely affect the Divisional Separation Zone rooms or equipment.
- The Divisional Separation Zone compartments can maintain their integrity for minor leaks within the compartment's barrier. They can accommodate larger leaks without compromising other DSZ compartments or equipments.
- Breaks outside primary containment do not require secondary containment or divisional separation compartment integrity. These breaks do, however, require successful operation of at least the equivalent of some parts of the one or more divisions of ECCS. Equipment in divisional compartments are designed for intra and inter DSZ compartment breaks.
- Not all of the break, fire, flood and harsh environs protection features in the Divisional Separation Zone compartments are required to be maintained at all times and under all conditions. Fire barriers do not preclude break effect impositions. Flood door barriers integrities are not expected nor required during outside break conditions.

Divisional Separation Zones (DSZs) - General Design Bases (continued)

- Divisional compartments are entered from common corridors to enhance inspection and maintenance capabilities. These corridors are defined as divisional or non-divisional zones depending of fire, flood or break aspects.
- Divisional separation throughout the secondary containment is not necessarily required for all events (fire, flood, breaks or adverse environs).
- Under both design basis fire conditions, the Divisional Separation Zone barriers maintain their design integrity. It's only under outside break conditions that the barriers are challenged and allowed to be breached. Under flooding in one DSZ compartment, excess water is permitted into the non-divisional corridor. Entry into other DSZ compartments is precluded.
- Breaks inside the Divisional Separation compartments are vented outside the compartment and within the secondary containment then out of the secondary containment to the site environs in a relatively controlled manner.
- For breaks in the Secondary Containment or in Divisional Separation Zone compartments, the break effects are by design quickly terminated (valve closures), vented to the MS tunnel (through blowout panels) or to other secondary containment volumes. These immediate break effects are limited to the affected area. Ultimately, residual or possible carryover effects to other compartments or zones is expected and designed into the shutdown equipment qualification specifications.
- Only two areas have high energy lines (CUW and RCIC).
- Based on evaluation of the outside containment break risk (frequency of occurrence X severity of consequences), these events represent less than 1% of the total plant risk.
- During normal operation or during transients, the Secondary Containment and Divisional Separation Zone barriers are not subject to abnormal operating conditions, their integrity is maintained, and their status is monitored.

Secondary Containment and Divisional Separation Barriers

- Structural Walls
  - Between Reactor Building and Secondary Containment
  - Between Secondary Containment and Divisional Zones
  - Between Divisional Zones
  - Between Divisional Zones and Primary Containment
  - Between Divisional Zone Individual Compartments
  - Between Divisional Zones and Non-Divisional Areas
  - Ceilings and Floors between all of the above
- Access Openings
  - Access/Egress Doors (Fire, Water-Tight, Water-Resistant, Entry)
  - Hatches (Personnel, Equipment, Inspection)
  - Removable Walls (Block, Shield, Partition)
  - Stairwells
  - Elevators
  - Major Equipment Entries
  - Relief Panels (Blowout, Vents, Vacuum)
  - Piping Electrical and HVAC Tunnel Chases
- Penetrations
  - Piping (Water, Air, Gaseous, Oil)
  - Electrical (I&C, Power)
  - HVAC (Hardened, Soft Ductwork)
  - Drains (Equipment, Floor)
  - Sumps (HCW, LCW)
  - Tunnel Connections (Internal, External)
  - Entry Tunnels

Specific Critique - Breaks Outside Containment - Barrier Aspects

There are a number of reasons for considering breaks outside containment, harsh environment occurrences and barrier design basis differently. The reasons include:

- Secondary Containment does not have specific safety function for outside containment breaks.
- Breaks outside containment are less frequent; they result in less consequences; and they are more readily preventable by frequent periodic inspection, increased monitoring and more sensitive leak before break detection.
- Breaks outside containment are more likely to be isolatable and terminated by automatic, timely and responsive break detection and isolation valve closure actions.
- Breaks of the type designed for HELB events (e.g., CUW and RCIC) do not result in core damage, core uncovery or appreciable radiological or environmental effects.
- These breaks result in immediate but short term environmental effects. Their effects are not curtailable by rapid valve closure, early break detections, etc. or even reasonable barrier considerations.
- The most effective and efficient means to accommodate such sudden and momentary energy releases is to provide a large blowdown volume and a large ventable pathway for the released effluents to the outside environs.
- Safe shutdown event mitigation equipment can be and is sheltered out of the direct effects of the break blowdown. Residual effects of the blowdown are included in the equipment qualifications. It is essentially engineering the blowdown pathway.
- Many of the current DSZ barriers, have conflicting missions when used for other events (e.g., fire and flood door closures are rigid barrier features). For pressurization events, door opening are very helpful. They provide additional blowdown pathways.
- The failure modes and effects of most barriers tend to assist the depressurization objective rather than resist it. Door openings are more predictable than door closures.
- Sensitivity of most barrier performances have minimal effects on the depressurization/ event outcome. Blowout panels go over a wide range of pressures. Ventilation dampers closure characteristics are very hard to protect and predict.
- The risk to plant and public are less than 1% of total risk for the CUW and RCIC breaks.

Divisional Structural Walls - Break Considerations

All the structural load bearing, etc. walls are designed to building code structural requirements. Structural integrity will be assured during all DBA events. These are discussed in Subsection 3.8.

The Reactor Building exterior walls and the divisional walls used for flood protection on the –8,200 mm elevation of the Reactor Building will be designed to withstand the differential pressure resulting from a HELB that is vented only into the corridor spaces within the division on that elevation. Credit could be taken for all the non-divisional corridor volume at -8200. The Secondary Containment and divisional walls on elevation -1,700 mm and above in the Reactor Building will be designed to withstand the resulting differential pressure from HELB that is assumed to expand into the volumes of these elevations.

Appendix 3H.4 provides the Secondary Containment and Divisional Separation Zone wall design thickness and capabilities. Lower level walls are shown to be capable of maintaining their structural integrity for the pressurization analysis pressures cited.

Divisional Access Doors - Break Considerations

Lower corridor divisional compartment water tight doors are expected to maintain their closed position during fire and flood events.

Lower corridor doors are expected to open on pressurization events.

Lower divisional doors are expected to stay closed.

Upper divisional level doors are expected to be less affected by the venting pressures. They may or may not open depending on vent pressure pathways.

Secondary Containment external access doors are expected to maintain their closed position during fire, flood and break events.

Blowout Panels will not become missiles but will be retained in place.

Elevator Shaft will not be affected pressurization transient.

Equipment Hatches will leak but will be retained in place.

Vertical HVAC and Piping Chimneys are expected to be available as a vent pathway.

Divisional Penetrations - Break Considerations

Lower corridor divisional penetrations (water, power, I&C) are expected to maintain their integrity under fire and flood conditions.

Lower corridor to divisional compartment penetrations are expected to leak under breaks outside containment pressurization events.

Division compartment HVAC are expected to maintain their integrity under inside DBA events and internal fire and flood event conditions.

Divisional compartment HVAC penetrations are expected to leak or open upon outside break pressurization events.

Summary Conclusions

The following overall summary conclusions are offered:

- The ABWR Design Containment structures, systems and barriers provide adequate protection to the plant and public for a wide spectrum of events—Design Basis Accidents, Special Events and Severe Accidents.
- The individual containment structures, systems and barriers comply with a wide spectrum of design basis and performance requirements.
- Plant Containment Structures will maintain their structural integrity for all postulated design basis events.
- The Secondary Containment and the Divisional Separation Zones will maintain their design basis barriers for all radiologically significant events—DBA breaks inside containment, core/fuel integrity anomalies and refueling accidents.

GENERAL SAFETY EVALUATIONS

1/25/94

General Safety Evaluations

- Deterministic Evaluation Results
    - LOCA
    - Fire
    - Flood
- Probabilistic Evaluation Results
    - Level 1 PRA
    - Fire
    - Flood
- CUW Break Evaluation Results

Deterministic Evaluation Results

- LOCA
  - Complete break spectrum analyzed.
  - Worst single active failure assumed.
  - Only ECCS assumed to be available to mitigate break consequences.
  - Results
    - No core uncovery occurs.
    - Peak cladding temperatures well below 2200F limit.

Deterministic Evaluation Results

- Fire
  - Fire Hazards Analysis performed for all fire areas.
  - All postulated fires within ASTM-E119 limits.
  - Fire detection and alarm systems provided in all fire areas.
  - A fire in any fire area (without recovery) will not prevent safe shutdown of the plant.
  - Effective smoke removal provided.
  - Stand-pipes/hose reels and hand held extinguishers provided throughout the plant.
  - Results: ABWR fire protection program adequate for safe operation and shutdown of the plant.

Deterministic Evaluation Results

- Flood
  - ANSI/ANS 56.11 line break assumed in piping greater than one inch.
  - No credit for operation of sump pumps.
  - Operator action in 30 minutes terminates flooding due to moderate energy line breaks.
  - Automatic actuation within one minute terminates high energy line breaks.
  - Single active failure criterion met.
  - All buildings evaluated.
  - Results:
    - All potential floods terminated with no more than one division of safe shutdown equipment being affected.

Probabilistic Evaluation Results

- Level 1 PRA
    - Core damage frequency (CDF) very low, ~ 1.6E-7/year.
    - USNRC CDF goal (1E-4/year) and ALWR goal (1E-5/year) met by a large margin.
    - Station blackout sequences contribute most to the very low CDF.

Probabilistic Evaluation Results

- Fire

  - Mutual NRC/GE agreement that EPRI fire and vulnerability evaluation (FIVE) methodology appropriate vehicle for performing analysis.

  - FIVE provides prescriptive procedures for identifying fire compartments, defining ignition frequencies, and performing quantitative screening analysis.

  - Level 1 PRA fault and event trees were used to calculate bounding CDFs.

  - ABWR fire vulnerability found to be very low (CDF <<1E-6/year).

Probabilistic Evaluation Results

- Flooding
  - All potential flooding sources evaluated.
  - Worst case (i.e., double ended shear of pipe) floods assumed.
  - Buildings with potential flooding concerns determined to be Reactor, Control, and Turbine Buildings.
  - Operation of sump pumps not credited.
  - Appropriate operator actions modeled.
  - Common cause effects modeled.
  - Conservative bounding analysis.
  - Total CDF less than 2E-8/year.

SPECIFIC SAFETY EVALUATIONS

DESIGN BASIS HELB ANALYSES

Analyses include:

- Revised compartment pressure/temperature analyses
  - CUW and RCIC inside secondary containment HELB analyses revised to take credit for natural vent paths in the building layout
  - Break mass/energy blowdown input same as in previous analyses
- Performed compartment transient cooling analyses
  - Considered and modeled structural (concrete) heat sinks
  - Compared transient temperature response with design basis EQ temperature profile
- Also evaluated beyond the design basis conditions

REVISED PRESSURE/TEMPERATURE ANALYSES

Calculate compartment pressure/temperature conditions due to postulated high energy line breaks (HELB) in different compartments

Calculated results provide input to

- design of compartment walls
- equipment qualification (EQ) temperature profile

Assumptions:

- Double ended guillotine break

- Compartment doors act as blowdown panels

- Doors at stairway entrances fail on pressurization

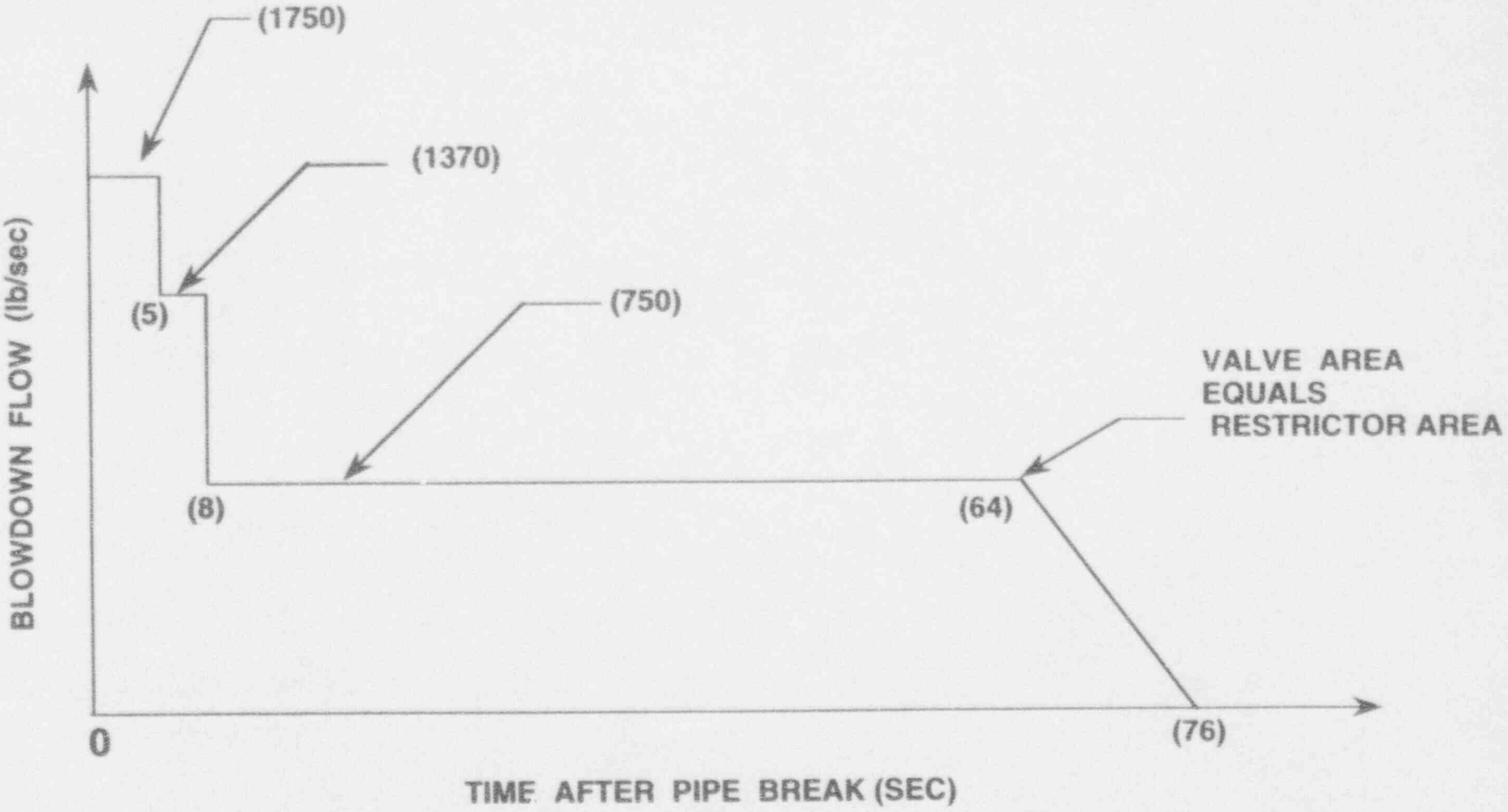
- HVAC vertical ducts and staircases provide exit flow path for air/steam mixture

For CUW HELB

- Mass/energy blowdown assumes 76 seconds to full isolation valve closure

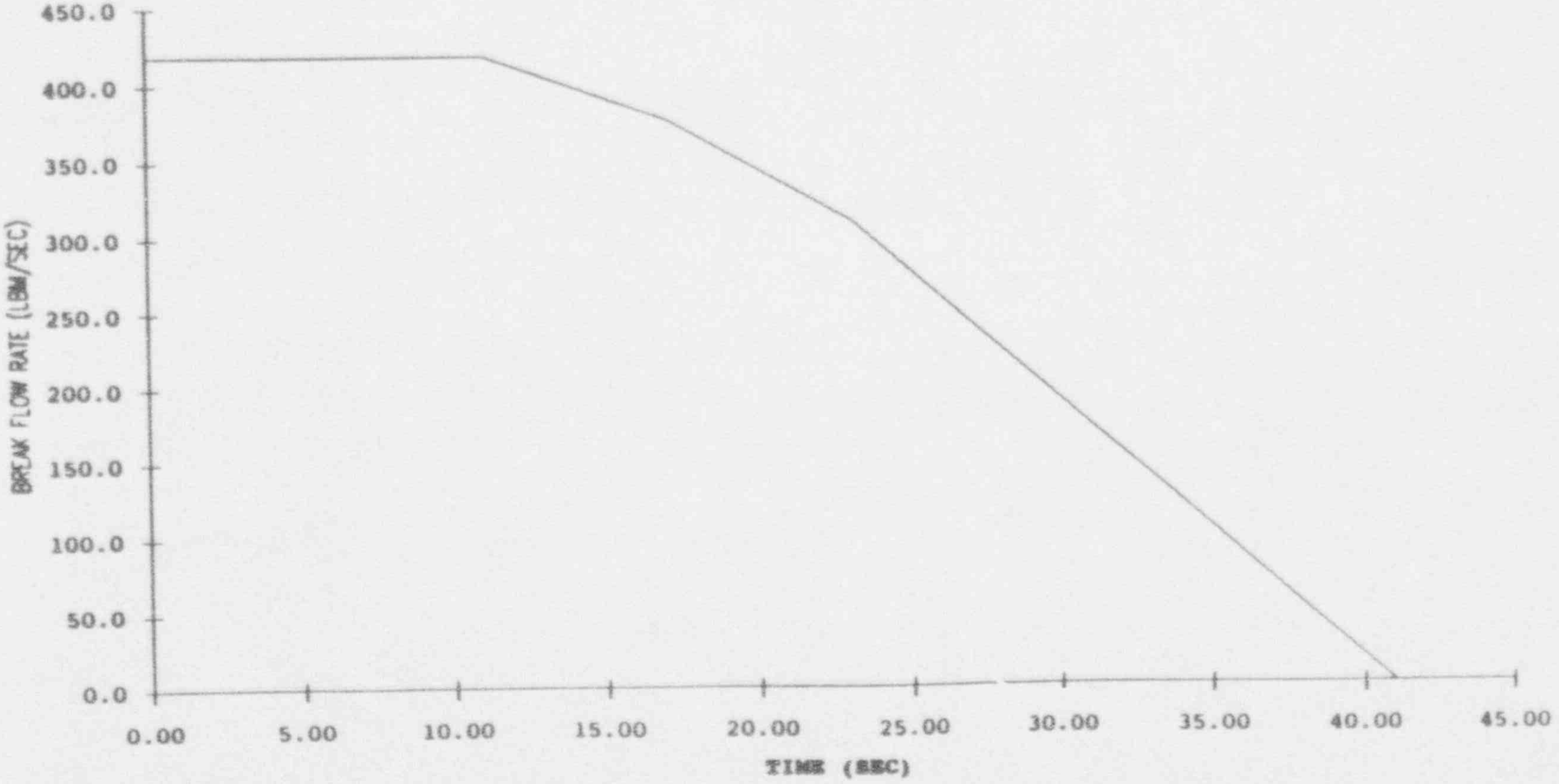
For RCIC HELB

- Mass energy blowdown assumes 41 seconds to full isolation valve closure



BLOWDOWN FLOW IN CUW ROOM(s) AT EL - 8200

HELB IN SUBCOMPARTMENT SA1 & SA3



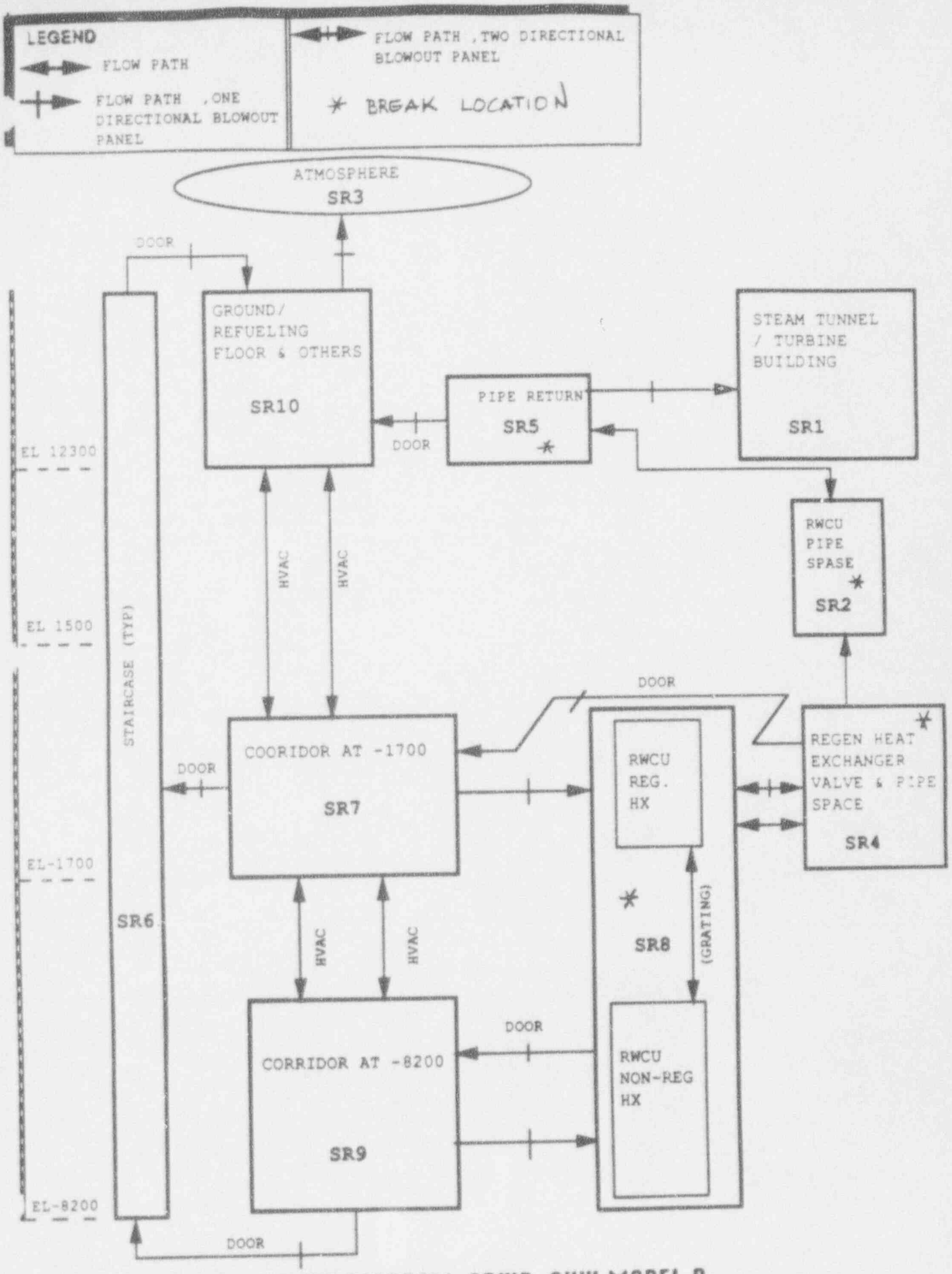
REVISED PRESSURE/TEMPERATURE ANALYSES

METHODOLOGY

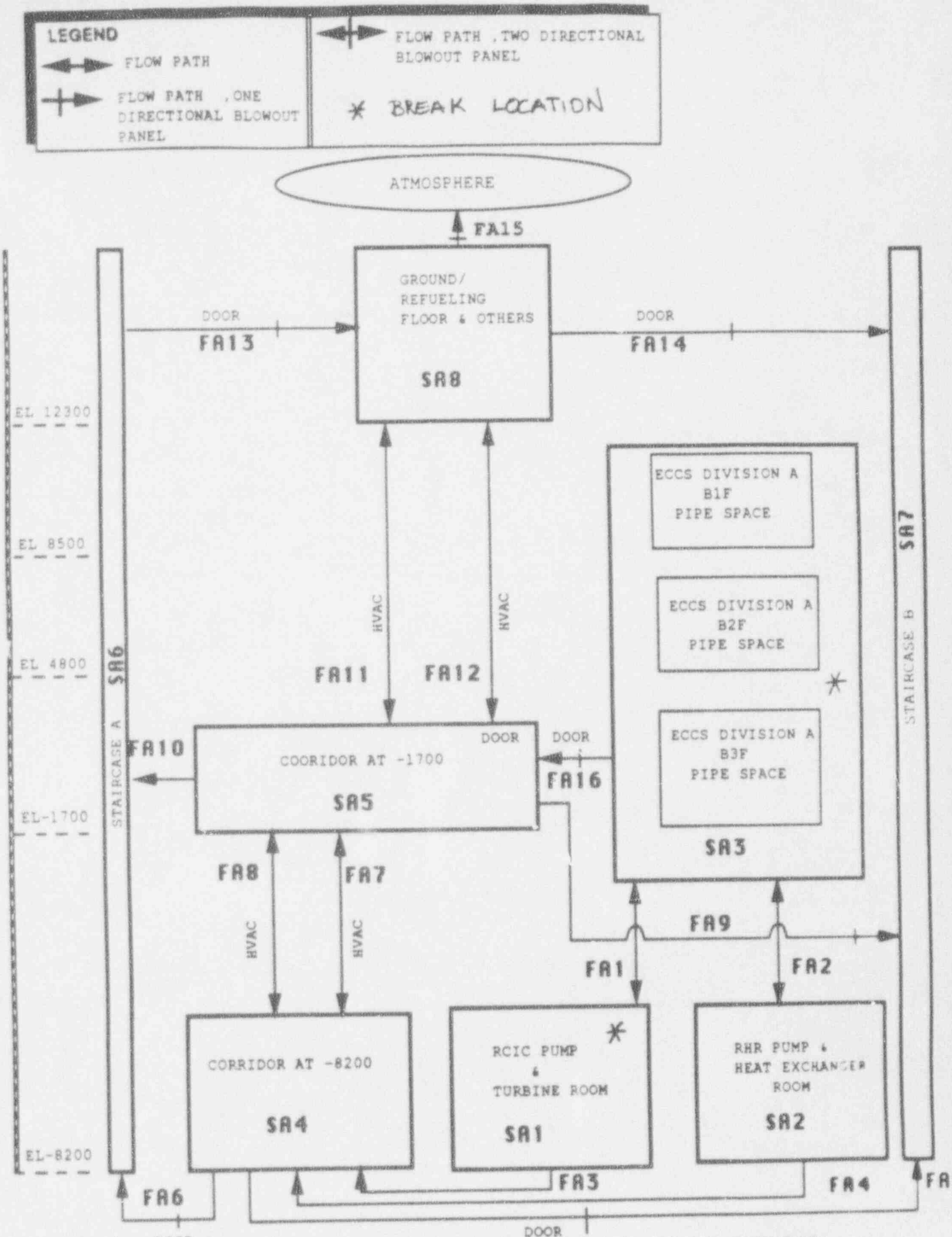
- Models multiple node cases with arbitrary flow paths. Each compartment modeled as a single node
- Models homogeneous mixture of air and water vapor in the compartment
- No credit for heat transfer between the flowing fluid and the compartment walls and internal equipment
- Compartment doors act as blowout panels.
  Range of pressure differentials at which doors assumed to fail:
  - Minimum Pressure 1.5 psid
  - Maximum Pressure 5 psid

CALCULATIONS

- Break blowdown duration determined by
  - Valve closure sensor response time
  - Built in delay timer
  - Valve closure time (fully open to fully closed position)
- Blowout panels full open upon a differential pressure of 0.5 psid
- Compartment walls design based on calculated maximum absolute pressure and temperature values



SCHEMATIC FLOW DIAGRAM ABWR CUW MODEL D



(EMERGENCY CORE COOLING/REACTOR CORE ISOLATION COOLING)

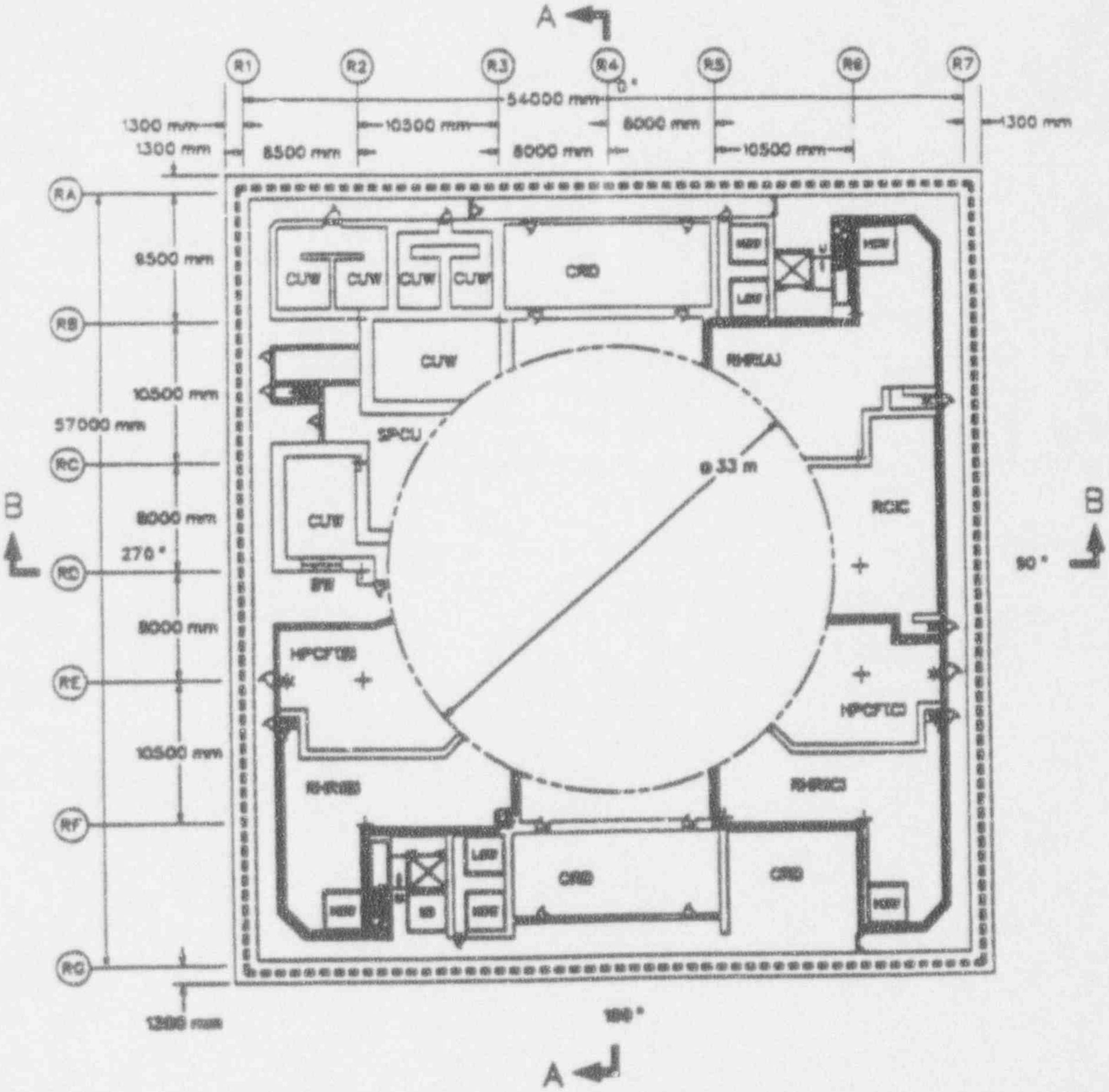


Figure 2.15.10c Reactor Building Arrangement, Floor B3F with Divisional Boundary for Flood—Elevation –8200 mm

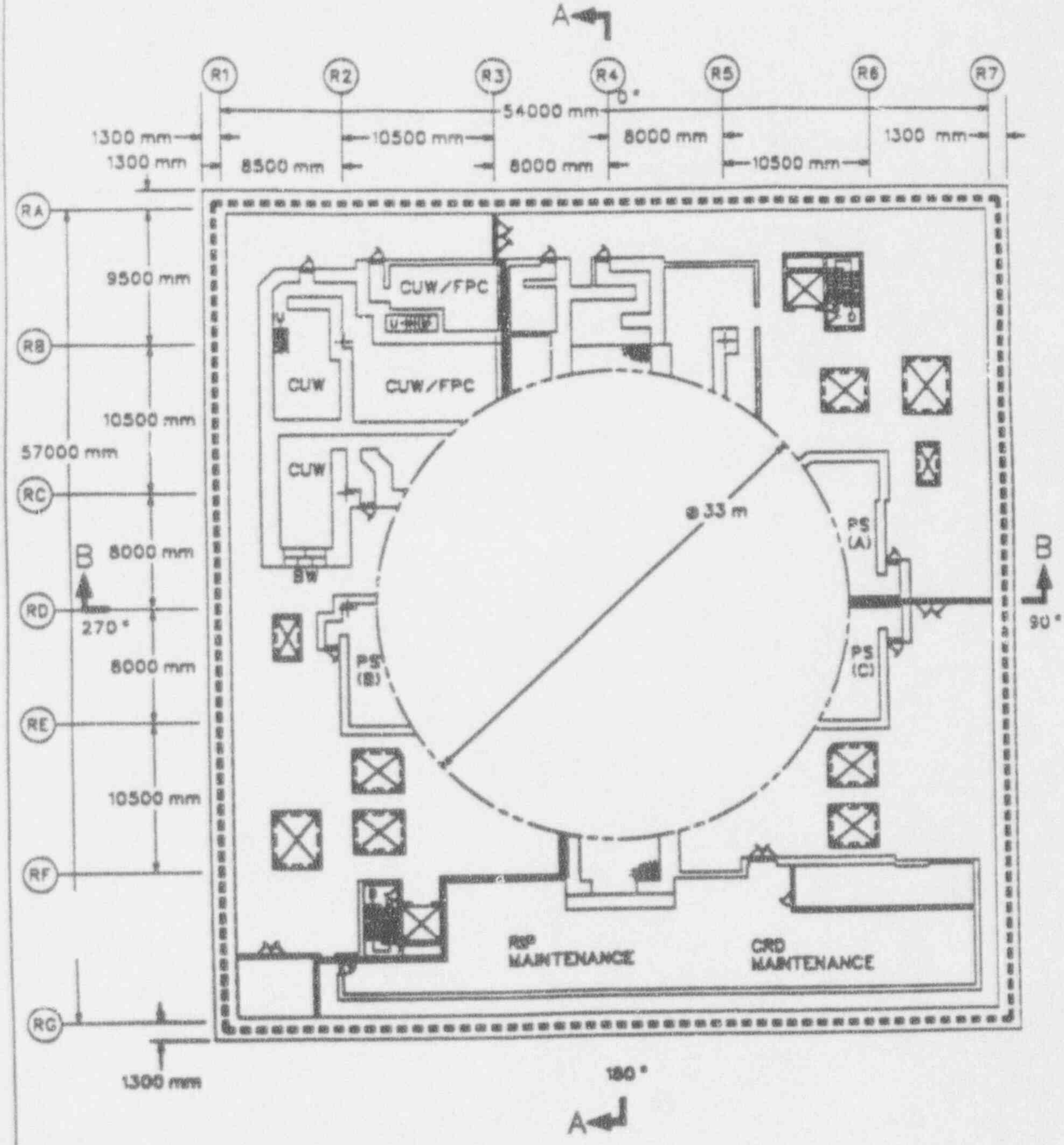
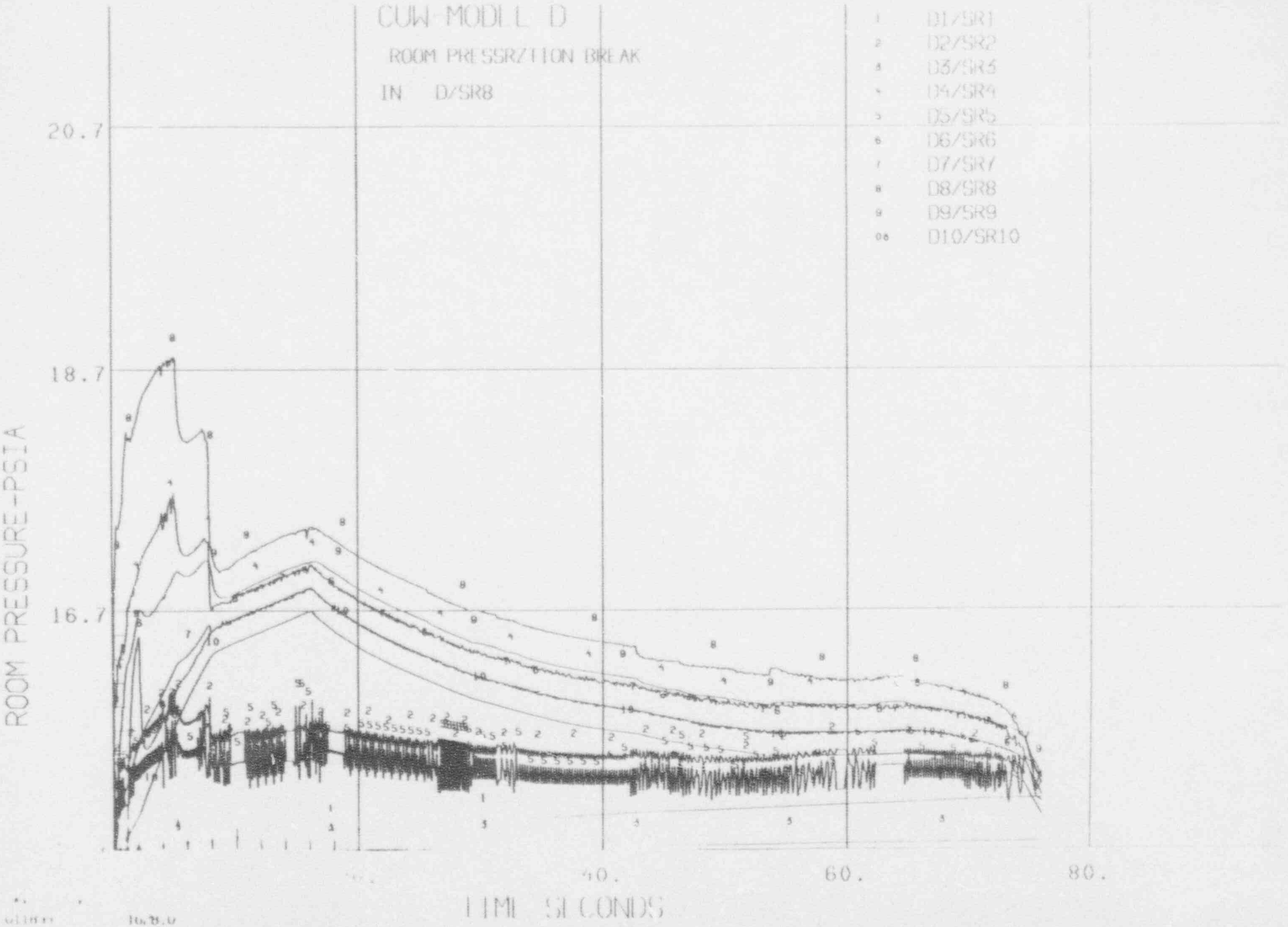


Figure 2.15.10f Reactor Building Arrangement, Floor B2F—Elevation –1700 mm

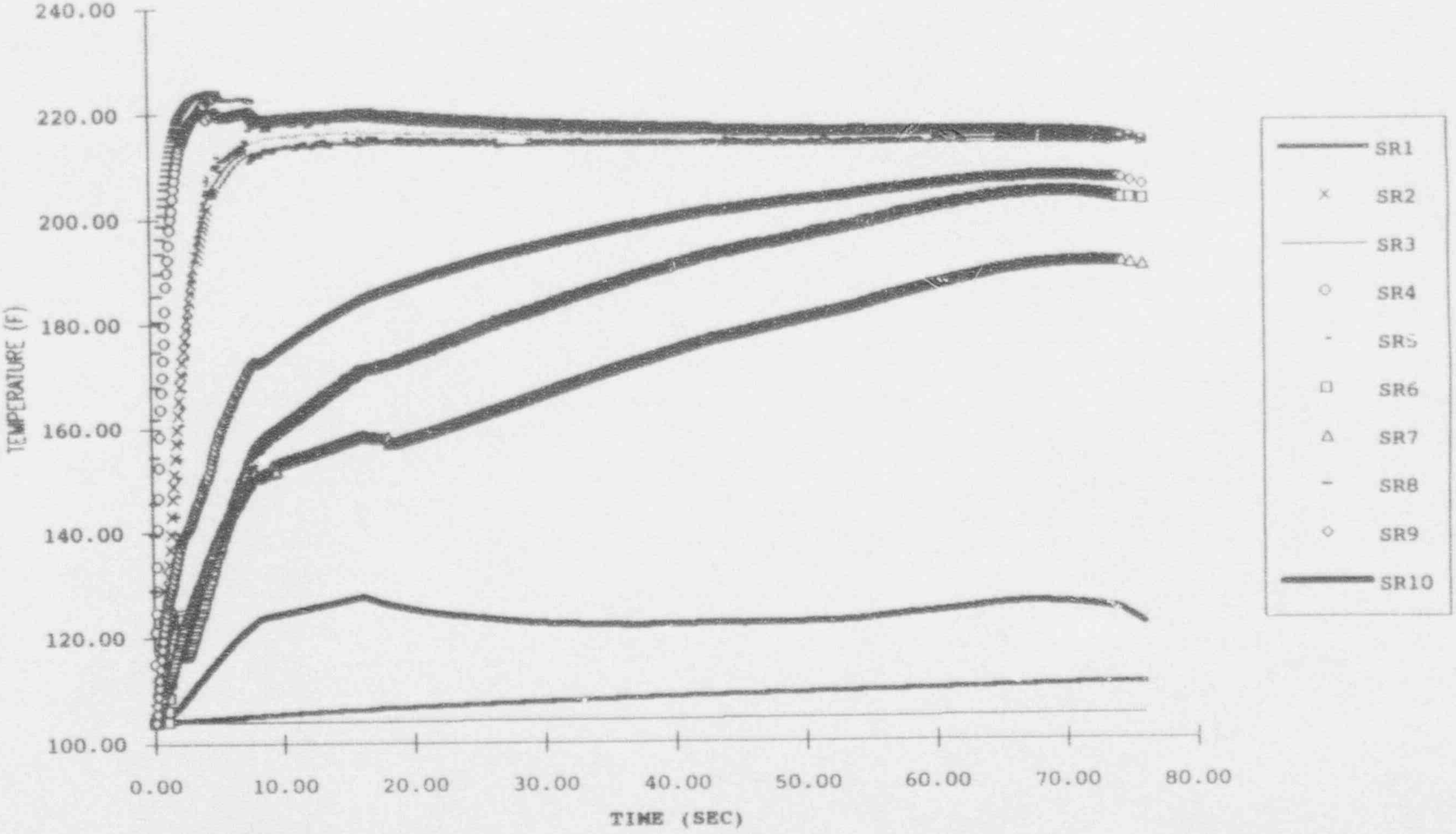
REVISED PRESSURE/TEMPERATURE ANALYSES

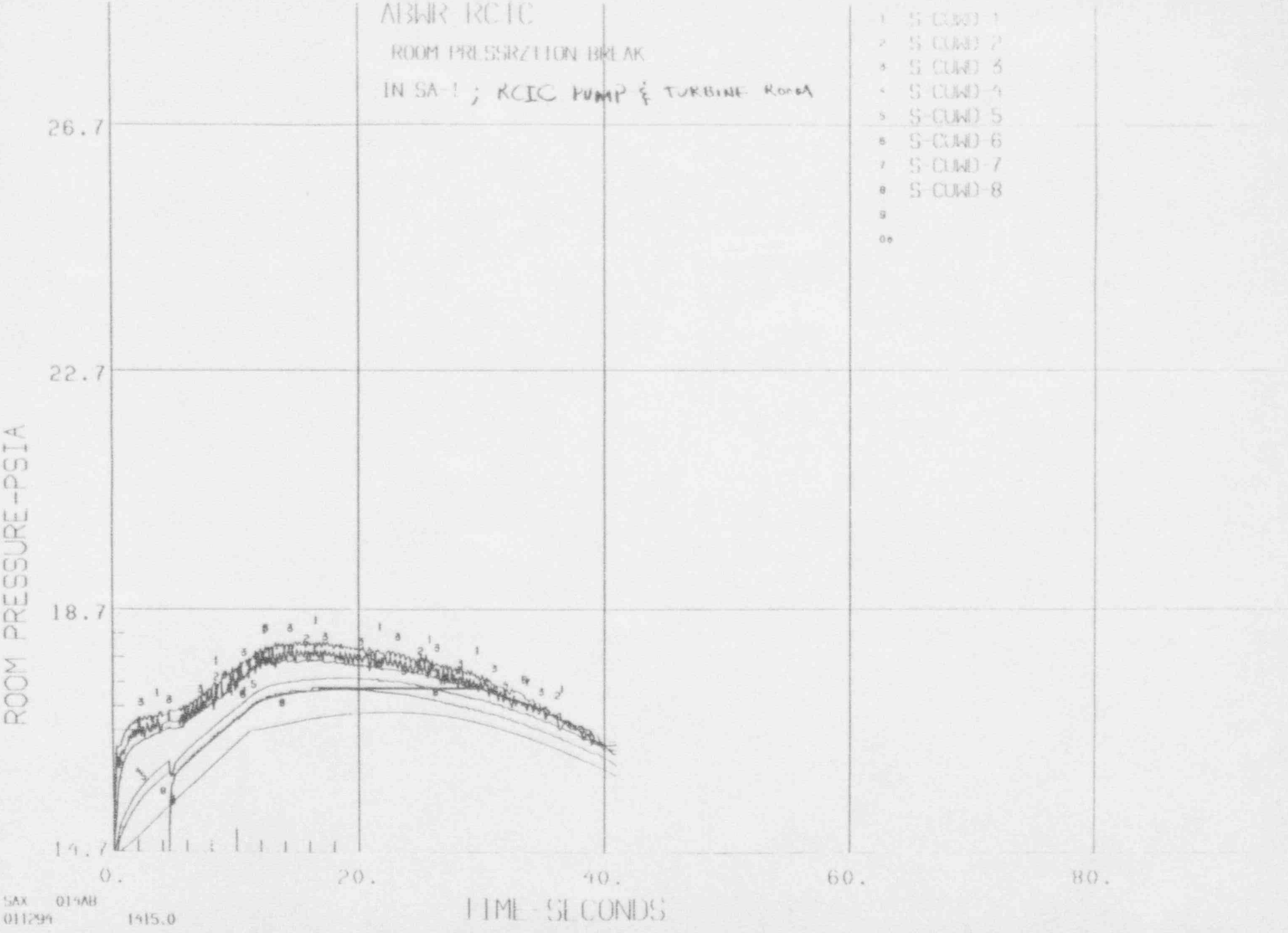
RESULTS

- Peak pressure due to both breaks are well below previously calculated 15 psig compartment (room) design pressures
- Peak pressures in EL -8200 and EL -1700 corridor are below 5 psig
- Peak pressure in balance of secondary containment, including walls separating secondary containment from safety-related electrical rooms stays within 2 psig.

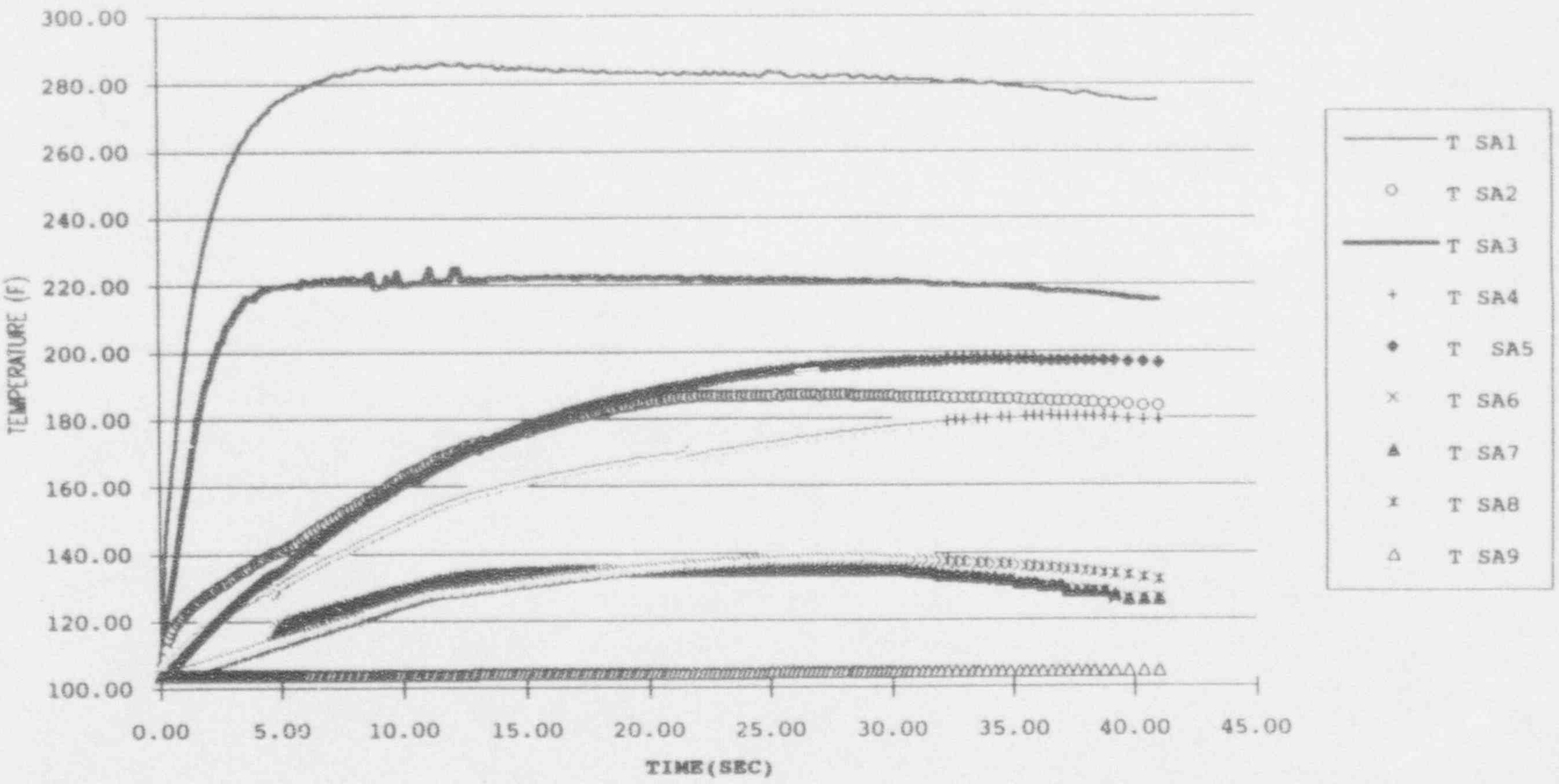

CUW MODLL D
ROOM PRESSRZTION BREAK
IN D/SR8
1 D1/SR1
2 D2/SR2
3 D3/SR3
4 D4/SR4
5 D5/SR5
6 D6/SR6
7 D7/SR7
8 D8/SR8
9 D9/SR9
08 D10/SR10
ROOM PRESSURE-PSIA
20.7
18.7
16.7
40.
60.
80.
TIME SECONDS

CUW MODEL D BRAEK AT SR8




ABWR RCIC
ROOM PRESSRZTION BREAK
IN SA-1 ; RCIC PUMP & TURBINE ROOM
1 S-CUWD 1
2 S-CUWD 2
3 S-CUWD 3
4 S-CUWD 4
5 S-CUWD 5
6 S-CUWD 6
7 S-CUWD 7
8 S-CUWD 8
9
00
ROOM PRESSURE-PSIA
26.7
22.7
18.7
14.7
0.
20.
40.
60.
80.
TIME-SECONDS
SAX 01AB
011294 1415.0

BREAK AT RCIC PUMP& TURBINE ROOM (SA)



COMPARTMENT TRANSIENT COOLING ANALYSES

PURPOSE

Determine compartment transient temperature response, utilizing structural heat sinks, and compare with the design basis EQ temperature profile.

ANALYSES:

- Evaluated double ended guillotine break in CUW rooms (at EL -8200)
- Two Separate Cases Were Analyzed:

Isolated Case:	Isolation valve(s) close automatically, as designed
Unisolated Case:	Isolation valve(s) failed to close automatically, as designed Operator actions close valve(s)

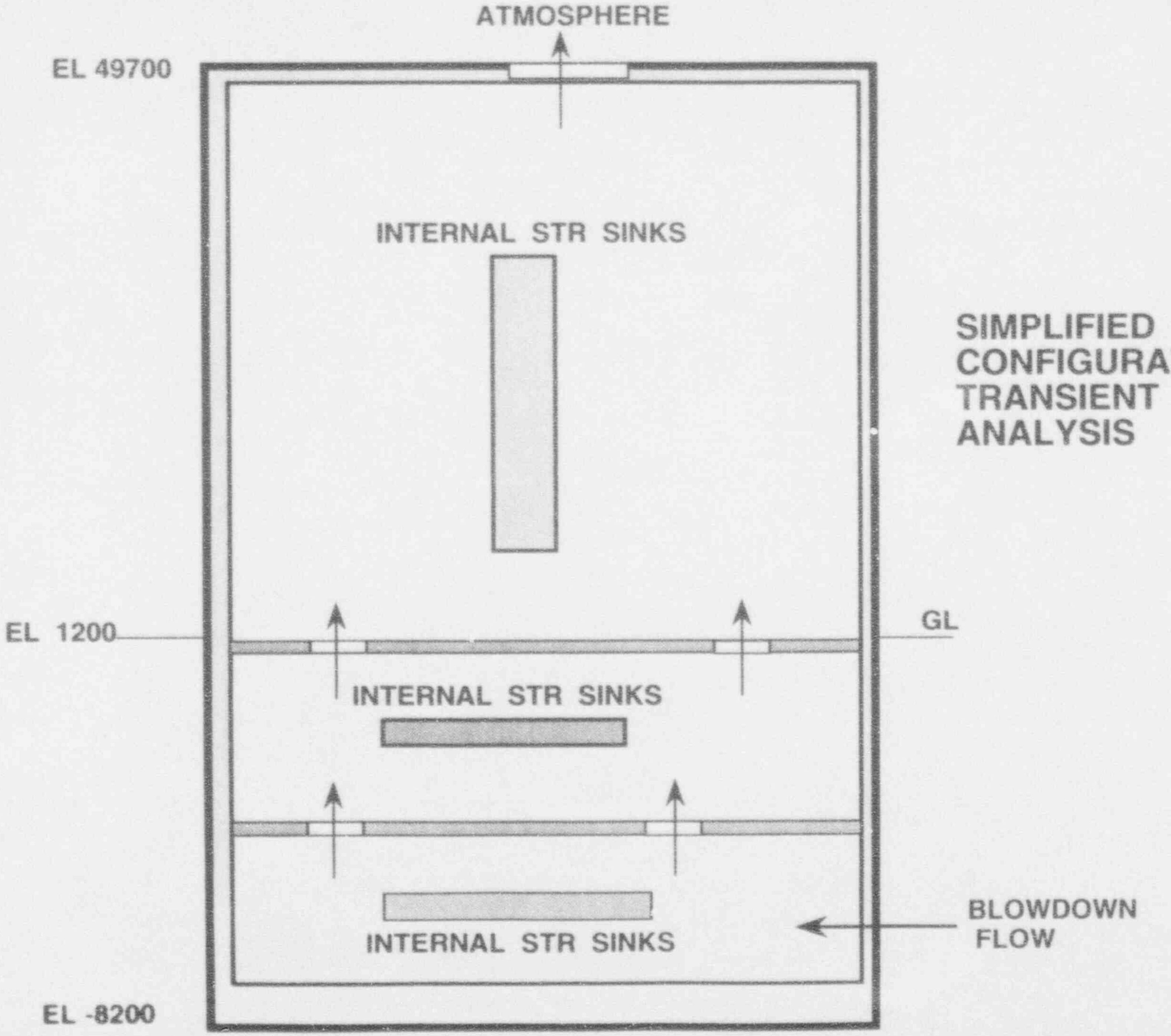
- Simplified, but conservative, analyses were performed.

COMPARTMENT TRANSIENT COOLING ANALYSES

MODELING APPROACH

- Secondary containment simplified as three interconnecting compartments:
- For Isolated case, break flow was confined to EL -8200 compartment only, for conservatism.
  - No credit for communication with higher floors
- For Unisolated case, break flow was confined to entire secondary containment volume. Sufficient time for steady flow (through top blowout openings) to establish
- Structural heat sinks modeled:
  - All boundary walls, including -8200 floor and the 49700 top ceiling
  - Internal walls/floors between -8200 and the 12000 (GL) elevation only
- Structural heat sinks ignored:
  - internal equipment (pumps, motors, piping, HXs, etc.)
  - Internal walls and floors from GL elevation to the top ceiling
- Modeled natural convection plus radiation heat transfer mechanism between compartment environment and the structural heat sinks
  - No credit for steam condensation effect
  - No credit for room coolers

SIMPLIFIED BUILDING CONFIGURATION FOR TRANSIENT COOLING ANALYSIS



COMPARTMENT TRANSIENT COOLING ANALYSES

MASS/ENERGY BLOWDOWN

- Mass/energy blowdown from broken pipe determined in a conservative manner

- Blowdown includes initial pipe inventory depletion from both RPV and BOP sides

- After inventory depletion, RPV side flow chokes at flow restrictor and continues

  - Saturated liquid blowdown at ful vessel pressure
    - Makeup systems maintain RPV NWL
    - Vessel depressurization from makeup systems and/or operator actions ignored for conservatism

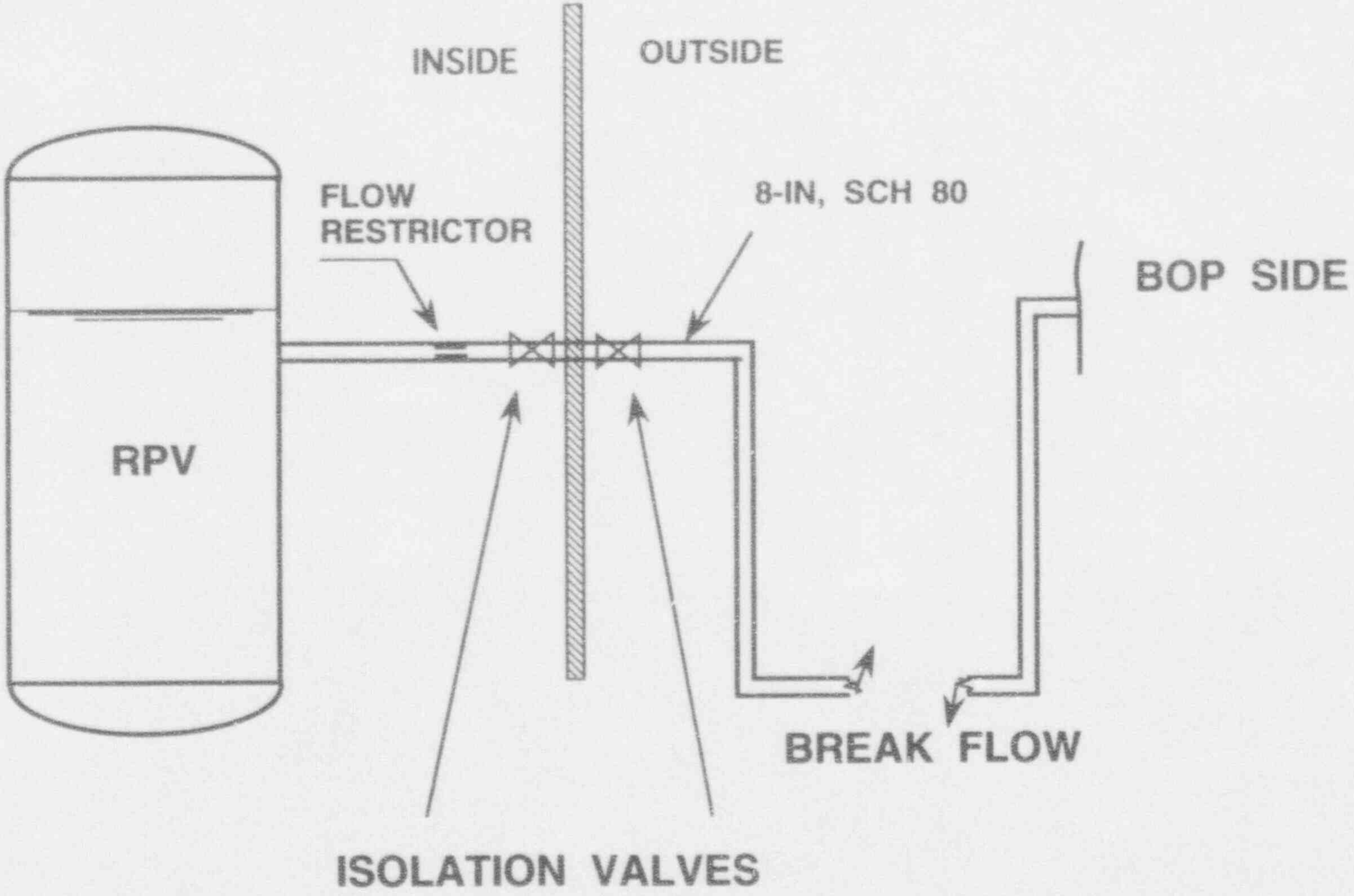
- Mass/energy blowdown duration terminates with the closure of isolation valve(s)

  - For Isolation Case, blowdown duration is 76 seconds (worst case):

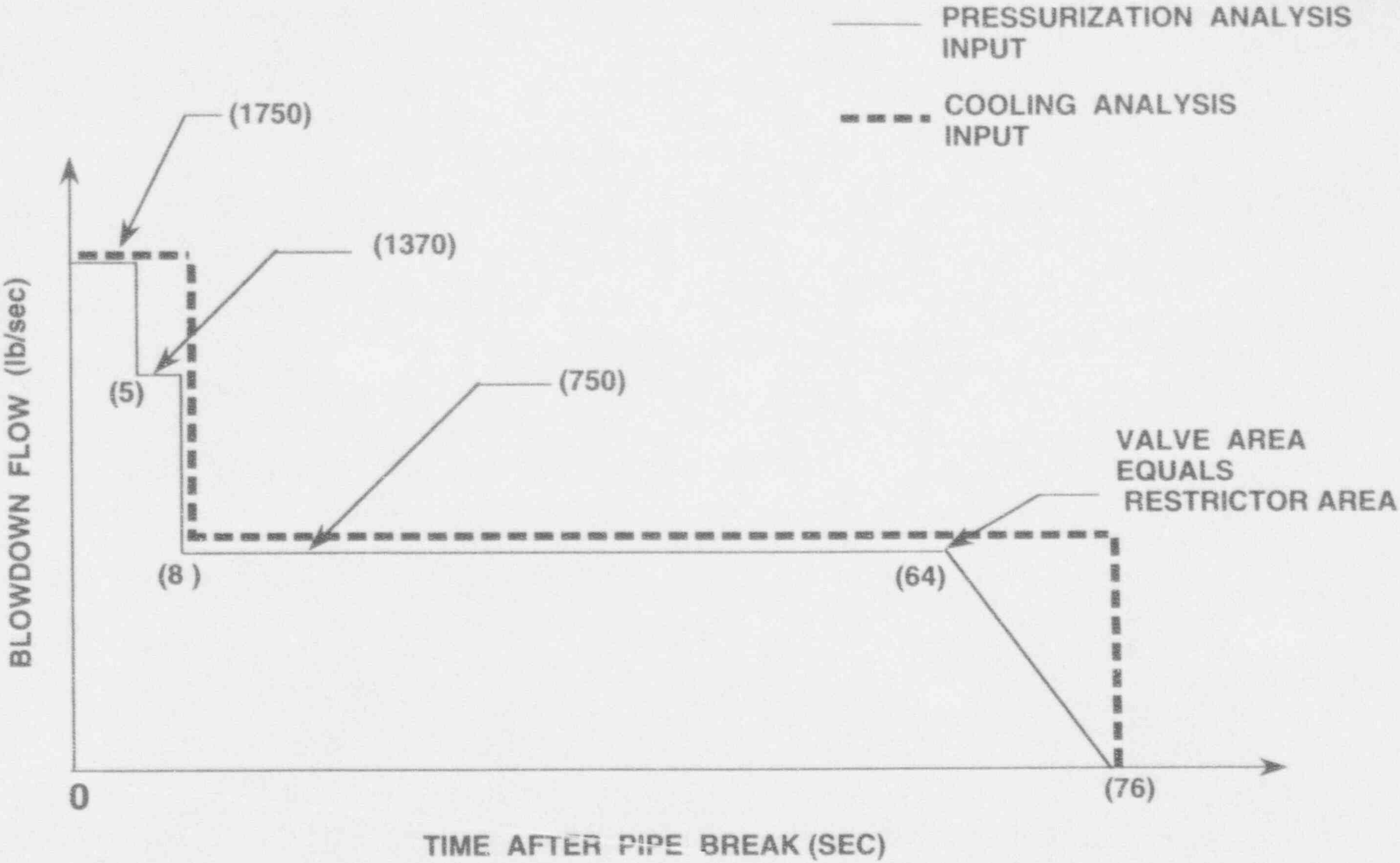
Sensor (Diff Flow) response	1 sec
Built in instrument delay	45 seconds
Valve closure time	30 seconds

  - For Unisolated Case, two blowdown durations were evaluated

    - 1/2 hour: Operator action time to close isolation valve(s)
    - 1 hour: Operator action time to close isolation valve(s)



HELB IN CUW ROOM AT EL - 8200



BLOWDOWN FLOW IN CUW ROOM(s) AT EL - 8200

COMPARTMENT TRANSIENT COOLING ANALYSES

ANALYSES AND RESULTS

ISOLATED CASE

ANALYSIS

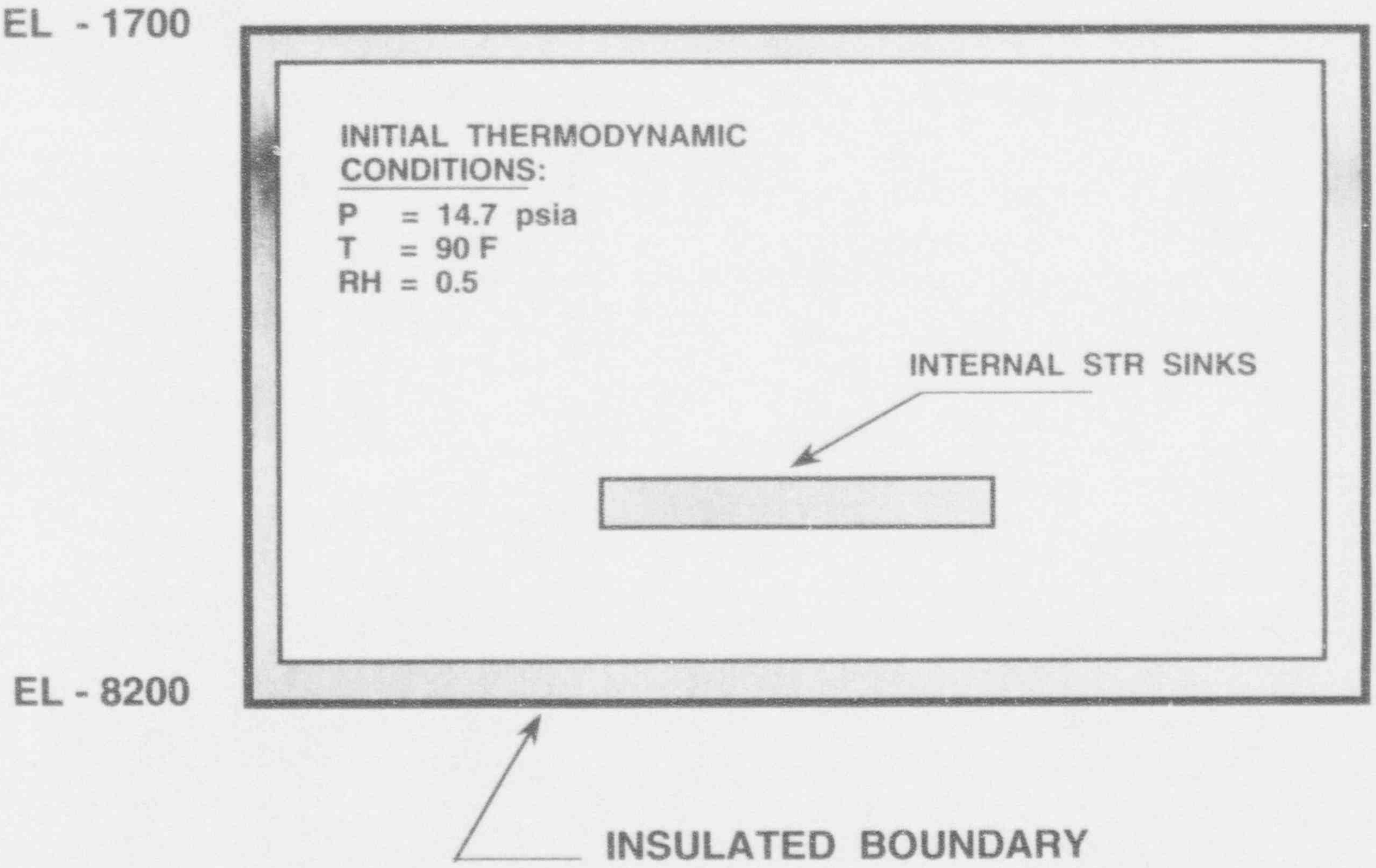
- Volume between EL-8200 and EL-1700 floors modeled as a single compartment, representative of ECCS rooms
- Blowdown flow confined into this single compartment
  - Outflow into higher level compartments ignored
- Heat sinks modeled as slab, with insulated boundary condition on the outside surface
- Blowdown flow and compartment initial air content mixed homogeneously
- Nominal initial thermodynamic conditions:

  P = 14.7 psia; T = 90 °F; RH = 50%

RESULTS

- Calculated peak temperature is about 212 °F, well below the design basis EQ temperature profile maximum of 248 °F
- Calculated compartment temperature drops to 150 °F in less than 6 hours

COMPARTMENT TEMPERATURE TRANSIENT WELL WITHIN THE DESIGN BASIS EQ TEMPERATURE PROFILE



EL - 1700

INITIAL THERMODYNAMIC CONDITIONS:

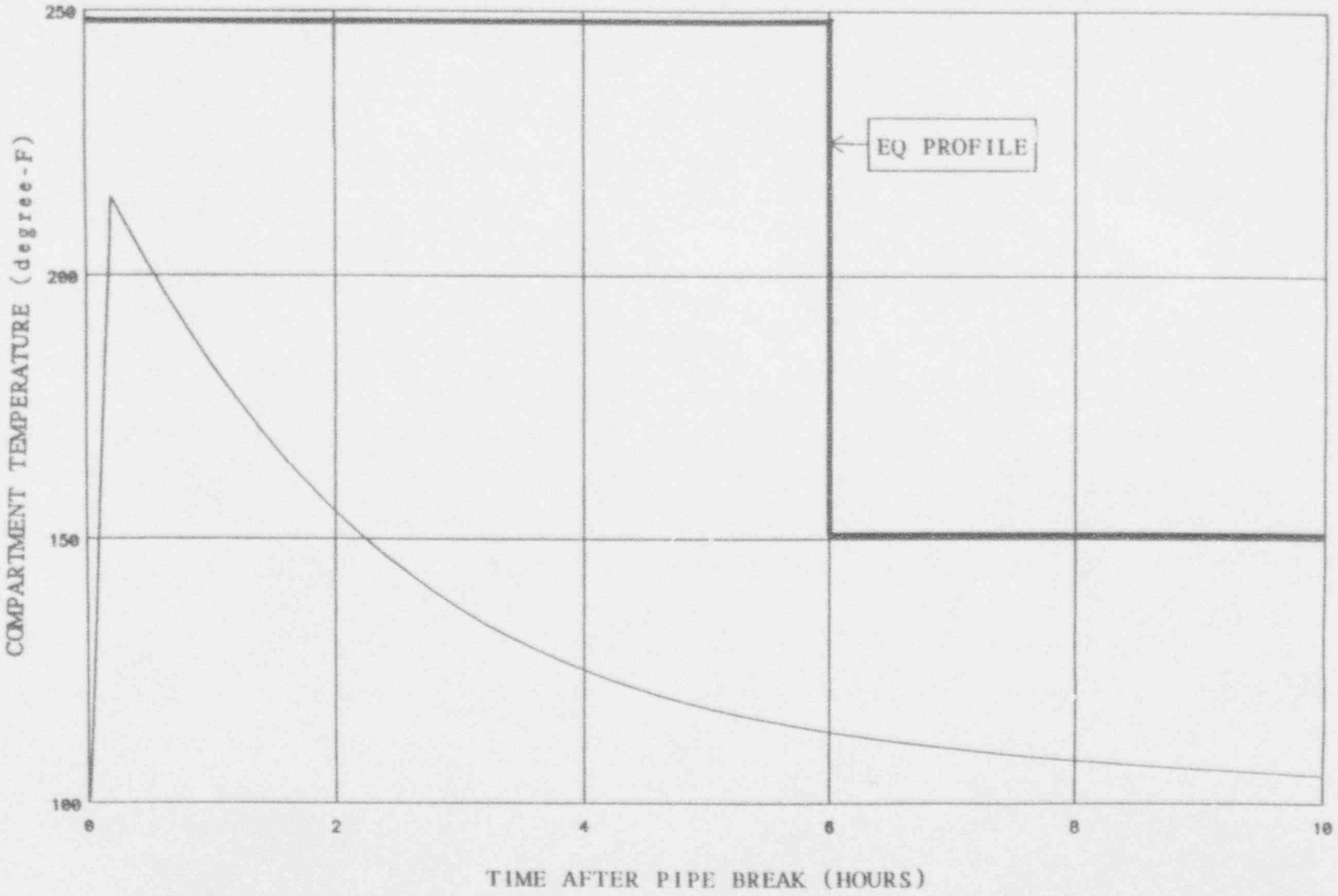
P = 14.7 psia
T = 90 F
RH = 0.5

INTERNAL STR SINKS

EL - 8200

INSULATED BOUNDARY

TRANSIENT COOLING MODEL: ISOLATED CASE



COMPARTMENT TEMPERATURE RESPONSE (ISOLATED CASE)

COMPARTMENT TRANSIENT COOLING ANALYSES

ANALYSES AND RESULTS

UNISOLATED CASE

ANALYSES

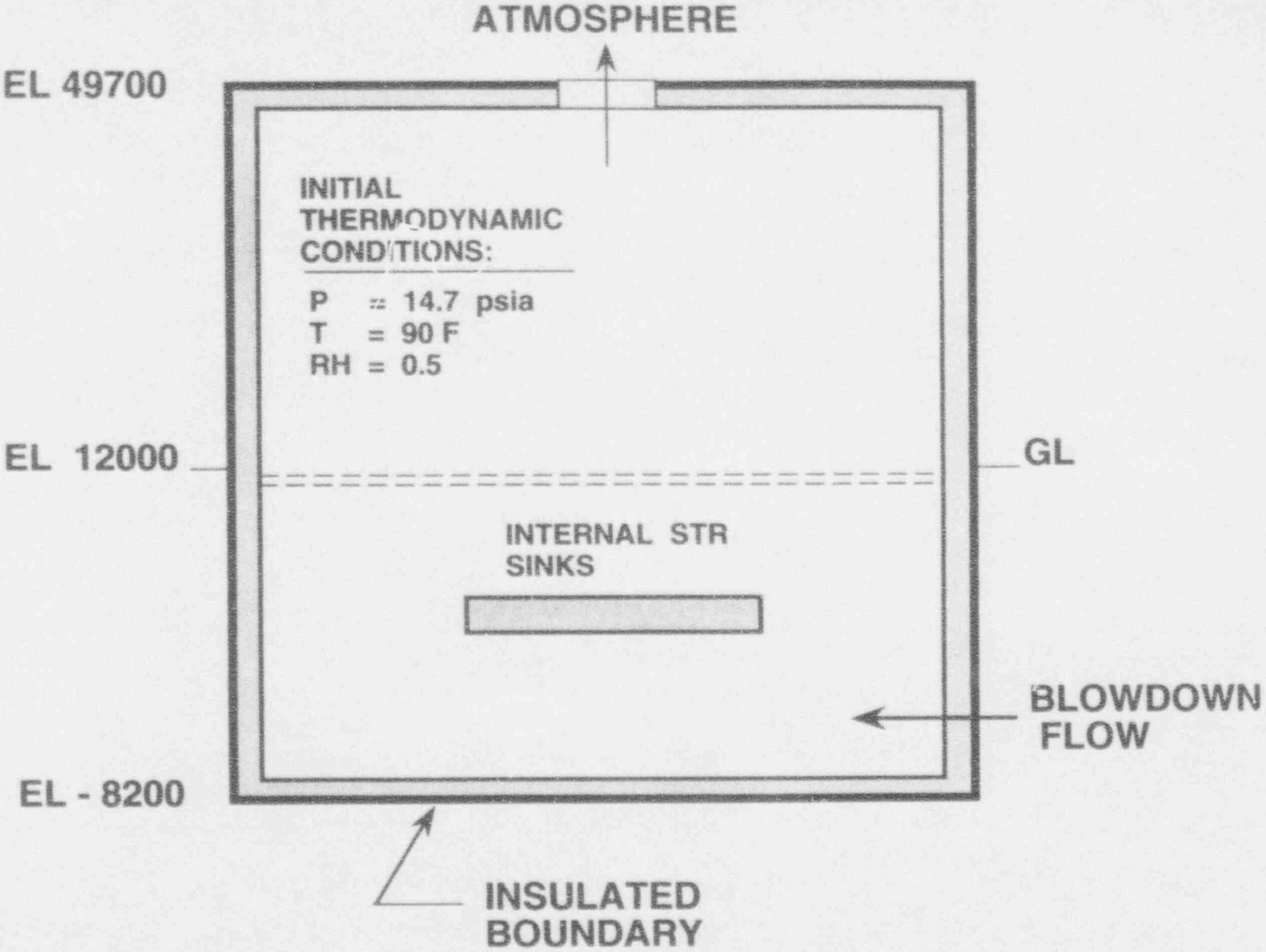
- o Assumes isolation valve(s) have failed to close, blowdown continues beyond 76 seconds
- o Outflow through (building ceiling blowout) openings will result in quasi-steady flow condition - ouflow equals the blowdown flow
- o Entire secondary containment (EL -8200 to EL 49700) modeled as a single compartment
- o Blowdown flow into the compartment terminates when at valve shut-off time (i.e., 1/2 hour, and 1 hour)
- o Nominal initial thermodynamic conditions:

  P = 14.7 psia; T = 90 °F; RH = 50%

RESULTS

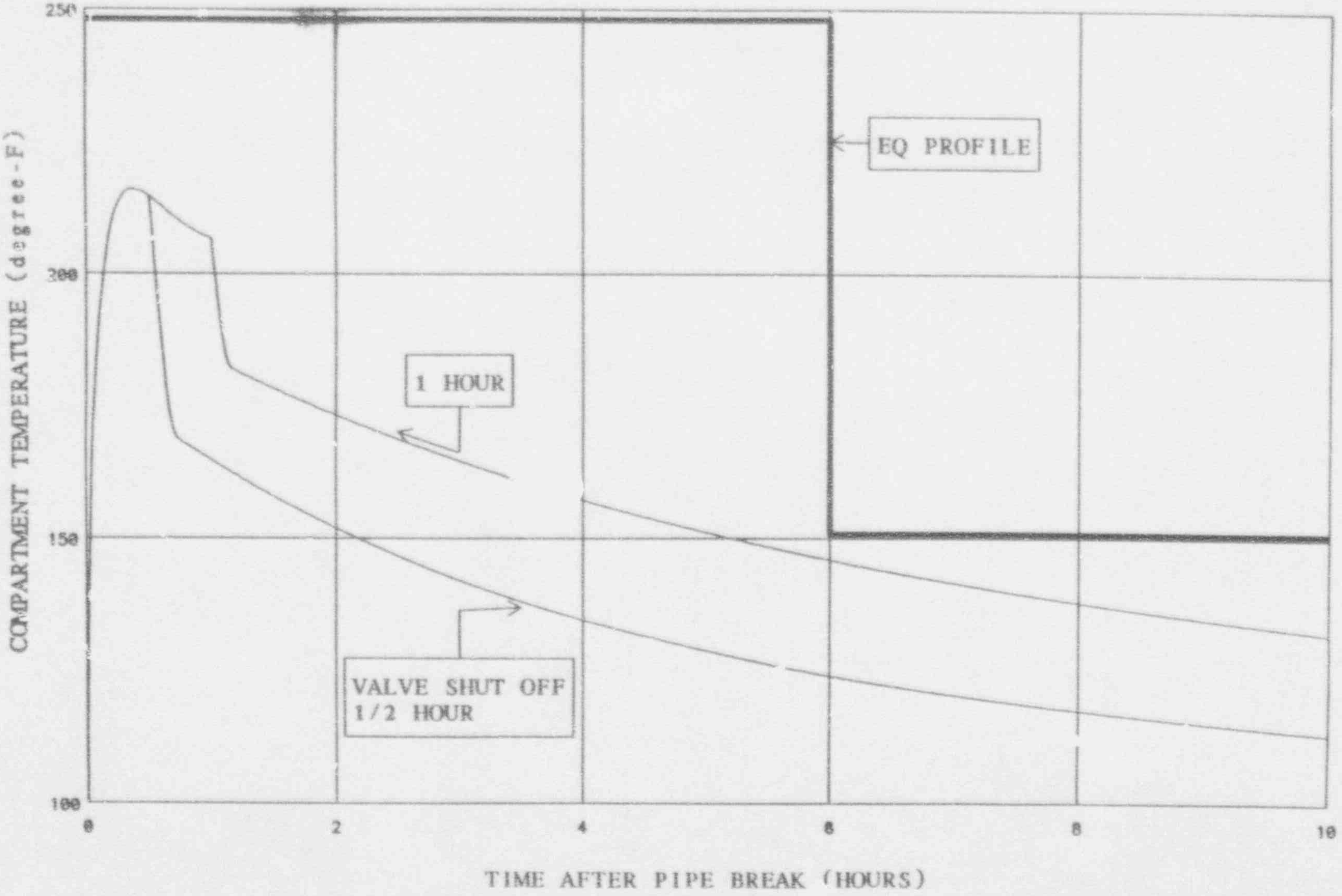
- o For both 1/2 hour and 1 hour shut-off time
  - calculated peak temperature is about 215 °F, well below the design basis EQ temperature profile maximum of 248 °F
  - calculated compartment temperature drops to 150 °F in less than 6 hours

FOR BOTH 1/2 HOUR AND 1 HOUR SHUT-OFF TIMES, COMPARTMENT TEMPERATURE TRANSIENT WELL WITHIN THE DESIGN BASIS EQ TEMPERATURE PROFILE



TRANSIENT COOLING MODEL: UNISOLATED CASE

COMPARTMENT TEMPERATURE RESPONSE (UNISOLATED CASE)



Revised Design Basis HELB Analysis Summary
-- Door Failure Parameter Study --

- Door Opening Pressure Sensitivity Analysis Performed to determine pressure sensitivity to door opening pressure
    1. For subcompartment doors, door swing coincided with expected flow direction.
    2. For stairwell doors, door swing is opposite to expected flow direction

- The range of pressures at which doors assumed to fail
    1. Minimum Pressure -- 1.5 psid
    2. Maximum Pressure -- 5 psid

- Door Opening Pressure Sensitivity Results
    1. Pressure in lower corridors independent of stairway door opening pressure.
    2. Compartment pressure increases with increasing door opening pressure.

Revised Design Basis HELB Analysis Summary
-- Flood Effects On ECCS Availability --

- 60% Break flow expected as water
- Floor Drain system, open stairways, and elevator shafts carry water to -8200mm basement level
- Large empty floor areas on -1700mm elevation prevent accumulation of large quantities of water above ECCS pump rooms
- ECCS pump room watertight doors act as flood barrier at -8200mm elevation
- HVAC duct, cable tray penetrations are at least 2.5m above the floor.

Revised Design Basis HELB Analysis Summary

-- Pressure and Temperature Effects on ECCS Availability --

- HVAC duct, cable tray penetrations are at least 2.5m above the floor penetrations are assumed to be open or fail allowing steam to enter ECCS pump rooms.

- ECCS equipment short term qualification pressure and temperature values based on HELB results with no credit for room cooling.

Revised Design Basis HELB Analysis Summary
-- HELB Pressure Effects --

- Pressure from both breaks are below 15psig compartment design pressure.
- -8200mm and -1700mm corridor pressures are below 5psig.
- Balance of secondary containment, including walls separating secondary containment from safety-related electrical rooms stays below 2psig.
- HVAC openings between the ECCS pump rooms and the surrounding corridor prevent large differential pressure on pump room walls .
- Peak pressure at RBCW penetration level is less than the assumed ground water pore pressure.

Revised Design Basis HELB Analysis Summary
-- HELB Temperature Effects --

- All 3 RHR divisions short term temperature EQ limits are based on RCIC HELB results. (Temperature at 12psig, in a steam atmosphere).
- Actual RHR divisions B and C maximum short term temperature due to HELB is below EQ limit.
- HPCF divisions B and C short term temperature EQ limits based upon the CUW HELB results. (Temperature at 5psig, in a steam atmosphere)

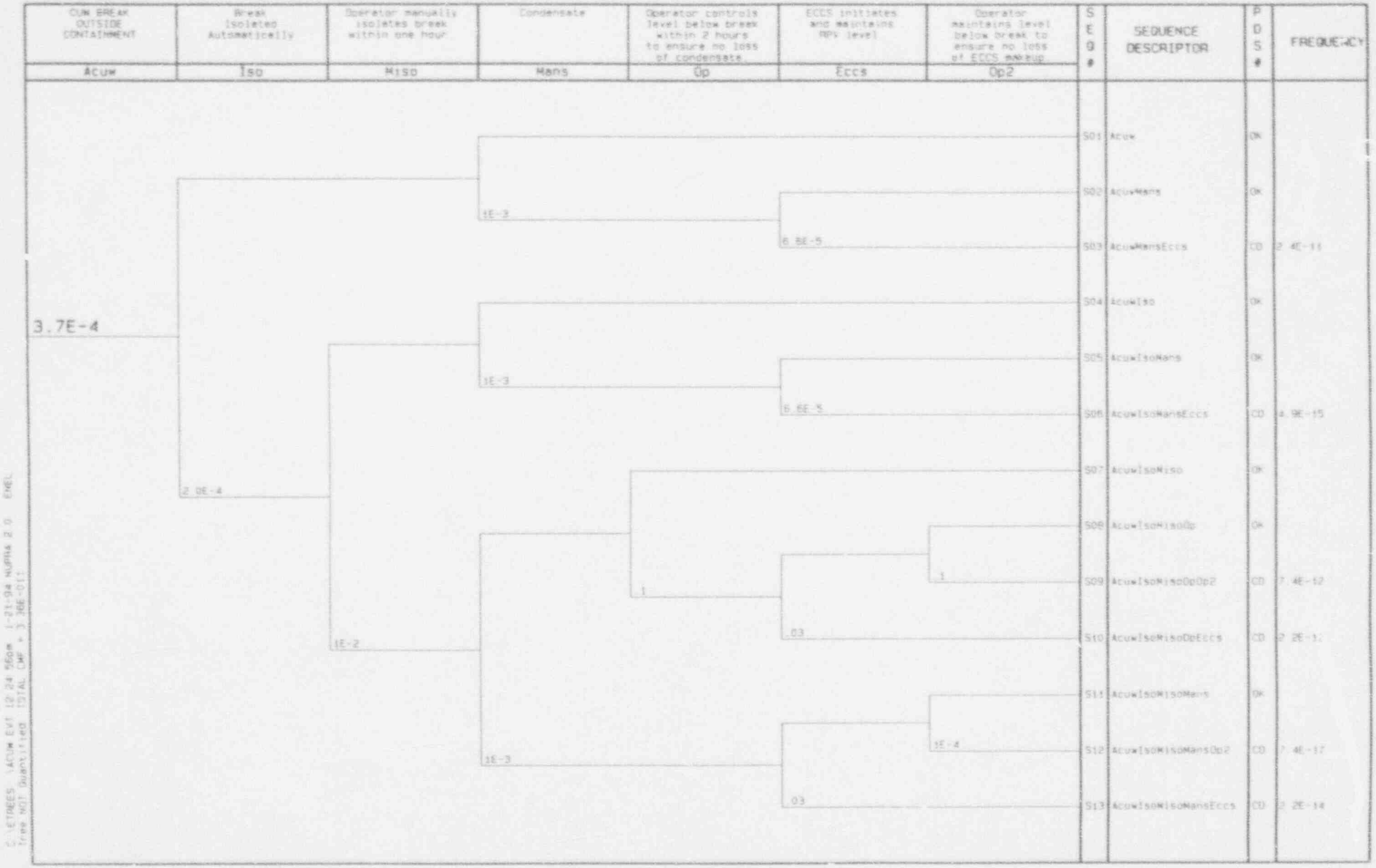
CUW Line Break Probabilistic Analysis

- System Description

-Line Break Frequency

-Component Response to Harsh Environment

-Core Damage Frequency



ABWR CUW BREAK OUTSIDE CONTAINMENT

CUW System Description

- Functions:

    - Maintains purity of reactor coolant in accordance with RG 1.56.

    - Inventory control during startup and shutdown.

    - RPV head spray.

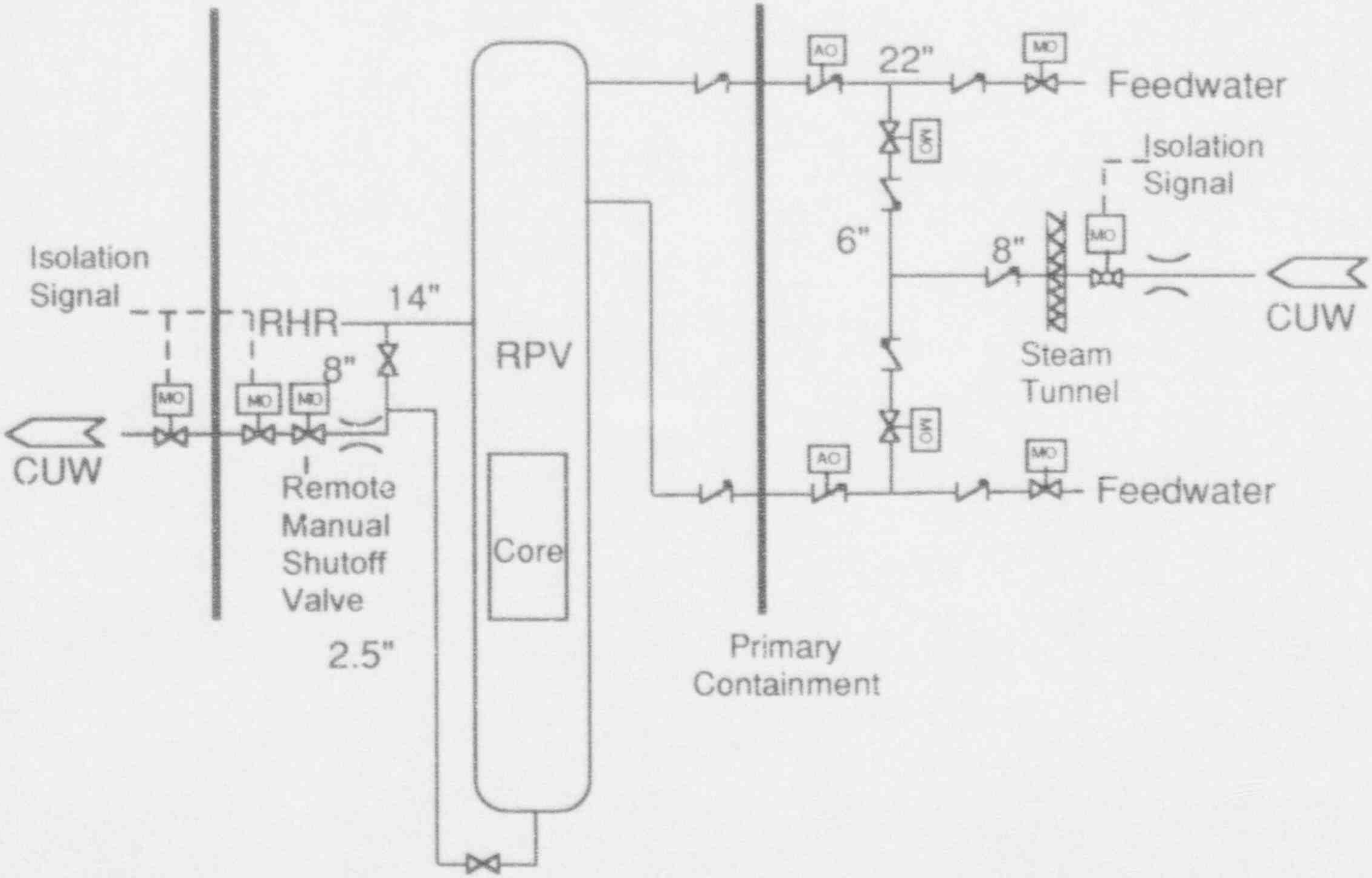
    - Minimize RPV temperature gradients via bottom head flow when RIPs are not operating.

- Isolates on :
    - High system flow rate.
    - Low RPV level.
    - High ambient main steam tunnel area temperature.
    - High ambient CUW equipment area temperature.
    - Actuation of SLCS.

CUW System Description

- CUW isolation valves are classified as safety related.
    - Designed to meet closure requirements under full flow and differential pressure conditions.
    - Manufacturer will be required to conduct factory or valve lab demonstration test under break conditions prior to use in the plant.
- Piping and components inside primary containment ASME Section III Class 1.
- Piping outside primary containment (generally) non-safety related ASME Section III Class 3.
    - Material SA-333 Grade 6 Seamless Piping (same as Class 1)
    - Same design loads as Class 1 except seismic (affects supports mostly).
    - Induction bending of pipe to minimize the number of welds.

CUW SCHEMATIC



CUW Line Break Frequency

- Break frequency estimate is based on WASH 1400 methodology.
    - Median failure rate for pipes >3 inches in diameter is 1E-10/hour/pipe segment.
    - Pipe segment defined to be length between major discontinuities such as pumps and valves.
- ABWR CUW system has 50 segments which results in a mean failure rate of 3.7E-4/year.

- Over 1500 reactor years of experience exists with no major breaks in clean up system piping in BWRs and PWRs.
    - Chi Square mean failure rate of 2.4E-4/year.
    - Compares favorably with assumed frequency of 3.7E-4/year.

ACRS Concerns:Component Reliability in Harsh Environment

- Little data exists on operability of equipment at high temperatures.

- Environmental qualification (EQ) of equipment demonstrates the capability of components to operate at high temperature/steam environments but does not treat reliability (i.e., one successful test only required to qualify a component).

- EQ completed on equipment in new condition. Maintenance and other factors can degrade equipment capability to operate in a harsh environment (e.g., seals can be improperly installed or corrode over time).

- Existing PRA databases do not treat equipment operability in high temperature/steam environments.

ECCS Equipment Reliability at High Temperatures

- Evaluations in support of NUREG - 1150 using expert judgment solicitations were completed to address operation of equipment at high temperature. Results were documented in NUREG/CR - 4550.

  - Consensus was that failure rates increased as temperature approached qualification limits.

  - Wide range of predicted failure rates as a function of deviation from EQ limits.

  - Predominant failure mode would be short circuits due to moisture intrusion into connector boxes.

  - Most electrical equipment has connector boxes so same failure mode for all equipment.

ECCS Equipment Reliability at High Temperatures

- If qualified for environment, failure mode not totally common cause.

  - Maintenance errors during seal replacement and seal degradation over time important.

- If not qualified for environment, failures are common mode due to lack of capability to withstand environment.

<u>IEEE Experience</u>

- Multiple tests completed per IEEE 275, 323, and 383 demonstrate that motors can continue to run at >100C and 100% humidity for extended periods of time (> 3 weeks). Including associated connector boxes.

ECCS Equipment Reliability at High Temperatures

- Temperature profile in ECCS rooms following a CUW line break outside containment:

  - Auto Isolated Case (100 C decreasing to 66 C within 2 - 3 hours.)
  - Manual Isolation within 1 hour (100C decreasing to 66C within 5 hours.)
  - Unisolated Case (100 C indefinitely (until isolated)).

- ECCS components in secondary containment relied upon for this event qualified to at least 100 C for 6 hours and 66 C for 100 days.

  - Margin in EQ profiles to address reliability concerns.

- Harsh environment confined to secondary containment and will not affect electrical equipment outside secondary containment (e.g., essential electrical rooms).

- RCIC unavailable due to high room temperature.

ECCS Equipment Reliability at High Temperature

1) Auto Isolated Case

- ECCS network failure = 6.6E-5/demand (within EQ limits)
    - Compared to 3E-7/demand for non harsh environment.

2) Manually Isolated Case

- Failure to isolate within one hour dominated by operator error of 1E-2/demand.
- ECCS network failure = 6.6E-5/demand (within EQ limits)

3) Unisolated Case

- ECCS network failure 3E-2/demand (outside EQ limits).

CUW Break Scenario

1) Auto Isolated Case

- CUW break on first floor of reactor building inside secondary containment.

- Actuation of blow out panels and failure of fire doors allow steam to escape up through secondary containment and exit through the steam tunnel and refueling floor to atmosphere.

- Reactor building clean areas (e.g., essential electrical rooms) do not experience elevated temperatures/steam.

- ECCS rooms heat up to 100 C within 10 seconds.

- CUW isolation valves directed to close on several signals including high system flow. Closure time 76 seconds.

- Feedwater/condensate continues to run and maintain normal water level. ECCS also available as a backup.

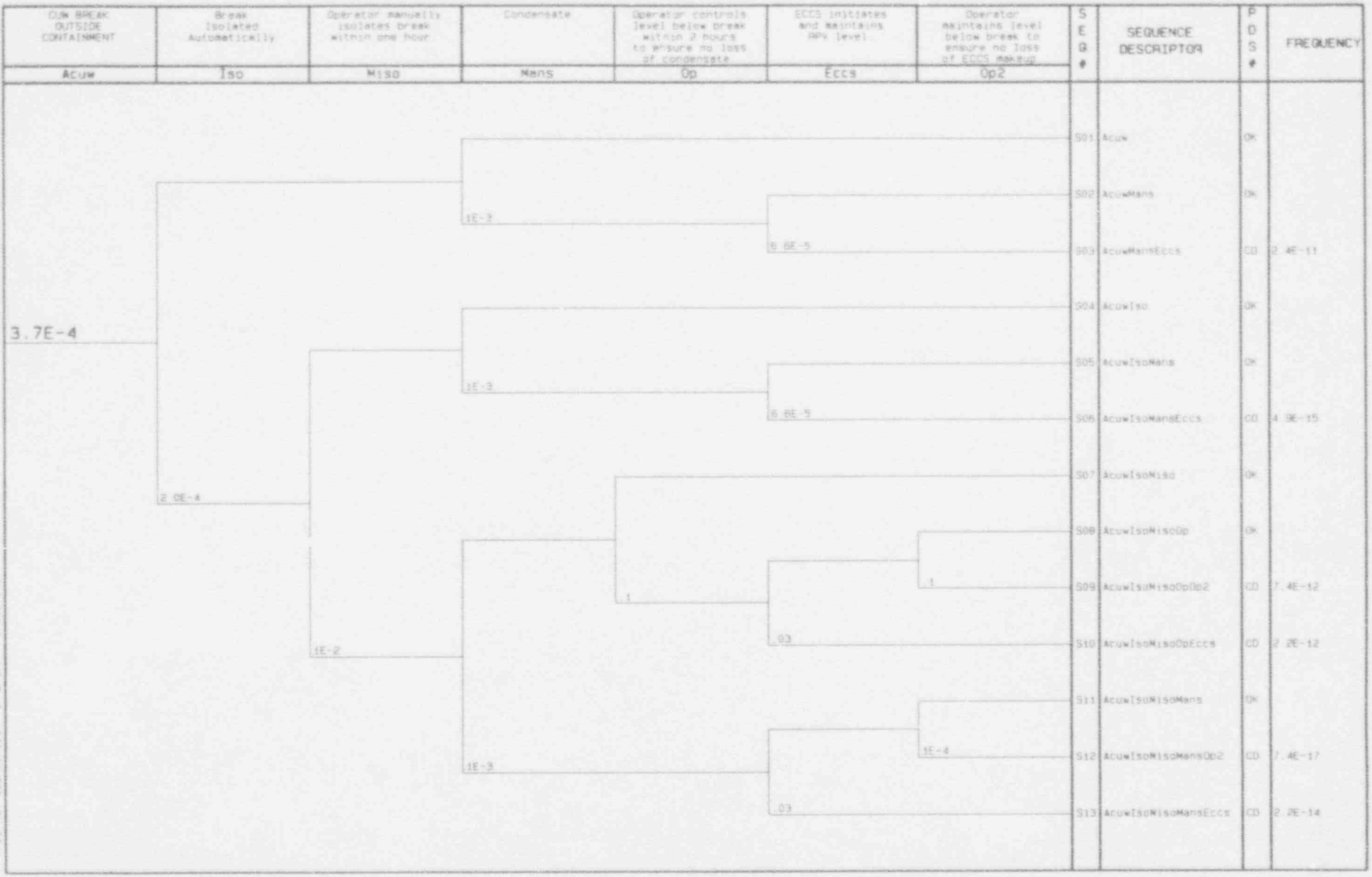
CUW Break Scenario

2) Remote Manual Isolation Within One Hour

- Manually close main isolation valves or,
- After blow down, close remote manual shutoff valve.
- Feed/condensate continue to run and maintain water level.
- ECCS equipment remain within EQ limits.

3) Isolation Failure

- Operator directed by procedure to depressurize and control RPV level below break elevation to minimize loss of makeup.
- Enter the reactor building and close isolation valves when environment appropriate for personnel access.



ABWR CUW BREAK OUTSIDE CONTAINMENT

C:\ETREES \ACUW.EVT 12:24:56pm 1-21-94 NUPRA 2.0 ENEL
Tree NOT Quantified TOTAL CMF = 3.36E-011

Summary

- Core damage frequency :

Isolated	2.4E-11/year
Unisolated	9.6E-12/year

- Unisolated case significantly lower than Level 1 CDF of 1.6E-7/year.

- CUW line break outside containment insignificant risk contributor.

SUMMARY CONCLUSIONS

1/25/94