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COMBINED ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE ON GESSAR II

AND

RELIABILITY AND PROBABILISTIC ASSESSMENT

GESSAR II FDA REVIEW

LOS ANGELES, CALIFORNIA

OCTOBER 18, 1984

REPORTER'S TRANSCRIPT OF PROCEEDINGS

DAVID OKRENT, Chairman of the Subcommittees

JACK EBERSOLE, ACRS Member

C. MICHELSON, ACRS Member

LOS ANGELES, CALIFORNIA; THURSDAY, OCTOBER 18, 1984; 8:30 A.M.

MR. OKRENT: The meeting will come to order. This is a joint meeting of the Advisory Board of the Reactor Safeguards Subcommittees on GESSAR II and Reliability and Probabilistic Assessment.

I am David Okrent, Chairman of the Subcommittees.

The other ACRS members present today are Mr. Ebersole and Mr. Michelson.

We will have some ACRS consultants later this morning, I believe.

Mr. Richard Major, on my right is the assigned ACRS staff member for this meeting. Also present are ACRS fellow S. Seth and Staff Members John Schiffgens and Richard Savio

The purpose of this meeting will be to review the application of the General Electric Company for a Final Design Approval that can be applied to future plants referencing the GESSAR II concept, a BWR/6 Mark III Nuclear Island.

This will be the first in a series of meetings. Severe accident concerns will be addressed so that General Electric can achieve certification of this design through rulemaking as outlined in draft NUREG-1070, "NRC Policy on Future Reactor Designs: Decision on Severe Accident Issues in Nuclear Power Plant Regulation."

By the way, since that's a draft document I'm not quite sure that we can say more than in a way perhaps similar to the draft. We don't know what the commissioners will eventually adopt.

The first day of the meeting will focus primarily on the deterministic questions, the standard review plan type of issues.

The second day of the meeting will begin the examination of the severe accident probabilistic risk assessment (PRA) performed in connection with the GESSAR II design.

Portions of the meeting may be closed due to the proprietary nature of some of the material covered. I would ask GE to alert me to those portions of the meeting which they believe will involve proprietary meeting and to explain to me why the matter is proprietary.

A transcript of the meeting is being kept and it is requested that each speaker first identify himself or herself and speak with sufficient clarity and volume so that he or she can be readily heard we have not received any requests to make oral statements nor have we received any written comments from members of the public.

There was a tentative agenda prepared for today which showed us running from 8:30 until 6:00 p.m. Since in fact, there are going to be three days of subcommittee meeting here with a day of Limerick following these two, it is my hope and intention to not run late and, in fact, to try to finish at 5:00 today rather than 6:00. If necessary by carrying topics over or by shortening on topics that don't warrant the time. We are not in the situation where we need to complete something by the end of the day.

It seems to me that one of the things that we need most to do is to think in connection with this review and thinking sometimes is done better when you're not talking and other people are not talking.

The subcommittee members may comment on the proposed agenda or the proposed modification of the order by GE or any other comments they would like to make at this time.

MR. EBERSOLE: Not at all.

MR. OKRENT: Well, that being the case, why don't we go to the staff for their introductions.

MR. SCALETTI: Good morning. My name is Dino Scaletti and I'm the NRT project manager for the GESSAR II sever-accident review. Before I address the items necessary to complete the severe accident review I would like to introduce my staff.

To my right is Dr. Cecil Thomas who is Chief of the Standardization Special Project Branch. On my left I have Ron Frahm, who is in the risk and reliability assessment branch. Mark Rubin, who is in the same branch. And Dr. Jack Rosenthal, who is in the division of systems integration, reactor systems branch. Mr. Brad Hardy, who is also in the reactive systems divisions. The same branch.

We have Dr. Kelvin Shiu from Brookhaven National Laboratory. Doctor Nelson Hanan from the Brook Haven National Laboratory. Dr. Jack Raed from the N.R.C. reactor Evaluation Branch. Dr. Hans Ludewig from Brookhaven National Laboratory.

MR. OKRENT: By the way, you remind me of a question. Are there documents that Brook Haven has not yet completed or issued in final report form which report on the work it's doing as part of the GESSAR preview?

MR. SCALETTI: I don't believe that any of the documents are in final form yet. There are some documents that are still outstanding.

MR. OKRENT: Is there a schedule -- well, is there a list of the documents that will be prepared and a schedule for when they will be available?

MR. SCALETTI: We can get you a list of the documents. I don't have it in hand and the schedule for their completion.

MR. OKRENT: And Is Brook Haven the only consultant to the staff on GESSAR II?

MR. ROSENTHAL: My name is Jack Rosenthal, Reactor Systems Branch Brookhaven principal systems reviewer. We gain phenomenological advice from ACRS review of Theofanous at Purdue on occasion and we're using RDA extensively on consideration assistance mitigation aspects.

MR. OKRENT: Have they sent you written reports covering their advice? The latter two.

MR. ROSENTHAL: We have two generic documents from RDA which would include the Mark III. And Mark III report soon --

MR. SCALETTI: I believe we have turned all documents we have over to the ACRS.

MR. OKRENT: I've seen something from RDA that I guess I would call generic. I don't remember whether I've seen something from Theofanous on GESSAR that means he has only given you oral advice?

MR. ROSENTHAL: On GESSAR, yes, sir.

MR. OKRENT: Does the staff ever put ideas down on paper that they explore with each other? Just when I look through whatever information I've received -- Limerick more than GESSAR, but -- I'm not quite sure I recall the the seeding material.

MR. SAVIO: We have some material on GESSAR being copied in the office.

MR. OKRENT: It has just arrived?

MR. SAVIO: It has been here since last full committee meeting.

MR. OKRENT: I see, well that would have just arrived.

MR. SAVIO: We are sorting -- the staff is looking through it and having it copied and picking out the more interesting documents to send out.

MR. OKRENT: In looking through the pile of information from Limerick I must say it seemed to me that the staff never wrote to one another raising technical questions to one another or offering technical opinions to one another. They must have done this all in the men's or ladies' room or some other place. But -- am I wrong? Are there memoranda in which the staff exchanges ideas?

MR. SCALETTI: I do believe they are some -- they are identified whether they are actually in the pile sent down. Along with the pile of information we transmitted on GESSAR we also transmitted a list of documents for the committee. If they wanted these documents the word was just call and we would get the documents and transmit them.

Some of the information was withheld but most of the information was generated and put together originally on FOIA requests in which all the staff members researched their files and pulled out everything they had on GESSAR and transmitted to the office of -- that handled the FOIA's they compiled the list of all the information and released some, withheld some, and you people have the list of everything that was given out.

MR. OKRENT: Well, again, I haven't seen the GESSAR list so I'm basing these thoughts on what I've seen of Limerick. But it seemed to me there was an absence of what I would call technical interaction in writing among the staff.

I didn't see any different -- differing ideas in what the staff wrote from the position on Limerick although you might have expected that if 50 or 100 people are reviewing a thing they might at least initially have ideas that varied.

I'm just trying to understand at the moment whether the system, including the fact that people issue F -- freedom -- FOIA's or other things the fact they have to go to ASLB's leads the staff never to put anything down on paper except sanitized summary of meetings and notices of meetings and the final SER.

Am I missing something? Are there some other things I should have --

MR. SCALETTI: I do recall that in the list of information that we transmitted there are internal memoranda that have discussion of technical issues. There is also I believe handwritten memorandum between the staff.

I don't know if that's totally what you are looking for but I do recall the stuff being in there.

The GESSAR review has gone along rather rapidly. We have had a lot of internal staff meetings and aired differences in meetings. I don't believe these were always -- maybe never -- written down, but we are all in one building and it is very easy to just get together and have a meeting.

MR. OKRENT: But somehow the method of procedures doesn't give the ACRS the benefit of any thoughts except those that are in the SER.

MR. SCALETTI: Well I don't know. I think if you look in the information we transmitted you will find the original, you'll find draft draft SER's you'll find the original draft that was officially transmitted to the Division of Licensing and you will then have the current version of the SER now and if you look through that you will probably see where opinions have changed.

MR. OKRENT: There may be a little of that but that I'm afraid has to be late in the review stage, when you are putting something down -- well, let me just leave it as an observation now.

It seems to me it is not a trivial question and we may want to come back to it in some way. Either with the staff or commissioners or whatever.

Okay, why don't you go on.

MR. SCALETTI: Okay. Again, I would like to just hit some of the major milestones that have occurred in the past. To take just a minute to do that.

We met with the subcommittee in April of 1983 to consider the results of the staff review of a limited use FDA for GESSAR II. The full committee reviewed the application in two meetings in May and June of 1983, the ACRS report was issued on June 15, 1983. The staff responded to the committee's concerns in supplement one to the SER issued in July 1983. FDA one was issued July 27th in 1983. Although it was limited in use it was the first FDA ever to be issued by the nuclear reactor regulation for standard plant design.

The staff review of GESSAR II for severe accident concerns began following PE submittal of a PRA in March of 1982. The staff's severe accident review paralleled the deterministic review. However, the review was subject to changes in the requirements of revolving policy statements on severe accidents and certain delays in the development of accident source term methodologies.

Now, the areas of review that need to be completed prior to design certification are listed in the policy statement. There are four:

Demonstration of compliance with current commission regulations including the Three Mile Island

Requirements for new plants as reflected in the CP rule 10CFI5034F.

Demonstration of technical resolution of all applicable unresolved safety issues and medium and high proprietary generic safety issues.

Number C is completion of probabilistic risk assessment and consideration of the severe accident vulnerabilities it exposes along with insights that it may add to the assurance no undue risk to public health and safety and property.

Number D finally the completion of the staff review of the design with the conclusions of safety acceptability.

Consideration of those four issues the staff believes with issuance of SSER Number two, that the step A has been essentially completed with the exceptions of consideration of three additional design modifications which the staff has asked GE to answer some questions on.

Steps B, C and D of the policy statement have been completed in part. Step B will be completed following a favorable resolution of the USI and generic safety issues identified in section 1.A. That's the section on outstanding issues on SSER number two. The staff plans to address these items in the next upcoming supplement presently planned for early November.

Step C will be completed following a favorable resolution of the seismic PRA. This evaluation is presently scheduled again to be provided in supplement number three in early November.

Step D will be completed following the staff's response to the ACRS concerns to be published in SSER Number four following the receipt of an ACSR report.

Following this the staff plans to prepare a second paper -- this will be subject to favorable resolution of all the issues -- prepare a second paper to incorporate the GESSAR II design into commissions regulations in rule --

MR. OKRENT: A point has been called to my attention that there is a group of generic items whose priority has not yet been established. Therefore, we don't know whether they are going to be medium or high or something else.

How do you propose, as part of GESSAR II, covering the relevant generic items in that list?

MR. SCALETTI: Right now the policy statement says technical resolution must be achieved for all the medium and high priority generic issues. Therefore the staff at this time are not considering the multitude of other generic issues if they are not so classified.

Now, I do believe that at a time if the issue were to be classified as high priority generic issue it would be looked at to determine whether it had any safety significance for GESSAR II and then either addressed -- if prior to rule-making addressed the rule-making process or within the purview of commission's backfit policy, if rule-making has been accomplished.

MR. OKRENT: Well, it seemed to me that since the generic item was identified before the FDA will have been approved, if it is approved -- backfit is a curious word.

And I think -- why doesn't the staff make an effort to look through those generic items to see which are first applicable to GE, if any are, or to GESSAR, and to accelerate its design making at least to the point of saying, "Here are a group which are likely candidates for a medium and high."

Is that not feasible? If not, why?

MR. THOMAS: I'm Cecil Thomas of division of licensing. I guess one of the problems is a time sequence problem.

At any point in time regardless of where GESSAR is, whether it be still under the staff's review or whether it be before the commission, issues are going to be identified. And until such time as due course they are determined to meet the requirements for a generic safety issue or resolved safety issue, we just have to deal with them in the time frame that -- the time and place where the GESSAR review is.

I think as Dino said, if some of these issues that are now being looked at for the first time turn out to be unresolved safety issues or high priority or media priority generic safety issues, they will certainly be considered wherever GESSAR is at that time, whether it be still in the staff's ball -- in the staff's realm of review or during the rule-making proceeding or wherever. Certainly even after the rule-making is completed, issues will continue to be identified.

And I think what Dino meant by backfit after GESSAR is certified the normal course of determining the applicability of these issues will address that.

MR. OKRENT: I'm not talking about future generic issues. I'm talking about those that are on your list now.

MR. THOMAS: They continue to go identified as we go along. Somewhere we have got to draw the line and say to the best of our knowledge at this point we have to make a decision and go forward.

MR. MICHELSON: These are issues that have already been identified. This is not some future tense. These are solid issues that have been discussed in detail but have -- the staff for one reason or another has not yet elected to say what their priority is and as a consequence apparently this GESSAR process is avoiding these issues completely.

These are unaddressed issues simply because the staff for one reason or another has not set a priority on them yet.

As I understand it we have this problem with a few other areas. As I understand it the staff simply hasn't had the resources to go through some of these issues and make these decisions some of them they are not even working on yet. Although in some people's view they might be high priority issues when they get around to think seriously about them.

How do you intend to handle those in this process? And I think your answer is that you won't do anything about them until such time as the staff assigns a priority, which might be another good reason to get off a letter soon from ACRS to the commission pointing out our concern on the fact that the staff is dragging their feet. We have asked the staff for a schedule for doing this. After we get the schedule answer -- hopefully that will come soon, at least -- then GESSAR ought to be included in that reply if it appears to be a concern.

MR. THOMAS: We understand your concern, Mr. Michelson, and I think it was expressed in the full committee meeting on GESSAR. And that's about all I can say about it at this time. That is our present intent, to handle these issues as I've described.

MR. OKRENT: Well, if you think something is relevant along that line, I think you should draft something for the next day's testimony.

MR. MICHELSON: Yes. Which I won't be at.

MR. OKRENT: Well, maybe you can talk to Jesse about it.

MR. MICHELSON: He won't be there either. He will be with me.

MR. OKRENT: Why don't you go on?

MR. SCALETTI: I've completed now.

MR. OKRENT: All right. If I understand what General Electric proposes, then, we would now have Mr. Quirk give the GE introduction, discussing GESSAR evolution and the description of the GESSAR II Nuclear Island. And then we would get into the topic of the current status of the severe accident policy statement with both staff and GE participating. So Mr. Quirk?

MR. QUIRK: Yes, Dr. Okrent. My name is Joe Quirk.

I would like to introduce Dr. Glenn Sherwood, who is the manager of nuclear safety and licensing operations, who has a short introductory comment to make. Then I'll begin with the evolution of the GESSAR.

Doctor Sherwood.

MR. SHERWOOD: It is a pleasure for us to be here today with Dr. Okrent and his ACRS subcommittee on the boiling water reactor GESSAR docket.

We have been reviewing this project for the last two-and-a-half years with the staff, and both from the point of view of its standard FSAR level review which resulted in a final design approval in July of 1983, and finally the severe accident review over the last year, which we are beginning to discuss today.

So we feel we have come a long way with this review. We have made a number of I think interesting changes to the BWR/6 which we will be discussing with you over the next couple of days, and we believe that the results of the studies, especially the PRA results, show that the BWR/6 is one of the safest light water reactors ever reviewed by the commission and brought to the ACRS.

I would like to introduce the staff who we have today. This is Mr. Joe Quirk, Mr. Rudy Villa. David Foreman, and the individual who I just displaced is Kevin Holtzclaw. And we have additional General Electric representatives from our technical staff who Joe Quirk and Rudy Villa will introduce later.

I'll turn this over now to Joe.

MR. QUIRK: Doctor Okrent, I was wondering if it would be appropriate for me to address a couple of the questions you raised already this morning before I begin my presentation.

MR. OKRENT: As you wish.

MR. QUIRK: It will be brief.

You raised not a trivial question, the apparent absence of internal staff memos that question approaches that were taken on GESSAR. I think this technical debate, if you want to call it that, took place, and it did not take place in restrooms, nor did it take place exclusively in internal staff memos.

But due to the uniqueness of a severe accident review -- and to my recollection GESSAR is the first standard plant design or any design to undergo a severe accident review -- and because of the uniqueness of that review, the information that was placed on the record for General Electric Company to address was voluminous. And I'm recalling the kickoff meetings a couple of years ago -- that yourself and Mr. Ebersole and Mr. Michelson were part of -- desirable features for new designs. And the question that was raised at that time, are the present designs safe enough? or should there be features added to these designs that make them appropriately safe?

And the backdrop for our review began under that type of discussion and grew, through the many additions of the severe accident policy statement and through many of the USI's and GSI's that have been passed along.

So I would like to say that we intend today and tomorrow to show you the depth of the review that we have undergone and the numerous USI's and GSI's that we have addressed and how we have addressed them and what manner we have resolved them. And I hope that we were responsive to this very important question that you have raised already.

MR. OKRENT: Well, if you would like an example of an area in which I think it would be useful to the ACSR to have the benefit of what I assume must have been the several opinions within the staff before one evolved and appeared in the SER, the subject of sabotage and whether additional protection beyond what is in the plant is appropriate is a nice interesting topic. It would be astonishing to me if all members of the staff came to the view monolithically, that is in the SER. If they didn't I would be interested in knowing what kinds of suggestions some of the members of the staff thought were really worthy of consideration for things beyond what is in the SER. And why it was decided not to pursue these and so forth.

Now, maybe I'm wrong. Maybe in fact there just was one opinion. But if there was just one opinion we need a new staff. I'll leave it at that.

(Slide 1 shown.)

MR. QUIRK: Dr. Okrent, I would like to begin with the first item on the agenda that GE is to address which is the evolution of the General Electric GESSAR II BWR/6 Nuclear Island design. I would like to say with relationship to the agenda that the ACRS subcommittee has handed out that our presentation is geared exactly along those lines only. In a few minor cases have we chosen to combine certain topics to facilitate the presentation. We will identify where we divert at that time.

I also acknowledge your comments on the proprietary information. We have arranged our presentation so that today all the presentations are non-proprietary and there will be no need to go off the record unless of course questions go into details that are proprietary and we will identify those as we go along. And tomorrow we will identify the areas that are proprietary and discuss with you why.

(Slide 2 shown.)

MR. QUIRK: In the interest of time I think some of the subcommittee members have seen some of the presentations with respect to evolving the GESSAR design. I have one chart that summarizes a very long presentation and I would just like to recalibrate your memories on the revolutionary process of the reactor design. We'll walk through that.

I will also discuss evolution of the design through analysis of operational feedback. Data in the field that are analyzed and diagnosed by General Electric reliability engineering and how that is fed back into our design.

I would briefly like to talk about the evolution to the evaluation of abnormal occurrence. Happenings in the field and what the lessons learned from those are and how they have been accommodated in GESSAR. And then a summary of evolution of design changes through testing.

(Slide 3 shown.)

MR. QUIRK: This is a summary of this presentation and it is very busy, but it is meant to put everything on one slide to facilitate your review of the material I'm going to present.

I will begin with a one-page description of the reactor design evolution beginning with the Dresden 1 reactor, going all the way to the BWR/6 identifying important features of evolution through that process.

I will then talk about the GE containments beginning in the early days with our dry containment where we developed the pressure suppression concept and then revolved that design into Mark I to Mark III. And then we will talk about operational feedback, abnormal occurrences and testing.

What I've tried to do here is show a time line from 1955 through 1980 and beyond, and show the events that happened and where in time and you can see where the product evolution points happened in time. And I think this facilitates the whole presentation and puts on one chart everything together.

(Slide 4 shown.)

MR. MICHELSON: Excuse me, before you leave that. You are not going to discuss the bottom of the slide, I guess. Would you refresh my memory on what led to the two events you were pointing out as an abnormal occurrence milestone.

MR. QUIRK: Yes I will. I will talk about each of those events and the lessons learned and how they were incorporated.

MR. MICHELSON: Thank you.

MR. QUIRK: Yes.

Beginning with the evolution reactor systems. 25 years ago indirect cycle pressurized water reactor technology was being developed for the Navy and GE was heavily involved in that program, and others. We were selecting PWR technology for central power station application. GE, however, departed from this course and chose the direct cycle BWR.

We made that decision because we felt that the direct cycle offered safety and economic advantages through simplicity, through lower pressure, through inherent reactivity control, and direct communication between water sources and reactor vessel.

We recognized that the BWR represented a more developmental product and would require greater investments in supporting technology. But we are convinced that the benefits of direct cycle justified that investment.

Now, the Dresden 1 had the characteristics of the first commercial product offering that General Electric offered. And as you can see it had many features similar to pressurized water reactor, reactor vessel, four-steam generator, and this is different in that it is a steam drum.

And the way this process worked was that steam would go to the turbine either from the steam drum or from the steam generators and thus we called this a dual cycle process where we could experiment with direct cycle and retain the proven features of indirect cycle. We then evolved to the next design or the KRB design which was the first major step in simplification, and as you can see the steam drum was deleted and the steam drying function and the separation function was incorporated internal to the reactor vessel pressure.

And this feature stayed with all the subsequent design improvements in the BWR. It still retained the proven indirect cycle and so this was also a dual cycle wherein the steam came directly from the vessel and also from the steam generators. We got more data with both the indirect and the direct cycle.

And I refer to this next picture, which is the Oyster Creek-type plant, as cutting the umbilical cord. Because this is the first time that we appeared with a direct cycle process only and there were no steam generators in this design. A very significant step for the BWR and one that we think was the right step.

We evolved from the Oyster Creek 5-loop design to the reactor vessel with the internal jet pumps, which allowed us to reduce the recirculation loops to two. And this feature was then with the BWR/3, 4, 5 and BWR/6.

MR. EBERSOLE: Joe, may I ask a question?

MR. QUIRK: Yes.

MR. EBERSOLE: I find this fascinating to see the history of the evolution of the BWR, but if I step backwards a little bit could you either now or at some time in the future discuss the more fundamental aspects of why you went this way.

I believe you have reduction in what used to be called material efficiency in the core. You have a bigger core, a more distributed fuel load, lots more uranium, you have this terrible problem of oxygen to deal with in the piping system.

Would you go backwards a little bit and discuss these evolutions and how -- and describe to us eventually here how are you going to cope with these in the competitive context.

MR. QUIRK: Okay, I would like to do that on a subsequent slide where I provide a matrix of some of these.

I would like to say that the benefits of the direct cycle I've already enumerated on and I think together with the benefits there are some developmental processes and problems along the way.

And I wish to talk about some of these and how we have incorporated lessons learned from those experiences into our design.

MR. EBERSOLE: You know we are well-acquainted with salesmen who only mention the good sides of their products and we would like to get the full picture.

MR. QUIRK: We will get into the darker side very shortly.

(Slide 5 shown.)

MR. QUIRK: Another major departure from the present containment designs was General Electric's continued development of pressure suppression. And this chart summarizes the evolution of the containment design. Began with the early designs having a large dry containment and General Electric then first developed the pressure suppression concept as shown by the Mark I which is a torque and light bulb effect as we describe it. It is interesting to note that in this design the pressure barrier and the fission product barrier are one. And I will explain the significance of that in a minute.

The Mark I evolved then into a Mark II, which is over-under design, as we call it, the suppression pool is underneath the reactor. And this also -- the drywell is also both a pressure barrier and a fission product barrier. The significance of that is that if one postulates a failed containment or a failed penetration one can postulate radio nuclei escaping the fission product barrier.

Whereas in the Mark III we have separated the pressure barrier, which is shown here as the drywell, from the fission product barrier. So the pressure bearing acts to channel the steam that escapes from, say a postulated pipe rupture, escapes into the drywell. The drywell then channels the steam through the horizontal vent into a million gallon suppression pool and quenches and scrubs the fission product. This drywell and pool is surrounded by a fission product barrier and I think this is significant because if one postulates some types of bypass through the drywell you still have a mechanism for played out or another barrier there that would tend to slow the reaction for a bit, anyway. And I think it just provides some redundancy and capability that others don't.

MR. EBERSOLE: One of the striking visual effects of your pictures up there is to notice that the Mark II has an interception path if you have a core melt down before you get into the dry concrete, whereas the Mark III does not. Was that even considered as worthy of any consideration at all?

MR. QUIRK: I'm not sure I understand your question. The diaphragm floor here?

MR. EBERSOLE: Before you get to the containment perimeter you have got to go through water. Is that correct?

I hear yes and I hear no.

In short, if I have a core melt and a vessel failure I will intercept a water path.

MR. QUIRK: You will eat through this diaphragm and then go into the water.

MR. EBERSOLE: Whatever, but I don't do it on a Mark III.

MR. QUIRK: Now, in here, you start interacting with the concrete here and the non-condensibles that are generated off tend to pressurize this cavity and purge it through the water.

MR. EBERSOLE: But you must face the potential chewing through the concrete.

MR. QUIRK: Chewing through the concrete, that's right.

MR. EBERSOLE: Was that considered not worthy of any in particular (missing).

MR. QUIRK: I don't know the answer.

MR. EBERSOLE: Sometimes it can bring a problem. I don't know.

MR. QUIRK: I don't know.

MR. VILLA: Rudy Villa here.

The configuration of the -- that's more conceptual than it is actual. In fact, the configuration of the Mark II drywells varies quite a bit depending on which architect engineer has designed the plans. And in fact many pedestals are designed so that the -- if you want to consider that pathway, it would be exactly the same as the Mark III. There is no -- there would be no water directly underneath.

MR. EBERSOLE: So you're saying there is no discreet plan --

MR. VILLA: That's correct.

MR. EBERSOLE: -- to intercept with water or not to intercept with water --

MR. VILLA: That's correct.

MR. EBERSOLE: -- that's an open principal consideration?

MR. VILLA: That's correct.

MR. EBERSOLE: Do you have any favorable direction that you want to go if you were going to press the AE?

MR. VILLA: No, I don't.

MR. EBERSOLE: So we have no direction in that direction?

MR. VILLA: No.

MS. HANKINS: My name is Deborah Hankins, I'm with engineering General Electric. We did consider flooding the drywell cavity in terms of the probabilistic risk assessment. In fact, most of our accidents were terminated by the assumed flooding of the cavity via introduction of water into the suppression pool allowing that water to overflow into the drywell cavity.

At that time it was assumed that the fission products were used as terminators and there was no further risk from the plant. We analyzed the capability of the core to eat through the 15 feet of base mat. Our codes indicated that the corium would not make it through the base mat before freezing. All failure loads of the containment in terms of fission product release considered the air bone pathway, in other words, the containment would fail due to say, gas generation, prior to any -- even uncertainty considerations of base mat penetration.

So in summary, having a liquid core catcher, if you will, present in the Mark III containment is insignificant in terms of its risk reduction, but it was considered.

MR. EBERSOLE: Thank you.

MR. QUIRK: I think one of the significant features of pressure suppression, of course, is the ability to direct heat from the reactor to the large storage pool, if you will. But it has high heat capacity and can take on this heat without needing active containment cooling systems in the near term. And it enables the operator to focus on a singular most important thing, which is to align his pumps with that water to cover the core, and secondary after he has established that to bring on containment cooling systems.

MR. EBERSOLE: Now having got this in configuration you know, of course, you have a limited storage capacity which of course is extensive and very large but eventually you have to get the heat out.

You have two ways of doing it. You can run through the exchangers and evaporate that through their secondary, or you can do it by brute force which is water cooler. The older designs had, you know, shut down condensers. Somehow we got away from them which I thought was a little sad and got into these heavy massive water circulation systems which require extensive power.

How do you rationalize your move towards that end with the obvious heavy dependency on heavy power?

MR. QUIRK: Well, going away from the isolation condenser and adding the RCIC on a suppression pool gave us the best of both worlds. And I think that's what it is. For example the RCIC makes up the reactor and the high pressure conditions and it's DC operated. And battery powered. Steam driven. And so it need not have a dependency on AC to provide makeup.

MR. EBERSOLE: It does nothing to get the heat out of the suppression pool?

MR. QUIRK: Now the suppression pool functions to absorb the heat delivered to it. And as you said there is two ways to remove that heat.

One is brute force, as you say, cooling water to water. And in the Mark III we have added a feature, that you are going to hear about in the next three days. Which is a vent -- enables us to open a vent in a containment and allow the cool to vaporize -- well the water will steam and then the steam will then be vented outside. And so we can make up water to the core without AC power. We can depressurize the reactor without AC power, and now we can remove heat passively without AC power. And I think that's a superior feature of this design.

You will hear more about that concept later in the meetings.

(Slide 6 shown.)

MR. QUIRK: This is a chart that I referred to earlier, which is a summary of the design evolution data.

It has another page with it that you mentioned fuel and fuel geometry and fuel channels and things like that. And these differences may be commercial impediment, I guess is one way of saying it. That may be true on one hand, but on the other hand we have things that offset that.

For example, here we show the fuel geometry anywhere on BWR/1 from 6x6 to 12x12, and we pretty much locked in on 7x7 throughout the BWR/5 and then we went to 8x8.

And you can see what the maximum linear power ratio fluctuated around and we ended up on BWR/6 dropping it down to 13.4. And I think when you stand back and look at this chart you can see all the data and history that we have gathered, and I think you can see that the last column really does make steps in the right way. And does tend to make it more efficient and less expensive.

I mentioned steam separation, external steam drum was replaced with the internal separators and dryers and the steam cycle began both and we finally went with direct cycle.

Recirculation loops, we had multiple loops as many as five at one time. We reduced that to two loops, and as you will hear later, on the ABWR the next evolved designs will have no loops.

(Slide 7 shown.)

MR. QUIRK: Continuing with the design summary of some parameters this shows the ECCS configuration for BWR/1 through BWR/6.

We've ended with a high pressure HPCS system that has its own dedicated diesel it is separated entirely from division one and two. It also has an RCIC system which is powered by steam and controlled through DC-operated control and independent of AC operation. We have, of course, our low pressure flooding and spraying system.

So we think that we have ended up with a design that has both flooding and spraying and non AC dependent make up systems and a suppression pool heat sink and we think it has superior safety features for these reasons.

MR. MICHELSON: From time to time there have been questions about the spray distribution from high and low pressure sprays on the core. Are you going back now to the concept that indeed you can take credit for a spray distribution?

MR. QUIRK: We have documented that the spray distribution is not important, that the water comes in and you get what is referred to as counter current flow limiting. Which is steam rushing up through the central channels holding the water above the core. The water will accumulate there and then go down the peripheral bundles and come up through the core.

So we've shown through rigorous analysis and also testing that the testing spray distribution for those is not important.

MR. MICHELSON: Why do you continue to call it a spray just simply because it's becoming a stream? It is just a water injection from the top is all it amounts to, doesn't it?

MR. QUIRK: Well that's true it provides --

MR. MICHELSON: Since you were continuing to use the word spray I wondered if you drifted back to being able to start to take credit for distribution?

MR. QUIRK: Well, no. We haven't, Mr. Michelson, but the spray offers a feature that just has more tolerance for forgiveness.

For example, we don't do this and we don't suggest anyone does it. But if you postulate a penetration failure, for example, in the bottom of the vessel which could result in fluid escaping you have the ability to spray the fuel from the top. And no one wants to postulate things like that and you take steps to assure that won't happen --

MR. MICHELSON: In order to take credit for core cooling from the top you have to have the integrity of the bottom of the vessel yet, don't you?

MR. QUIRK: I wouldn't think so.

MR. MICHELSON: How do you get the counter current flow up the channel --

MR. QUIRK: Well if there is no counter --

MR. MICHELSON: -- with a hole in the bottom of the vessel?

MR. QUIRK: Well if there is no counter current flow the spray will cover and go down the channel.

MR. EBERSOLE: Then you need the distribution.

MR. MICHELSON: That's what I was going to say. You eventually even when you get down to low power when your conduct flow is reduced don't you gradually regress to a need for spray distribution?

MR. QUIRK: Well, then the spray distribution wouldn't be impeded by a --

MR. MICHELSON: Well, of course, I know, but you then merge into a need for spray distribution don't you?

MR. QUIRK: Right. I would say that it is adequate under those conditions.

MR. MICHELSON: Have your tests demonstrated the adequacy under those conditions?

MR. QUIRK: No, sir.

MR. MICHELSON: It is not a postulated condition.

MR. QUIRK: That's right. I'm trying to point out a defense in-depth argument here.

MR. MICHELSON: You can't really have it both ways or you can't make your claim for defense in-depth unless you have made a demonstration of defensive mechanisms.

MR. QUIRK: I understand.

MR. MICHELSON: And I don't believe you have demonstrated the spray distribution for those conditions.

MR. QUIRK: Okay. I agree.

Before I get into evolution of design through evaluation of abnormal occurrence, which I have many charts on, and we're going to go through some of them. I would first like to talk about evolution through analysis of operational feedback. I have one chart on that.

(Slide 8 shown.)

MR. QUIRK: And it identifies that we have a reliability engineering operation which is an independent group at GE that analyzes feedback from operating plants worldwide.

We get data from around the globe and we process it in our computers. We do periodic trend reports of these results and show performance by system and major component. The line organization at GE and the reliability engineers review this data for application to a plant to enhance maybe plant safety or to indirectly enhance through increased capacity factors.

MR. MICHELSON: Excuse me, to what extent now are you using the output of the revised NPRDS system and INPO?

MR. QUIRK: We're wired -- we're plugged in on the

NPRDS system and INPO extralaterally. Engineers evaluate that data base as well as our own.

MR. MICHELSON: You have on-line access then to the NPRDS system?

MR. QUIRK: Yes, yes, we do.

MR. EBERSOLE: Joe, implicit in what you say about evolution is the thesis that evolution is always towards better things. Yet when the M.B.A.'s from the Ivy Leagues get their hands into your management that can be contradictory and you may not have the superior product you might just have one that makes more money.

Do you think all of your evolutions have been progressive towards safety?

MR. QUIRK: I personally do, Mr. Ebersole. I've had debates with some people, including some staff members, about evolutionary features and the staff pointed out one feature, the Mark III containment design pressure was 15 PSI, and they noted that was not an evolution of improvement, if you will. And I definitely disagreed with that because the design margin from the calculated pressure in the containment to the design pressure is the highest on the Mark III than it is on the other, even though the other containments are higher pressure.

So there may be some evolutions that I haven't come across that maybe aren't an improvement. I haven't seen it yet.

MR. EBERSOLE: Well, just a few weeks ago, I was out at your ancient Humble Bay Plant -- which I consider it being tragically shut down, it looks like a very good plant to me.

Anyway, it is going for a variety of reasons, and I saw a feature there which I was subsequently unable to find at any of the diagrammatical presentations. It was the fact that apparently there your reactivity control system had individualized raw discharges where the common dump volume, should it become solid, would really not provide a common mode failure since there were individual reliefs on each discharge pipe. I take this as just a case in point.

I haven't really verified it, but you had a degree of independence in that old design that you don't have today. But it appears that way and I would like to have you kind of look that up. I'm having trouble finding out the true facts of the case.

MR. QUIRK: I will indeed.

MR. EBERSOLE: Do you follow me?

MR. QUIRK: Yes, I do. I will look that up and I'll get back to you.

Kevin, will you note that.

MR. MICHELSON: You do understand the question, don't you?

MR. QUIRK: I do understand the question. Would you like for me to say it in my own words?

MR. MICHELSON: Yeah, I would like to know so when I hear the answer I was sure you understood the question.

MR. QUIRK: Well, as I understand the question, Mr. Ebersole thinks that Humble Bay design has a relief on each discharge line of the control rods such that should the discharge volume not permit discharge into it that this relief would enable the discharge to occur and the rods to go in. Is that in essence to --

MR. EBERSOLE: Some other tank or some other receiver?

MR. QUIRK: Yes.

I would like to put up a summary chart here and kind of walk you through where we are now and where we're going.

(Slide 9 shown.)

MR. QUIRK: We are now going to begin the discussion on abnormal occurrence. And I will talk about the Dresden 2 event what happened there, what lessons learned, and what actions we have taken. The same with Browns Ferry Fire, and the TMI accident, the Oyster Creek event, and the Browns Ferry 3. This is not the salesman approach here, Mr. Ebersole.

MR. EBERSOLE: Yes, Joe. Of course, you know that was just an aside. I know you're no salesman.

MR. QUIRK: I've been called worse.

MR. EBERSOLE: I'm speaking about the true salesman.

MR. QUIRK: The Dresden 2 event was in June of 1970. And it began with feedwater control problems that resulted in a reduction of reactor pressure. The containment and main steam line were isolated but the feedwater continued to fill the vessel. The operator assumed manual control of the feedwater and he relied on a faulty level indicator, which was stuck in the low position. So thinking that the reactor was low on water level, he cranked the feedwater system up until water overflowed into the steam lines.

And the two-phased mixture in the steam lines and the high pressure caused the safety valve to lift and the discharge from that -- this is of a design, I might add, that had pipe safety relief values. And the safety values had a handle on them to facilitate maintenance of the safety valve and this discharge from the safety valve impinged on a maintenance handle causing others to partially open.

So we had an adjacent safety valve partially open discharging to the drywell causing high ambient conditions and damaged cables and equipment.

MR. MICHELSON: Wasn't that actually the handle that actuates manually the safety valve or some other handle? I thought it was the manual actuation for the safety valve.

MR. QUIRK: Well, I believe you can -- it was a maintenance handle to facilitate maintenance.

MR. EBERSOLE: Joe, were these cables that were damaged assigned to any critical safety functions? The reason I'm asking that is, of course, is you are supposed to have pretty good cables for the drywell.

I used to advocate that you go in with a steam jenny and clean the whole thing up, but I always got thrown out. Here is the case where you did it anyway. Were those cables in the category of safety grade cables that are needed?

MR. QUIRK: I really don't know the answer. I do know that remaining equipment was available to safely shut down the reactor to follow the level, but I would have to surmise that some safety cables were damaged.

MR. EBERSOLE: Well, see this then is a little contradictory to the thesis that we're supposed to have environmentally qualified equipment in here.

MR. QUIRK: You're getting a little ahead here. Let's go through the lessons learned.

MR. EBERSOLE: Okay, all right.

MR. QUIRK: The lessons learned from this event we feel are listed here. The operator should not rely on a single level indicator, because it can be misleading and he was trained to look at others and be aware of what conflicting information he may be getting.

Automatic protection we thought should be provided to prevent overfilling the vessel. We thought that the containment environment can be more severe than the then-current design basis.

MR. OKRENT: Excuse me. Was the steam line consciously designed to withstand the forces that could arise should it be flooded?

MR. QUIRK: Yes, it is.

MR. OKRENT: It was then for Dresden?

MR. QUIRK: Steam lines? Water?

I don't know the answer.

MR. MICHELSON: We sure understood what you did say though at least there are several additional forces if you fill the steam lines partially with water. One of course is simply dead weight. Another perhaps more significant one is hydraulic perturbations that occur when you start putting colder fluid into a steam flow line. Which might tend to open valves that wouldn't otherwise open, so forth, or to introduce additional loadings on the piping. I think it was that later type -- well, it was both types that Dr. Okrent asked about.

Now, what was your reply, is it that you're not sure of any of the reply or just the hydraulic loadings from the steam condensing?

MR. QUIRK: I took Dr. Okrent's question to be was the design basis for that piping -- did it include the flooding load as as well the two phase discharge.

MR. MICHELSON: By "flooding load" you meant dead weight water.

MR. QUIRK: Dead weight water as well as loads as the result of flashing. And I do not know the answer if the original piping had that as a design requirement.

MR. MICHELSON: There is an important aspect of that and that is what dead weight overflow leads the isolation valves to operate because you may have put extra moments on the valves now which prohibit them from operating, even though you haven't overstressed the material itself. So there is a lot of ramifications to the question.

MR. EBERSOLE: Yeah, I was going to say there is a systematic effect here you are describing in that one valve affected another valve and I guess if a designer worked at it he could make a complete domino job.

MR. QUIRK: Yes, okay, let's continue with some of the other things we found out, you are right.

We felt a lesson learned also was to remove the test handles from the valves. That it would reduce the likelihood of their being opened by jet impingement from the discharge of adjacent valves that the safety relief valves we felt also a lesson learned would be that they should be piped directly to the suppression pool.

So the actions I've listed on this page and on the next page retrace the lessons learned one or two and say we did it.

(Slide 10 shown.)

MR. QUIRK: I think this is an example of learning from experience that happens in the field and having follow-up action that adequately corrects the point.

MR. OKRENT: GESSAR is the design of the steam lines and the things in the steam lines based on the assumption that the lines may partly flood or fully flood?

MR. QUIRK: Yes, sir.

MR. OKRENT: And this includes unsteady forces that could result, so forth?

MR. QUIRK: Yes. Now, we --

MR. OKRENT: And the the NSIV's are included in this as to functionality?

MR. QUIRK: Yes, sir? Now this may seem contradicting in that one of the fixes was to put in a high level trip, which would prevent the overflow of water into the steam lines. But we have identified an alternate backup to decay heat removal, which uses these steam lines that fills them purposely full of water and then opens -- we open a safety leak valve and take the water back down to the pool and we have another way of establishing communication with the pool, and for that reason these lines have been analyzed for the weight of the water.

MR. MICHELSON: Now that's analyzed just for the dead weight?

MR. QUIRK: Yes.

MR. MICHELSON: I think the question was more emcompassing and was your answer that you are handling it for the more encompassing question?

MR. QUIRK: For failure of the high level trip and the resultant dynamic forces due to failure.

MR. MICHELSON: Now it gets you into a little difficulty as RCIC or HPCI happen to be operating when you get into your overflow condition because now you've got the water flow down to the HPCI turbine and RCIC turbine and they will start getting intermittent slug flow and I'm not sure those turbines are designed for intermittent slug flow of this nature. They were tested a long time ago for water pick up and not for slug flow.

Has that been included then or how do you handle, if you overflow the steam line, how do you keep the water out of the RCIC line for instance or the HPCI line which is also getting overflow because of vessel level.

MR. FRAHM: Ron Frahm, NRC staff.

Number one, on GESSAR there is no high pressure core injection HPCI, but it has a diesel driven turbine.

Number two, the other question about water hammering the MSIVs, normally the valve is closed before you get into the situation where you have two-phase flow to the steam line.

MR. MICHELSON: Normally, you shouldn't overfill the vessel either, so I'm not sure I understand your reply. Because normally is not any longer applicable.

MR. FRAHM: You had a transient situation here where you had the overfill. And normally in a transient situation on a BWR the MSIVs would be closed.

MR. MICHELSON: Yes, and normally you wouldn't have the overfill either, but something went wrong so if something goes wrong I'm not sure that the MSIVs are closed.

And RCIC -- you are right. This is now a diesel-driven HPCI so RCIC still would be a problem --

MR. FRAHM: RCIC is still a problem but what Mr. Quirk is talking about the alternate decay heat removal you would have long since been gone, you would have been a low pressure mode and RCIC would not have been running anymore.

MR. MICHELSON: I would like to have for the record you recheck with your people and see if you have indeed designed for dynamics effects of overfill and not just the static loadings and did that include the RCIC steam line as well or any other steam that's being taken involved in the process now.

MR. QUIRK: All right.

MR. OKRENT: When you are designing for dynamic effects, I'm interested in knowing whether these include water hammer and if so, how you quantify the forces that you think you need to design for with regard to the water hammer.

MR. EBERSOLE: In that connection, Joe, if you get into this mode where you are overfilling eventually the SRV or some sort of V's someplace are going to see water suddenly when they heretofore have been seeing steam; is that correct? Your valves will they suddenly see water?

MR. QUIRK: Let me say that the fix -- one of the lessons learned and the actions taken was to put in a redundant high level trip.

MR. EBERSOLE: I know.

MR. QUIRK: So there is a protective field that has been added.

MR. EBERSOLE: I know, you put an intercept in front of what was a problem. At the same time you are still invoking the use of that I suppose under controlled circumstances. But are you sticking to the notion that you can accidently still overflow and impact on these SRV's suddenly with water?

What I've always wondered about, you know, when you suddenly fill a vessel which is relieving steam, with steam relief valves, as the water approaches the valve, if it is coming pretty fast, the valve undergoes some shocks as it goes through a phase change. Are the SRVs and other valves competent to cope with that transition phase from steam to water?

MR. QUIRK: We'll answer that question.

MR. MICHELSON: I'm a little surprised that you are attempting to design for all of these funny effects when you have already put in a redundant safety grade means for preventing them because there is a number of other cases where that's all that stands between you and a mildly large disaster you must depend upon redundant safety grade equipment and here though you seem to be telling me that in addition to the redundant safety grade equipment you design for the event. Anyhow I'm a little surprised if that's true.

MR. QUIRK: Well I pointed out that that may be a contradiction, earlier, and the reason that we do was because we also use the steam lines to purposely flood them for certain conditions.

MR. MICHELSON: But not under this circumstance. That's just dead weight loading that can be handled.

MR. OKRENT: Is the high water level trip safety grade? I thought I read that it was commercial grade, although it may be redundant. Did I misread?

MR. QUIRK: I think on some designs it is commercial grade. On BWR/6 I believe it is redundant and we will confirm that for you.

I'm told by the staff that's true.

MR. OKRENT: I'm sorry. What is true?

MR. FRAHM: The staff required that the high level trip be safety grade on the later designs. There are few earlier designs, BWR/4s, that have as Mr. Quirk said the commercial grade safety trip. I can't answer if we backfit those or not but we required it on the newer plants.

MR. OKRENT: The staff hasn't seen fit to do the same on B and W plants hasn't it?

MR. FRAHM: I can't answer to the B and W plants.

MR. OKRENT: Very curious staff. I would like to see if there ever were any discussions on this point and was anything written down.

MR. QUIRK: We'd be interested in that answer too.

(Slide 11 shown.)

MR. QUIRK: Let's see if the subcommittee is interested in pursuing on each one of these.

We have talked about Dresden 2. I'm prepared to talk about the Browns Ferry fire and the TMI accident and Oyster Creek and Browns Ferry in that format. Is the subcommittee interested or would they like to pick one or how would they like to proceed?

In the interest of time recognizing we are probably getting late already.

MR. EBERSOLE: Joe, I of course remember the Browns Ferry fire very well indeed. At the time of the design process of Browns Ferry fire there was a tremendous hullabaloo about whether there should be an auxiliary shutout center. In fact, GE fought it tooth and nail all the way through but it was put in any way.

Do you in your new designs now, could you say a word or two about your refinement of that design how it is better than it used to be. And what you do to make it at least provide the instrumentation control functions, I'm sure it doesn't provide the fire pump power funtions for shut down in case of intense fire which involve large areas.

MR. QUIRK: Yes, I will.

MR. MICHELSON: When you say yes, you will, are you going --

MR. QUIRK: Right now, yes

(Slide 12 shown.)

MR. QUIRK: The actions taken on GESSAR as a result of the lessons learned from the Browns Ferry fire are listed here.

It is interesting to note that at the time of the Browns Ferry fire the GESSAR II fire protection systems were in the process of being designed. And as you know, Mr. Ebersole, right after that there was a REG-guides and NUREG documents and SPR's that required fire hazard analysis as well as generic descriptions of capabilities to defect and suppress fire.

And the GESSAR design was subjected in great rigor to this scrutiny. And it included, by the way, the redundant single failure proof remote shutdown panel located in separate environmental areas of the auxiliary building such that no environmental phenomenon could take out both divisions of the remote shutdown station.

MR. EBERSOLE: We had the privilege not long ago, about three weeks, of listening to the folks and staff talk about fire protection. And found the curious fact now, in talking about fire protection they were in a highly compartmentalized mode of operation that they weren't talking about fire protection in a systemic sense which would incorporate considerations of the design of the remote panel, whether or not local fires, say intensive fire, in intake buildings or cable tunnels or wherever, would have compensatory controls and provisions in a centralized and distant and immune facility to cope with those unique fires in sort as is usual we found fire protection compartmentalized like most other areas of expertise.

I take it that your fire protection is in a larger context that you look at it in a systemic context and that your records say I can't generate a fire anywhere with my fire gallons of acetone and keep us from shutting down safe.

MR. QUIRK: Yes, sir, I will say that.

MR. MICHELSON: Is General Electric including fire protection in its scope of supply and its design.

MR. QUIRK: Yes, it is.

MR. MICHELSON: What type of fire protection are you putting in the spreading room?

MR. HOLTZCLAW: Mr. Michelson, we will be talking in more detail about the specific analysis that we have done on our external vents for fire protection.

But there is one feature of GESSAR with regards to the so-called cable spreading room in that it doesn't have the -- a cable spreading room per se that's been typical of all other plants. But what the design does have then is probably multiple areas where potential fires could cause damage to cabling in general.

And it ended up that we evaluated multiple areas of the control room where such threats exist. We do have, and I think we will indicate this in some more detail the suppression capabilities in area by area.

MR. MICHELSON: In order to -- just for the sake of efficiency let me tell you what I would like to hear about at such time as you get to the part of the discussion. Generic issue 57 has not yet been prioritized by the staff and therefore it apparently wasn't addressed by you people at least in the formal sense. 57 deals with the effects of inadvertent actuation of fire protection features on equipment and so forth.

And I would like to hear sometime during the next couple of days how you are handling 57 even though you apparently weren't required to address it formally. Thank you.

MR. EBERSOLE: Joe, I think this is a good place to jump ahead. I'm sure you're going to talk to us later on about the UPPS system. I've been an advocate of that system for 16 years and I'm just so pleased I just can't even wait to see it appear.

I want to ask you this, though, and I just pick this as the point to do it. In the design of that system if you pay attention to how it you can make it a defense against numerous unique accident sets, one of them would be fire. On the other hand, you can design it on point basis for which it is only good for compensating for weaknesses in a few other systems.

Would you argue that that system in itself is a good defense against fire if it is properly designed and located and otherwise considerations given to that aspect of the weakness of the current fire protection rationale?

MR. QUIRK: I would not, Mr. Ebersole. If we have learned one lesson, I think, in this industry, I think one of the lessons we should have learned is that you start with a fairly simple concept and then you begin explaining it and reviewing it and separation criteria and redundancy and complicated logic pnd you end up with -- it is not very simple anymore and it is fairly complicated and the reliability may be reduced even.

MR. EBERSOLE: Right, but would you say the UPPS is no protection against fire?

MR. QUIRK: I would say that it is not intended to protect against fire. It is intended to do one of three -- three safety functions. Which are to depressurize the reactor, enabling the alignment of the diesel fire pump systems to pump into the reactor or even a fire truck connection so it can pump into the core.

So the two functions are depressurization and core make up. And then the third function it provides a vent which enables the containment chamber to be vented.

Allowing pass of decay heat removal.

MR. EBERSOLE: So it would not, at least in the present rationale, cope with an unexpected fire of a large size in an office building someplace.

MR. QUIRK: Not designed or intended for that.

MR. EBERSOLE: I think that's going to be an interesting discussion. It seems to me to be a rather catch all, if you look at it.

MR. QUIRK: We have a section, Dave and I here, it is the insights of PRA and things like that. And I think we can get into this discussion there. But the long and the short of it is the dominant accident sequences in our BWR/6 that lead to core melt are extended blackout events and so this system was aimed at knocking down the dominant sequence and reducing the overall core melt probability by order of magnitude.

MR. EBERSOLE: It's selective in its capabilities to improve, it improves the few what you considered to be needed places but not wholesale bunker-type approach?

MR. QUIRK: That's right. Nor even seismic and I think we ought to own up to that. The system is not intended to be a seismic one due to the purchase of air operated valves and operational analysis and things like that.

MR. EBERSOLE: Okay.

MR. QUIRK: Maybe we are going to -- we have all talked about TMI and we are going to get more into the PRA so I don't think we have to go into that. And the Oyster Creek event was really unique to the 5-loop plant where the operator inadvertently tried to close all the recirc loops and thus interpret the natural circulation but because of the bypass lines he wasn't able to do that even though he tried. And it really doesn't apply to the BWR/6. But the Browns Ferry 3 partial scram maybe is of interest and so maybe we ought to jump to that.

(Slide 13 shown.)

MR. QUIRK: Now if I was any good at sales I would have skipped over this one, too.

The description of the event. It was in June of 1980, where there was a manual scram and the normal control rod insertion did not occur when the scram buttons were pushed. That is 10 of the 185 control rods were fully inserted prior to manual scram. And that was because they were coming down on power. They had dropped down about 35 percent power and you do that by putting in some control rods. So 10 were already in prior to the manual scram. 77 rods failed to insert fully upon manual scram. They did partially insert.

The operator then went through procedures that allow him to recharge accumulators, drain the scram discharge volume and hit it again. And 59 rods then remained only partially inserted after that attempt. So he went through the third manual scram and 47 rods remained partially inserted. And on the fourth they all were fully inserted. And that whole sequence took about 14 minutes from the first scram attempt.

MR. EBERSOLE: You are talking about lessons learned. You might mention the statistical estimate of the probability of that event as calculated prior to its occurrence. I think it was like ten to the minus ten or something.

MR. QUIRK: I think that's probably in that neighborhood.

In the lessons learned we felt that you should guard against an obstruction obviously in the scram discharge volume and the scram discharge instrument volume. We have a diagram we are going to present sometime during these two day meetings to diagnose that and talk about it. The design of the scram discharge volume and the instrument volume connector pipe or pipe vent should not produce a trap or a local seal. That is make sure there is a positive vent there. The intent -- we specify in our interface requirements that it should be a positive vent, but sometimes those vents are hooked up to other systems and sometimes what you think is a positive vent turns out really not to be.

Avoid interference with the clean rod waste drain system with the operation of the scram discharge volume and instrument volume system which I just alluded to. Reliable opening of the scram discharge vent line valves was a lesson learned. And adequate vent or drain capacity to insure rapid drainage of the scrm discharge instrument volume.

MR. MICHELSON: When you talked about preventing obstruction I didn't see listed the individual discharge lines themselves which have to come out of the reactor and snake around and eventually get to the modules.

Were there any lessons learned there? That of course didn't actually happen, but it is another form of obstruction.

MR. QUIRK: I'm sorry. What is the obstruction on these lines?

MR. MICHELSON: Pinching off of the discharge lines individually or in groups and thereby pinching off the ability of a section to expose the core --

MR. QUIRK: Our evaluation did look at that, and in fact that is exactly what would have to occur to prevent that rod from going in. A full 100 percent crimp of the line. If it was completely severed circumferentially that would not preclude the rod from going in, or if it was partially crimped it would not preclude, but if it was totally crimped it would. And our evaluation showed that we felt that would be unlikely.

MR. MICHELSON: Well, I notice in your new designs, of course, you have taken apparently greater pains to route this away from high energy pipes and so forth but you are saying that wasn't a lesson learned. That there is some other reason then for your new routings. And if so what was reason for bringing them on in a significantly different manner?

MR. QUIRK: Well, as a result of this event we didn't make those kinds of changes to the BWR/6. In fact, the action taken at the earlier plants was to design the scram discharge volume along the lines of the BWR/6 volume.

MR. MICHELSON: I'm not talking about scram discharge volume. I'm talking about the routing of the individual discharge lines from each and every control rod drive unit.

MR. QUIRK: Okay. I do not know of any action that was taken along those lines as a result of this event.

MR. MICHELSON: Well your design is significantly different than with the BWR/5.

MR. QUIRK: I think that's just through evolution.

MR. MICHELSON: You mean you went to all the extra pain of bringing it out away from the steam lines just from evolution?

MR. QUIRK: And system requirements on separation and pipe whip and segregation of high energy lines, yes.

MR. EBERSOLE: Joe, this whole visit to the Humble Bay plant reenforced a position I already had. Wnich was if one thing, as you say, could add redundant and diverse instrumentation and stack instrumentaion all over a system which has intrinsically and fundamentally got some problems, in general that's not a mode of operation to be preferred.

One ought to pick a system that doesn't have problems in the first place and then improve on it if you have to. Not overcome intrinsic problems with it. You have added redundant and diverse instrumentation, and of course you are trying to overcome the potential of this common dump volume from being plugged up with water or whatever. I mentioned, I think, and I'm not certain that Humble wouldn't do that.

But there is another thing. The logic here -- and I guess I will stick to this till the day I die I think one ought to know the rods are home before you close the exit path. Do you follow me?

MR. QUIRK: Yes.

MR. EBERSOLE: How the language can lead you down the primrose path either that or your redundant vent and drain valves. They are not redundant to open, they are redundant to close. And the good reason for that is in the current Hatch report. Have you all got the Hatch report? It is a scenario of unbelievably ineptitude operations, et cetera. Where they did have only single drain valves and those leaked. The membrane didn't fail, I think that had a probability of here like ten to the minus fourteenth or something, but the valves stuck open.

Isn't it true that when you say redundant here you mean redundant to close? This is not a four-valve matrix you have put in, is it?

MR. QUIRK: Let's see now, redundant to close?

MR. EBERSOLE: To keep it from leaking once you execute a scram.

MR. QUIRK: Yes, I understand.

MR. EBERSOLE: It would take a four valve matrix to also guarantee it opening plus the monitoring on the first failure of each. I don't think you have gone that far. Am I right?

MR. QUIRK: I believe you are right. It is redundant to close and not to open.

MR. EBERSOLE: These catch phrases can lead you straight down -- well the uninitiated can think you have done a good thing but you have only made it worse, and even the context I'm talking about you've made it easier to close the dump volume.

MR. QUIRK: I understand fully your comment and I think we have talked about this before and I guess we continue to agree to disagree.

MR. EBERSOLE: Right.

MR. QUIRK: The design has been shown to have excess volume in it so that with the valves closed and even at a high level fill point there is sufficient volume to take the discharge.

MR. EBERSOLE: Well maybe that great step to gravity drop rods out of the steam separator will fix it.

MR. QUIRK: I will say that in the ABWR presentation you will be probably gratified to know that we don't have a scram discharge volume anymore.

MR. MICHELSON: How do you handle the interface now between the scram discharge volume and the clean rod waste system? Or is that a part of the scope of supply as well?

MR. QUIRK: It is not a part of the scope of supply. But we have taken steps to insure and have the owner check to insure that there is a direct vent path and that if the connects to another system, that he assures himself that that connection provides a vent path. Our guidance was even more strange than that. It was have a dedicated vent path and don't hook it up into another pipe.

MR. MICHELSON: Dedicated to atmosphere?

MR. QUIRK: Yes.

But what I wanted to point out before we leave the Browns Ferry 3 event was that this problem was as a result of an earlier design that had two volumes a discharge volume and an instrument volume and there was a pipe that connected the two. And it was a blockage in the connecting pipe that caused this event. And that the solution that was implemented in the field was to have a common volume. One discharge volume with instruments mounted on it and thus it prevented this same thing from happening, although Mr. Ebersole will point out that there are still other possibilities of having the discharge volume full and thus not enable a scram.

And we believe we have addressed that by providing additional instrumentation to monitor the level and even the temperature so it would detect leaking values to begin with.

(Slide 14 shown.)

MR. EBERSOLE: It is always possible to tie a loose design together with string of various sorts.

MR. QUIRK: This I will skip through in the interest of time, because I think it is a good news story and it is one that we like to tell at General Electric Company.

We have multiple test facilities in our plant in

San Jose that test anything from the critical heat fluxes in the fuel assemblies to the suppression pool dynamic load phenomenon to the materials, laboratories and the test before use is employed where ever possible. And I will admit a lot of these facilities came in after we had a fleet operating.

But better late than never and we have learned a lot from these test facilities and it is helpful to support the fleet in its operating history and we take great pride in the test facilities we have at GE and we always make it a point to show guest visitors a tour of these facilities.

MR. MICHELSON: A test of particular interest and one you may hear a little more about from time to time is a test to assure the operability of certain isolation valves under the dynamic conditions they were intended to see when they were put in, for instance isolation valves designed to intercept full pipe breaks downstream.

Can you tell us briefly what you have in mind for testing such valving to insure that indeed under these conditions it could intercept the break or maybe you have no breaks that have to be isolated with such valves in that case you wouldn't need a test. I'm sure there are but I just --

MR. QUIRK: Let me refer to a test here of the main steam isolation valves.

MR. MICHELSON: Well, let's not use them because everybody is pretty familiar with main steam I'm thinking of the little more mundane ones.

As Jesse pointed out, reactor water clean up isolation valves are always good ones, because you can't use the check valve on the supply side there so the valves have to intercept the break. And it is about a six-inch line break outside the containment at full temperature and pressure.

So what kind of testing is General Electric going to propose for their scope of supply for the reactor water clean up plan? Maybe you don't have the answer at the moment. Maybe in the next two days we could get just a brief discussion of that aspect. RCIC line is another one that might be of interest.

MR. EBERSOLE: Joe, once you show us how well these valves are going to do this job a subsidiary aspect of this is, how well are they going to work after 25 odd years with the surveillance test that you put on to show that they can still do it?

MR. QUIRK: That's a tough one. I don't know.

MR. EBERSOLE: I know. There are ways to go at it though, like truck measurements or whatever.

MR. MICHELSON: But you'd like to at least be sure that when you start out that it would work and you then experience such a break that you have to get into the aging arguments which is another whole field.

I'm wondering which assurance you have initially that these values would be able to intercept the break that they are designed to intercept. Keeping in mind flashing fluids, two phase flows, flow rates several times normal, whole differential pressure at the time of final exposure, choke flow through the valve at the time of final exposure and so forth. These are all the real world effects that that value sees if there is a break downstream it is trying to intercept.

MR. EBERSOLE: The alternative is the design approach which says so I can cope with an extended run down or blow down. As some plants, I think notably Limerick, is showing they can do pretty well with this in certain cases.

MR. QUIRK: What do you mean by extended blow down?

MR. EBERSOLE: They can take a prolonged blow down at least on steam side.

MR. MICHELSON: They really can't take the -- if the valves fail to function they can't handle it they cannot not handle an indefinite blow down reactor water clean up.

MR. EBERSOLE: Oh, I know, I didn't mean that. I said in special cases like steam supply to the HPCI.

MR. MICHELSON: They can't handle it there either for very long periods of time. They really haven't addressed that. They're depending upon redundant systems to isolate eventually.

And here I would hope that the answer -- the answer is obviously on reactor water clean up there is a redundant isolation valve arrangement my only question is are we sure ii will work. Because if one valve doesn't fail to function the other one may very well fail also for the same reason mainly it wasn't designed to handle that kind of blow down condition but redundancy is not an answer it has to be qualification by testing which is kind of what your slide was talking about.

MR. QUIRK: Are you also including the check valves?

MR. MICHELSON: No because on the supply side you can't use check valves. On the return side you can use a check valve for one of the valves, which you do.

MR. QUIRK: Which we have.

MR. EBERSOLE: This is the out bound flow.

MR. QUIRK: This is the section line off the recircs in the line.

MR. MICHELSON: It's a blow down -- it's a six-inch break in the recirc line outside of containment.

MR. QUIRK: We will add that to the list.

(Slide 15 shown.)

MR. MICHELSON: One question along the same line, you are designing completely the reactor building and the the divisional walls and things of that sort. You are compartmentalizing the buildings to your specs?

MR. QUIRK: Yes.

MR. MICHELSON: None of that is outside --

MR. QUIRK: We are talking about the nuclear island which includes the auxiliary building and the fuel buildings the rod waste building and the diesel generator building and the control building.

MR. MICHELSON: Auxiliary building is what we used to call the reactor building, I guess, it is outside of containment now and you are now going to be using that term.

MR. QUIRK: Yes.

Well, purposely in the interest of time, I skipped through the testing.

We encourage and welcome any of you to San Jose to have a personal tour of these facilities. If you haven't seen them, I would recommend that you do. A lot of interesting information and data is being developed and applied because of these facilities.

MR. MICHELSON: One brief question on testing of the suppression pool process. You went through a large number of Mark III tests to demonstrate the viability of this process. Sometimes in the next two days could you have somebody tell me very briefly how you finally determined whether or not entrained air in the pool was a problem or a non-problem keeping in mind that the air comes in with the steam and the steam is rapidly condensed and leaves finally entrained air that then bubbles up to the surface and leaves again. Is that entrained air a pumping problem for the RHR system?

MR. QUIRK: No, it is not.

MR. MICHELSON: But do you have some tests results that simulated that situation sufficiently well so you can say it is a non-problem? Or is it just that you think it is a non-problem?

MR. QUIRK: The discharge points through the quenchers are in an elevation above suction points for the RHR so any entrained air does not get down to the elevation where it can be sucked in.

MR. MICHELSON: Your suction is now at the bottom of the pool?

MR. QUIRK: Yes.

MR. MICHELSON: In earlier models --

MR. QUIRK: It is off the bottom some amount but it is still --

MR. MICHELSON: Four or five feet off the bottom as opposed to near the top as it is in some other earlier designs for Mark II, for instance.

Then another question I would like to hear about in the next couple days is I'm wondering in PRA whether or not you figured the finite probability of value rupture. Some PRA's for like Limerick which we just got done retaining, they do have a finite probability valve rupture.

THE REPORTER: Would you please keep your voice up.

MR. MICHELSON: In the case of GESSAR if you do experience the RHR value rupture which is the first value out board of the suppression pool you proceed to drain the pool into that area you will tell me how you confined the drainage and what the ultimate effect is and so forth.

Or are you going to tell me it is incredible it is not a part of your PRA?

MR. QUIRK: We have looked at that.

MR. MICHELSON: Is it credible or incredible. Other people in doing BWR's are claiming it is credible you put a low probability on it but when you started looking at the consequences it begins to get a little more interesting even though it is a low probability event.

MR. QUIRK: We have evaluated that.

MR. MICHELSON: And you will tell me in the next couple of days?

MR. QUIRK: Yes.

MR. MICHELSON: That's all I really wanted to know.

MR. ROSENTHAL: Jack Rosenthal. I think that you will have to provide a better description of the location of the ex-quenchers and the RHR. Our recollection is somewhat different than yours and maybe now or later we could draw him a picture and I can point out where those items are. That always helps.

MR. QUIRK: Well, that picture I don't think will serve the purpose.

MR. ROSENTHAL: Perhaps just point that out or later.

(Slide 16 shown.)

MR. QUIRK: Mr. Rosenthal, handed me this picture which is of a Mark III and you can see the SRV discharge line that comes off the vessel and goes into the water. This is not to scale, I don't believe. But it doesn't show the suction relative to this discharge.

MR. MICHELSON: How far from the bottom is the discharge quencher?

MR. QUIRK: So what I propose to do --

MR. MICHELSON: I asked a question.

How far from the bottom is the quencher? Five feet?

MR. QUIRK: Let's's see here, five foot four.

MR. MICHELSON: Where is the RHR suction relative to the bottom of the core?

MR. QUIRK: I'm going to have to show that from a picture. I don't recall what it is.

MR. MICHELSON: All right.

MR. EBERSOLE: That's a poor cartoon because it shows a potential for suppression bypass in the pipe and that's not --

MR. QUIRK: Yes, that is a very poor picture. It is not that way at all. In fact it enters the water on the drywell side so that there is no potential for that kind of stuff. This isn't GE's slide.

Okay. I would like to wrap up this section and move on to the rest of the program, but what I've hoped to do here is go back over and show you that the GESSAR design has not been revolutionary, evolutionary is a better word that we hope we have left with you today. And that it takes the strength and the benefits of experience from different features in the reactor designs and containment designs as well as abnormal occurrence and operational feedback and testing results.

And we believe that all of these have been incorporated and wrapped up in the BWR/6 Mark III making that a very very safe design as we will talk about when we get to the period.

MR. HATCH: Joe, I'm Steve Hatch, ACR's consultant. An important aspect of any PRA is the frequency of initiating events.

Could you comment on the evolution of the GESSAR design with respect to how often you expect the plant to trip and perhaps what insights your data evaluation team that you described earlier might have gotten from other utilities or perhaps the Japanese with respect to keeping the frequency of initiating events to a minimum.

MR. QUIRK: Let's see. Let me talk a little bit on that. If this doesn't fully address your question, we will get into when we get into the details of the PRA, because initiating event frequencies were an important part of that.

Earlier Dave Okrent was saying that there are never a different internal staff memos that talk about differing opinions but that didn't prevent the staff from having many differing opinions with us. And one of them was initiating event frequencies and that we took the data and analyzed the data with respect to the actual BWR/6 configuration. And we tossed out data that didn't apply to that design because of evolution features that, you know, designed that problem away.

And we, you know, with our system experts applied the data to our actual capability and ended up initiating event frequencies which were much different from the staff and we couldn't resolve this dispute. And the staff ended up using their number, which we felt was conservative.

But we also felt that it kind of became a moot point when we looked at the enhanced capability RCIC system that would operate to handle initiating frequencies that resulted in say a blackout event and with the up system you know. It tends to make the argument not too important when you can take the consequences and show acceptable results.

So we felt that rather than get into a knock down drag out over the initiating event frequency numbers that we would show the capabilities of existing system or the new system that we added that would offset that.

I don't know if that's responsive to your question, but technically we will talk more about the actual numbers and which data points we tossed out.

MR. HATCH: I guess I was more interested in whether there were any particular design evolutions that had been done specifically addressing the reliability question. That might be of interest to bring up.

MR. QUIRK: I see.

MR. EBERSOLE: Joe, when you do talk about this later I wish you would tend to the fine structure of what is an initiating event. If I say an event is a spurious scram because somebody hit something with a broom or something and it was just an exercise of the shut down function. That didn't really trigger a safety system in the context of real need. Okay?

MR. QUIRK: Yes, okay.

MR. EBERSOLE: That would be true if in the course of the accident -- I'm not sure this always take place -- you maintain the configuration of normal modes of operation if you swung into bypass and taper down the main feeds and you didn't ask RCIC or HPCI or any other critical systems to jump up and do their thing. I call that a benign shut down. And that's really not an initiating event in the context that time talking about.

On the other hand, if you demanded that a bunch of systems stand up and answered without fail that is. The fine structure of this I think needs to be addressed when we talk about initiating events.

MR. QUIRK: Okay. We'll do that.

MR. MICHELSON: Did you say that RCIC had some enhancements? And if so when are you going to tell us about these?

MR. QUIRK: I'll talk about it now.

The design requirement that the license design bases for the RCIC system is that it handle blackout for two hours. Our GE design specs for BWR/6 say four hours. So our design exceeds the licensing requirement.

In meetings with the staff I observed that we had often undersold the capability RCIC system and for reasons

I never knew. Because I felt that the RCIC system had a much better capability beyond two hours or even four hours. And the staff felt that if that was so it would be important to say because in the PRA if you can say you can withstand a total blackout for four to six to eight to ten hours that was a very important feature and it ought to be quantified.

So as a result of their request GE provided an analysis on the actual equipment capability to withstand a blackout situation. And along with that submittal we identified some design changes that were common sense we felt and would facilitate the operator in surviving the blackout.

Now, the staff interpreted these changes to mean you needed to make these changes in order to accomplish the extended blackout capability but we didn't communicate very well with them that that is not the case. That it just enabled them to survive the event without leaving the control room, for example. And that in some cases he could have access to a valve and switch it from the suppression pool to the condensation tank. He could go out in the building and do that. But there are other cases where maybe he couldn't. So I'm not saying all the changes.

MR. ROSENTHAL: Excuse me. If you go back to the initiator, which I think is where the question was more oriented to.

We're under the general impression that things like the turbine control system, which has been a traditional source of spurious trips is probably better designed.

There has been a lot of electrical-type electronic instrumentation control type initiated spurious trips of the plant and GESSAR design probably has an overall better instrumentation control system with respect to spurious trips through the solid state equipment trips -- so at least in -- I could speak in a qualitative fashion along with what one would expect less spurious trips at least from the GESSAR plant than from earlier designs. We have people in the room who could speak to it quantitatively.

MR. MICHELSON: That wasn't my question and that wasn't the train of thought. The train of thought was consideration of what had been done to RCIC to enhance it. And you told me you are really doing various things or taking advantage of things that are already features already there to move it on up to maybe ten hours.

MR. QUIRK: Right.

MR. MICHELSON: Is the ventilation system in your scope of control? Which is one of pinch points on making RCIC last for ten hours.

You're designing the building. Are you also designing the heat removal capability from the rooms so that you are assured that it will work like you think it will work?

MR. QUIRK: Are we?

VOICE: Yes.

MR. MICHELSON: One of the design requirements of your heating and ventilating designers then is lost of off-site power. There is a heat removal mechanism in the RCIC room that will take heat out for ten hours or control heat for ten hours?

MR. QUIRK: No not in the RCIC equipment room we evaluated the --

MR. MICHELSON: How do you take credit for ten hours of operation if you don't take heat out? Whatever the feature is that's what I'm trying to get to.

You are supposed to be telling me what you've done to make it last ten hours in a power blackout.

MR. QUIRK: We have Don Knecht here who is -- wait a minute -- you Don are scheduled to give a presentation on blackout?

MR. KNECHT: No.

MR. QUIRK: Please come up.

MR. KNECHT: I am Don Knecht with the GE System Engineering Department.

The RCIC room temperature was studied as part of our safe blackout evaluation. What was found was that by taking credit for the heat sinks in the unleaded piping and also in the walls and the other equipment in the room, that the room temperature would not exceed the equipment limits for, I believe, it was on the order of 12 to 16 hours, something in that order.

So there was substantial capability in that room, provided that we use the condensate storage tank as a source of cold water for the RCIC turbine.

MR. EBERSOLE: Well, does this put the pinch point back on the batteries?

MR. KNECHT: It did in our back analysis.

MR. EBERSOLE: I've never been really able to figure out if it was worth anything or not but if you didn't want the pinch point to be on the batteries you could cheaply avoid it. You could just put an engine driven DC charger on the system at modest low cost. I don't know whether it is worth it or not, of course. But do you consider that pinch point to be a place that you would want to make a cheap improvement.

MR. KNECHT: Well, I think when we looked at the results of the blackout analysis and tried to weigh that against the PRA results that going much beyond ten hours --

MR. EBERSOLE: Didn't help you out? Can you hang out for ten hours on the batteries?

MR. KNECHT: Yes we can go that long.

MR. MICHELSON: I would like to pursue the rest of your answer since I didn't come back to get some clarification.

If you are lasting 12 to 16 hours I'm very surprised that you aren't in thermal equilibrium by that time and you can go on forever. Your heat sinks it's a strange calculation that will last for 16 hours and yet apparently then reaching a limiting point. So I'm a little surprised on that. What temperatures did you reach at the end of 16 hours?

MR. KNECHT: I believe it was -- my memory is unclear on the exact number, but I believe it was on the order of 175 degrees or something of that order in the room.

We have the report here I can look it up for you.

MR. MICHELSON: Can we just get a copy of the report instead?

MR. RUBIN: I'm Mark Rubin from the reliability risk assessment group. I think that the committee should be aware this is an area under active investigation. The ultimate capability of the RCIC system is one we are evaluating now and discussing with General Electric.

MR. MICHELSON: That's fine. That's great. However, I would like to read for myself.

MR. RUBIN: We are still continuing our evaluation of it also.

MR. MICHELSON: Another question. Whatever your calculation shows to be the 16 hour conditions in the room, are you qualifying them all equipment associated with RCIC in that area for that condition?

MR. KNECHT: The qualification limits or basis for the equipment is 12 hours under -- it's a slightly different envelope than what we have under a blackout. But we have considered the equipment capability in excess of what it is actually being qualified for. What it would realistically be --

MR. MICHELSON: Can you give me a number for the classification then. What is it?

MR. KNECHT: Looking here at the results --

MR. MICHELSON: You can answer this all later, if you prefer. Why don't you answer it later after you have looked it up.

Because another question I would like to have answered is: what have you done about fire protection features? Which are up in the range of actuating now? What have you done about the steam isolation features which when you get up to these temperatures they think there has been a steam line break? How did you handled this whole thing to assure that for 12 hours nothing will go wrong, which I think is the position you are taking? It will take a few minutes, but maybe sometime in the next few days.

MR. KNECHT: I can address those later on.

MR. MICHELSON: And also address the electronic governor on the qualifications of the governor that you are going to use on the RCIC turbine.

MR. KNECHT: That one I might be able to answer quickly.

MR. MICHELSON: Why don't you do it all later though for the sake of time.

MR. KNECHT: Fine.

MR. QUIRK: We still have a question over here that I would like to take up later as well as -- but let me understand what I think your question to be.

Are there hardware improvements that we have made that lessen the demand for scram or transient events from occurring?

MR. HATCH: Perhaps as you go through your description of the GESSAR design if there are certain instrumentation and controls that have been changed or any set points that have been lowered with the specific intent to reduce the demands on the safety system I think is appealing.

MR. KNECHT: Okay.

MR. QUIRK: Dr. Okrent, that concludes this portion of the presentation.

I could continue with the next one.

MR. OKRENT: Well, according to the agenda this was about the time for a break. So I would suggest that we do that at this time and try to be back in ten, but certainly take no more than 15 minutes.

(Recess taken.)

MR. OKRENT: The meeting will reconvene.

If I understand where we are on the agenda, we have gone through GESSAR evolution. Have we finished description of GESSAR II Nuclear Island, or have we not begun it?

MR. QUIRK: No. We have finished that, by definition.

MR. OKRENT: All right. In that case, current status of severe accident policy. And I guess the staff is up first.

MR. THOMAS: Just in the interest of time, I'll be very brief.

MR. OKRENT: You don't have to be brief.

MR. THOMAS: There is a lot of history of the severe accident policy statement. I won't burden you with going back through all of that.

I think the important thing is on September 19th new Reg. 1070, which contains the proposed severe accident policy statement was sent to the commission for their approval by second key 84 370. Second key 84 370 recommended that the commission consider approval of the policy statement in an open meeting.

And on October 9th, 1984 the commission held such a meeting. During that meeting the commission had a number of questions for the staff, and we understand the commissions, in the process of formalizing these questions and will submit them to the staff for their response.

In fact, I understand the staff maybe has already received some of these questions.

The staff expects to be able to respond to these questions during the course of the next couple of weeks and is optimistic that the commission will approve the severe accident policy statement shortly after receiving the staff response.

MR. OKRENT: Do you know what the nature of these questions is?

MR. THOMAS: I don't.

Dino, can you add anything? Do you have any feel from your attendance at the meetings?

MR. SCALETTI: I don't think that they were too specific at the meeting. They did indicate they would put them all in writing and submit them to the staff the following week. And I know that some indicated they had many, some indicated they didn't have any at all. That's the best I can tell you. Just general discussion about policy and the need to have a policy in a relatively short period of time.

MR. THOMAS: One thing that is important is from the discussions at the meeting and subsequent staff discussions, it is our understanding that at least the commission has expressed no concerns exclusively about the requirements of the severe accident policy statement as they would apply to standard design such as GESSAR. So that's one area where we are not expecting questions.

MR. OKRENT: Maybe Mr. Savio can find out for us by tomorrow what the questions are.

MR. THOMAS: That was all I was going to say on that subject.

MR. OKRENT: Let's see, then. Can I ask one or two questions of the staff.

Does the staff feel that the draft severe accident policy statement gives it guidance on how to make decisions regarding the level of safety it should seek in a new FDA? I believe the new policy statement somewhere says that future plants should be safer, or words like this.

Do you feel that you have guidance. And if so, would you explain the guidance to me.

MR. THOMAS: Beyond what you have said, we would be hard pressed to say that the draft policy statement provides any more specific guidance.

MR. OKRENT: Well, how is the staff going to arrive at judgments as to whether a new FDA conforms with the commission's wishes that new plants be safer?

MR. THOMAS: There are a number of requirements in the policy statement for new standard designs that have not been requirements for previous designs, at least as explicitly.

Besides having to comply with the latest version of the standard review plan, the severe accident policy statement would have us consider the unresolved safety issues, the medium and high priority generic safety issues, and so on. It requires the technical resolution of these issues, perhaps in anticipation and in other cases before the generic resolution of these issues are arrived at.

That sort of thing, I think, plus requirements for design improvements such as the TMI rule requirements, gives us some sort of -- some assurance that at least these matters have been considered, along both deterministically and with insights from the PRA.

Of course, the use of the PRA is somewhat nebulous too. The policy statement, draft policy statement, doesn't give us explicit guidance on what is an acceptable criterion for use of the PRA. It talks a little bit about the safety goal. It said that we have explicit orders not to use the safety goal. Nevertheless, the direction we take should be congruent with the evolving safety goal.

So I think having directions to look at more specific deterministic matters than we have in past reviews and to use the PRA for insight, that's the way we believe that was intended for us to assure ourselves of this plant was -- that this design is at least as good as those that are out there now.

MR. OKRENT: I must say I would be hard put to explain to the committee what the staff's method of deciding a new plant was safer was from what I've heard.

Weren't near-term construction permits supposed to look at generic items and develop safety issues?

MR. THOMAS: No, they just had to satisfy the CP and L rule.

MR. OKRENT: It had to have a PRA, but they didn't have to look at the --

MR. THOMAS: The requirements for the near term -- maybe we are talking about two different things. Prior to the severe accident policy statement drafts, the near-term construction permit applications that were pending at the time of the TMI accident did not have to do with PRA; they only had to satisfy the --

MR. OKRENT: I'm sorry. There was a group of plants that had to be with PRA as part of their --

MR. THOMAS: We're asking for any new applications, be they standard or custom, to do a PRA. The policy statement currently says that for reactivated CP's they will be considered separately. The policy statement is silent on that. That was a fairly recent change.

MR. OKRENT: I'm sorry.

MR. EBERSOLE: May I ask a question on that?

PRA suggests a sort of continuity -- well, if you could state the picture in its overall context. But there are really two aspects of the containment design that mitigate it. And then there is an effort at preventing, which can run the gamut from not too good to very good indeed.

I think this plant here has got a good a chance as any I know to prevent core melt -- a great deal better than most.

What does that buy them in the context of reducing requirements on containment design? Anything? What is the rationale? Can I get a set of words someplace that gives me a practical approach which is guaranteed that I can follow and not get in trouble later? I see ourselves on the horns again, and I don't like to stay there.

MR. THOMAS: I believe the policy statement goes into striking a good balance between prevention and mitigation. Beyond that it doesn't give much in the way of guidance.

We have essentially the same dilemma you have: which basket should we put our eggs in? How can we be assured we have the right eggs in the right basket? It is really left to judgment.

MR. OKRENT: Has the staff made some kind of an estimate of what the containment performance for GESSAR II is, given a severe core accident?

MR. ROSENTHAL: Yes, we have --

MR. OKRENT: On the average, as it were, over the range of accidents with their presumed frequency?

MR. ROSENTHAL: We have estimated conditional consequences, yes, and those estimated conditional consequences are lower for GESSAR than for other PRA's that we have in review. That's a very measured average statement. But in any case, one can look at conditional consequences, either from GE or from the staff, and compare them.

We are also struggling with a containment performance goal as part of the safety goal evaluation plan, as you know. And I think that the original concern was that there would be a trade-off between prevention and mitigation unbounded, and one would end up with arguments on very low estimated core melt frequencies in a paper-thin containment.

And that is not the case in practice. We don't see claims for across-the-board -- in other words, concern for very, very low for sacrificing the containment integrity. So the hypothetical question of striking this balance just doesn't seem to be a pragmatic problem when we look at actual proposed plants like GESSAR.

MR. EBERSOLE: Wouldn't this plant -- since it has this low probability of core melt, and it employs a pre-accident venting method to enhance the reliability -- wouldn't it be a natural successor for it to fall into a post-accident venting approach with due regard for control of fission product retention in the venting process?

MR. ROSENTHAL: Well, we would -- GESSAR will -- or the applicant referencing GESSAR would use the then-current version of the GE emergency procedure guidelines, and those include provisions for wet-well venting.

MR. EBERSOLE: I'm talking about post core damage.

MR. ROSENTHAL: Post core damage, yes.

MR. EBERSOLE: Which would suggest some additional treatment of the discharge, effluent discharge.

MR. ROSENTHAL: Well, in many of the --

MR. EBERSOLE: Down raw discharge.

MR. ROSENTHAL: In many of the sequences in the GESSAR PRA's a containment is assumed to fail due to hydrogen phenomena, which is a method of venting, in its limit, and one looks at the efficacy of -- well, the fission product distribution including the efficacy of the pool, and one concludes that the conditional consequences are acceptable and are low compared to other designs that we have seen. Now --

MR. MICHELSON: I have a question for Cecil Thomas.

You remember earlier this morning we discussed the fact that certain of these generic safety issues are not yet prioritized, and therefore really haven't been considered. In the severe accident policy I don't recollect that they differentiated between those that might have been prioritized and those that might not have been prioritized. Is that correct?

MR. THOMAS: It is my understanding that the severe accident policy statement explicitly says that you will achieve the technical resolution -- you will consider and if necessary achieve the technical resolution of the unresolved safety issues and medium- and high-priority generic safety issues. And I believe the staff interprets that, any issues that were identified had to at least go through that ranking process and be labeled one of those three.

MR. MICHELSON: It did actually identify the medium and highs on those?

MR. THOMAS: Yes.

MR. MICHELSON: So I guess until such time as it's deemed to be medium or high or something, you can avoid that issue completely in looking at GESSAR.

MR. THOMAS: Well, I would prefer not to say we could avoid some of the --

MR. MICHELSON: Well, in reality you are avoiding it until such time as it is prioritized, I assume, unless you can show me in some other way it is addressed. And I didn't find it in the document that I read. The SER didn't address those issues that hadn't been prioritized.

MR. THOMAS: That's the way we are using the proposed policy statement.

MR. MICHELSON: But that seems then to be consistent with the severe accident policy statement.

MR. THOMAS: Yes.

MR. MICHELSON: Thank you.

MR. EBERSOLE: The one with a one-horse shake. It's the entire conversation. Some people seem to advocate it, but I don't. And what seems to come out of this is, considering the capabilities of suppression pool, are we saying that what this looks like is, we need what I would call an extremely robust dry wells, which guarantees suppression, and then a more or less standard approach to the residual part of the containment design? Is that what I'm beginning to see come out the shadows here?

MR. ROSENTHAL: Yes.

MR. THOMAS: Yes. We have to be careful here. The staff is not a designer. We -- Even though on occasion we do tend to get into the design part of it. But what we have to do is evaluate what was presented to us. And we find it it is either acceptable or not. The criteria, as Dr. Okrent currently has pointed out, aren't always that helpful to us. That's the posture we are in.

MR. EBERSOLE: The criteria more often than not come out of a mental design, anyway.

MR. ROSENTHAL: May I just offer a word on the USI's and generic issues.

I was involved in some of the policy writing. And I see this thing in a much more positive light. Now, if you go back a little bit, the hearing boards have prescribed how the staff treats generic issues. And with three reasons -- three ways of treating it on any plant: either it is not applicable, or it is fixed on that plant, or it can be postponed in terms of if there is time to repair it. And we have to make those findings on every single operating license.

Now we go to --

MR. MICHELSON: Just for clarification before you proceed. You make those findings on all generic issues --

MR. ROSENTHAL: On all --

MR. MICHELSON: -- irrespective of whether prioritized or not?

MR. ROSENTHAL: On USI's.

MR. MICHELSON: Oh, on USI's. Okay.

MR. ROSENTHAL: On USI's. And in normal LL, you will find a section which describes the status of each one. It is not applicable. It has been fixed on that specific plant, although the generic problem is still there. Or alternately there is time and expectation it can be resolved. ETS would be the third category.

Okay. The managers, our manager said, "No. Wait a minute. We don't want to keep just pushing things off. Let's actually get some of these things resolved."

And I think that the policy statement is a much more positive thing where the goal was not to indefinitely push things off in the future, but to actually get stuff done. Or resolved. So I think it is a much more positive thing.

MR. MICHELSON: We are not questioning the USI's. We are questioning the generic safety issues and how they are being handled. I don't think anyone is questioning how the USI's are being handled.

So in the sense of GSI's, I'm not sure there is a positive step being taken, unless the staff has already decided that it's a medium or high priority issue. And until they decide, nothing happens even though it might be a high or might be a USI if they stopped to think about it for a moment.

But until they stop to think about it in some future schedule, nothing will happen. That's the thing that concerns me.

MR. THOMAS: To say nothing will happen may be just a tad of an overstatement. If in the regulatory analysis it is determined that it should be backfit on everything, sure.

MR. MICHELSON: The problem is, of course, the staff is not obligated to make a conscious examination of the issue, since it hasn't yet been prioritized. But they might make an examination anyway, and that's great. I wish they would with every one of these items, document that they have looked at them. I cannot find such documentation. So it is a happenstance if you do look at something and you decide to treat it anywhere.

MR. EBERSOLE: I have to say, I hope we are going to eventually get rid of this need for what I call point type backfitting. We have got to quit that. That will kill us all. We have got to have a distant immune backup capacity that eliminates the deeper point backup -- or backfit. We find the vulnerability, but then we say, "Oh, well. I can cope with it."

I think this plant is moving toward that kind of capacity. Or it can.

MR. THOMAS: I certainly agree with you on the point backfit. You know, it is a timing problem. It is a trade-off. It is a compromise situation. You have got to stop somewhere. I prefer to see backfits and any kind of new requirements considered in an integrated fashion as opposed to, "Hey here's a band-aid approach for this particular problem."

To be able to factor that into the PRA you somewhere along the line say, "Look, we have gone far enough. We have been reviewing for umpty-scrunch years. We're going to look at this in an integrated fashion." Otherwise you are forced to go the point route, and that's not the most desirable.

MR. EBERSOLE: We have been on the point backfit road for 20 years. Our plants look like barns with 40 uthouses on them. And I would like to get away from that.

MR. OKRENT: Let's see if we could get back to the guidance the staff may think it has or it has adopted on the decision-making as part of this draft severe accident policy statement.

And let's look at the role of the PRA.

Can you give me in some specific fashion what you think the role of the PRA is, the role of cost benefit analysis, the role of other considerations in decision-making on, for example, the advisability or not of additional features and what these other considerations are? Do you have some kind of a cohesive policy that you use in this regard?

MR. THOMAS: Let me just say that was an agenda item for tomorrow morning. We had a presentation prepared for it. Would you like for us to try to anticipate that?

MR. OKRENT: No. If in fact --

MR. THOMAS: I believe at 8:45 in the morning. We can certainly cover those subjects then.

MR. OKRENT: I must confess when I looked at the agenda I couldn't tell that staff was going to answer this question at that time. But if you tell me you are, I'll wait.

MR. THOMAS: We will.

MR. OKRENT: Among the things I'll be interested in hearing about are your views on discount rates and discounting and the role of uncertainties, the role of things that are left out of PRA's. Everything that you think in fact is relevant to decision-making. If you haven't mentioned anything, I'll assume you think it is irrelevant.

We will wait until tomorrow morning at 8:45 on that.

Do you have any more to say at the moment on the severe accident policy statement?

MR. THOMAS: No, sir.

MR. OKRENT: I guess we should ask GE for their comments in this area.

MR. SHERWOOD: I'm Glenn Sherwood.

With regard to the framework for issuing final design approvals to standard plants, we at GE feel that the current version of the severe accident policy paper is adequate to provide the necessary policy framework for the commission to begin issuing these.

I guess it goes without saying that that the commission has no policy at this stage of the game for issuing final design approvals to designs such as GESSAR IV new plant applications, even though there may not be in the U.S. in the immediate future, and our own example is that a final design approval without the severe accident part was issued to GESSAR roughly in July of 1983, and this application is only to plants which already have construction permits. And this turns out to be a number of cancelled plants around the U.S. So technically the GESSAR review really has no product in terms of that application. And we feel that's very unfortunate, since the GESSAR review was very exhaustive, and I think we feel demonstrated that the BWR/6 Mark III GESSAR design is a very thoughtful design in terms of forgiving design with a number of improvements which I think meets the spirit of the severe accident policy paper, as well the committee, in terms of a safer plant.

So therefore, with the approval of the current framework in the policy paper, this would then enable the NRR to, as it were, upgrade the FDA for new applications and would remove any restrictions which the FDA now has.

With regard to let's say the spirit of the paper in terms of a safer design, I have also addressed that point, and we believe that our presentations today and tomorrow will show that the considerations that have been given by our design groups to the various concerns over the last several years have resulted in a lower core melt probabilities and lower dose rates off-site for severe accidents, and a number of other modifications which we believe makes the GESSAR BWR/6 Mark III the safest LWR in the licensing process today.

And that is essentially a summary, Mr. Okrent, of our position on the policy paper. I would be happy to answer any questions.

MR. OKRENT: Any questions at this time?

MR. EBERSOLE: Glenn, I hear what you are saying. There is no market for it. And I guess one of the major reasons for that is just the staff agree to say that they are going to give it a great deal of further massage down the road, and how are they going to certify guarantees they are not, and what controls they are going to put on it so they don't have to. I guess the details any sort of certification of components and equipment, or something. I don't know what the picture is. It is as nebulous to me what plant might see later, as it must be to you.

Does the staff agree they have got a fix on this point with attention to details that can in fact establish a basis for building it without extended and extrapolated future requirements?

MR. SCALETTI: Well, I can say that our review has progressed considerably, and we are nearing the completion of this preview, and I think in this latest supplement indicate our conclusion is we believe it can be built safely and operated safely providing satisfactory resolution of the remaining issues. Yes, I believe we have a handle -- a fix on the plant. I believe the review has progressed and we should be able to say that someday soon.

MR. SHERWOOD: Mr. Ebersole, with regard to your comment about the -- no interest within -- at least no domestic interest for new plants. I think that you certainly know there is interest around the world for new plants. And in that environment, at least in our participation and RFP's to date, all of these countries of interest have required that the plant be licensed in their own country.

Now, we have explained, of course, the fact that the GESSAR has the FDA, but of course we all realize that technically we still have the limitation in the U.S. So therefore it would certainly clear the air or U.S. competition around the world in comparison with the convoy plant and the various other plants which our competitors are licensed by their authorities.

MR. OKRENT: I guess I have a general kind of question for GE.

It appears that public opinion in the United States is such that the public is not convinced that nuclear plants are sufficiently safe. At least this is what I ascertain from such polls of public opinion as are reported. I must confess I've also ascertained it from the opinions of the professional people with whom I have contact who are outside of the nuclear industry. And for example, it wouldn't suprise me if the National Academy were to support research studies or to look at what kind of research programs should be done on what are called the inherently safe reactors, whatever those are.

Is it GE's position that they're thinking about some other reactors than GESSAR II, and GESSAR II is really some kind of a giant step safer, and if they knew this they would feel, you know, look at other inherently safe reactors. This is an inherently safe reactor. They would only -- if we were only on TV, that would be the result. Or that these really are safe enough, but we just have had problems that the public has a different opinion and somebody is going to have to figure out how to do it, but it is not GE. Or just what is GE's thought on this rather complex question?

MR. SHERWOOD: Well, I'll try to respond to that. I'm not sure what the GE corporate view is, but I'll give you my personal view.

MR. OKRENT: Sure.

MR. SHERWOOD: With regard to -- You asked a number of questions, but I'll try to respond to each one of them, if I can.

I think with regard to the issue of the public concern -- and I think we all see that I see that in my neighborhood and even my wife asks me occasionally about the things.

But I think I certainly feel, and I think our staff does, that with the passage of time when the public sees nuclear power plants operated better, with improved staffs on each -- within each utility and with the info having its impact and when the availability improves and the trips are reduced and in general let's say just the malaise we have seen in this country on plant operation tends to wind down, hopefully then, with the improved availability, rates will improve at the same time. That probably the attention we hope will then turn away from plant safety and maybe other concerns, whatever they might be. Maybe it's Star Wars.

But I think there is probably enough things going on in the paper that certainly with TMI happening as it did five years ago, to be a cause for concern by the 50 percent of the public, or 45, whatever, whatever the polls show.

With regard to -- so I don't think there is anything dramatic that can happen to change the public attitude unless there is an OPEC disaster, other than essentially safe operation over a number of years the whole fleet of white water reactor plants, both the B's and the P's. And certainly we have a clue that that can happen with the experience of a number of the utilities in the U.S. and the Japanese and the Swiss. As you well know, some of their records are -- I guess for lack of better word -- impeccable.

With regard to the new designs, as you well know we are a big company that had designed a lot of big equipment like generators, steam generators, and so forth. So the philosophy in a company like ours is one of gradualism and evolution. And we look at the BWR/6 as an evolution over -- as Joe Quirk said -- over essentially 20 to 25 years of a number of designs, where one can get to the point where one can expect a plant to operate with a fairly sophisticated availability base and sophisticated record.

And that doesn't mean that some new plant might not come on the horizon in a decade or two to come, such as PIUS, but certainly a utility would not want to experiment with a billion-dollar project such as PIUS. He is more interested in a safe plant that he knows is operating in a number of locations and can operate for him let's say over 30, 40 years with low maintenance problems and certainly minimum problems with the media.

So essentially what we hope to offer, then, with our BWR/6, is precisely that kind of an offering, namely a very safe design with an opportunity for high availability if the utility operates it properly.

And we also are looking at the new designs. As you will hear later, we are investigating BWR with the Japanese, and we are also looking with some of our research groups at various future designs that the DOE has -- we are in competition with a number of vendors and looking at modular designs white water as well as feeder designs, and so forth. But I think we feel that those are a decade or two away in terms of a practical offering.

MR. EBERSOLE: Glenn, I was reading the PRA data, and I couldn't help but notice that the position of a large loca in the spectrum of accident potentials, one-tenth of 1 percent, I think, or some low fraction of the total risk. Let me go back to the PRA relationship and at least my personal opinion of what happened.

We led the public into their state of disbelief in the reliability of these things by focusing on the wrong things. Certainly the public must think that to shut a reactor down and cool it is an enormously complex problem, especially if something is wrong with it like that. And we certainly might come right into their consternation. And we had a lot from a lot of folks that didn't want to do it anyway.

I think there is a lot to be said for reorienting and honestly -- not erroneously -- telling the public some simple things: if you can shut down a core from the fission process, all you have got to do is cover it with water. If you cover it with water, you can put it in an open pot and pour water on it. That's not an engineering problem that I would call complex. You have moved in this direction. I think the public needs to know how simple a reactor shutdown process can be, and erase that cloud which is even in the universities all over the place, wherever, that somehow to shut down a core takes 14 dozen systems in support of each other all operating in harmony, et cetera, et cetera, et cetera. It's not so. I think people need to know that.

MR. SHERWOOD: Certainly I think we feel the PWR is in that direction. And part of the review that's taking place in the severe accident area will be described to you as is the new source term from the decontamination of the Mark III pool. And that the results from that should show a marked decrease in off-site dose, let's say vis-a-vis the wash 1400 results of six or eight years ago.

So with these results we believe that this should be the basis, then, for our petitioning the staff to revisit the Appendix E and other criteria for emergency planning and evacuation. And I think this would also provide some long-term comfort to the public that things are not quite as grim as they might suspect from the point of view of off-site impact.

MR. EBERSOLE: I think you have got a new base for PR work, which is unconvincing them that that is a tough job, which they have certainly been led to believe up to now.

MR. SHERWOOD: Yes. That whole area as you know as well I do or better is moving very slowly. But nevertheless, it seems that all of the efforts by the various groups are corroborating early initial GE sampling data which shows fairly high DF. So we are fairly optimistic that will provide an area that we can develop into PR later.

MR. EBERSOLE: You have already jumped to the DF I'm in the front of the DF. I'm saying you don't need the DF.

MR. SHERWOOD: I understand. Right.

MR. EVERSOLE: If you jump to DF you invite doubt and trouble again.

MR. SHERWOOD: Right. You have a good point.

Did I answer your question, Professor Okrent?

MR. OKRENT: Well, let's just leave the point where it is for the moment. Let me ask a kind of specific question of the staff as to how they make judgments concerning something being safer and so forth.

It is my understanding that in West Germany, when they look at the question of how many trains of some important system there should be, they not only ask for redundancy but then ask for an additional one which they assume was in maintenance.

Has the staff considered this specific philosophy, compared it with whatever is the approach in GESSAR for systems where this might be applicable, and in some either ordered way or by some judgmental process decided why it is appropriate one way rather than the other? Or hasn't that entered your review?

MR. RUBIN: Perhaps not the exact philosophy you are bringing up from the foreign operators. But to the extent that a structured approach was applied, quite beyond the design basis, I think indeed we have done that, and that was intent of drafting the policy statement, that we include a PRA as part of the process.

Certainly in the areas of the third diesel, which operates the high pressure system, separate and diverse, we are getting into areas where we have additional systems beyond what will be required from the current licensing basis.

Same thing in some of the design improvements, such as the up system, I guess it would be overall influenced by that basic philosophy of depth for the plant protection. And here we are seeing what is hoped to be a simple system completely separate, able to respond to what has been identified in the risk study as the major frequency of core damage, the loss of off-site power.

So I think the intent of what drove some of the foreign operators into their third train, for instance, really is what is controlling us from applying this process.

I think it is as rigorous as we can make it, as structured as we can make it, at this time. I don't think we want to to put too much reliance on the PRA as an object to stand alone. There are a lot of things missing from it. We are quite aware of that. But it does give structure to our approach.

MR. OKRENT: I don't think you really quite answered the question. In fact, I have seen PRA studies done which examine two trains and three trains and four trains and so forth, and tried to do cost benefit of evaluations, and they tend, in fact -- at least in those that I've seen -- to say you shouldn't add this extra train that the Germans. On some basis they decided they want to see. I'm trying to understand how -- well, in the first place, whether the staff took this specific philosophic approach and examined it and tried to apply it to GESSAR; if so where, and and then on what basis did you make a decision? Or did you in fact try to apply this on any of the systems?

MR. RUBIN: Yes, we did. That process was done --

MR. OKRENT: Not the diesels, because that's something GE supplied, to the best of my knowledge. So that's not your example.

MR. RUBIN: That process was gone through and is still ongoing, for the design improvement steps considered approximately 85 issues. Cost benefit analyses were carried out by General Electric. Their input was an element the staff is currently cons.dering in deciding what further modifications to the plant are desirable, cost-beneficial to the extent we think it is relevant in making our final decisions. Those aren't complete yet. But indeed we are looking at just those issues: What modifications are sufficient, what would be too much.

MR. OKRENT: You answered a different question, but I won't repeat it.

MR. EBERSOLE: On the matter of the third diesel, that's a little unfortunate topic.

The idea of an independent diverse or even different manufacturer of third diesel requires a great deal of attention on the part of GE and in running surveillance over how that materializes in the field. A GE can botch it, a vendor can botch it. It is incumbent on GE to see that the whole concept isn't botched. It was botched at River Bend. Because the cooling water for the third diesel was provided by one of the other two. I don't know how many cases like that you can find, but what it indicated to me is that GE is not sitting tight on its companions in this business as it should. I was dismayed that GE would let such a thing happen. So you won't let that happen again, will you, fellows?

MR. SHERWOOD: No. Not a GESSAR, anyway.

Professor Okrent, with regard to your question, we were familiar with the size of all work and with generally we have their PSAR's, if that's what it can be called, and we know a little bit about what the Germans did. So we looked at our sequences to core melt, and without any official internal objective, but in general, we wanted to try to come as close to ten to the minus sixth per sequence to core melt as we could. So with the various design fixes and fine tuning that were done on the GESSAR design, we have essentially achieved what we feel the Germans and the English have achieved in terms of their probabilities of core melt. So while we don't have a one-for-one correspondence, we feel we have a similar objective which we achieved. And these results will be discussed with you later.

And it was during that review, one question was, of course, are the shutdown trains adequate? And we found that with the systems that we had in place that we did not need to add an additional RHR system.

MR. OKRENT: Well, I'll not pursue that question further now. At the moment I'm just trying to understand, if I can, the depth, I suppose, of the staff's judgmental process, so I'm asking different kinds of questions.

Let's see. It is 20 to 12:00. It looks like we can try agenda Item 5 before lunch. The staff is up.

MR. SCALETTI: Presently there are ten areas of the severe accident review that remain outstanding as far as staff is concerned. This may be the result of further information being needed from General Electric in response to some staff questions or that the staff just has not completed its review yet.

All of these items will be resolved prior to the staff completing its review.

The following areas are identified in Supplement number two in section 1.8. They are as follows: External events of the seismic PRA, the staff is in final stages of its review. It plans to have it completed and its conclusions in its supplement coming up in early November,

Supplement three. Containment structural analysis was identified as an open item. This results from certain design changes that were made to the Mark III containment to increase the surface level three pressure to 45 p.s.i. By doing this, General Electric made some design changes in the knuckle region of the steel containment. This was previously the failure of the weakest point in the containment as far as the PRA analysis went.

The staff has asked them to provide to us the supporting analysis for the 45 p.s.i. redesign. To review the dry well analysis to determine that the increased containment capability won't have an impact on the failure of the dry well. And also provide an analysis that will demonstrate that containment failure will not cause loss of the suppression pool.

GE is working on this, and we have not received responses from them. We will be meeting with General Electric in the next week and -- to hopefully get the analysis and complete our review, which may not be in supplement three, though.

Hydrogen control is another open item. This was required by the CPML rule and also USI A 48. GE has agreed to commit utility applicants in reference to the GESSAR design to assist them to control hydrogen that will be consistent with the results of the H cog effort and the staff effort being carried on the Grand Gulf plant. GE has also provided the UPPS to further reduce the risks from H two generation.

The staff has not completed its review of the ultimate plant protection system. It has asked General Electric some questions on this and hopefully we will have that resolved in Supplement number three. Potential design modifications, currently we have three or two design modifications plus the UPPS system which has been incorporated into the GESSAR design. We are asking questions on that plus AC crossties and ten-hour batteries with station blackout. I must say that all these systems had a cost/benefit ratio less than ten.

Safety parameter displace systems which is required by the CPML rule. The staff is in the final stages of completing that review and will provide its evaluation in Supplement three in November.

The remaining five issues are -- two of them are USI A 43. And A 43 may have a resolution through the use of UPPS. UPPS is an alternate core makeup process and it may resolve that USI. The safety implications of the control system, USI A 47, is still under review, and I can't tell you more about that.

The three generic issues that are listed there are again under review by the staff.

MR. EBERSOLE: There was something about UPPS that bugged me a little bit, and I am hopeful that maybe you in your review do like -- I remember I used to take this back and bring something back later, and not say anything about what should be brought about later, which is a troublesome position to be in.

I heard it said that UPPS was designed to a narrow scope competence to overcome a few -- well, to provide what might be a few needs here and there. And there have been no efforts to exploit it, if that's a good word, for its broad potential to cope with fires or sabotage, or you can name 14 dozen other things if you want to.

So in evaluating UPPS and looking at its value were you evaluating it in its narrow scope current configuration as GE offered it, or in its potential -- broad scope potential which it might be in?

MR. ROJENTHAL: First of all, with the broad scope PRA without UPPS, the plant shows low risk. And one cannot, from a -- make a cost-beneficial argument without -- to add the system. That's a perspective.

Then there is the perspective is what is driving the risk to the plant? And what drives the risk of the plant is believed to be A 44 and A 45, unless you take the power and the inability to move the KV in the broadest sense of the term, not just -- okay. Then you look for a system that fixes what is broken and if what is broken is the reliability of the AC systems and the -- and questions on decay heat removal, then UPPS satisfies those needs. In the sense that it enhances the ability to cope with station blackout and enhances the ability to remove heat from the primary system. We haven't --

All right. Then the system is originally offered for -- to fill those two functions which is where I believe the emphasis should be spent.

The issue came up, "Well, what else can we use UPPS for?" And clearly, if you have injection paths, you can use it with containment sprays to -- as a mitigation feature, and that's still under review. But I think that --

MR. EBERSOLE: Let me comment on that.

MR. ROSENTHAL: The point is that we are trying to fix what's broken.

MR. EBERSOLE: I think that's an example of a compartmentalized viewpoint of doing things. It is analogous to kind of a broad but point fix. Surely the system has potential for sabotage protection. Surely it has potential for fire protection. It has potential for all sorts of point vulnerabilities which you have compromised to a degree of satisfaction, you think.

Fire is a good case in point. I think it would be extremely ultimately foolish not to cause the scope of UPPS to be as broad as you possibly can.

MR. ROSENTHAL: With respect to fire, you can't use the fire system to suppress the fire hazard because if the system --

MR. EBERSOLE: Look, if the UPPS system is designed correctly the plant can burn down, and you will still cool the core.

MR. FRAHM: I think that the point you are making is GE came in with a fixed design to basically take care of the weaknesses in plant, if you will. And the staff did go back and ask GE to consider adding sprays to the system, plus suppressant --

MR. EBERSOLE: The classical patch approach.

MR. FRAHM: I don't know if I would agree with that being a patch.

MR. EBERSOLE: It might be a broader patch than usual, but it is still a patch.

MR. SCALETTI: Mr. Ebersole, we have not completed our review yet of the system and what it is now and what it may be is -- we just haven't completed.

MR. EBERSOLE: I invite you to consider the sabotage potential of that system. Park it to one side and see what you can do with it. Or the designer ought to do it. I think you can do a lot.

MR. OKRENT: Did you have further comments?

MR. SCALETTI: Yes. The confirmatory issues in SSER one, there were 11 that were identified. Some of these have subsequently been resolved. The staff is awaiting information on three of them and one remains still under review.

Two have been added. We've added A 44 and A 45 station blackout and shutdown decay heat removal. And confirmatories, depending on the final outcome of the staff's review of the optimum plant protection system.

There were three FDA conditions that were identified in FDA one. One of these has been resolved, fuel rod internal pressure, and this is addressed in the Supplement number two, in section four.

Condition two of the FDA one was post-accident monitoring instrumentation. In effect, it would be closed out in January of next year.

And condition three of FDA one, which deals with the Humphrey issues, is still being reviewed by the staff and as yet no date has been set for the resolution of these issues.

MR. MICHELSON: Excuse me. Can you clarify when you say more information is needed versus still under review? What is the difference?

MR. SCALETTI: One of them is that more information is needed. We are awaiting information from General Electric. If it is categorized as being under review, the staff has the information needs at hand, and it just has not completed its review yet.

MR. MICHELSON: So both are under review yet the one has the category of you think you have got everything you want, and you just haven't finished it.

MR. SCALETTI: Right.

MR. MICHELSON: Okay. Thank you.

MR. OKPENT: I guess I wasn't quite clear on what you thought were the steps that would be needed for the hydrogen control issue resolution. Could you repeat that?

MR. SCALETTI: Right now the hydrogen control owners group and the staff are working on resolving the type of system that is going to be used in Grand Gulf. GE has committed to the resolution of this system. The staff-approved system for Grand Gulf for the GESSAR design. Along with the -- the ultimate plant protection system which would reduce the risk or reduce the generation of hydrogen in GESSAR.

MR. OKRENT: It would reduce the generation by --

MR. SCALETTI: By prevention.

MR. OKRENT: By prevention. All right. So that's really not directly --

MR. SCALETTI: Right.

MR. OKRENT: -- part of the hydrogen control?

MR. SCALETTI: Right. Right.

MR. OKRENT: Now, is it then your intention not to have something worked out for GESSAR II on this issue before you would say it is okay, that you would just accept the commitment to implement something to be worked out in the future for some other plants?

MR. SCALETTI: Well, it is something. It is the hydrogen igniter system, which is -- which would be similar to or identical to the Grand Gulf system.

As far as knowing the ultimate outcome of this review and what the staff is going to require of Grand Gulf, we don't know that yet. It is still under review.

So from the standpoint of we do have a system, we know it is going to be an igniter system. Do we know that it will -- the plans are to control up to a 75 percent metal-water reaction.

MR. OKRENT: Why is 75 percent the right number for GESSAR? I mean, in fact, there were times when you were talking about larger numbers for CP plants.

MR. SCALETTI: Clearly, the rules, the CPML rules still said 100 percent.

MR. ROSENTHAL: With respect to severe accident, when you look at H cog, first of all, we don't accept 100 percent circ. water.

Next, the threat to the containment is a rate of hydrogen production and hence a rate of heat load to critical components of containment, and it is not an issue of the absolute magnitude, the total magnitude. So it is moot. It's just from a severe accident viewpoint, it doesn't matter if it is 50 or 75 or 100 percent circ. because you are burning that hydrogen off with the igniter system. It's what is the rate of hydrogen production? Can the igniters keep up with the rate of hydrogen production?

MR. OKRENT: Well, it was implicit in your statement with the existence of AC power, for example, so one wants to be a little bit cautious in --

MR. ROSENTHAL: On the other hand, if you don't power the igniters, then 30 percent or less circ. water reaction is enough to make an identical mixture in the Mark

III containment. So again the absolute magnitude of circ. water reaction is not the key issue.

MR. OKRENT: No. But the original question related to whether or not you were accepting for GESSAR II some solution that you would accept for existing plants. And it is conceivable to me that you might decide something was acceptable for existing plants where with the GESSAR II you would prefer to go a step further. Certainly that's done on occasion in other kinds of issues.

So I'm asking the question in that light and also trying to understand what state of resolution the staff thinks is needed at the point of issuance of an FDA, whether something can be in the position of to be specified by further research and so forth.

MR. SCALETTI: Well, again, GE has stated right along that they did not want to have hydrogen control within the design --

MR. OKRENT: I read that.

MR. SCALETTI: Staff laid on them that you shall have some hydrogen control, and the resolution appears to be the igniter system that comes out of the intense Grand Gulf H cog staff effort for Grand Gulf.

MR. OKRENT: Well, let's leave it as something to think on.

Can I ask a different kind of question that comes out of something you said.

You mentioned an interest in -- in avoiding containment failure in the wet well area, I believe. Presumably, then, failure in this area needs to be a relatively low probability event compared to failure elsewhere in the containment, given that the containment is failing for some reason. What probability of failure in the wet well region, given the containment failure, do you feel acceptable? And with what degree of confidence should that number be met?

MR. ROSENTHAL: Well, I'll have to back out some numbers. One has to have high expectation that the pool survives. Hence one has to have expectations that the failure is -- umm --

MR. SCALETTI: Well, Jack, I would just like to add a comment with regard to the structural analysis.

We met with General Electric. And as I said before, by redesigning the knuckle region, it did not -- perhaps that was not the weak link in containment any more. It could possibly be the containment anchorage point.

The agreement that we have right now is that if General Electric cannot demonstrate that it won't fail so they will loose the pool, then they will redesign the containment anchorage to overrule that or to do away with that probability of failing in that type of form, so that they will lose the pool.

Our review hasn't progressed that far yet. Hence, I can't tell you any more.

MR. OKRENT: You are using probability numbers all over the lot in making decisions on whether or not some feature is desirable or is not cost-beneficial, or so forth.

A moment ago you said that -- I can't remember the exact words you used -- but something to the effect that it was of very considerable importance that the containment not fail in the wet well region. Those weren't your words, but they were something of that sort. And I'm trying to find out, you know, what those words mean in the quantitative sense. As I say --

MR. SCALETTI: I don't think we have quantified it yet. All I said was it is still under review. We are waiting for General Electric to provide the analysis to demonstrate to us that it won't fail in the dry well -- I mean in the wet well. Excuse me.

MR. OKRENT: Now you just made a statement to demonstrate to you that it won't fail. That suggests zero probability. And you think that that might be achievable?

MR. SCALETTI: I don't know if anything has zero probability.

MR. ROSENTHAL: You should say, do this in the proportion to the credit you are taking for the pool the issue is, will the pool be there or not? If you are taking credit for the pool having a DF of ten thousand and if your judgments of safety are based on a pool DF of ten thousand, then you better know that with a very high surety that the pool survives -- on the order of one in ten thousand.

I may not be doing the arithmetic correctly.

Okay. Now let's say that one takes a pool DF of 100. Then one should have confidence that most of the time the pool survives. But the measure is against the one in 100 number rather than in ten thousand number.

MR. EBERSOLE: I like that logic. But let me ask you this. What is the --

MR. OKRENT: Hold it a minute.

MR. ROSENTHAL: In the staff's analyses. Okay? We have taken what I believe are pessimistic values of pool DF's, ranging from, I think, six to -- six to 60 for an upper bound number, and alternately we can do it with 600 and ten thousand, which is GE's's numbers, and we can reach certain conclusions about ultimate health effects with a pessimistic pool DF -- a whole set of estimates and assumptions with another set of assumptions with predicted health effects when one takes a lot of credit for the pool.

And in either case the conclusion is the same. And that is that the early fatalities -- predicted early fatalities are a vanishingly small number. Predicted latent fatalities are low. And that the total person REM is a moderate amount. The numbers are reported in the FDR. So that conclusion is independent of that.

MR. OKRENT: If I can interject a question now.

I never know just which set of numbers you are using when you say, "Well, on the one hand there is a set of numbers from six to 60, and on the other hand there is a set of numbers from one thousand to ten thousand." And although it may be that, taking some assumptions on core melt probability, the probability of early fatalities is in fact very small, when you do cost/benefit analyses, the answer you get may differ by an appreciable factor, depending on which of these DF's you used. At least it is possible in principle.

MR. ROSENTHAL: In GE's analysis they used pool DF's of ten thousand and 600, ten thousand for a sub-cool pool and 600 for a saturated pool.

MS. HANKINS: Ten thousand for the quencher, 600 for the vents.

MR. ROSENTHAL: In the staff's analysis, the values are shown on page 45 of the SER, which has been provided to you. And we used a range -- at least on this page -- of six to 90 -- let me explain this -- at the lower, our lower range. You look at the DF expected as a function of the time in the accident progression, and you expect a lot of scrubbing where you are pumping steam through the pool. You expect far less scrubbing when you are pumping air with aerosols through the pool. So we have a time dependent DF.

Now let's take the lower -- the staff high estimate of consequences, which would be compared to the staff's set of low pool DF's. One can use -- one finds that -- and compare that to the GE values, which may be right or may be optimistic. You would end up with a value of consequences, health consequences, which would vary by a factor of about one-hundredth to orders of magnitude.

Now you do the cost/benefit analyses and if -- you can conclude that costly features are not cost-beneficial using either set of numbers, that even accounting for two orders of magnitude on the consequences side, some orders -- an order of magnitude typically on the front end probability side of core melt -- you can reach the same conclusion and that is that costly features aren't warranted. And so I think that that conclusion is robust --

MR. OKRENT: I'm sorry. Would you say your last thing again, and if you took a factor of ten on the front end --

MR. ROSENTHAL: A factor of ten on the front end --

MR. OKRENT: -- and a factor of 100 --

MR. ROSENTHAL: Of 100 on back end. Factor one thousand higher, that would mean that the staff's upper bound cost estimates -- which I'm not saying it is correct it is a rank study, a sensitivity study -- even if you take the staff estimates which is a factor of one thousand per person REM higher than GE's. GE's values may be right. They would correspond to our low end range. The conclusion is the same, and that is that costly enhancements are not warranted.

MR. OKRENT: Well, that could be one thousand times more costly to reach one.

MR. ROSENTHAL: Something with a cost/benefit ratio of 100 thousand or a million, you know --

MR. OKRENT: All right. In fact there is some other things that also enter into cost benefit, but I didn't want to get into them now.

It does appear that with either set of DF you are counting on the lower pool not failing, with, should I say, 99 percent confidence? Is that fair? At least?

MR. ROSENTHAL: Yes, yes, now you have to test that assumption for internal events and external events. You can say for simple transients, not seismic events, how much you believe that the containment would fail due to other than draining the pool. And I think that one has high confidence that it would not fail at the pool but would fail at the knuckle region or up by the the hatches.

Now --

MR. OKRENT: Excuse me. Could I first ask a question here?

Have you asked in some systematic way how that conclusion might be in error, or what would it take for that conclusion you just stated to be in error? And then perhaps decided that your conclusion is correct, but have you examined, in other words, fault treated, as it were, the conclusion where the top event is inclusion in error, you know. I'm curious since you are looking for a high degree of confidence it seems to me it is not appropriate in this day and age of logic and so forth to just presume.

Like, for example, could design errors or construction errors if made, lead to a change in the conclusion? If so, how do you know what the likelihood is of design or construction errors sufficiently severe to do this? Could aging in some way, corrosion or whatever, do something? I'm just trying to see whether this has really been carefully reviewed and not, let's say, done only using sort of deterministic results as to which failure pressure point, you know, is first, using the non-probable list particular considerations.

MR. ROSENTHAL: I would have to bring a sensitivity study into it that I think I can bring to you tonight.

Let me point out that the division of engineering did a fair amount of work on the structural integrity of containment, and where it would fail, including consideration of shock loads, which is a hydrogen designation, as well as slower for pressurization. Now, in order to give you a better response to your answer I have to do some homework. I would try to do that overnight.

MR. OKRENT: I would rather have a good answer than a quick one.

MR. ROSENTHAL: Let me point out that we did a fair amount of determinative analyses and our --

MR. SCALETTI: We can probably address this when we have our structural engineers here, or whenever we are talking about the seismic analysis or the next subcommittee meeting, if you would rather.

MR OKRENT: As I say, I would rather have a good answer than a quick one. Your structural engineers had better be people who have some knowledge of the likelihood of -- of things being designed incorrectly or built incorrectly, because usually when they are designers -- if they are designers they think in terms of doing it right.

MR. EBERSOLE: I heard you say something about air transport and a low DF when you are moving air through the system. Did I hear you say that?

MR. ROSENTHAL: Yes, in the early part of the --

MR. EBERSOLE: What I wanted to ask you about that, are you taking the pessimistic view that in the early stages of a blowdown you have already failed fuel? There is a time displacement which I thought you could capitalize on.

MR. ROSENTHAL: We modeled the time dependent behavior of the fuel and when the volatiles and non-volatiles are expected to be emitted, and we look at the steam flow and water and steam flows from the primary system would be, and then eventually one ends up with a very low steaming rate in the primary system and hydrogen production and you look at the transport of the -- I'm worried about the accident scenario when I melt down on core and have steam coming off and I have hydrogen coming off and I have aerosols coming off. At some point you would ultimately put the core on the floor, and you would be driving off the air in the dry well region with aerosols and later into -- you have core concrete reactions. You would again generate some water evolving from the concrete, and then you would be blowing some water-air mixture through the pool.

And then one questions what is the fission products and what is the aerosols being transported by first steam then hydrogen, then air, then water and where -- what is the submergence in the pool at the time and what is the scrubbing, and you have a time dependent pool DF. The particle size is probably a function of time, and we know that's a very sensitive function.

MR. EBERSOLE: This is air transported across the special pool in the late stage in the accident?

MR. ROSENTHAL: Yes.

MR. EBERSOLE: Thank you.

MR. MICHELSON: When you look at the structural integrity of the containment, do you also include a look at the first isolation valve outboard of the suppression pool, for instance, and its structural integrity and the nature the motor operators that might be on it and how close to stripping off the bottom they may be, and things of this sort? Is that a part of your looking at the structure? Or are you just looking at the place the containment is made out of it?

MR. ROSENTHAL: I need some help on that.

MR. HARDING: During our review of the PRA that was submitted by GESSAR -- Brad Harding from the staff -- there were some questions that were asked regarding the bypass values such as you mentioned, and we reviewed those and these were documented quite extensively.

MR. MICHELSON: By "bypass" do you mear rupture of the valve bonnet, or the dripping-off of the valve bonnet? Is that what you mean by "bypass"?

MR. HARDING: I don't recall the --

MR. MICHELSON: That was my question. Of course if "bypass" has the same meaning, then fine, I can go there and read about it. But if "bypass" is something else, then I guess I won't find it by reading.

MR. ROSENTHAL: Yes. I'm having a hard time responding to your question in part -- I think it is a picture sometimes to tell just which components we are talking about.

MR. MICHELSON; The RHR suction valve, for instance, off of the containment.

MR. ROSENTHAL: In the accident scenarios we assumed that we had hydrogen detonation failing the wet well. And I'm not sure if your point is then moot and then focus on our bypass between the wet well and the dry well, and that was the integrity that we were concerned with. Outboard isolation values on the wet well are moot when you assume that you have generated enough hydrogen and detonated that hydrogen to fail the containment boundary.

MR. MICHELSON: Oh, absolutely. There's no doubt about it. We were making sure what you are talking about when you are talking about structural integrity containment. As long as it's that one event, fine. Then you have to look at the structural integrity for other events. And if that's -- you know, there are other events where in that valve and its leakage -- draining the pool become an important consideration.

For instance, if there is no longer any suppression process, you have drained all the water sufficiently out.

MR. ROSENTHAL: Earlier we started talking about one has to examine the failure for internal events. Where do you think containment is going to fail? And the next point was, what about the seismic events? And we are just getting into the seismic review.

MR. MICHELSON: I wasn't asking seismic. I was asking valve structural integrity. It is a part of the -- you have to keep in mind it's a part of primary containment. And the water line of the pool. And one failure there, the failure of that boundary drains the pool out of the primary system into the auxiliary building. And you have to look to see if there are scenarios where that is an important consideration.

And I'm just saying have you looked at the structural integrity of the valves and their possible modes of failure, and how probable is such an event? You must have a number -- ten to the minus ten frequency?

MR. ROSENTHAL: I would have to get back to you.

MR. OKRENT: One more point, if I may, that came to my mind, as I read the SER, with regard to the generic item on sabotage -- what is it, A 29? -- I guess it might be possible to draw the conclusion from reading what the staff says there, they conclude the matter is resolved for GESSAR, that this matter presumably is resolved for all plants that have about the same kind of redundancy and degree of separation that GESSAR II says it has. And that's the end of the issue.

Is my conclusion wrong?

MR. SCALETTI: Well, I think we were only addressing -- for A 29 and the FCR it only applies to GESSAR. We only have the submittal which -- on sabotage from General Electric Company relating to GESSAR. We haven't looked at this generic safety issue, at least from the standpoint of staff here today, with regard to other BWR's or other plants with the same redundancy capability as GESSAR has.

MR. OKRENT: Now, there have been, of course, questions of sabotage that have been raised from time to time that maybe you wouldn't put in terms of industrial sabotage, but which nevertheless have been examined in studies by Santilla.

I even heard something on television within the last week that some commission or other in Washington was advising the government how ill protected its electric-generating and other important facilities were against sabotage.

I'm trying to understand whether the staff's review of the sabotage issue has been broad enough, it thinks, for GESSAR II; that all sabotage issues have been considered and then if you -- in other words, it is resolved. Or if they have not all been considered, what is the class that remains to be considered. If any.

MR. THOMAS: Certainly as far as the sabotage prevention features of the design are concerned, we do think it is resolved. As you know, design features are only one part of sabotage protection.

MR. OKRENT: Let's leave out the personnel screening and all this part of it from this discussion.

MR. THOMAS: Even beyond that there will be plant-specific or applicant-specific design measures beyond this that will have to be looked at as a specific application comes in. As far as the design features offered by the GESSAR design, yes. The issues are resolved.

MR. EBERSOLE: Pardon me.

MR. OKRENT: Okay.

MR. EBERSOLE: Yes. Again, like in fire protection, I think it is more often a channelized effort where you call the police department and they look at sabotage picture and they don't know how the plant works or anything. And it is never a systemic approach to what the problem, which is to keep the core cool. And I deplore that mode of attack to it.

Awhile ago I mentioned, for instance, the potential of -- what this thing, UPPS -- as being completely -- not considered in its potential capability to encapsulate and perhaps make safe a critical shutdown function, one which is not interdependent. Could have defended. Certainly it's something you could work around and see what you could get out of it. I don't see any effort in that direction at all. Zero.

MR. THOMAS: Well, I'm not sure that's quite fair. In the past year or so the staff has taken some measures and is continuing to improve its integration of what was classically a very segregated look at sabotage protection and bring into it the the safety aspects. We have a number of things going on right now to attempt to do this.

In the case of GESSAR, it was looked at from this integrated approach. I can assure you that. We have had a number of meetings with GE in which the safeguards people were involved, and also our systems people. And many things were considered.

MR. EBERSOLE: Has that all been laid out and the results -- the pros and cons of how you reached your decision, is that one these internal flow things that Dave was talking about?

MR. THOMAS: We have to be a little careful now. We are talking about safeguards and --

MR. EBERSOLE: This is classified stuff. I understand.

MR. OKRENT: It could could have still been written down if in fact there were something to write down.

MR. THOMAS: I think safeguards people are more reluctant to write down things than maybe staff members are from fear of FOIA's, because classified information is -- we take it very seriously.

There were a number of discussions, quite detailed discussions. They considered a number of diverse water sources.

And we recognized that while GE may not take specific credit for being able to use the UPPS system as a source from the standpoint of sabotage, we would hope to see that in utilities emergency procedures, they would recognize that. And if push came to pull, boy, they could go and get some water.

MR. EBERSOLE: But it hasn't been designed --

MR. THOMAS: I understand.

MR. EBERSOLE: -- with the advantageous features --

That's like, as far as you know these PWR's, the German ones, bunkers that can take airplane crashes those are relatively complex systems, relatively. I see some potential advantages here which I won't mention further.

MR. OKRENT: GESSAR takes a sort de facto decision -- GESSAR II SER, that is, takes the de facto position that bunker systems are not needed. Am I right?

MR. THOMAS: Yes.

MR. OKRENT: So without --

MR. THOMAS: For this design.

MR. OKRENT: But I know how to go from one design to the other. I've been meeting with the staff for more than 20 years, and with applicants.

Well, this is a question we are going to come back to probably in some depth in closed session. But I wanted to make the observations that I have that the so-called resolution of some of these generic issues and unresolved safety issues open some questions to be resolved, let me put it that way.

MR. THOMAS: You have to remember also --

MR. MICHELSON: Let me get a clarification from GE on the sabotage question.

Is the design of special building and system provisions as opposed to simply door locks and that sort thing, is a design of the basic sabotage philosophy of the plant a part of the GE scope?

So GE is claiming that GESSAR II has adequate safeguards provisions from the viewpoint of basic design philosophy and that the customer now just has to put in the door locks and so forth?

MR. QUIRK: We have even done that.

MR. MICHELSON: The perimeter is secure?

MR. QUIRK: The perimeter, the internal.

MR. MICHELSON: The internal, within the building. You have controlled access?

MR. QUIRK: Yes.

MR. MICHELSON: And you prescribe the types of devices to be used on the doors and that sort of thing?

MR. QUIRK: Yes.

MR. MICHELSON: Okay. Thank you.

MR. OKRENT: It's now 12:30, which the agenda says is lunchtime. Anyone disagree with breaking for lunch?

If not, we'll be back at 1:30.

(Lunch recess from 12:30 P.M. to 1:30 P.M.)

MR. OKRENT: The meeting will reconvene.

At the request of General Electric we are going to undergo a detour in the schedule and pick up item 8-b, which relates to water chemistry and corrosion cracking. After that we will go back to the regular agenda at least for awhile.

MR. QUIRK: I would like to introduce Dr. Jerry Gordon.

(Slide 1 shown.)

MR. GORDON: What I would like to review briefly is the intergranular stress corrosion cracking resistance of the GESSAR II materials since IGSCC has been a problem in the operating plants.

(Slide 2 shown.)

MR. GORDON: In terms of the various systems the principle materials in the GESSAR plant are in the piping system 316 nuclear grade and in some of the systems carbon steel. And in the internals they're all L grade either 304 low carbon or 316 nuclear grade, which is also a very low carbon material. And the control rod drives are using the materials that are currently in the drives. XM-19 is a stablized stainless steel stress corrosion resistant and there are castings which are also low carbon. Then the conventional pressure vessel materials.

(Slide 3 shown.)

MR. MICHELSON: What does the note at the bottom of the slide supposed to be noting this "excellent field performance"?

MR. GORDON: I'll get into that as I go through but there are materials that are used in the field and have been and it had very good performance.

MR. MICHELSON: Are you going to discuss the fabrication of these materials in the field also?

MR. GORDON: To some extent, yes.

MR. MICHELSON: And the effect on corrosion as you try to take these good materials and put them together in the field?

MR. GORDON: Right, I will cover that.

(Slide 4 shown.)

MR. GORDON: Now if this will show up. This is sort of a color coded breakdown of where the various materials are and again the material that's suffered most from stress corrosion cracking has been the recirculation system and that's -- a special alloy was developed and I'll talk a little about it. 316 nuclear grade. Most of the internals, as I said, are L grade material and the steam lines and the feedwater system have been and continue to be carbon steel which has performed very well. Then there is some, of course, Zircaloys for the fuel and some Inconel 600 and the spring materials are X-750.

MR. MICHELSON: What is the jet pump beam made of?

MR. GORDON: Inconel X-750. It doesn't show up very well and it now has a special heat treatment to restore the stress corrosion resistance also the applied stress is lower on that.

MR. EBERSOLE: Could you tell us about the developmental history of this material you call nuclear grade steel? Has it been around long?

MR. GORDON: I have two or three flimsies on it it's been around in various forms but this specific material was developed and qualified about 1978. It has been used in a number of the requisition projects.

(Slide 5 shown.)

MR. GORDON: You have seen this before, I'm sure, at various presentations. The three necessary conditions for stress corrosion and the thrust in the GESSAR plant has focused on the material. There also is active effort underway in terms of the environment for this next slide.

(Slide 6 shown.)

MR. OKRENT: Excuse me. That term "sensitized material," would you call the cladding in the fuel sensitized material?

MR. GORDON: No. This is dealing with the stainless steels and the nickel alloys, not the Zircaloys. It refers to chromium depletion on the grain boundaries which results from thermal processes like welding or post well heat treatment. Stainless steels, the chromium that's there for this general corrosion resistance gets tied up with carbon during some of these processes and that leads to what is called sensitization.

MR. OKRENT: All right.

(Slide 7 shown.)

MR. GORDON: As I mentioned, the thrust in the GESSAR is on the material itself and the materials are L grade or stablized grades of stainless steel.

There is also significant effort underway primarily for the operating plants to develop a retrofittable remedy called hydrogen water chemistry which basically shrinks the environmental circle below the threshold by dropping the dissolved oxygen in the BWR from its normal 200 parts per billion to 20 parts per billion. Drops it by about a factor of ten and then a lot of data that indicates that that is sufficient to mitigate stress corrosion cracking.

MR. MICHELSON: Even in sensitized materials?

MR. GORDON: Yes.

MR. MICHELSON: I was thinking of all the lab work done in the distant past since this problem is rather ancient now, and people never worried much about hydrogen environment in their tests, laboratory tests they just worried about the stress, of course, and the presence of the sensitization and they were able to under various ways get good stress corrosion cracking without worrying about necessarily oxygen over pressures or things of this sort.

Some explanation of why this was an important consideration that somehow escaped the process so long?

MR. GORDON: It's a systems effect the hydrogen is introduced in the feedwater and as it goes through the core it suppresses the --

MR. MICHELSON: I understand that, but what I don't understand is the fact that you are claiming this environment, if you can control it then takes away the problem even if you already have presensitized materials. And high stress.

MR. GORDON: That's true.

MR. MICHELSON: I don't believe that's true, because most of this has escaped the experimental process starting back in the early 60's.

MR. GORDON: Well, there is a very intensive effort underway with the department of energy initially and GE Commonwealth Edison and now the electric power research institute.

MR. MICHELSON: I guess what I thought you said to me and you can verify it, is that irrespective of the degree of sensitization and the degree of stress you will get no stress corrosion cracking if you can remove these adverse environments?

MR. GORDON: The data support that.

MR. MICHELSON: Recent data support the effect of the adverse environment but does it support the fact that if you can remove these adverse environments that there will be no cracking even though you have highly sensitized materials and stress?

MR. GORDON: Yes, it does that.

MR. MICHELSON: How did the people in the old days get stress corrosion cracking? There is a vast amount of work that has been done.

MR. GORDON: You are talking about high purity water. You can get cracking in fluorides and other environments.

MR. MICHELSON: People have gone even high purity water and even relatively cold conditions and got cracking if there was sufficient sensitization of the materials.

MR. GORDON: Going back to the Naval reactors program of the 1950's much of those results were summarized in the corrosion and water handbook, and there the hydrogen was effective in suppressing stress --

MR. MICHELSON: But what you didn't do apparently was determine if you remove the hydrogen does the stress corrosion cracking go away and there were many experiments run in which hydrogen was not a controlling parameter. There was no hydrogen over pressure. These were bench top tests. You just take the bench specimen and stick it in a corrosive environment without any over pressure or gases and it will crack fine.

MR. GORDON: In high temperature oxygenated water.

MR. MICHELSON: It doesn't have to be very high it doesn't have to be oxygenated water. A lot of them where bench tops at almost room temperature, if it's sufficiently sensitized and a severe corrosion with liquid you didn't need any gas.

MR. GORDON: That's true, but in high purity water you need dissolved oxygen or something to raise the electric chemical potential and gain cracking.

MR. MICHELSON: They would always have the dissolved gases and gee, I -- somehow you can get rid of this dissolved gas, you are okay.

MR. GORDON: If you reduce the dissolved oxygen which reduces the electrochemical potential, which is the driving force, then you can suppress stress corrosion.

MR. MICHELSON: Eliminate or just suppress it?

MR. GORDON: Eliminate it.

MR. MICHELSON: That's a difference.

MR. EBERSOLE: So you are going to put hydrogen as an additive in the water is this right?

MR. GORDON: Not in the GESSAR plant, I pointed out that for operating plants where one doesn't without a major trauma have the option of replacing all the materials. Another approach rather than focusing on the materials circle is to focus on the environment cycle and make it benign and the hydrogen has that effect.

MR. EBERSOLE: Does this result in a problematic in a new gas release rate out in the condenser which must be recombined?

MR. GORDON: No, it is net gas generated because it suppresses radiolysis the hydrogen and oxygen that are generated in the core are actually decreased.

MR. EBERSOLE: I see.

MR. GORDON: Finally, there are retrofittable remedies for operating plants that focus on the residual stress in the wells by basically putting the wells into compression rather than tension. And as I mentioned the thrust in the GESSAR plan is to put in materials that are not susceptible to stress corrosion, that do not sensitize.

(Slide 8 shown.)

MR. GORDON: In addition to the L grade materials, there are design changes to avoid crevices, for example, that were built into the early designs where the thermal sleeves were welded into the inside of the safe heads. Crevices can also accelerate cracking.

Also cold work is a detrimental contributor to cracking and that has been eliminated through controls in the fabrication process. And finally the material specifications now have in place tests to demonstrate the material is not sensitized. Various types of tests in the acceptance specifications on the material, quality assurance to assure that the materials meet the specification.

MR. MICHELSON: How do you assure that the materials retain that degree of protection since they are now in the as-delivered condition where they are carefully arranged and so forth and now you are going to weld them up. How do you know you have got the material?

MR. GORDON: You build the resistance into the material and you just assure --

MR. MICHELSON: I can take it out real quick though by the right kind of heat treatment. So how do I assure that the material -- that the protected features are retained when people go and weld them up and so forth.

MR. GORDON: I'll show on some slides the material like the nuclear grade materials have very, very great resistance to inadvertent screwups during fabrication, not proper quenching from solution heat treatment, for example.

Post-weld heat treatment of the stainless steels is now explicitly prohibited which is probably the only way you could make the nuclear material sensitized. That is by welding them to the pressure vessel then going into the cold post weld heat treatment. Normal welding processes no matter what heat input will not sensitize the material if the carbon content is low enough. It is a kinetic problem. If the carbon is below about 035 you do not get sensitization during welding. You could sensitize during post-weld heat treatments.

THE REPORTER: Could you speak up, please.

MR. GORDON: There is fairly extensive field experience with the L grade low carbon steels. A large number of welds.

In many cases, when the initial systems that suffer stress corrosion such as the bypass lines and the recirculation system and the course gray lines, when they crack the utilities replace the type 304 stainless steel, which was the high carbon version with low carbon material and now in many plants there are a number of areas of operation these relatively highly stressed from the stress corrosion standpoint systems, and no evidence of stress corrosion cracking in any low carbon materials, as I'll show in the next slide.

It is also used in safe ends as well as piping and in no case has it the suffered stress corrosion cracking and that's consistent with understanding because the materials don't sensitize.

(Slide 9 shown.)

MR. GORDON: This is just a breakdown by carbon content of the various welds that have suffered stress corrosion cracking. It doesn't include every incident. It is those incidents where the carbon content was known on the material. And the nuclear grade material has a carbon content of 02 percent. The L grades are 03 percent. And as I mentioned there are a number of materials in this range in the field and none of it has suffered stress corrosion.

(Slide 10 shown.)

MR. GORDON: There was an extensive qualification program to verify the resistances of the L grade materials and the nuclear grade materials. It included a range of tests, the principal test vehicle was a full-scale pipe test. I think perhaps some of you have seen the pipe test laboratory in San Jose. Able to actually stress the piping in a range from 4 inch up to 16 inch in diameter with a series of circumferential butt wells stretch an F 288 centigrade with high temperature oxygenated water flowing through the inside and cycle the pipe in addition periodically to accelerate the potential for stress corrosion. Under those conditions the welded 304 stainless steel will fail in times on the order of 100 hours depending on the carbon content as I'll show in the next slide.

The nuclear grade materials ran out to several thousand hours in many cases to a year or more under high stress and in no case does did it cover suppress corrosion. Also was looked at in terms of the kind of processing parameters that if there were a screwup in solution heat treatment of fabrication the kind of parameters that might lead to sensitization. And I'll show some results on that.

And it was looked at also in the crevice condition and from the standpoint of if you initiated a fatigue crack, what was the crack growth rate? Would it somehow be significant relative to the code kind of fatigue crack growth data.

And in all cases the material fully met the objectives of the test, did not suffer stress corrosion cracking. Other properties were fully acceptable.

MR. EBERSOLE: Could you tell me is there a cost factor here? I gather it was sort of a process of in the years past of guessing that there would not be as much trouble as there has been. You know it costs about a million dollars a day to shut a plant down and somehow there was some misguessing. Wasn't low carbon steel available 15 years ago?

MR. GORDON: It was and as I showed some plants had low carbon steel the principal problem was it has a lower code allowable strength. The nuclear grade gets around that problem by having a small amount of nitrogen added to restore the strength. If you drop the carbon the strength goes down and so you would have had to redesign the entire system to go to the L grade in general.

MR. EBERSOLE: In retrosoect I suspect it would have been cheaper in the long run?

MR. GORDON: It certainly would have been cheaper.

I'll show some pipe test data on the nuclear grade material.

All the materials have gone through pipe testing as well as other environmental testing to assure their cracking resistance and the pipe test, as I mentioned employs very high oxygen eight parts per million rather than 200 parts per billion. More oxygen up to a point the more acceleration. It also uses a higher than code allowable stresses in cyclic loading.

(Slide 11 shown.)

MR. GORDON: The type of data that one derives from the pipe test are of this type where we have the applied stress on the pipe. In addition the pipe has the residual stresses of the wells. And this is just test time and the solid points represent failures intergranular stress corrosion cracking failures and these open points are run out points. They ran out on the order of ten thousand hours when the tests were completed.

The 304 stainless steel I mentioned fails in the order of 100 hours at high stress and the stress drops it goes on out in time.

When we get down to field kind of stress levels we are talking several years. This is at eight parts per million oxygen and point two parts per million.

Curve is extended there is another data curve available. It is out somewhat because oxygen as I said is an accelerant. The nuclear grades, we looked at L grades and even lower carbon nuclear grade. A large number of pipes, each pipe has about 11 butt wells.

And a number of different heats to assure that there was no heat to heat variability surprises and in no cases did we get intergranular stress corrosion as one would expect because the material doesn't sensitize. And one can extrapolate out to the kind of stress levels that exist in the field and at eight parts per million one would say one has certainly greater than 4 years of expected life with the material in terms of stress corrosion, and in fact, in .2 ppm oxygen that would be significantly greater.

MR. OKRENT: When it says "no intergranular stress corrosion failures," does that mean no flaw that goes through the pipe?

MR. GORDON: The pipes are examined periodically ultrasonically. At the end of the test we cut the pipes up and did dipenetrant testing on the inside surface and found no cracking.

MR. OKRENT: When you say no failure you mean no cracks?

MR. GORDON: No cracks once cracks initiate in this type of test at these high loads a crack growth will drive right through the wall fairly quickly and the system is set up to detect a leak. There is a timer -- each pipe is contained in a mini-containment. There is a pressure surge when there is a leak and it shuts the test down and triggers a timer.

MR. EBERSOLE: When you say "once a crack initiates it will go fast" why is that?

MR. GORDON: Relatively fast. Because we are driving it in the nuclear grade that's not the case, but in the 304 stainless steel the bulk of the time is in initiation.

MR. EBERSOLE: I misunderstood. You never initiated any cracks in the other?

MR. GORDON: No. If you ran long enough and you were to initiate a crack, since it is a cyclic test you would get fatigue propagation and eventually it would fail, presumably.

MR. OKRENT: Was there any specific surface preparation?

MR. GORDON: These pipes were deliberately abusively ground on the inside surface because that is an accelerant. The well heat inputs were very high. We did everything to accelerate the potential for cracking.

Also looked at off chemistry environments, chloride intrusions, resin intrusions the kind of things that could happen and again, the nuclear grade materials are very, very resistant.

MR. EBERSOLE: This phenomenon we are talking about is said to -- many people think it is the vein of the boilers and you are talking about almost a panacea here. Is it really true that --

MR. GORDON: The field is telling us that. As I mentioned there is a lot of L grade material out there and it has never cracked. It's run in the same lines and in many cases it has replaced the 304 material that cracked in a year or so. The L grades were developed many, many years ago, not the nuclear grade but the L grades.

MR. EBERSOLE: In the old reactors, the old boilers which have gone a number of years without trouble, why haven't you gone back and found out why they did that? There have been some old boilers that never had much cracking problem.

MR. GORDON: That have the higher carbon material?

MR. EBERSOLE: I don't know. There have been some boilers with good experience.

MR. GORDON: That's true the Big Rock Point reactor has now run 22 years without --

MR. EBERSOLE: Did they by hook, crook, or whatever happen to have low carbon?

MR. GORDON: No, not really the environmental circle, the stress circle, the material, Big Rock Point the large piping actually is centrifugally cast which is much more resistant material.

MR. OKRENT: I'm trying to understand something. Did they or did they not find some small cracks at Peach Bottom you know in low carbon stainless?

MR. GORDON: They did, very shallow cracking in an abusively ground region where a thermal sleeve was welded to an attachment weld. If you cold work the material you can get cracking. It depends on the carbon content and that's why I mentioned that there are controls and there have been controls in place for several years to avoid that type of severe cold work.

We went back at Peach Bottom and traced the fabrication history. They had great difficulty making -- I don't have a sketch of it -- but there is basically two concentric pipes a thermal sleeve inside of a safe end and they had to reach in and make an attachment weld between the two, and they didn't get welding of the weld metal on the inside of the safe end. They had to continually grind and reweld, grind and reweld.

We went back to the people that did the fabrication originally and we cut out both samples from the safe end and brought them back to hot cells at Pleasanton, California and indeed there is severe cold work in the material and the region where the crack -- cracking was 16 thousandths of an inch deep and appeared to stop when it propagated past the surface cold work area.

MR. MICHELSON: Since the material was apparantly the right material and since the environment I guess -- are you claiming the environment was also adequate?

In other words, what parameter went awry that caused it to crack there at all even with severe cold working because earlier we discussed this you remember and you said with that type of materials you aren't going to get the cracking.

MR. GORDON: I said you needed oxygen. If you drop the oxygen even the cold work material will not crack.

MR. MICHELSON: So what you are saying is they did not drop it sufficiently in this case to prevent it from cracking?

MR. GORDON: It was not a plant with hydrogen water chemistry. It is going on hydrogen water chemistry, but it did not have it at the time.

MR. MICHELSON: In the case of Browns Ferry, I'm sure you are familiar with the results of their in-service inspection for unit one, two probably one case in unit one they found a lot of cracking and in unit two they found practically no cracking. Why the difference? Essentially the same materials, as I understand it.

MR. GORDON: The differences in fabrication history, for example Duane Arnold also has no cracking --

MR. MICHELSON: Yeah but I can't imagine that every weld had a different fabrication history on unit two and unit one. There must have been some substance you know the same kinds of crews doing the work.

MR. GORDON: I know at Duane Arnold the fabrication was such that they spread cold to get in past the temperature control on the inside of the pipe and that's sort of equivalent to induction heating stress improvement if you will.

MR. MICHELSON: Are they saying they did that on union two at Browns Ferry but not unit one?

MR. GORDON: I'm not aware I haven't been directly involved in it but I'm just saying there are plants -- they were fabricated at different times and like different processes in some cases. It is hard to explain all the variability in the field why some welds crack and others don't.

MR. MICHELSON: I guess I'm just -- I've got to be shown in this business because I've heard -- I mean, I've been in boilers a long time and I kept hearing all good stories about the next material down the road is going to be the answer.

And now today I hear yet another story. Yes everything we have got so far doesn't seem to quite work. We have got the panacea now down the road.

Am I really seeing it this time or is this just going to be another case where it takes a few years to find out?

MR. GORDON: Well as I mentioned there is alot of service experience with L grade material and its performance has been very good. There is the option in addition to the L grade material to go to hydrogen water chemistry, if that should prove necessary. We don't think it is necessary based on the qualification testing for a GESSAR plant.

MR. MICHELSON: Browns Ferry didn't have L grade material?

MR. GORDON: No.

MR. MICHELSON: I think they changed out the nozzles and went to L grade?

MR. GORDON: At Browns Ferry the L grade material did not crack. Let's put it that way. I'm not familiar with all the heats of material in the plant.

MR. MICHELSON: So as far as you know none of the L grade material cracked?

MR. GORDON: No. The only incident of L grade that I'm aware of was at Peach Bottom and I looked at the metalography and it was very heavily cold work and there was also a process control that took place on the nuclear grade material.

MR. MICHELSON: But if they had had good oxygen control they would not have gotten the cracking.

MR. GORDON: Right if they had added hydrogen to the feedwater.

(Slide 12 shown.)

MR. GORDON: You asked the question about processing and this just shows the added margin in the low carbon material.

This is time temperature sensitization plot or this is a boundary at which for longer times at any given temperature you get sensitization. You can sensitize a nuclear grade material but it takes a long, long time and the normal welding processes in processing thermal processes intersect that boundary where sensitization will occur.

We have a lot of margin. That's not to say that somebody can't screw things up to the point perhaps where they might sensitize it.

MR. MICHELSON: What information do you have for the various rod materials for valve bodies pump casings or other kinds of things?

MR. GORDON: They are the castings rather than the rod. And in the --

MR. MICHELSON: Some of them are forging some of them are casting?

MR. GORDON: Well in the carbon steel. Most of the stainless steels are casting. They are L grade in the GESSAR plant and in addition there is ferrite control. Ferrite enhances resistence to sensitization and there is a minimum ferrite level of 8 percent spelled out.

MR. MICHELSON: As I recollect I have seen some amount of cracking in the weld bodies near the heat effected zone in the weld of piping.

MR. GORDON: It can happen and yes, it has happened. If the ferrite is low and the carbon content is high.

MR. MICHELSON: So in the new GESSAR what are you going to use for materials on say weld bodies?

MR. GORDON: The L grade material on the first slide, CF-3. CF-3 is basically the cast version of 304L. In addition there is control on the ferrite.

MR. MICHELSON: You have got good data to show that that takes care of the problem?

MR. GORDON: Right. Pipe test data again, plus other stress corrosion data, plus field experience also.

MR. OKRENT: What does it mean really to say one has control? I assume it is not being somehow 100 percent sampled, because that's sort of not possible. So you are going to do some kind of sampling process at most of whatever comes from the steel fabrication facility.

I would say there is mixed experience if you look across the board with the adequacy of ASTM sampling procedures, I mean, you are, I'm sure, aware of any one of the problems with bolts. Well BWR may not run into the problem.

MR. GORDON: Boric acid problem.

MR. OKRENT: No, there is another problem.

MR. GORDON: With strength? Heat treatment.

MR. OKRENT: Heat treatment. So it is not completely clear to me that we have a basis for knowing with what confidence the material will lie within the required tolerances to be truly resistant to intergranular stress corrosion given the presence of oxygen.

MR. GORDON: The principal control is the composition material specification that spells out the carbon level in the material. It is spelled out as .020 max for example on the nuclear grade.

There is margin -- if for some reason the actual carbon were somewhat higher you would still have resistance but if you were too high you would be back to 304 stainless steel kind of problem. There is a sensitization test in the specification on incoming material you actually heat it for an hour at 1200 Fahrenheit and do a sensitization test on it.

MR. OKRENT: But it is not on every piece of pipe?

MR. GORDON: It is on a quality assurance sampling plan that's true the material could circumvent somehow the quality assurance. Then it would have to be in a highly stressed weld, you know, have to be in the right location, but there is a lot of margin for that kind of a screw up in composition. It would have to be a gross screw up on a nuclear grade material. But I guess that's possible.

MR. OKRENT: Well, they have occurred. In bulk manufacturers, so --

MR. GORDON: I'm not sure if that was more of a heat treatment-caused problem.

MR. OKRENT: Well, my point is a screw up occurred in the overall fabrication process and in that particular case it was heat treated, but in another case it might be composition.

MR. GORDON: As I said, there are checks in addition to the composition there are sensitization tests, but they're not 100 percent.

MR. MICHELSON: Probably easier to get screwed up during construction. Getting the wrong material into the process, after it leaves the warehouse and goes into the field.

MR. GORDON: At least in the CESSAR plant all the material is L grade, all the piping material in the internals is L grade so you might mix it up but it presumably would still be L grade unless you use carbon steel.

MR. MICHELSON: You use both 304 standard and 304L on the plant normally unless you say you're not gonna have anything but 304L or nuclear grade.

MR. GORDON: That's true. All the systems that are 200 degrees F and higher are L grade but in the balance of the plant it could be higher carbon, right.

MR. MICHELSON: It could be stainless.

(Slide 13 shown.)

MR. GORDON: This is a NUREG. Spence Bush headed up a task force at the request of the N.R.C. to look into the stress corrosion cracking problem. They came out with at least at the stage I saw it, it was the final draft but NUREG-1061. Which is going to be the basis for revision to NUREG-0313 which controls the use of sensitized stainless steel with the reactor pressure boundary. And it recommends the use of the materials that are used in the GESSAR plant, the L grade materials and the cast stainless steels with ferrite control and carbon content control as well as carbon steel.

MR. MICHELSON: I may not recall, but I thought that task force recommended control of two of your three circles any two of the three, wasn't it?

MR. GORDON: As I understood, with 304 stainless steel you would go to residual stress plus hydrogen water chemistry. But if you have 316 nuclear grade it was not necessary to go mitigate a second circle as well.

MR. MICHELSON: You could get by with only one circle?

MR. GORDON: That's my understanding of the 1061.

MR. MICHELSON: Maybe. I didn't quite recollect it that way.

MR. GORDON: With 304, for example, solution heat treatment was not adequate you would have to mitigate a second circle as well.

(Slide 14 shown.)

MR. GORDON: I mentioned crevices and the GESSAR design avoids crevices. This is the recirculation inlet, safe in the thermal sleeve design.

In the past, for example, at Peach Bottom the thermal sleeve was welded directly to the inside of the safe end. That's the weld I mentioned they had to reach in and make it was very difficult and they did a lot of grinding.

The GESSAR plant as well as most of the requisition plants use the so-called tuning fork design. The annulus is sized so that you get flow of flushing so there is no crevice anymore like there was in the older designs. And also it is -- the design of the welds in the piping is such that ISI is readily accessible. You don't have access probable. You don't have a bump from the weld crown so forth to interfere with UT, which has been a problem in the operating plants.

MR. MICHELSON: What is your position on the use of Inconel as a buttering material. My recollection is that they have seen some cracking of Inconel butters.

MR. GORDON: Inconel 182 material is susceptible to stress corrosion. There is one instance at the Pilgram plant where the weld butters cracked. It is not clear that's a generic problem but it may be.

MR. MICHELSON: Are you proposing any use of Inconel as a well butter?

MR. GORDON: In the GESSAR plant the well butters are either Inconel 82 which is very, very resistant, in fact the route pass at the Pilgram was Inconel 82 and the subsequent were 182 and the cracking initiated and propagated in the 182. When it hit the 82 route pass it arrested. And there was metalography that shows that.

Most of the weld butters will be 308L. In the case where you are using Inconel rod material it will be Inconel 82 rather than 182.

(Slide 15 shown.)

MR. GORDON: So to summarize the stress corrosion cracking phenomenon, there has been a lot of effort focused on understanding it. The National Laboratory, General Electric, Electric Power Research Institute. Pretty well understood phenomenon three circles seem to hold up.

GESSAR material focuses primarily on putting resistant materials in to start with. The materials have been qualified in all cases with extensive testing environmental testing. In addition the field experience on the materials that are used is good to date and there is a pretty good experience based out there by now.

MR. MICHELSON: Is General Electric going to guarantee these materials not to crack, provide you a warranty of some sort? You think you now have the answer irrespective of control of chemistry or control of fabrication if you use nuclear grade you are going to have no problems? Is General Electric going to guarantee that?

MR. GORDON: On the replacement piping in the operating plans there are warranties of various periods depending on the utility's desire.

MR. MICHELSON: Do they require any control of these other parameters? Are you just warranting the material itself irrespective of the fabrication or water chemistry.

MR. GORDON: The warranty requires that the installation be done properly because again you could abusively grind or cold work the material.

MR. MICHELSON: How about the water chemistry do you require it in certain ranges of control too?

MR. GORDON: It has to remain within the water quality specification.

MR. MICHELSON: From what you have told me it really isn't necessary to control water chemistry if I used nuclear grade material.

MR. GORDON: Within the specification if you deviate for example the very high chloride content then you get transgranular cracking which is also stress corrosion. Nuclear grades are somewhat more resistant but they are not immune.

MR. MICHELSON: You still have to be careful?

MR. GORDON: Water quality is still important. That pretty well summarizes it, unless you have any more questions.

MR. OKRENT: Thank you. We will then go back to the agenda and I guess we are at deviations from the standard review plan. General Electric stuff.

MR. QUIRK: I would like to introduce Mr. Jack Fox.

MR. FOX: Good afternoon. I'm sure glad Jerry got to go on before I did because I was still a little full from lunch.

This presentation hopefully will be limited and what I mean is there was a total of 32 deviations from the standard review plan. I didn't try to count the total number of possible deviations, but it is on the order of 500, in that ballpark.

And we had ten of which would be associated with chapter four being fuel or the fuel design and the -- they were primarily deviations from the fact that at the time we wrote the deviations from the SRP, our evaluations there were two documents still under review, generic documents licenses and topical reports that have now since been approved by the staff. And all ten of those fall under that category.

Basically it was methods, acceptable analytical methods and so on that have been associated with fuel design that have been under review for several years. Remaining 22 primarily they are scattered throughout the chapters. Most of them in chapter seven, which is the electrical chapter. One of which is associated with REG-197 and probably would take the rest of the day to explain. I don't know how many of you are familiar with the extent and the complexity of compliance with REG-197 but it is somewhat extensive and in a sense it is an FDA condition anyhow and is still under review by the staff.

I would propose not responding or -- to any questions on that subject, not that it is not important, but it is just one of many.

So what I would like to do -- first of all, I made a copy of the SRP summary appendix H to the SSER two, which basically -- it gives the topic. I'll even put it -- I've got all four pages.

(Slide 16 shown.)

MR. FOX: I can respond to any of these, I hope. Now, this is what you had to look at in terms of your review and rather than go through each one of them, there is I say there is a total of over 30. And with the presence of time I would like see if there was any specific questions that came up in your review on this page or the three similar pages that were reported in the SSER.

One point I would like to make. The staff, staff's analysis was in agreement with basically our evaluation, that the -- although the deviations occurred the SRP allow that to be a fact provided there is adequate technical justification. We provided that and the staff reviewed it and the first page of Appendix H to the SSER that is stated. That is the format.

Are there any questions?

MR. EBERSOLE: That particular one about lift-off, is that for the case of the large loca?

MR. FOX: Yes.

MR. EBERSOLE: Does that incorporate this matter of the lift that derived from the control rod drives skidding along the square sides of the boxes?

MR. FOX: Yes.

MR. EBERSOLE: Does it involve friction factors and the realization that the control rods don't roll but they both skid?

MR. FOX: Yes.

MR. EBERSOLE: You know there are little rollers on there but they don't roll in this case. You do get a lift-off?

MR. FOX: There is a lift-off, but it is -- it is a finite -- let's say it is less than that value -- about half an inch.

MR. EBERSOLE: What stops the lift-off. I think the only real interest is that they go crushing into the separator?

MR. FOX: No, no. It does not lift -- the bundle does not lift off far enough to interfere with control rod motion.

MR. EBERSOLE: What stops it at .52 inches? That sounds fascinatingly accurate.

MR. FOX: Analytical models. I mean, that's the -- you know the evaluation that is done is a combination of different ground accelerations and forces and the whole thing, so it is -- .52.

MR. EBERSOLE: Gound accelerations is this related to a seismic event?

MR. FOX: Yes, in fact, every applicant -- GESSAR uses the same design basis as any of our other similar plants.

MR. EBERSOLE: I earlier stated is it related to a loca.

MR. FOX: Yes.

MR. EBERSOLE: And a seismic event?

MR. FOX: Yes. The variation is in the ground movement.

MR. EBERSOLE: So this then is predicated on the notion that a seismic event will precipitate a loca?

MR. FOX: No, sir.

MR. EBERSOLE: How did you get the combinational effect if you didn't combine the event?

MR. FOX: Add them together. It is a non-mechanistic requirement. So anyhow this particular basis is the same used for all other plants and it requires a plant specific evaluation depending on the ground levels.

MR. EBERSOLE: If I can come back to more near reality. If you just get a plane -- not plane -- if you get a loss of -- is there any levitation of the fuel that without seismic --

MR. FOX: Levitation of the fuel?

MR. EBERSOLE: Yes.

MR. FOX: I'm sure there is a differential movement within the channel.

MR. EBERSOLE: I mean is it a lift, no lift?

MR. FOX: No lift. Motion is a very relevant thing.

MR. MICHELSON: Are you prepared to discuss those on the third or fourth slide already. You are not trying to do these in any order?

MR. FOX: No, no not at all.

MR. MICHELSON: I would like to ask you first on 8.3.2, what was going on there.

MR. FOX: I should put that up so everyone knows what we are talking that. I know it is in here somewhere.

(Slide 17 shown.)

MR. FOX: Let me check the numbers here. I know what the requirement is. Our design is based on all these fluctuations. But I'm trying to find what the SRP says specific to that.

The SRP requires a second level of 100 volts protection for -- to protect against swings -- let's say large variations, okay? As opposed to taking that as -- well, that was one way of doing it, okay? We felt that we could require -- well, that the applicant -- well, we would -- the applicant could show with appropriate means that their system was within the 5 percent variation.

MR. MICHELSON: Was this a part of the problem of the voltage fluctuation from rapid loading on the emergency boards and that the component has to be designed to operate at 80 percent of voltage? Was that something else? I don't remember what section in the branch technical position that included. Is this something else?

MR. FOX: I think that's something else. Jack? Where did he go? Is anybody in the room a little more familiar with that? This was associated strictly with the grid voltage --

MR. MICHELSON: Well, that is -- that one was associated with the bus voltage, of course.

MR. FOX: Yes.

MR. MICHELSON: So that was my question. Was this -- is the 20 percent requirement still in there?

MR. FOX: Yes, definitely.

MR. MICHELSON: The next item, 951, the very next item, apparently you don't have three hour fire dampers. What rating are you proposing?

MR. FOX: Well, it is not quite -- it is not quite this simple. There is -- I can't give you -- it is normally no less than two hours, okay? But really what we are trying to do is meet the intent of what the SRP was doing.

MR. MICHELSON: The intent was to provide three-hour fire barriers.

MR. FOX: That's not the intent. The intent was to be able to do something in a fire.

MR. MICHELSON: But if you have got a ventilation system penetrating a wall that's greater than three hours, then the ventilation system ought to be rated for three hours also. Ventilation penetration, that is. I thought that was what this related to.

MR. FOX: No.

MR. MICHELSON: I guess -- Maybe you can find out and give us the answer.

MR. FOX: Two-and-a-half page analysis to come to the end to conclude that you met the intent of the criteria. I'm not one the did that specifically, but --

MR. MICHELSON: What I was trying to ascertain in what cases is it all right to have less than a three-hour fire barrier?

MR. FOX: I'll find out specifically.

MR. MICHELSON: There must be cases where you didn't, for one reason or another --

MR. FOX: Oh, yeah. In fact, in general we have three-hour fire barriers, in general.

MR. MICHELSON: Where dampers are generally three hour, but not in all cases?

MR. FOX: Right.

MR. MICHELSON: Is that what you are saying?

MR. FOX: I'll give you the specific deviation.

MR. MICHELSON: Next item is 15 point three point one. Here you are dealing with the use of non-safety grade equipment. And the description said that credit is taken for non-safety grade equipment and failure of non-safety grade equipment is not assumed. Could you explain that, please.

MR. FOX: Yes.

(Slide 18 shown.)

MR. FOX: That was -- I thought there was two of them. That was section 1533 and 34.

What we -- in the actual analysis that was performed in the -- in GESSAR there was in fact, as it said non-safety grade equipment. But if you go back and analyze -- but it turns out we over -- we --

The way we analyze the model, it specifically, it provided a more conservative than we really had to do in this particular event. And if we -- if we do the analysis specifically as the SRP section three three and three four require, the resulting parameters or severity of the accident is actually less. So it turns out we --

MR. MICHELSON: I'm finding this a little difficult to track.

MR. FOX: Yes.

MR. MICHELSON: Are you saying it is a standard review plan requires that if you are going to use a piece of equipment to mitigate one of design basis events is that equipment must be safety grade --

MR. FOX: Yes.

MR. MICHELSON: -- and what you are saying is yes you recognize that, but you are going to use non-safety grade in some cases anyhow, but it gives you a more conservative answer?

MR. FOX: We took and did the analysis the way we thought Mother Nature would allow it to happen irrespective of safety grade versus non-safety grade. That does not agree with the standard review plans. If we do the analysis as the review plans calls for, the results are less severe.

MR. MICHELSON: Well, the review plan requires safety grade equipment, and if you do the analysis of safety grade equipment and the results are less severe, that's great.

MR. FOX: Our scenario was different. It is one of paper. If we follow out and did the analysis just like that, we met the criteria, and we would add some --

MR. MICHELSON: Why didn't you just quit there? If you did the analysis the way you are supposed to you met the criteria and you quit?

MR. FOX: This SRP tracking changes periodically. And when we had done the analysis that SRP was not necessarily -- in fact, in regulation 100 didn't exist. Certainly revision two or whatever it is, didn't exist. We had done the analysis already. We had -- so we went back and did the perturbation type analysis.

MR. MICHELSON: What you are saying is they revised the criteria, revised the plan after you did your analysis, then you went back and attempted to justify why the analysis was all right? That's a little different and in the process you recognize that -- you are taking credit or certain non-safety grade equipment in your original analysis, because, apparently, the standard review plan allowed that then, I guess?

MR. FOX: I don't think it was all that clear on it then.

MR. MICHELSON: This thing leaves me a just a little fuzzy and maybe you can clear it up.

MR. FOX: Sure.

MR. MICHELSON: The next one is five three three -- The next one down the line is another part of same thing. Here you are saying that the you did not analyze coincident loss of out -- off-site power. Does the the standard review require the analysis of off-site power and you didn't?

MR. FOX: Again, again, this falls into the same type of category.

MR. MICHELSON: Maybe just check on it.

MR. FOX: What we have done basically is go back and make a re-analysis of our -- the analysis we started with.

MR. MICHELSON: This may be perfectly all right. I'm just trying to understand what you did and I was going to ask the staff did they agree, or what is the present status of it.

MR. FOX: I'll do that for sure. I just didn't want to cover all 30 of them today in detail, unless --

MR. OKRENT: I think we have managed to cover none of them.

What comments does the staff have in this area?

MR. SCALETTI: I don't believe we have. All I can say is we did review GESSAR II to the current standard review plan. We have documented what we consider to be deviations in the safety evaluation report and in supplement one. I can't -- I can't answer Mr. Michelson's questions, but I know the staff has looked in and the staff has reviewed GE's deviations.

MR. MICHELSON: Should I be able to go to -- I think this is supplement two that I have here. Should I be able to go to supplement two and find this discussion or would I have to go back to supplement one?

MR. SCALETTI: No. The deterministic review and the basis for these deviations from the SRP are all discussed in the SAR and supplement one.

MR. MICHELSON: Okay. So I have to go back to those documents and read it. Thank you.

MR. SCALETTI: Again they may not all be addressed in there.

MR. MICHELSON: Well, if there are deviations listed here by GE, you must have found them and brought it to their attention and -- but you are saying maybe you didn't write it up, is that it?

MR. SCALETTI: True. I know of one case one reviewer where he didn't believe it was a deviation, so he didn't discuss it.

MR. MICHELSON: So you are saying don't be surprised if I really can't read about it.

MR. SCALETTI: In some instances, yes, but I believe in probably most of them being there.

MR. MICHELSON: These seem to be a little out of the ordinary. I mean I thought these were kind of fundamental requirements, like you can only address accidents with safety grade equipment. If the standard review plan says that, I'm surprised that you now round up the accident but you want to see what the accident is and so forth and see if it looks reasonable. But if I can't read about it at all because it wasn't discussed in there, then I wonder why you contend a deviation without an explanation.

MR. RAED: Jack Raed of staff.

There is only one of those of the 30 that I know of, which is the last one on the list. And in that case, GE made assumptions about where the iodine was post-accident which I'm sure is not discussed in the ACR for the simple reason that without that spine they make that assumption in their SSAR. We just followed the standard review plan in the review and reported that in the SER.

MR. MICHELSON: I would be able to read about these others in either the SER or supplement one?

MR. RAED: If indeed the staff just followed the SRP.

MR. MICHELSON: Clearly they didn't follow the SRP. That's why there is a difference.

MR. RAED: GE ignored the SRP in those 30 instances. If indeed the staff did not slavishly follow the SRP, then it would be in the SRP.

MR. MICHELSON: But if they followed it, if you believed your standard review plan and GE took exception, don't you have to justify why it is all right in that case to take exceptions? Don't you document such justification?

MR. SCALETTI: I believe that most of them are documented. There are some that aren't, clearly.

MR. MICHELSON: I would be a little surprised not to find it, then.

MR. EBERSOLE: In any case it sounds like it is a partially completed job. We don't know where we quite are on these. Is it possible to get these put together with the --

MR. SCALETTI: You want a road map?

MR. EBERSOLE: Just disposition of them and some hard clear facts. I detect a lot of confusion here. Some of them are there. Some of them are not there. You have adopted them with reservations or not.

MR. SCALETTI: We did our evaluation of GESSAR II based upon the standard review plan as it now exists or as it existed at the time we were doing review. If we found deviations at that time, we documented them in the SER.

MR. EBERSOLE: Are they consistent with this list?

MR. SCALETTI: Not totally, because the numbering system of the SER might be a little bit different.

MR. EBERSOLE: I'm just trying to converge how many they were and how they were handled.

MR. SCALETTI: I think perhaps the number is somewhat consistent. I'm not sure.

MR. EBERSOLE: In some cases there is some pretty much ambiguous statements here that I don't know how to read at all. I'll give you an example.

You say that, "GESSAR II requires operator action within ten minutes for some events." Well, if it is within ten minutes, it could be one second. And that is not very prudent, I think. So I don't know where it is or on what grounds. Shall I find in the SER or its supplement a rational explanation, let's say that the operator is going to do something in two-and-a-half minutes and on what basis? Or one minute or 30 seconds? Ten minutes was just an old arbitrary rule.

MR. HARDING: The words there are referring to the assumption that was made in the GE analysis that the staff analyzed, and the assumption would be that a certain operator action was taken in ten minutes, and that's why the words are in the SER. That action was assumed in ten minutes. So it was an analysis assumption, and the answer then is that it was not assumed at two minutes.

MR. EBERSOLE: This says, "GESSAR II requires operator action within ten minutes."

MR. HARDING: Well, the wording may be confusing, but what it means is that in the analysis of the staff review that was done by GE that some action was assumed to have taken place at ten minutes.

MR. EBERSOLE: At ten minutes.

MR. HARDING: Not any too many sooner than that.

MR. EBERSOLE: That's the invert of what it says here. This says within ten minutes.

MR. MICHELSON: GESSAR II does require operator actions in some cases in less than ten minutes, which could be one thing, and those are the cases you would like to read about. And they might be one second or one minute or five minutes. We don't know until we read.

MR. HARDING: We will have to check on that and confirm it.

MR. THOMAS: We are going to look it up right now and see if we can find a specific example.

MR. FOX: It turns out there is a lot of explanation that goes into this and it is a stack that thick out of GESSAR SAR and what I was -- what we are trying to do is find out where your interest was and then feed that back to you with a little more detail.

MR. MICHELSON: You can see we have some interest in this one. The standard review plan is of course just guidance for reviewers, but in the event that the reviewer deviates from the guidance is he obligated to kind of document the deviations and write a little justification?

MR. FOX: Yes. That's what I've got.

MR. MICHELSON: On each and every item like this I would expect to see that deviation and then I would like more explanation.

MR. SCALETTI: Only if the reviewer considered it a deviation.

MR. MICHELSON: This gets back like into what is a backfit. If the staff doesn't think you don't call it a backfit, then even though you require the utility to put it in and it goes under a different set of rules -- and I don't buy that it's a deviation if it doesn't agree with the words in your plan. There can be narrow problems of judgment.

MR. FOX: As a matter of fact the SRP itself says an approved alternate method, but it takes that deviation and acceptance, if you will, from -- from the prescribed methods.

MR. MICHELSON: I would expect to be able to read about it. It should be documented.

MR. FOX: You have got it.

MR. OKRENT: When next we discuss a subject I'll assume both General Electric and the staff are better prepared. I think we best go on.

Evaluation of USI's and GSI's. The staff presumably has written what it has to say in this area in the second supplement; is that correct?

MR. SCALETTI: Correct.

CHAIRMAN OKRENT: Do you have any significant additions to that supplement that you can make at this time?

MR. SCALETTI: No.

MR. OKRENT: Well's let's hear from General Electric on the matter.

MR. QUIRK: Mr. Kevin Holtzclaw.

(Slide 19 shown.)

MR. HOLTZCLAW: My name is Kevin Holtzclaw. I'm the program manager at General Electric for the GE severe accident program.

What I would like to do in this presentation is to go through the evaluations that GE performed in providing the technical basis for resolution of the USI's and GSI's.

I do have information I think on every issue as per the ACRS directions. I think we will be focusing on those that are open and confirmatory, but I also have some charts at the end part of my presentation that focuses also on the GESSAR II features that allowed the technical resolution of the individual issues as documented in the SER.

As we noted in our discussions this morning, the current draft severe accident policy requires a demonstration of technical resolution of all the applicable USI's and the medium and high priority GSI's. As far as the prioritization basis for the GSI issues we are referring to the NUREG-0933 in the specific version of NUREG-0933 was that issued, I believe it was in December of 1983. That had the prioritization of these issues.

Just by way of some background, in order to be clear on the issues that General Electric was going to address, we did meet with members of the staff to review our interpretation of the issues that came within our scope and those that we would be provided technical evaluations for. This meeting was held in May of this year.

As a result of that meeting we identified seven of the USI's and 23 of generic safety issues. We ultimately reviewed these issues and reported on them in a General Electric NEDO report resolution of applicable unresolved safety issues and generic safety issues for GESSAR II, with an issue date of June 1984 that was provided formally on the GESSAR II docket to the staff July 13, 1984.

As you probably noted in reading the staff SER there is a various, I guess, various identification of how these issues -- what the status of these issues is today. Three of the USI's A-43, A-43 and A-47, are identified as outstanding issues as are three of the GSI's as noted here.

Two of the USI's, A-44 and A-45, is a station blackout and decay heat removal, have been identified as confirmatory issues.

One, USI A 17, is an interface item as are three of the GSI's.

In the category of resolved issue one USI and 17 of the GSI's.

What I would like to do is focus on these first two categories, the outstanding issues and the confirmatory issues, and then I will be also addressing the design features that allowed us to resolve the 18 issues at the bottom of this chart.

I apologize that first chart just kind of noted the issues by number. This gives you some titles to go with the issues and, as I said, we will be focusing on the first classes in the succeeding charts.

(Slide 20 shown.)

MR. HOLTZCLAW: The next two or three pages of handouts are taken directly from the GE report with an added column that I wrote in to give you an idea of what the current resolution is. That's probably more indicative of the GSI charts that clearly specify the issues that were resolved.

(Slide 21 shown.)

MR. HOLTZCLAW: What I would like to do now is move through the principal outstanding issues providing you some indication of the issue description, safety significance and a very encapsulated discussion of the resolution for GESSAR II that General Electric provided to the staff in our report.

First of the issues is a USI A-43 on containment emergency sump liability. Issue description: it concerns debris primarily from insulation. Piping insulation could cause sump blockage and adversely affect the emergency core cooling system equipment.

Furthermore, that the hydraulic performance of such equipment could be degraded, affecting long term cooling following the loca.

Primary focus for BWR's on potential for degraded ECCS performance.

There was also a secondary concern on the potential vortex formation causing problems with MPSA.

This has been an area of fairly intense investigation by the NRC. There are a number of NUREG documents that have been issued by the staff on these investigations, which have included full scale testing to assess the thermal hydraulic effects. With regards to the GESSAR design there is potential for debris blockage. However, we believe, from some of the characteristics of the plant that are shown on the next page, that this is fairly minimal. NRC investigations have looked into the potential for void formation and specifically vortex formation. They believe that the air ingestion due to vortex formation was quite a bit lower than previously hypothesized when the issue was initially identified.

MR. EBERSOLE: Let me ask -- for years there was a great intensive effort to control the quality and character of the paint inside the containment. In the same period there was zero attention to thermal insulation. With the end result we had to fight with tons of cracked insulation but a lot of good paint, and we were in essence -- as we so often do -- we were looking at the wrong end of the problem. Potential for blockage was insulation material.

I haven't heard you say you have a tight positive control over all the materials that might act as debris in the suction process or in the cooling process, including consideration of bearings, journal, seals, nozzles and sprayers. Why don't you say that someplace and say that GE will run surveillance and control and specify the character of potential debris of the generating material in the containment? Why don't you just do this and be done with it? Will GE do that?

MR. HOLTZCLAW: I'm not sure I can answer that question.

MR. QUIRK: There is a regulatory guide that governs the design of insulation materials in the drywell and the containment, and I don't know of a problem that we have in meeting that reg guide. So it is an indirect answer, I guess. I don't know of a problem there.

MR. EBERSOLE: You are saying you are riding on somebody else following the guide?

MR. QUIRK: No. We specify in our design the type of insulation to be used. And I believe that to be a metallic substance. And the staff has looked at jet impingement discharging pieces of insulation, whether it causes blockage and things like that. We have been all through that and I don't know of residual problems.

MR. EBERSOLE: Do you still use hydrochlone as a centerpiece in devices, seals and journals which you are unable to accept a rather dilute contaminant strain in which they act as a concentrator? I'm talking about the old designs of 20 years ago where you had journals and seals that were vulnerable to very dilute streams of contaminants because they act as a final filter themselves.

MR. QUIRK: You have got me there.

MR. EBERSOLE: You use hydrochlone to separate the seal water out. That water which provided lubrication --

MR. QUIRK: You are talking about cooling to the pump seals?

MR. EBERSOLE: Not cooling. It was debris removal. And the interesting thing was you did not know whether the contaminant had a specific gravity of more than one or less than one. And that hardly qualified the hydrochlone as being either a remover or adder to the problem. I understand many places have taken them off so I'm just trying to see how you are going to converge on this problem. I thought a deep bed filter was going to be a solution. I don't see any control.

MR. MICHELSON: The work that the staff has done really has not yet addressed the question of finely divided contaminants because it is quite sensitive to the kind of pump seal design that you are using when you take the cooling water off your process stream or provide a separate one-seal injection. Generally General Electric has been using water off the process steams to cool the seals. As a result you have got to clean the water up if you have got contaminants in it and hydrochlone has been one way of doing that but a certain amount of bypass still has to occur because of the density problem and it slowly but surely builds up and seals the pumps then because they've become very fine filters. And in a few hours of operation, you have to talk about many hours after an accident, you begin to build up too much in the seals and the flow goes down and the seals overheat.

MR. QUIRK: I undertand.

MR. EBERSOLE: There is something here that I think is worth mentioning. Your competitors don't use that kind of pump seal and journals and they avoid this problem. And it just doesn't come up. They use coil cooling, which has an open cross section rather than --

MR. QUIRK: They use a separate cooling system, then.

MR. EBERSOLE: Right, they are not -- I don't think they even use a water lubrication.

MR. MICHELSON: Yes, so they have to. It's an integral circulator. It's got its only little propeller on the shaft and it circulates the water out to an exterior cooler and you don't use the processed water.

In other words to lubricate the shaft so the only contamination that ever gets into it is just small amounts of casters you might have off the end of a shaft.

MR. EBERSOLE: That's right. Just trying to close on the nagging issue of longstanding.

MR. QUIRK: Well, Mr. Ebersole, I haven't heard of this issue on our designs lately so let me go back and find out why.

MR. EBERSOLE: You haven't had a loca.

MR. MICHELSON: It gets into the specification of the insulation materials and when you ask people ask them also about, do you have any insulation on your heating and ventilating type of equipment where you have water coolers or whatever inside a containment and what kind of insulation they use in there. I think you will find it is not metal insulation if you are using chilled water.

MR. QUIRK: We don't in the containment. We don't have safety grade coolers for --

MR. MICHELSON: Non-safety grade cooling of containment is often done with chilled water and you have to insulate the pipe to keep it from sweating too much and when they do they use standard refrigeration type insulation, and so forth.

MR. HOLTZCLAW: There were some additional considerations that we addressed when we were looking at this unresolved safety issue and that was the probability of blockage. The main concerns that have been brought up in a good deal of the NRC documentation on this problem was the potential blocking ACCS equipment primarily by funneling out of insulation on the suppression pool and then being sucked into the intakes of the ECCS pumping.

A couple of points just with regards to the design geometry. The suction center line is well above the bottom of the pool surface. Under the assumption that this stuff would settle towards the bottom of the pool there is that one geometrical feature.

The other fact was that in our fall trees for our accident sequences we did evaluate or we did have an item in there to look at blocked suction lines and that was factored into the tree. To that extent it was considered in the course of the severe accident analyses in the risk assessment itself.

MR. MICHELSON: How large a mesh screen are you proposing for this?

MR. HOLTZCLAW: I've got the information. I don't have it at my fingertips but I can get that for you.

MR. MICHELSON: This is all buried at the bottom of the suppression pool, very near the bottom?

MR. HOLTZCLAW: That's correct. We identified the screen size in our -- we can pull that information without --

MR. MICHELSON: Compare that screen size with the throat of the separater cycle which I will kind of suspect you will find on your pumps. That's another number you have have to have.

MR. HOLTZCLAW: Right.

There is one additional factor with regards to the potential for blockage and the substantial pool depth provided for fairly low approach velocities of this equipment which tended to negate some adverse flow conditions.

MR. EBERSOLE: Well a lot of that is based on the premise that this material is heavier than water or it floats up on top when as a matter of unfortunate fact some of it is almost precisely with a specific gravity of one so that it just sits there.

MR. HOLTZCLAW: That's correct. And I do believe that some of the NRC full-scale testing is going to be looking at essentially entrained material of those kind of qualities and again assessing the impact of pump performance.

MR. MICHELSON: The coatings that you are going to use that do have a bearing on the performance of the pump suction, they're designed so that they do not fall or chip or come off at these elevated conditions of 350, 400 degrees Fahrenheit.

MR. QUIRK: Yes, and also we assume that the chloride leaked out. We have been all through that with the GESSAR review.

MR. MICHELSON: They are all qualified?

MR. QUIRK: Qualified paint.

MR. MICHELSON: That includes the paint the vendor puts on the pumps and valves he supplied to you.

MR. QUIRK: And the surface paint in the containment.

MR. CAMP: Is there any impact of deliberate containment venting on pump performance since the pool will be saturated?

MR. QUIRK: Not in Mark III. Pumps are designed for saturated conditions.

MR. OKRENT: Are the paints designed for 40 years?

MR. MICHELSON: A lot of things aren't designed for 40 years.

MR. QUIRK: Well, I doubt it.

MR. EBERSOLE: I don't know of any paint --

MR. OKRENT: Even Sears doesn't.

MR. HATCH: At least on some of the other older BWR's they are almost repainting the cores. It's cosmetically true now to be done more than once in the plant lifetime.

MR. EBERSOLE: Do they paint over paint or scrub it?

MR. HATCH: I don't know. ᵀ would imagine it would be hard to scrub all that off.

MR. EBERSOLE: I'm just wondering whether it is cosmetic or not.

MR. OKRENT: Well, I would be interested in learning more about paint over 40 years.

MR. EBERSOLE: Whether you paint over paint?

MR. QUIRK: The reason why we don't have all of these on the tips of our tongues is because the deterministic review was really the SSER one -- and which is the review and the FDA -- so we just got to go back and dig it out.

MR. MICHELSON: Most of the paint tests that I have read about, all you start out with is a sandblasted base, and I've never read one yet where they painted over paint. I doubt that that has ever been tested and therefore something you can't do but I think I've seen people doing it -- I just wondered how that works.

MR. EBERSOLE: It would tend to add to the load.

MR. MICHELSON: Not so much to the load but the outer coat may beam along an awful lot differently than the inner coat. If you only qualify the inner coat you have a problem.

MR. HOLTZCLAW: To move along here the next item is a confirmatory item Task A-44 USI 44 a station blackout issue discription. Total loss of AC power offsite and onsite which may have an unacceptable safety risk or high risk.

The items here are as far as the overall safety signifiance as identified in the NRC NUREG in regards to GESSAR II, this is really a point of issue with the severe accident review. We do have the three diesel generators, one of which the HPCI diesel is a diverse diesel. We also have the capability of RCIC to provide core filling for some time period much longer than the two hour FSAR assumption and in a station blackout. In fact initially with our PRA analysis we did only assume that FSAR capability.

I think as we pointed out this morning we went back subsequent to our GESSAR evaluation and did a more thorough station blackout study. One of the items that you will be seeing when we report on the PRA and its results was that based on this re-analysis. We believe the risk to be fairly low even though blackout itself is risk dominant. That is the bottom line risk from the GESSAR design we believe is acceptable, but despite this we are still, I guess, as a result of our severe accident review, hardening the GESSAR design to this dominant accident sequence by providing an additional system, the UPPS system, that we will be talking about in more detail that is independent of power and provides long term cooling and heat removal.

And I think along those lines we will be trying to address some of the issues this morning as far as the fact that we don't believe UPPS is quite as constrained as we might have led you to believe in our discussions earlier.

MR. EBERSOLE: The reason I said what I did is I fell in and approached it identical to the patch process. You find a deficiency and you put a patch on it but you fail to capitalize on the versatility of the patch you put on it.

MR. HOLTZCLAW: I understand. We maybe overreacted with regards to the capability for fire protection in that we were containing ourselves to thinking in the typical fire protection. In any event we are going to be talking to you some more about UPPS and its capabilities.

The staff has identified this as an interface item that is dependent on the completion of the review of the ultimate plant protection system and we will be talking to you some more about blackout and its place as far as the dominant risk sequence.

CHAIRMAN OKRENT: Leave it a minute, please.

In the SSER two, when the staff discusses USI A 44 they mention a few things, for example, ability to withstand a station blackout for ten hours. I would like to understand is this ability, that is the ten hour ability, a criterion that the staff thinks all future FDA's or standard designs should meet? And if not, why not and if so, why?

MR. FRAHM: I believe if you read the discussion of the issue in NUREG-0933 the blackout capability in 610, 16 hours depends upon the grid system and also offsite power frequency. Plus the diesel generator reliability. So it was varying. So I do not think the answer to your question is that we will require ten hours capability for all future FDA's.

MR. OKRENT: Might you require less?

MR. FRAHM: I believe the one 610, 16 hours so the answer is it could be less depending upon the diesel generator reliability and grid reliability.

MR. OKRENT: What is the effect of a severe earthquake on the station blackout question?

MR. FRAHM: Probably cause the blackout.

MR. OKRENT: But the resolution, I mean, and how do you decide whether or not it influences how long what is inside the plant should be able to work and so forth? Or has that entered into the review at all?

MR. FRAHM: We were only addressing here the internal events.

CHAIRMAN OKRENT: We are addressing station blackout. I'm sorry. It is a general question. And if the staff wrote a document in which it thought it was resolving it presumably considered all attributes. I have to assume.

MR. SHIU: Kelvin Shiu from Brookhaven. I would like to share a couple of things that related to the seismic related offsite power and the station blackout situation that we have considered.

When we reviewed the GESSAR seismic events as far as the other part of your questions, I would not be able to offer any answer. What we have looked at in review was the likelihood of such an event that given the earthquake there will be a loss of offsite power and a failure of the three diesels either by random failure or due to seismically induced failures. And we have presented the result to the staff in support of whatever resolutions that they have to take with regard to this issue.

MR. OKRENT: Well, thank you. But of itself it is not quite a complete answer to my original question.

MR. SHIU: Could you repeat your question again. Maybe I could offer some additional information.

MR. OKRENT: Well, the first question related to whether the ten hours was somehow going to be a general criterion, if not, why not, and if so, why? And I was given a response which said there existed a NUREG which included considerations of offsite grid reliability, which of course we don't know for any of the GESSAR plants -- and the diesel capability of the plant.

And then I asked a second question, what was the influence of severe seismic events on this resolution approach? I think those are the two questions I asked.

MR. EBERSOLE: While this thought process is going on back there --

MR. OKRENT: Wait just a minute.

MR. SHIU: I will not be able to address the first question.

As far as the second question, the frequency that we have assessed is in the order of ten to the minus six, ten to the minus six, thereabouts.

MR. OKRENT: What is ten to the minus six?

MR. SHIU: A station blackout given a seismic event. Assuming a certain --

MR. OKRENT: So this assumes then that you know in some way the fragility of the onsite AC power system?

MR. SHIU: That's correct.

MR. OKRENT: And everything related to that? What was your fragility, since I don't think we have this many design details on that.

MR. SHIU: The fragility -- I think you are asking me for the fragility for the seismic induce of the diesel.

MR. OKRENT: Well, for the onsite AC power, which is more than diesel, now.

MR. SHIU: That's right.

MR. OKRENT: Everything you need to maintain AC power onsite. Go ahead.

MR. SHIU: Let me separate in two parts actually two groups of sequences.

One of them is specifically related to loss of the diesel which includes the common modes and the seismic related failure modes off the diesel and other related failures of the diesel generator.

Then there is the other group which is given the loss of offsite power and electrical components type of failures leading to the loss of power of your onsite AC.

MR. OKRENT: I'm sorry you omitted one which is a severe earthquake which automatically knocks out offsite power.

MR. SHIU: That's my given condition.

MR. OKRENT: Fine.

MR. SHIU: And so under those two groups the second groups has arranged fragilities and I think it would be better to go into that in more detail some other time.

There is a range of fragility values used including breakers, switching gears and things of that nature. They range in fragility from 1 to 1.5, offhand I recall. As far as the diesel is concerned, we have use of fragility value of .91 or .9.

MR. OKRENT: Well, I hear you, but I must say I'm rather skeptical about the assurance with which you define the fragility of an AC power system consisting of a large number of components which may or may not in the end have relay chatter -- I can't tell from what I've read and so forth and so on. So you are talking about it being able to resist a one in a million per year earthquake. This is what your answer was.

MR. SHIU: May I add to that that in the B and L limited reassessment that we did. We did try to include relay chatter as a potential failure mode leading to the loss of the onsite AC and it had substantial impact based on this limited reasses~ment. So relay chatter was included or we made an attempt to include relay chatter as a failure phenomenon.

MR. EBERSOLE: Basically this plant, although you have a tertiary diesel or third diesel, that third diesel performs no function relative to getting the heat out the station. It just puts water on the core period. So I am on a two track diesel system and without an earthquake. I have some reliability, I suspect from what we just quoted, even without an earthquake, if I ask it to start and run. Are you with me?

MR. SHIU: Yes.

MR. EBERSOLE: These machines are as Dave says, they are enormously complex. They have got lots of parts. They are supported by enormously complex auxiliary support systems like cooling water and you name it. And here is a classic example in an earthquake -- I'll call it a target grouping of enormous complexity and perhaps some wonderment as to whether we have thought of all the parts of it. In your development of the UPPS system you elected I think shortly --

CHAIRMAN OKRENT: He didn't develop the --

MR. SHIU: I don't want to take credit for that.

MR. OKRENT: He is a consultant for Brookhaven. Consultant to the staff.

MR. EBERSOLE: You now have a system in front of you of very few parts, which presumably could be extremely simple and rugged and have a minimum target size for earthquake influence. Yet you refuse to consider implementing it in that context. You are rather defending the larger target.

MR. SHIU: I got a little confused here as to why --

MR. EBERSOLE: I'm saying you are qualifying the more difficult part of your design and not the least difficult and I don't understand that.

MR. SHIU: I don't know whether I should be the one to say.

MR. EBERSOLE: Maybe we ought to ask in what way were you involved.

MR. ROSENTHAL: We have an internal events review. We have perceptions of risks in the internal events review and our perceptions of the risks at large. In addition -- and I hate to see the focus on the UPPS system rather than on the plant -- there is a proposal to add some defense in-depth to the UPPS system.

Now, the seismic review is underway. If it turns out that the seismic hazard is a low fraction of the perceived total risk then the decisions that we have made will stand that seismic review is now underway. Should it turn out that seismic dominates the plant, we will revisit the issue and we would like for seismically hard enhancements, but it would just not take time to do that.

Now, with respect to the ten hours on the -- that's enough.

MR. OKRENT: Can we come back to the ten hours. The ten hours, as I understand it, is a period of time that you want the plant to be able to withstand a full station blackout; is that correct?

MR. ROSENTHAL: The ten hours is somewhat an arbitrary number. You have postulated a blackout and then you look at a recovery curve and one finds it is most probable that you will recover rather quickly. You then look at the differential recovery as a function of time and you can readily conclude that by the time you get out to numbers like ten hours, but not -- that if you haven't recovered power by then, adding another hour or two of battery life really doesn't change the probability, the total recovery. So that there is a degree of arbitrariness in ten hours.

MR. OKRENT: How does one judge the recovery time if a severe earthquake has occurred and is the reason why you have lost not only offsite power but onsite power?

MR. SHIU: I think in both the GE analyses on seismic as well as the B and L review no recovery action was assumed for either loss of offsite power or onsite power. So actually the point is moot as far as the recovery in ten hours is concerned when you applied to the seismic event because in the analyses no recovery action is assumed.

MR. OKRENT: So you have got ten hours in which to evacuate, you are writing off the plant? I'm trying to understand what you are telling me.

Are you assuming that after ten hours you have lost AC and DC and -- unless there is some -- well --

MR. SHIU: Given the answer --

MR. OKRENT: We didn't have the UPPS when you did your review so I don't know if it has any seismic capability at the moment.

MR. SHIU: Given the onset of a seismic event we look at the response of the system and if we have lost our onsite power due to the failure of the seismic insulators and at the same time we have lost onsite AC as well, there is no assumption used to recover either power source. So in essence we assume failure. That's it. Because there is a two train diesel system. You have lost the containment capability at that point. So the ten hour question never enters into the picture.

MR. FRAHM: You assume you have the core melt and then you go through and assess the consequences and that has been assessed and is being assessed, and I think we are dwelling on the seismic issue which the staff has said we have not reviewed yet for presentation to the ACRS.

The other thing is maybe I ought to clarify -- the staff in resolution of A 44 did not say that ten hours was the magic number to withstand station blackout. GE had made a presentation to the staff saying it could withstand station blackout for ten hours. And also it is part of their design improvement potential or potential design improvement, which we are still reviewing. But there is nothing magic about the ten hours. As a matter of fact the PRA assumes, as Kevin had said, two hours station blackout capability.

But if you do some slight modifications to the plant and some operator actions like load shedding you can extend that to ten hours and if you do that, you will have a factor of two or three reduction in core melt frequency before the loss of offsite power sequence. I hope I didn't confuse you originally when I said ten hours. It is not a magic number at all.

MR. OKRENT: I'm sure it is not a magic number.

Let me see if I can get you to in fact restate where the staff stands in general on A 44. My recollection is its final resolution awaited A 45. Am I wrong on that?

MR. FRAHM: That may be tied in. I'm not sure about whether it is going to be tied to A 45. It may well be.

MR. SCALETTI: You said that the resolution of A 44 was dependent upon the staff completing its review of the ultimate plan protection system and extended battery capability.

MR. OKRENT: I'm talking about the general approach and my recollection -- correct me if I'm wrong -- is that A-44 with regard to its complete resolution, was related to what happened in A-45?

MR. ROSENTHAL: Yes, but there is ANSI standard ANSI 58 point -- I think it is 12. That is now under review by the staff. That ANSI standard in turn will be endorsed ultimately and planned as a REG guide and then would have to go to Keugler for some sort of implementation. So I think that's the game plan on A-44.

MR. OKRENT: But right now there is not an accepted general resolution for A-44; is that correct? Independent of A-45.

MR. FRAUM: That's a correct statement.

MR. OKRENT: Now, really partly where I'm trying to get by my questioning is to find out whether in reviewing the FDA in this area the staff has some kind of general guidance other than it is a low risk contributor in resolving what should be done for station blackout.

And one of the kinds of things is should there be an ability to ride out a complete blackout for some period of time for any plant, for example. You might say no for the following reasons or whatever. But at least then you would say no and have the reasons not only specified but well defended. If yes, then that would also be an approach.

Now, with regard to seismic, that's of course, just one of the possible ways, but it is certainly one of the ways in which you don't expect early restoration of offsite power. So you are sort of tied to whatever is going to happen on the plant. And it might be again, it might have been possible -- you had some general guidance in that area and I was exploring to understand in part.

You may or may not recall, because it was a different part of the staff we talked to about severe accident policy in part, but one of the questions that the ACRS raised was should there be general guidance from the commission or whoever, in reviewing FDA's or standard plants on major questions of safety so that one wasn't using what some people call over emphasis on the bottom line. In fact, many people on the staff used to use that term. The staff is using the bottom line very heavily these days.

But one reason, again, why I am probing in this area was to see whether there does in fact exist some general guidance so that if company GF instead of GE brought in a plant for an FDA or design tomorrow, would it begin ad hoc in regard to station blackout review or would somehow your position be guided by some -- shall I say -- general safety principles or whatever? I can't tell at the moment just what the situation is.

MR. EBERSOLE: As I remember this -- it is a very old issue -- if you look at the numbers there you could see that station blackout was a major problem.

But anyway, I thought -- certain people realized they didn't want to have instantaneous trouble if total AC power failed and I thought, as is many times the case, we reached up in the sky and grabbed a number and it was two hours within which we didn't know what we were going to do or what we were going to do with it or who was going to do it. But we grabbed a number for wont of any other better method and for a long time that two hours sort of stood and we verified that the plants could at least do that.

Then out of the various analyses those numbers fell out but they didn't mean anything since in that time interval there was never any qualified set of things that took place.

Who did them, what was done or whatever. I think what we probably need is to get a fix on some time interval which will be commonly used and a set of activities and people who perform them within that stated interval to give some reality to whatever number we pick.

MR. ROSENTHAL: Both the ANSI standard that is progressing and the B and W emergency -- GE emergency procedure guidelines and all the vendor guidelines require -- the ANSI standard would require that procedures be developed. The vendor emergency guidelines incorporate consideration of events such as including station blackout. So that far we have gone. And the future applicant referencing GESSAR would adopt GE EPG's as they then existed. That effort is underway.

MR. OKRENT: That's the easier part of the answer in effect, because a -- somewhat harder and in the end judgemental, it is --

Do you specify some period of time that it can withstand full loss of AC and if so, what? And what do you require of your DC batteries, for example, and various other things?

MR. FRAUM: I think the answer to your question is that when A-44 is resolved there will be a requirement for a time to withstand station blackout. However, now the issue is not resolved and there is no specified time.

What I was trying to say in the beginning is that it was dependent on a number of things, grid frequency and reliability, diesel generator reliability.

MR. ROSENTHAL: I think that we are also in reasonable shape. One, we perceive the risk to be low.

Two, if we are told don't look at bottom line risk because we look at what a contributor station blackout risk is, it looks bad with respect to external events, we know that extending the battery life and insuring that the RCIC will function are the way to go to reduce the core melt frequency from that sort of sense, those actions have taken place. Procedures have been developed. So what we are really left with at this point are -- it seems almost like down to the question of what should be the battery life and as I recall, the restoration curves.

You may see a big difference in the core melt frequency between going from a two hour to ten hour battery but you are not going to see those sorts of risk reductions when you move that ten hour number around a little bit. So I think that we have got 95 percent of the problem down.

MR. OKRENT: Well, I'm not sure it is only DC batteries that are the question.

If one looks at foreign practice one will see that some countries develop one kind of approach to this issue, others may do another thing. And it is something that I think we need to understand -- whatever it is that's adopted here.

MR. ROSENTHAL: We did prepare a table showing what the French and the Germans and the British were doing relative to American practice on hardware for A-44. I know, for our management -- and one has to in order to adopt a different scheme -- one has to be assured that -- one would like to believe there is some risk reduction associated with it.

So just because the French are advertising they have a 24-hour criteria, which I've yet to see, doesn't mean that's necessarily better than the -- at least the proposal now is for ten hours.

MR. OKRENT: Well, why don't we take a ten minute break before we go on to the next issue?

(Recess taken.)

MR. OKRENT: Before we proceed, let me just make one comment concerning the remainder of the day. As I said at the beginning of the day, it was not my intention to go through this day's agenda no matter when it ended, that we would end before 6:00 o'clock. And that's still my firm intent.

That means, of course, we will not get through this ambitious agenda today. I think it would be well, probably for all parties concerned, to see where we are, at the end of today and look at what remains of today's agenda, what we have on tomorrow's ambitious agenda and we can have a five-minute caucus tomorrow morning to see what the ideas are and what should be covered. And I won't guarantee to accept your proposals, but I'll listen very intently. Okay?

MR. QUIRK: Okay.

MR. OKRENT: Just one point.

In our discussion on A-44 and A-45 I think it is perhaps worth noting that at least for A-45 and I believe for A-44, the work of the staff is aimed at what I'll call existing plans, those not already in operation or under construction and that they -- I know in the A-45 work scope, work on future plans was actually excised from the proposed work plan. So that in the end we can't, I suppose, expect full guidance and maybe not even major guidance from whatever the resolution is for existing plants unless it is somehow judged that in this area things are really so good that it is not an area where one would take the general words of the draft that one looks for improved safety and apply them in this area. In any event let's go on.

MR. QUIRK: Can I bring the A-44 and A-45 discussions to a collusion with just a few statements?

I think the staff has been really hard on us in these two areas because the designs that we have ended up with in my opinion provide an indefinite capability given blackout. And that's because we have the RCIC to handle the short term, whether it is four to eight hours somewhere in there.

And then you bring on UPPS which is a system that can definitely maintain that status. And so they have gone well beyond, in my opinion, any foreseeable criteria, because we have ended up with a design that can handle that degraded situation indefinitely.

Let me address your comment, sir, on external event. When you take a very large earthquake and can say that initiated station blackout, now you have got something. And our present design, as I said, is not seismic, so we don't have that indefinite capability for that set of assumptions. By I just wanted to make clear that we have gone well beyond, I know, anything that's ever been written down on A-44 and A-45 with our present systems.

MR. OKRENT: If I can add a couple of general thoughts, as I tried to indicate earlier.

Since there does not exist a set of reasonably specific policy guidance papers or whatever from the commission -- for new plants -- to some extent the policy is going to be made in the process of reviewing the first one or two. That's one thing. And so we have to keep this in mind and try to understand why whatever it is is being done and accept it -- is acceptable.

Another thing is the general area of sabotage protection brings inquest of A-45, as you well know, and that in some countries has led to the use of systems that we don't have here. That doesn't mean we have to have them here, but we need to understand why we are accepting what we are accepting. So we are going to have to go through these thought processes since we don't have the benefit of the commission giving us guidance along these lines. And any way, ACSR would go through the process if it did have the guidance.

MR. EBERSOLE: I just want to make the remark that the extreme simplicity as I see it of your indicated system needs to be looked at with a view toward extrapolating its competence without incurring too great a cost.

MR. QUIRK: I understand and I hear you. You are saying that given all the big ticket items -- sabotage and big seismic -- there may be some common sense cost-beneficial things that could be done to provide enormous capability for those things.

MR. EBERSOLE: If you were working a PWR that's not true. You would have a lot of complexity; you don't have that here.

MR. OKRENT: He is prejudiced.

MR. QUIRK: No.

MR. OKRENT: Go ahead.

MR. HOLTZCLAW: Move on to another quick issue here on A-45.

The safety significance here was a dominant contributor to the BWR sequence and more important as a point of interest is that BWR risk is somewhat different than the long course BWR plant that was analyzed. And I think that's characterized in both the GE analysis and the probablistic risk assessment for internal events and we calculated 1 percent contributor to GESSAR. Staff consultant analysis showed it to be a 7 percent contributor but irrespective of the absolute number it was not a siz able contributor. These were reasons for this in the multiple and diverse heat removal capability.

Again the proposed design for the UPPS system provides additional capability in this area and in the staff SSER there is also the code indication or the identification of this as an interface item, confirmatory item that again is hinged on the evaluation of the UPPS system.

(Slide 22 shown.)

MR. HOLTZCLAW: Next two charts deal with the unresolved safety issue A 47 which is also identified as an outstanding issue in the issue description in the NRC NUREG.

The concern here for potential for increasing severity of the accidents as a result of control systems failures or malfunctions in the unresolved safety issue description, there is particular emphasis on two specific types of transient events for the BWR. This is identified as reactor overfill transient.

I think what I want to do now is just identify some of the items that we put together in our response for this issue for GESSAR II and that's really the goal for the overall system design, in that singular or multiple failure would not prevent automatic germanial safety equipment that requires to bring the plant to save shutdown.

In addition to that goal, there are safety system reviews that are performed to insure that this is carried out in the systems analysis portion of GESSAR II. There are also specific evaluations performed in the control system following TMI in the evaluation of high energy line breaks and the staff evaluation of that GE analysis was contained in the GESSAR II SSER one.

Furthermore, there are other pending reviews with regard to REG guide 197 and INE bulletin 7927 that have been included in the evaluation of the GESSAR II design and also documented in the course of the staff review. The staff SSER two on this item indicates that the GE design is being further reviewed against this unresolved safety issue and that the staff will report on that review in the succeeding SSER.

MR. OKRENT: Can I ask the staff a question here?

It is my impression that there is one national laboratory or another looking at the question of the impact of control system reliability on safety for BWR's. My memory tells me it is Idaho but I may be wrong.

I don't recall having seen much, if any, in the way of reports in this area and I would like to know where that work stands and have they found any interesting multiple failures. Would they agree with the GE goal as the right and only goal and so forth and so on?

Can you help me?

MR. SCALETTI: I don't believe we can help you at this time. We will have to respond to this at a later time.

MR. OKRENT: I would appreciate it. And if there are any memoranda or draft reports that would help us know what seems to be the technical status of the work done thus far, I would appreciate that. That might expedite the discussion.

(Slide 23 shown.)

MR. HOLTZCLAW: Next unresolved safety issue is one we have touched on in discussions earlier this morning and that's with regard to hydrogen control.

The issue here is that core meltdown obviously results in generation and release of large quantities of hydrogen. With regard to the safety significance, the GESSAR II PRA quantified the risk for hydrogen cumbustion in that we did not employ any additional hydrogen control systems in the evaluation in the PRA.

That is there were no igniters, no post-accident burning or any of the effects that have been postulated for

BWR's. We did evaluate the impact of hydrogen detonation on the containment design. It did lead to loss of containment integrity, but the resultant risks were found to be acceptably low. This formed the basis of the General Electric position that for the GESSAR II design no additional hydrogen control is cost-beneficial in that there is an insignificant risk reduction associated with it.

However, the technical issue aside, CE has indicated we will comply with the CPML rule to provide a hydrogen control system. I think it was discussed this morning with the open issues with regards to the staff and where that task is right now. Resolution is pending a staff review of our commitment of the impact of UPPS as far as reducing the incidence of core melt accidents, and that I believe will also be reported on in the future staff SER.

MR. OKRENT: I think we will want to see what happens when more than one pipe of non-seismically qualified-type breaks. We want to understand what it is that results, if anything -- you know, from the risk point of view it may not change the risk substantially. But we want to understand that that's the case, if that's the case.

MR. QUIRK: We are headed for all seismic piping. Because to answer that question, you have to do that.

MR. MICHELSON: Maybe we have to go to all seismically qualified piping. We don't know because we haven't seen an analysis of the severity of the risk involved if you don't have seismically qualified pipe.

MR. EBERSOLE: Carl, there is an industry group called SKWUG. I think. Is that correct?

MR. MICHELSON: That's right.

MR. EBERSOLE: They are developing some pretty good information that leads you to sort of a qualitative feel that you don't get pipe failures.

MR. MICHELSON: Unfortunately, they are dealing with only big pipe. Small pipe is much more vulnerable because it can be broken not by its own weakness, but by something falling on it. And they have no evidence in these various plans of the vulnerability --

MR. EBERSOLE: We recently learned of second loss of an impeller rotor, the pump. I understand there was one prior to this, and out of the analysis of that grew the realization that in looking back at control system failures, if one fails to include limit switches which are control grade systems in major valves or even minor valves, or very complicated cranes, there can be created loads of enormous magnitude leading to the failure of the primary drive system or even potential pulling out the valve box, a loca producing mechanism, in essence.

I recall with some clarity the curing of a three-and-a-half inch stem at Browns Ferry. So in considering load combinations, I think one should add to it consideration of control grade malfunctions of position stops and limit stops and torque stops as a contributor to the load combination.

And then I would like to certainly advertise this new phenomenon that we recently heard about which is cold streaking, in which we took out the 24 pipe. Because we get cold water streaks developed along one side of it which pulls out anchors and at least sets up the notion that there may be some producing stresses at certain points in the piping system under these circumstances. This cold streaking is a new thing.

MR. OKRENT: Before you remove that, you mentioned or someone mentioned, that -- these are not the exact words -- for seismically analyzed pipe not having flaws of any significant size -- those weren't the words, but the intent -- the probability that the SSE shoes cause a loca is small, and you and I both know that their analyses that suggest that for earthquakes substantially larger than the SSE people calculate the probability is small.

However, it is less clear to me what would have been the case, for example, had we been so unfortunate as to have had a really severe earthquake hit at the time it had its problem with fracture. I just haven't seen a good analysis of it. I know people say stainless steel is tough and so forth, but we are not always talking about just the SSC of course, since it is not a terribly improbable event. I recognize that we heard a talk about new material, and your hope, maybe your belief, that BWR made with this new material maybe just won't have significant fractures at all.

However, it seems that in this particular field, nature has been adverse in the past, because I can recall hearing that the problem has been solved at least a couple times before, and I recall people saying even if we get cracks on small pipes they won't occur on large pipes. So at the moment, although your position may indeed be correct, I'm not sure history provides a basis for complete confidence.

That leaves us in an awkward position, it seems to me, with regard to trying to decide whether for future plants built with this new material the position the staff adopted with ACRS -- primary systems with PWR's is a good bet. And I think that the matter is going to have to somehow be dealt with in some way a part of this system with you, and there will need to be a robust basis, if one is going to part from the past approach.

MR. FOX: You are entirely right.

MR. OKRENT: What I'll have to say is good experience, but limited experience in the field, compared to a plant with many pipes running 40 years.

MR. FOX: I'm heading up a group on the standard associated with this phenomenon called "leak before break approach" as part of the whole process. I think one of the things that makes it -- I don't say "okay," but makes it a little different are two things.

One, you have a precursor to a break, in fact that's part of the process of applying to the leak before break approach is to demonstrate you can in fact measure it copiously well before it would run and become unstable. So that's one aspect that is not just a bunch of probabilities numbers. There is a precursor to the phenomenon. That's on one hand. And I think that's -- by the way it is difficult to demonstrate, but you can demonstrate it.

The second thing is this is a very unusual -- I think there is maybe two in the whole. The issues or the generic issue is one of those that if you take something out, according to every calculation I've seen in the write up associated in the specific treatment of this issue, is it saves potential exposure, both to the operators and to the public. So you know, there are other safety aspects. This isn't one of those you are going back through and say, "Well, we will save some money and take some out." As a result of doing that there is a benefit.

So I think you have got to weigh that just a little bit, too. It has some other merits in terms of total plant operation over the 40 years life, and I think that that has to be put in perspective with the precursor to -- that is the measurement process or the precursor to the event.

So I would just like to leave with those two thoughts on this specific issue.

MR. OKRENT: Well, with regard to the first point, it seems to me, if it has not been documented, there will need to be a look at the situation where you have flaws ready to leak but not leaking, which we have had --

MR. FOX: Right.

MR. OKRENT: -- and a fairly severe, and that means not only substantial acceleration but many peaks. In other words some, as you well know, earthquakes don't all have only a few peaks, and if you have a larger one, it is longer, and whether or not in this situation it can move from the position of not quite ready to leak to the position of ready to run.

Now, it may turn out that the material is tough enough and so forth, and the forces even in severe earthquakes are small enough that this is not a problem. But one has to look at it again and understand the risk. I guess the same goes if you have any material which isn't quite so ductile -- valve bodies and so forth. If indeed we are going to be able to have a firm basis for the decoupling.

MR. HOLTZCLAW: This discussion has focused on the items on this portion of the chart dealing with the resolution.

There is one other issue, item B-5 -- and Jack, maybe you can correct me here -- item B-5 would be Ductility of Two Way Slabs and Buckling Behavior in Steel Containments, and has been essentially joined with this item as far as the resolution.

MR. FOX: Sort of. This is Jack Fox. The containment portion is associated with -- Well, let me put it this way. If you solve this I-don't-break-the-pipe situation, then you don't have these local loads on the containment, so that's -- it is one solution. So it is tied.

The slab part of the other issue has already been written off, not for GESSAR but for general write-off. It is a two part issue. I don't have it right in front of me. I didn't want to couple the ductility of the two-way. This has been resolved generically. And if this turns out that GESSAR has done it in that particular fashion, so the second part is the containment.

MR. CAMP: With regard to the buckling of the steel containments, have you looked at the effects of diffusion plants in the wet well? And if so, what were the results?

MR. HOLTZCLAW: We have not looked at it directly. I think that is one of the activities that the high control group will be faced with because that seems to be the key issue with regards to igniter performances, the existence of diffusion plants opposite the surface of the suppression pole. As I said we haven't evaluated that.

Item B-58, which is another generic safety issue, is also identified in the outstanding item list by the N.R.C. This is a concern over valve failures, passive valve failures and the impact of safety related systems.

(Slide 24 shown.)

MR. HOLTZCLAW: As indicated in the N.R.C. Nureg on the generic safety related systems contain numerous passive valve failures themselves by their very nature can occur over a period of time and go unnoticed until the valve itself is challenged. And then rendered inoperable with failure on demand. With regards to the GESSAR II, the EQ program itself meets all the NUREG O eight hundred requirements, and, in addition to that, there is a commitment to REG guide one one one six, which provides additional competence for satifactory in service operation and inspection.

As far as the severe accidents go with regards to valve passive failures, the data base does include these types of failures. However, admittedly the data basis for passive failure is a lot smaller than the data base for active failures, but they are included and they were factored into the PRA analysis in that fashion. The staff is currently reviewing GESSAR II in this area and I believe will be reporting on that in the future supplement to the SER.

MR. MICHELSON: Can you clarify in this case when you talk about passive failure, are you talking about pressure valve failure? Generally passive failure and pressurized -- pressure boundary failure --

MR. QUIRK: No, it is not.

MR. MICHELSON: So will you clarify what you do mean by passive failure.

MR. QUIRK: No, I don't -- In the SER PDHR, it was defined as a packing failure, for example, valve packing failure, which would result in leakage into the compartment and subsequent radiological exposure.

MR. MICHELSON: Well, it is a pressure boundary failure.

MR. QUIRK: Well, you know, like a packing under a pressure boundary.

MR. MICHELSON: Most people do a pressure boundary It didn't have to be covered by the code. So, obviously, pressure retaining portion of the component. But it is still the pressure opposed to body failure. How about a body failure, is that a passive failure? The term threw me, because I had never seen it used quite this way before. I guess it is commonplace. I just didn't know. So when you are trying to describe your ratio here you talk about passive valve failures, can you tell me, besides packing, anything else?

MR. FOX: Wait a minute. Let me just read the words here. Distinction between active and passive way, the distinction is made here. The distinction is made here that the active failures is typically occurring during valve operation, while passive failures occur over a period of time, going unnoticed as the valve is rendered inoperable. Detection then occurs after valve operation is abandoned. Now, we basically, at least in my experience, that would all be classified as a quote active failure.

MR. MICHELSON: Those are all active failures.

MR. FOX: But that's the way the data is collected and this is the way the issue has been characterized to us.

MR. MICHELSON: I've been educated now.

MR. EBERSOLE: I've gotten confused. I think it may mean that for instance if a disk is -- become disconnected, then you can test the valve and for any period time it will look like it is working, but it is not working because you could come -- the major element of the valve is no longer moving and that's one problem.

The other thing, even if it did move, in view of the fact that the test -- valve tests are characteristic, this is demonstration of a capacity to go one way or the other unloaded. There could be progressive loss of a capacity to do it under a real load and you will be led in to believe and also provided with reliability data which is false; that you have got a valve which is working and it isn't working. It is not any good. Because the valves are not loaded.

MR. FOX: The fact that whatever you want to call them and however you want to characterize them, it represents ten to 12 percent of all the failures like that.

MR. EBERSOLE: Right.

MR. HATCH: Does the valve EQ program include all those environments that might be seen during the accident, such as blowdown, et cetera.

MR. HOLTZCLAW: I don't know what is contained in that EQ program.

MR. KNECHT: The valves aren't part of our scope. The actual hardware supplies.

MR. MICHELSON: Whose scope is it? General Electric does not supply the valve?

MR. FOX: We supply the specifications, which includes compliance with the --

MR. MICHELSON: You specify all the requirements on the valve except for the physically supplying.

MR. FOX: We specify the environmental conditions. Well, the conditions for which the valve is supposed to. You take each system --

MR. MICHELSON: Then it gets back to the earlier question today in the case of a valve whose function it is to isolate a break outside of containment, are you going to specify it be tested for break conditions?

MR. FOX: Yes.

MR. MICHELSON: You will.

MR. FOX: Yes.

MR. MICHELSON: Test or analysis. But in the case of this there is no analysis. You can only test to find out this answer.

MR. HOLTZCLAW: I think the final open generic safety issue is item 82, which is beyond design basis accident in spend fuel pool. The concern here emanates from actions -- for accidents larger than previously analyzed for spent fuel pool accidents in which you have an available inventory of unreacted circ. in spent fuel, and for some reason you lose the pool. There is then potential for fire and fire propagation with the large potential quantities of unreacted circ.

The staff analysis showed potential for large fission product releases for a combined seismic induced pool draining and loss of water makeup. This analysis as it is identified in the NRC NUREG made some very specific assumptions on geometry, primarily the fuel pool location, which had an impact on not only the -- impacted the seismic event itself, but the consequences in the -- in where the water would go.

And the analysis was based on a pool of ten-story elevation. There are some significant differences in the GESSAR design with the assumptions that are in the staff analysis. The pool is below grade and does sit on a face mat in a seismic category one building. So this would end up having a significant difference in the postulated consequences relative to those that we would calculate for GESSAR.

We believe that the GESSAR design is sufficiently different from the staff assumptions, and this issue I guess has been identified by the staff as pending not only the seismic capability review, but a more detailed review of the differences between GESSAR and the analysis assumptions within the original staff review. I think furthermore, not only the geometrical concern, but there were some assumptions made on the inventory that was assumed for the fuel in the fuel pool itself.

(Slide 25 shown.)

MR. MICHELSON: Is the fuel pool cooling equipment seismically qualified throughout?

MR. QUIRK: Yes.

MR. MICHELSON: All the pressure boundaries qualified?

MR. QUIRK: Thank you.

MR. MICHELSON: Let me ask you: In the case of reactor water cleanup, is that system seismically qualified throughout? Maybe you would want to check on that, because I would like a correct answer on it.

MR. QUIRK: I'll confirm it.

MR. MICHELSON: I don't know. I've found a mixed bag around the country in present day plants and I wondered what your intention was.

MR. QUIRK: I think it is identified as a safety class other, which means it doesn't perform a safety function. So it doesn't need to meet the safety requirement, but GE has applied ASME class three.

MR. MICHELSON: Check out carefully, keeping in mind, of course, it is at full temperature, full pressure and it is seeing reactor fluid -- you have to have those isolation valves closed under these rather strenuous conditions.

MR. QUIRK: The portion that provides isolation at depth change is --

MR. MICHELSON: Oh, yeah, but where the break occurs -- that's where you get into the question. Will you get that kind of break during an earthquake and I think I got the answer a little bit earlier, yes, you will get such a break of non-seismically qualified equipment during an earthquake. So you might want to check on that, too, to come back and tell me that in case of an earthquake the reactor water cleanup lines break or not.

MR. QUIRK: May I set that record straight, please. We do not assume that all non-seismically analyzed piping fails.

MR. MICHELSON: I did not say all. I thought you said earlier, one would fail during the earthquake. Now, maybe I misunderstood you, and that's important. Are you assuming any pipes during earthquake, qualified or not, is another way of asking the question. And I think the answer was yes, you do, but only one. But that one is going to be water reactor cleanup, full reactor pressure and temperature got to go into the whole isolation bit and so forth.

MR. EBERSOLE: Terribly hard to understand on a logical basis that you just want to fail one. You might just as well go ahead and say one or all. There is no logical reason to fail one or not at all.

MR. FOX: I agree with what you are saying but I don't believe you can demonstrate that -- I'm not talking about a good pipe, not something left over is going to fail in the seismic event. Seismically induced, so the rationale is that you have a pipe break and it happens to be coincident with the earthquake and then we analyze the consequences from there.

MR. EBERSOLE: Well, if you don't think there's any at all, I think there would be some statistical fraction of all of them, not just one brought out of blue sky.

MR. MICHELSON: Why bother, why are we going through this whole ritual? Unless we believe it, and if we believe it then we get into this logic problem this portion -- it is a logic problem as far as -- it is a real problem in the case of systems like reactor water clean up that are very high temperature, very high pressure.

(Slide 26 shown.)

MR. HOLTZCLAW: Item B ten is an interface item having to do with the behavior of the BWR Mark III containments. This is a concern for pool dynamic loads and potential for structural damage. This item was reviewed, the GE pool dynamic load definition was reviewed and contained in the SER with the FDA section six two one eight three. It is identified now as an interface item for the utility applicant referencing -- the GESSAR will address the staff acceptance criteria for the Mark III containment pool dynamic loads. An additional interface item.

(Slide 27 shown.)

MR. EBERSOLE: Let me just say the UPPS system may be the fastest, and he is just an escape route from these logic problems we have just been discussing.

MR. OKRENT: Wait until we talk about the UPPS system.

MR. HOLTZCLAW: We have talked around it all day today. Item 65 in the generic issue list is a probability of core melt due to component cooling water systems -- concern here is failure of component cooling water. Fault trees considered support system requirements with failure probabilities were provided with both room cooling units and essential service water system.

For GESSAR II specifically the design features relative to water delivery systems, central service water cooling is utilized for ECCS components, RCIC system pumps utilize self-cooling, component cooling with closed cooling water systems are utilized for sample cooling, collateral cooling and resurge pump seals. Because of the fact that portions of the ESSW is outside of GESSAR scope and it is potential to contribute to core damage is being addressed as an interface item.

MR. MICHELSON: Along the same lines does GESSAR use any chilled water system outside of control room environmental control? Are you using it for pump compartment cooling --

MR. QUIRK: Yes, emergency equipment area cooling.

MR. MICHELSON: And are they considered essential?

MR. QUIRK: Yes, they are.

MR. MICHELSON: How are you handling them since there is no standard review plan?

MR. QUIRK: Service water system is safety grade.

MR. MICHELSON: There is quite a difference between a service water system and a chilled water system. There are a number of significant differences. Have you looked into those? You might find some interesting effects.

For instance you are probably well acquainted with the fact that you can't restart chillers once they were tripped off on power, generally for something for like 20 to 30 minutes.

Have you really looked into the chiller packages?

MR. QUIRK: We have. We will refresh how it was resolved on the FDA and report.

MR. MICHELSON: If I can go somewhere and read about how you handle chill water --

MR. EBERSOLE: Probability of the pump water failure, you are talking about probabilities.

At the bottom down there it says you are going to put on interface requirements and I'm reminded of CE and its auxiliary feed water. Failure of this pump cooling system shall be less than whatever, and then how that's materialized? Ten to the minus four per day or per year or whatever.

MR. HOLTZCLAW: I guess we will be talking about that in a separation presentation. But the intent is for the specific reliability in our analysis that that would be then incumbent on the applicant to meet that reliability.

MR. EBERSOLE: So this is a subordinate PRA he has got to do.

MR. HOLTZCLAW: That's correct, yes.

(Slide 28 shown.)

MR. MICHELSON: In doing an analysis of a more exotic system like chilled water, do you have a data base that you can go to for reliability numbers on chillers, since -- without the chiller, perhaps you don't have an adequate cooling of essential pumps, so you need some numbers of their probability of failure. Did you get a data base somewhere to do that, or did you just make some assumptions?

MR. HOLTZCLAW: Did you know the answer to that?

MR. QUIRK: Is Roger here?

MR. MICHELSON: Just add it to the chilled water consideration, but I was kind of wondering how it was handled in PRA.

MR. HOLTZCLAW: Just go through the USI and GSI that were indicated as resolved for GESSAR. I don't have quite an exhaustive presentation. The intent here was to focus on the issues themselves and then look to the specific design feature of GESSAR that might have aided in the resolution.

USIA one is water hammer. This was addressed also at the FDA stage.

(Slide 29 shown.)

MR. HOLTZCLAW: GE pointed out in the -- in our submittal on USI and GSI's, I guess, the data base on water hammers in BWR's, and none have caused major pipe failures, and then we identified some of the -- I guess the features which the staff utilized in resolving this issue, that is, that the ECCS default systems utilizing jockey pumps to maintain -- maintain level or maintain the systems in the full state to minimize the impacts of water hammer when systems would be called upon.

Also the general criteria on minimizing impact loads and the pre-operational vibration in dynamics effects testing to minimize again the impact of water hammer.

The commitment within the GESSAR and then identified in the SER to resolve this issue commits the applicant to any revised SRP sections for the plant design that is outside of the GE scope.

MR. MICHELSON: In the case of GESSAR, how do you propose to keep pipes full of water when you lose power while the pumps are in operation and the discharge valves are open? You will get partial drainage of pipes of course down to at least certain vacuum conditions. So how do you restart with a full pipe quickly? I think in many cases you say you restart in 30 seconds or a minute or something. How does this jockey pump system refill? You got to pull the valve first and refill the pipe before you could have assured full pipe again.

MR. HOLTZCLAW: Don, do you have any information in that area.

MR. KNECHT: No, not right off the top of my head.

MR. OKRENT: I can't hear.

MR. KNECHT: I will have to get back with an answer on that.

MR. MICHELSON: You understand the problem. It is typical of any large pumping system. If you shut the pump off with the discharge valve open, you are going to lose some of the water in the system. And unless you close the valve and allow the jockey system to refill the pipe before you start again, there is a danger of having a partially filled pipe.

And as I look at the accident scenario, I don't see that allowance. When you lose off-site power you immediately reload from the diesel engine, you start the big pumps again without going through a refill process. Because you are in too big a hurry. You can't do a retake so I wonder how --

MR. KNECHT: Part of it I'm sure involves how fast pipes drain. We have done some studies on that and I just don't recall the results of how all that fits together.

MR. OKRENT: Can I use Mr. Michelson's question as an example of the general question, namely, are there conditions of various kinds which could set up the potential for severe water hammer, where it does not exist if things go according to the SAR? In other words, he just mentioned a possible way in which the jockey pump might not accomplish what you hope.

Another way of phrasing my question is to ask have you tried to use PRA logic where the top event is a large water hammer occurs, to identify the chains of events that if they did occur could lead to a large water hammer, so at least we know what they are and can then separately judge their importance or non-importance rather than not knowing whether there are some such possibilities.

I think we earlier today got into a discussion I guess on water hammer in connection with vessel overfill -- but at the moment I can't tell whether under stop-start-stop conditions of different types than the one he mentioned, or trying to use some piece of equipment as a backup that you wouldn't ordinarily do, or you name it, whether any of these can in fact lead to severe water hammer and if so, we don't care anyway because the pipe is so strong or it would be very awkward because this particular component is not a high strength or has some tubes or whatever that aren't that -- I haven't seen that kind of analysis, if it exists. I didn't see it in the staff resolution of USIA one. I think it was a defect, in my opinion, in their resolution. I think since we are looking into the future and trying to understand things perhaps a little better, we ought to have a better handle on this aspect.

MR. EBERSOLE: May I add a little bit to this thing here, if we are going to have a momentary pause here.

Failure with the valves open and the pump running full blast, and then invoke, as Carl has and Dave suggests, that there is a partial evacuation or emptying of the pressure side of the pumping system that it is not empty and the valves are open, if there then comes back the application of power, I think you may have a parallel condition where lots of pumps are now facing the terribly different problem of starting on open discharge.

Normally pumps start, centrifical pumps, start on low discharge and the power demands sudden sharp spike and then they get going and then the load is tapered onto them by valve function as the program starts. I'm not sure that once a group of pumps is up and running and there is a momentary stop leading to pipe evacuation that you don't face an impossible starting problem without reprograming all of the valves back to the original starting position which is what closed discharge.

Is there in your development of pump starting logic to include a detailed plan to resequence these things to include the immediate ability to start on closed discharge again. Is that part of your logic control?

MR. QUIRK: I doubt very much if there is.

MR. EBERSOLE: What about automatic recovery of AC power?

MR. FOX: Why don't we get you a complete story.

MR. MICHELSON: We might as well. I would like to hear about the spray sparger, the core spray sparger. It sets in the upper plan, up of the -- the upper shroud area of vessel, and it operates at essentially full temperature and pressure during normal operation.

Upon experiencing a large spray blowout, there is a very rapid depressurization of that area, the water within the core spray sparger also is going to rapidly depressurize, and it is going to flash partly to steam, partly to cooler water. It may even essentially evacuate much of the water out the sparger and that may then, in a matter of seconds, or a few minutes, you are going to turn the core spray system on and pump cold water into this hot evacuated sparger pipe.

Have you looked at the water hammer potential now, keeping in mind also that it is a rather confined pipe since all those little nozzles do not allow much room for rapid expansion? What is inside the pipes, so you have got a nice setup for some severe condensation knocking while you pour the core spray water into that hot sparger partially filled with hot water, partially filled with steam. So when you look at water hammers that night be an interesting one to look at.

MR. QUIRK: We looked at that one and I think the subcommittee asked the same question at River Bend.

MR. OKRENT: I wouldn't be surprised.

MR. QUIRK: And I had an answer. So I can tell you that we have analyzed that and the resultant loads aren't high at all. It has to do with the cushion effect of going into the sparger and it doesn't result in peak loads. It has a cushion effect and we have evaluated that and it is well within design basis.

MR. MICHELSON: What accounts for the cushion? I was mostly concerned with the rapid condensation, the steam in the system, which -- essentially will suck a cold water slug into it and this is a water hammer then. And you are saying no, that you have looked into that and --

MR. QUIRK: The question I answered at River Bend wasn't exactly that one. Now you have this cold fluid and a partially vacated line. And it is going to accelerate into the hot vessel and into the sparger and what is the load as a result of that? We answered the question.

MR. MICHELSON: That shouldn't be quite so severe.

MR. QUIRK: It wasn't.

MR. MICHELSON: You might want to look at water hammers involved in injecting.

MR. QUIRK: Can I share a little frustration I'm having here? Maybe you guys have detected it.

The thrust of our effort in this two-and-a-half years has been on the probabilistic behavior of our design. And we have been wrapped up here for an hour and a half or so in the deterministic as far as the GESSAR review, which was handled some time ago by a different team, if you will. It may seem to you like maybe we are not prepared in these areas, and I guess we would agree with that. But these have also been dealt with and documented and put away too.

So I just wanted to maybe make myself feel a little bit better. We will have to resurrect the resolutions on all these, but they will been dealt with.

MR. MICHELSON: I'll be very interested in seeing where they were dealt with so I can go read about them.

MR. QUIRK: Okay.

MR. EBERSOLE: A lot of these are very old questions. I see them being dragged up too. They don't seem to die.

MR. MICHELSON: The reason they don't die is because they never were put away. I think you will find that a number of these questions are still in vogue for BWR/4's and 5's. They simply haven't gone away. These are practical operating questions, really, in the case of the water hammer.

MR. HOLTZCLAW: Generic issue A 30 dealt with safety related DC power supplies. This was an area that was investigated with the staff review of the GESSAR PRA, and the evaluation was made of DC initiated core damage frequency. And I believe that the value for core damage frequency associated with loss of two DC power divisions was estimated at four times ten to the minus seventh, which was found to be an acceptably low value.

Again it was the GESSAR design with the four separate DC power divisions that has led to this conclusion, and so for that reason was identified as a resolved issue for GESSAR II.

MR. EBERSOLE: Is it implicit when you mentioned the failure of two of them, yet you mentioned that there are four, that in fact there are really just two between you and trouble?

See, the analysis here in the staff paper says that common failure of two DC buses has been analyzed, followed by failures of the high pressure systems. Many times it is stated that there are four or five or ten systems or whatever, but then when you asked the next question, how many do you have to fail to get in trouble? You find a much lower number.

And is it true that you are in fact not too well off if you fail two of the four?

MR. HOLTZCLAW: I guess I -- apparently I would ask the staff maybe to defend that number. Let me tell you where we were when we did the analysis of the PRA. We did not include the DC power failures because we thought initially that the core damage frequency would be very low in comparison with other internal initiators. So that would be one included on our list of tomorrow of things that were not included in the PRA evaluation.

MR. EBERSOLE: Well, let me ask the staff:

Is this plant, if I fail two DC systems, have I lost the totality of critical DC functions for safe shutdown?

No.

HPCI is on an independent, but --

High pressure core spray.

But you say I still have high pressure core spray.

MR. HANA: (Unintelligible).

MR. EBERSOLE: But high pressure core spray does nothing to get heat out of the containment. Thank you.

MR. HANA: (Unintelligible).

MR. EBERSOLE: Wait a minute. High pressure core spray does not remove heat from the containment.

MR. HANA: Did not remove heat.

MR. MICHELSON: Can you speak a little slower so I can understand what you are saying?

MR. HANA: High pressure core spray does not remove heat from containment.

MR. MICHELSON: So then you are not out of trouble.

MR. OKRENT: But in answer to the original question, though, if you lose two of the four DC buses, have you lost the DC function or enough of the DC function that you are unable to accomplish core cooling and containment heat removal?

MR. HANA: You are able to but the containment you don't (Unintelligible).

MR. MICHELSON: You have a rough idea of time in which it's available for recovery.

MR. HANA: Yes. You have got about 24 hours to recover the DC power for the RHR.

MR. EBERSOLE: That gives me the picture.

MR. MICHELSON: How hot are you getting in the containment of 24 hours without heat removal?

MR. HANA: The most we get is about 250 degrees.

MR. MICHELSON: How much?

MR. HANA: 250.

MR. MICHELSON: 250. That's fairly high pressure then.

MR. HANA: That's about 29 too much.

MR. MICHELSON: How much?

MR. HANA: 29.

MR. MICHELSON: 29?

MR. HANA: Yes.

MR. MICHELSON: And 29 is beyond the design basis but not beyond the failure basis for the containment.

MR. HANA: Yes.

MR. MICHELSON: Thank you.

MR. HATCH: I have one question on the DC power again.

One of the insights that came out of the A-44 was that improper maintenance actions on your DC batteries could potentially cause common mode failures among DC systems. Was that something that GESSAR looked into and if they did look into it what was the staff's comment on that?

MR. HANA: I don't know what you are looking at. I know that we did look at the maintenance cost.

(Unintelligible.)

MR. HATCH: Was it a loss of all DC?

MR. HANA: (Unintelligible.)

MR. HATCH: I can't understand at all.

MR. HOLTZCLAW: He said the loss of two buses that are interconnected by a breaker is enough to get you to core melt if you do not recover. GE did not analyze the loss of DC power but the staff did and all it takes is two out of the four DC power divisions without recovery to get you into a core melt.

MR. EBERSOLE: Since it has long been recognized that if there is an apex on which there is an inverted pyramid that's sitting that's the DC system. So how is it that GE does not analyze the most critical system in the whole plant? It is analogous to not analyzing the scram system. I can't really believe that GE didn't analyze the DC system.

MR. FREDERICK: I'm Larry Fredrick, General Electric.

It is not true that we didn't analyze DC power.

MR. EBERSOLE: I'm glad to hear you say that.

MR. FREDERICK: DC power was analyzed where it is used in all of the other systems -- all the safety systems. It was not analyzed as an initiating event because of the suspected low frequency of initiation.

MR. EBERSOLE: You got that as a point of starting and said it was low enough to not bother with.

MR. FREDERICK: But DC power was analyzed for --

MR. EBERSOLE: I see that.

MR. MICHELSON: Does that decision include the possibility of a maintenance error that was common cause?

MR. FREDERICK: Common mode failure of maintenance failure was considered, yes.

MR. MICHELSON: So you had extremely low probability of that event occurring then.

MR. FREDERICK: Yes.

MR. MICHELSON: Did you have some kind of a data base somewhere that gave you that degree of comfort to believe that was going to be a low probability human error?

MR. FREDERICK: There is no data base for common mode maintenance failure. That was an engineering judgment but there is substantial data base on DC power.

MR. MICHELSON: Yes, but none of that applies necessarily, although I guess you would argue maybe it does because when there was DC power it might have involved human error.

MR. FREDERICK: That's right.

MR. MICHELSON: Thank you.

MR. HOLTZCLAW: I guess I didn't make it clear in that answer to that question. We are looking at that relative to accident initiator.

Item B-17 deals with safety related operator actions and I'm trying to recall the staff justification here. I think there were three items that were pointed out in the staff review. The fact that we have developed emergency procedure guidelines -- in fact, that was one of the biggest items I think relative to the BWR post-TMI and also that we do simulator training to carry out the operator training for potential precursors to severe accidents.

There is also a significant design change made to reduce the load on the operator and this dealt with the logic modification to the automatic depressurization system which changed the logic to require only low water level as an initiation of the depressurization system and not the concurrence of low water level and high drywell pressure. So this automated the ADS logic and removed an additional requirement on the operator for ADS.

MR. EBERSOLE: When you did that, were you also trying to cope with this problem of what was called through line blow down where you would not get a containment depressurization but still have low water? You know the case where the valve didn't close and you were having to hold it to the heat sink outside?

MR. HOLTZCLAW: I'm not familiar with that.

MR. EBERSOLE: The phenomenon called through line blow down. You were blowing down to outer space through a maintenance steam line because you had a valve failure and achieving low water level without a high dry well insertion. It used to be called through line blow down.

MR. MICHELSON: Pipe break outside of containment.

MR. EBERSOLE: You got rid of the pressure analog.

MR. HOLTZCLAW: That's right. That's terminology we were more familiar with we use, "pipe break outside of containment."

GSI B-26 dealt with structural integrity of containment penetrations and in identifying the closure of this item for GESSAR II the staff noted the GE commitment to meet ASME section 11 and SRP section 362 requirements for containment penetrations. I don't have any more details on the generic safety issue identified another charts.

(Slide 30 shown.)

MR. HOLTZCLAW: Generic issue B-55 dealt with improved reliability of target rock safety relief valves the GESSAR II design does not utilize this type of safety relief valve; hence, the issue is somewhat inapplicable to the GESSAR design.

In resolving the issue for GESSAR the staff also noted the requirement placed on the applicant to participate in detailed SRV surveillance programs and that was two of the keys in resolving this issue for GESSAR II.

Item B-56 dealt with diesel reliability. This is an area that has been reviewed in some detail in the severe accident context in the probabilistic risk assessment. In resolving this issue the applicant was also committed to meet any applicable reliability criteria for diesel generators.

Generic safety issue B-61 was involved with allowable ECCS equipment outage periods. The unavailability due to maintenance was considered directly in the PRA based on the standard technical specifications and so was included in the evaluation of ECCS availability.

Generic safety issue C-8 deals with main stream line leakage control systems. The MSIV's were considered directly in two areas, one of these you will be hearing in a presentation with regards to pool bypass. And based on that evaluation I think we can show you that we would expect negligible releases through the MSIV's as one of the pathways that can bypass the suppression pool. And the staff considered this issue resolved providing that the MSIV leakage rates remain within technical specifications.

(Slide 31 shown.)

MR. HOLTZCLAW: Generic safety issue C-11 is dealing with the assessment of failures and reli ›bility of pumps and valves. These are obviously included in the probabilistic risk assessment.

It was pointed out that the PRA performed by General Electric and reviewed by the staff and their consultants identified that the dominant accident initiator was loss of off-site power followed by station blackout. And it was pointed out that even significant increases in reliability of these components probably would have a fairly small effect on the capability of the plant with regards to the bottom lines cf core damage probability and offsite releases. There are also improvements made in the safety relief valves and the main steam line isolation valves.

MR. OKRENT: I wonder if we could interrupt you for a minute.

There is a long list here and I was going to suggest that we see which ones the subcommittee would like you to discuss. We have no more than eight minutes on this subject tonight. So we can take it on at another time or another day but which ones would you like to hear tonight?

MR. MICHELSON: I don't see any that I need any additional information on.

MR. OKRENT: Well, then maybe in fact, we can assume that for now we have completed this item.

Let me now do the following: It was suggested that if I made some guesses about tomorrow's agenda today it would be helpful to those who need to make presentations. So I'll do that.

I'm going to assume that of the remaining items on today's agenda we would like to hear something on tomorrow on 9 A, B and D, that we would like to hear something on item 10, that then we would go into the agenda for tomorrow and after a certain amount of that we would see whether item 12, namely severe accident interfaces, looked like it was something we wanted to hear at the subcommittee meeting or a future one but I think it's better to have heard something about the PRA before we pick that one up.

Now, that's my suggestion for tomorrow. Do the subcommittee members want to add any specific items that I have for the moment dropped off what was this afternoon?

MR. EBERSOLE: I would just like to request that when we hear the UPPS presentation that we do it against a background of your having gone into a great many of these things here that we have talked about; for instance, component cooling failure or a host of other thing and made kind of a reverse check and determined in fact what the degree of flexibility or competence of the system may be to kill a lot of these burdens and then evaluate as fairly as we can whether we need to extend its design to make it do these things.

MR. MICHELSON: Is there a written description of the UPPS system that one might read?

MR. QUIRK: Yes.

MR. MICHELSON: Could you possibly supply one today? Hopefully it isn't real long.

MR. QUIRK: No, it is not real long.

MR. MICHELSON: I think if I could read it it would save all the questions I might otherwise have.

Is that the one that didn't have the description attached to it? I've got one that doesn't have the description attached. Maybe I don't have this one.

MR. FOX: But the basics are there.

MR. MICHELSON: This didn't come with my letter.

(Discussion held off the record.)

MR. OKRENT: Let me ask the subcommittee members, does that seem like a reasonable choice?

MR. EBERSOLE: Yes, fine. I think this is the shortened version of it, however, the point where you are taking to make the check.

MR. FOX: Let's say it is the, quote, "intended version."

MR. OKRENT: Are there any questions from either the staff or the applicant concerning the proposed agenda?

MR. ROSENTHAL: Yes, sir. If it is acceptable to you and GE, I would like to propose that the pool scrubbing hour be incorporated into the broader discussion of the PRA.

MR. OKRENT: I would just as soon at the moment not get into the pool scrubbing this time if we are short on time, since when we hear that seriously I may want to have one or two consultants in the field of thermal hydraulics and things of this sort that we didn't bring to this meeting. So that was my principal reason for not putting it in if we were short on time.

Now, if by some chance we finish early, I'll be happy to learn about this subject, because it is obviously an important subject. It is not one I want to rush. When we do deal with it I want to make sure that it sees all the appropriate questions and so forth.

MR. MICHELSON: Is it correct to assume that I can keep this copy?

MR. FOX: Yes, sir.

MR. MICHELSON: I knew I would need a description and we were unable to find it anywhere. I'll give it to Jesse later on this evening and he can read it for tomorrow.

MR. EBERSOLE: Thank you.

(Discussion held off the record.)

MR. OKRENT: Any other questions?

MR. ROSENTHAL: Yes, sir. The second day item two, a similar task a week ago Wednesday before the ACR subcommittee was meant to take 15 or 20 minutes and it went on for three or four hours.

MR. OKRENT: In fact, what we can do is make item four instead of item two and let's see what happens. Fair enough?

MR. RUBIN: Are you suggesting we delete item two?

MR. OKRENT: No. Just have it come at the same time as item four and hopefully we will hear some aspects of it tomorrow.

Now, there were a lot of questions raised today. I don't believe the subcommittee members feel it is necessary to hear the answers tomorrow unless somehow they bear very importantly on the subject matter of tomorrow. I think you should make a list of the questions. I'll ask Mr. Major who I know well anyway, to do the same, so we have -- we can remember what it was that we asked, so forth.

MR. MICHELSON: Does that mean that that will be at the next subcommittee meeting.

MR. OKRENT: That means it will be at the next subcommittee meeting and it will be on the agenda.

MR. MICHELSON: That would be a good time.

MR. OKRENT: And that would give you more time to develop it, I think, than trying to rush overnight and so forth. But if a question bears importantly on tomorrow's topics, then bring it in.

MR. QUIRK: Yes, sir.

MR. FRAHM: Item number two is the NRC staff report at 8:45. Are we going to defer that now to 4:30 with item four or are we going to move item four up to 8:45?

MR. OKRENT: No. My proposal was we would in fact pick up those limited items from this afternoon first, so that means a couple of hours. I'll arbitrarily allow only a certain amount of time for the rest of that. It is not going to be allowed to stretch into the whole day. We will then begin with item three, which is GE's presentation. I'll make sure that they don't use so much time that we have no chance to get comments from the staff and you will give us sort of two and four together, and we may not get through all the items on the list for the GE presentation. Again, it is a very ambitious schedule. We will just see where we get and let it go at that.

Any other questions?

Well, if not, thank you all. I think it is best not to go too late. For those in the east it is already 9:00 o'clock and I'll start feeling it pretty soon. Since there are three days of sitting like this, I think 6:00 o'clock is about long enough. So the meeting is recessed.

(Whereupon, the hearing was adjourned at 5:45 p.m.)

This is to certify that the attached proceedings before the UNITED STATES NUCLEAR REGULATORY COMMISSION in the matter of:

NAME OF PROCEEDING: GESSAR II AND RELIABILITY & PROBILISTIC ASSESSMENT(ACRS)

DOCKET NO.: NONE

PLACE: LOS-ANGELES, CA

DATE: THURSDAY, OCTOBER 18, 1984

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission.

(Sigt) Mary Ellen Tearney

(TYPED)

Official Reporter

Reporter's Affiliation