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UNITED STATE NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

DATE: April 1, 1992

The contents of this transcript of the proceedings of the United States Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards, (date) April 1, 1992, as Reported herein, are a record of the discussions recorded at the meeting held on the above date.

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UNITED STATES NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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PLANT OPERATIONS SUBCOMMITTEE MEETING

ON

RISK FROM LOW-POWER AND SHUTDOWN OPERATIONS

- - - -

Nuclear Regulatory Commission
Conference Room P-110
7920 Norfolk Avenue
Bethesda, Maryland

Wednesday, April 1, 1992

PARTICIPANTS:

T. KRESS, Acting ACRS Subcommittee Chairman

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W. [illegible], ACRS Member

H. LEWIS, ACRS Member

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C. RYDER, NRC/RES

T. PIETRANGELO, NUMARC

P R O C E E D I N G S

[8:32 a.m.]

MR. KRESS: The meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards Subcommittee on Plant Operations. I am Tom Kress. I am Acting Subcommittee Chairman in the absence of James Carroll.

Other ACRS members in attendance are Bill Kerr, Carl Michelson, Harold Lewis, Dave Ward, Charlie Wylie, Ivan Catton, and Paul Shewmon.

The purpose of this meeting is to review the staff's evaluation of the risk from shutdown and low-power operations at U.S. commercial nuclear power plants as well as the associated industry activities.

Mr. Paul Boehnert is the cognizant ACRS Staff Member for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on March 17, 1992.

A transcript of the meeting is being kept and will be made available as stated in the Federal Register Notice. It is requested that each speaker first identify himself or herself and speak with sufficient clarity and volume that he or she can be readily heard.

We have received no written comments or requests to make oral statements from members of the public.

In the way of background, the staff's program started, I think, heavily after the Vogtle event in 1990. The ACRS was briefed on the plans for that program shortly thereafter -- I think it was in July 1990 -- and then we subsequently heard a status report in our June 1991 meeting, after which we wrote a letter.

In general, it was a very favorable letter with expression of a couple of concerns having to do with the PRAs associated with the program and having to do with the control of switch yards and the closeability of the hatches during shutdown conditions.

One might think that under shutdown and low-power conditions, you are probably safer than full-power operations, but that's not necessarily the case because you still have all the fission products there, they still have to be kept cooled, and there is a lot of activity going on at that time.

The plant configuration may be different than usual, and you may have already opened up the containment as well as the primary system, and many of your systems may be out of commission for maintenance, or replacement, or repair, or inspection. So the concern is a legitimate one, I think.

Before we get started, I wonder if there are any comments any of the subcommittee members here wish to make. Anybody?

MR. KERR: Well, in reading this mass of material with which we were provided, there were a couple of things that impressed me, one that in those situations in which people have gotten into problems during shutdown, even when they didn't have procedures, I was impressed by the fact that in many cases, the operators were able to work out a solution to the problem, one of the reasons, I think, being that they had more time since, in the cases with which I'm familiar at least, the fission product activity had decayed sufficiently that the heat removal problem was not as severe.

This led me to wonder -- well, it led me to believe that we ought to look at this pretty carefully because it may be a severe risk, but we also certainly have other problems and we need to be sure, I think, that this one is given the appropriate priority.

The second was that in a number of cases where the PRAs were discussed, there were comments that, at this point, things were done conservatively, and if we're going to make a decision based on PRAs that are done conservatively, I think we need to be pretty careful about how we use the results of the PRA.

MR. KRESS: I think those are good comments.

MR. CATTON: On the other hand, some of those incidents were really kind of bizarre -- three level sensing devices, and none of them work? It seems to me some simple things ought to be done, that level sensing systems do work.

MR. KERR: I am simply saying that the operators, even without written procedures, may be more capable of improvising than we think.

MR. CATTON: I wasn't questioning that.

MR. KERR: I don't think that we necessarily want to make them improvise, particularly in estimating risk. I doubt if we're giving appropriate credit to that capability.

MR. CATTON: I'm not sure you can use the risk estimates to justify much of anything.

MR. KRESS: These particular risk estimates probably have much more uncertainty than the normal risk, which would be high.

MR. CATTON: The normal ones have a lot.

MR. KRESS: Yes. The staff has issued a draft report for comment on this subject. I presume all the members have seen this. They have also written a SECY and presented some preliminary conclusions from this report. I presume we are going to hear the details of what's in here today.

The program will be started by Gary Holahan of

NRR. Gary, the floor is yours.

[Slide.]

MR. HOLAHAN: My name is Gary Holahan. I am the Deputy Director of the Division of Systems Technology in NRR. I am going to make the introductory remarks for our meeting today.

The intent of the meeting is to cover the broad scope of the issues dealt with in the draft NUREG 1149, which covers low power and shutdown issues.

We will have a number of members of the Staff make presentations on those topics. We are prepared to address questions from the ACRS. In the context of the whole program to address shutdown and low power activities, the condition that we're in now, the status of the program, is that we've issued this NUREG report for comment. The major items left in the program will be to perform a formalized regulatory analysis doing a cost and benefit estimate to the extent that we can. We'll be dealing with ACRS's comments, public comments received on the report.

We will take Staff recommendations to the CRGR and then in accordance with the new Commission guidance where we have proposed new requirements we will issue those again for public comment. I would think that that would be probably in the summer.

Originally we had intended to complete the program by the end of June but with an additional stage of public comment, I think it will probably stretch out a few months beyond that but we will still try to complete it perhaps later in the summer or this year.

What we are aiming at as a final product is a final NUREG report and whatever vehicle is chosen to impose any actions that the Staff feels are appropriate. That could be throug . ,eneric letter or generic letter in combination with some rulemaking and those alternatives will be addressed later on and probably presented to the Commission to get Commissicn feedback with respect to implementation strategies.

What we intend to cover today is the technical findings in the NUREG report. We have also put on the agenda an item to at least outline our preliminary thinking as to how we are going to approach the regulatcry analysis. There is also later in the presentation a status report by Research on the two PRAs that are underway. At the end of the day there will be a presentation by NUMARC to cover their activities.

[Slide.]

MR. HOLAHAN: Very briefly, I would like to cover the program status. That is, if you recall, the program had three major elements, and that is to look at operating experience, to a number of technical studies including engineering analysis as well as PRA activities, and also a number of site visits.

The technical studies have been completed. The key issues that we believe will address these areas are in the draft NUREG report. That has been issued for comment and the comment period runs I believe through the 30th of this month.

The Staff has initiated some pilot team inspections which are basically inspections of shutdown activities at two plants and the pilot activities are supposed to give us insight as to how and if additional inspections would be conducted over the next few years. That is also a decision to be made later.

MR. KRESS: Gary, when you say the technical studies are complete, that doesn't include the PRAs, does it?

MR. HOLAHAN: It does not include the PRAs. I'll show you a list of the studies that I am referring t.

[Slide.]

MR. HOLAHAN: I am just showing this slide as a reminder of the activities that went into the program and also as a way of acknowledging the very strong support provided by other organizations to NRR in this activity.

AEOD was instrumental in doing the review of operating experience.

NRR conducted the site visits but had substantial support from the regional offices as well as other headquarters offices.

We used the accident sequence precursor program to look at a number of shutdown events and those are addressed in the Appendix to the draft NUREG report.

The first stage, the Level 1 PRA, coarse screening analysis by Brookhaven and Sandia, were included as part of our study. We had originally hoped that some numerical analysis, some of the results could be available to be used in the program but the stage and the process used in the coarse screening analysis didn't lend itself to using the numbers. I think it's the degree of conservatism and the nature of the assumptions made at a first-stage PRA level means that what we really used out of that study were none of the numerical values but some of the insights as to what sort of sequences would be important.

I'm not going to go over the rest of the slide in detail. You will see that there are a number of international and RES activities.

MR. KERR: We have seen some recent analyses of accident sequence precursor results over the past ten or fifteen years. Are those the ones that you used or did you use a different set of accident precursors?

MR. HOLAHAN: We used the same methodology but what we actually did, as part of the program we selected ten events identified in the AEOD study. AEOD basically identified approximately 350 shutdown events. Then we selected those. Those are ones that had not previously been studied.

MR. KERR: Had they not previously been studied because they had not been very big risk contributors or because nobody had thought to look at shutdown risk?

MR. HOLAHAN: I think I would say it's because no one thought to look at shutdown risk.

I think they had not been candidate issues before that point.

MR. KERR: Okay. If one now as the results of these, should they have been included in that --

MR. HOLAHAN: Let me correct myself a little bit because I think one of the events had previously been considered and that is the Vogtle event itself.

I think it was treated in the accident sequence precursors before this program and then we added ten more events.

As a result, we did identify at least one and perhaps a few events that should have been considered. I would say most of them probably were not comparable to the other events.

MR. KERR: So that they would not have had any significant influence on at least the numerical values attached to the charts that we saw recently other than the Vogtle event?

MR. HOLAHAN: Other than the Vogtle event, I believe a couple of others, perhaps the Waterford event and Ft. Calhoun.

MR. WARD: The Diablo event of a few years ago --

MR. HOLAHAN: I think the Diablo event was also included in the study but I think, well, it's a matter of judgment as to how significant it is.

Personally I would say it's a little bit below the threshold that I think Dr. Kerr is referring to.

I don't think it would have had a significant change in the total of the accident precursors.

MR. KRESS: Isn't that the result you are looking for from PRAs? To answer that particular question.

MR. HOLAHAN: I think the PRA certainly gives a lot more detail in that area. The difficulty with the PRA is that they are so difficult to do and so expensive that it would be difficult to do them for a large number of plants.

The accident sequence precursors and the operating experience allows you to select among 100 plants to get -- for example, insights on Vogtle and Ft. Calhoun, I think, would not have come out from the Surry study.

MR. KRESS: Would you characterize the ASP effort as basically a Level 1 PRA for the event?

MR. HOLAHAN: I would say it is Level 1 PRA for a specific event. I don't know that quite as much effort goes into it as a Level 1 PRA, and I think the kind of uncertainty analysis you normally expect to see in a Level 1 PRA isn't done in each of those events.

But otherwise, it has all the characteristics of a Level 1 PRA.

MR. MICHELSON: I'm a little confused. I thought Level 1 PRAs weren't including errors of commission, the kind of error you get involved in when you're doing maintenance and you leave a valve works open and turn the water on and flood out a compartment.

That was an error of commission. Somebody did something wrong.

What's the general approach here relative to errors of commission during shutdown, which is, I think, one of the likely ways of getting into this kind of trouble, and it's not normally, at least, in a PRA.

MR. HOLAHAN: Maybe I should let the PRA experts speak on that.

MR. MICHELSON: Well, you were inferring that we were kind of looking at Level 1 PRAs in this regard, and I'm not sure we are.

MR. HOLAHAN: Let me give you my impression, but I think I might need some help on it.

Certainly, in the Surry and Grand Gulf PRAs, they're looking at actual experience, from having gone back and looked at the log books on the plant, and so, it reflects the experience of whatever decisions were made to take equipment out of service.

I think whether willingly or inadvertently, I think all of those things work their way into the PRA.

MR. MICHELSON: I think the PRAs are being used in these cases to determine what else could have happened, the probability of that and so forth.

Therefore, the risk of having left a valve works open and having flooded a compartment, how close to a disaster were you, and use the PRA to kind of figure out how close you were.

You don't use a PRA to figure out the likelihood of this happening to begin with. That is not what PRAs are normally used for.

MR. KERR: Unless I misunderstand PRAs, I thought one did use operator error as a contribution to modern PRAs.

MR. MICHELSON: You're talking about maintenance commissions.

MR. KERR: I mean operations errors.

MR. MICHELSON: I haven't seen a PRA run through to determine maintenance errors and probability of it. Is that true? Those are in the PRAs?

MR. CUNNINGHAM: This is Mark Cunningham from the staff.

A large number of those types of errors are in there, that a valve is mis-positioned inadvertently during a maintenance act and then not -- it's not put back in its correct position. Those types of errors are in PRAs.

MR. MICHELSON: You have to go in and model the situation to begin with, namely that you have one valve works open for reasons of maintenance and now you inadvertently open the valve and it allows the water.

That kind of modeling is the only way you can get into the question of probability of occurrence and risk of the consequences.

MR. CUNNINGHAM: What we might do is -- you know, we're going to be talking this afternoon, as Gary indicated, and maybe we can come back to that at that point.

MR. MICHELSON: If you can tell me the PRA will give us this detailed modeling, I'll be happy to listen.

MR. WARD: Gary, could I just take a minute to go back to your answer on Bill's ASP question?

If we look at the recent ASP study as some kind of an indicator of the state of safety in the population of plants, should I worry that that did not include shutdown contributors or that it did include some or not the others or the ones that it didn't include wouldn't have been important anyway?

I didn't understand what your bottom line was.

MR. HOLAHAN: I guess what I would say is, at this stage, I wouldn't worry about it, because I think we have basically covered the same territory, but in hindsight, I think that it was a weakness in the accident sequence precursor program not to address the shutdown events.

MR. WARD: Okay. I don't understand why I shouldn't worry about it.

MR. HOLAHAN: I think you shouldn't worry about it, because as a part of this program, we have gone back, and I think we picked up the major events that the accident sequence precursor program could have been picking up all along.

MR. WARD: Okay. So you've got a methodology, but I mean, if I was going to look at the report as an indicator of the state of safety of the population of plants --

MR. HOLAHAN: At the accident sequence precursor itself.

MR. WARD: Yes.

MR. HOLAHAN: I think there is a piece missing. I think you need to have at least a part of this study to supplement the accident sequence precursors.

MR. KERR: But if you do introduce that supplement, I thought you told me that, with the exception of the Vogtle event and perhaps one or two others, there would be no significant change in the results that we saw earlier.

MR. HOLAHAN: Right.

MR. KERR: Okay.

MR. HOLAHAN: You're right. And I meant those two statements to be consistent. In fact, what you see from the accident sequence --

MR. WARD: I haven't figured out how they are yet, but I'll think about it.

MR. HOLAHAN: I think the accident sequence precursor program, based on the events that have been covered before, had missed a few events that should have been included.

I don't think it's a large number, but I think that there is some distortion in the results, not having included the shutdown risk.

MR. WARD: Okay. But then that's sort of contrary to the kind of general thing we've been hearing over the last couple of years about the contribution of shutdown risk to total risk.

I mean the French study and some -- an early EPRI study and so forth, some of those studies were indicating that shutdown risk may be contributing up to half of the total risk from plants, and what you're saying about the ASP study seems to indicate that that's far from being true.

MR. HOLAHAN: I'm not sure, and I wouldn't want to put a 50-percent, 20-percent number on shutdown versus power risk.

I think you take the numbers as to uncertainty. I would say they are in the same order of magnitude, but to expect a 50/50 split, you know, each year that the accident sequence precursors are done, I think, is more than I would expect to see.

MR. KERR: It's also possible, I think, Mr. Ward, that if you change the numbers that we saw earlier by a factor of two, it would not be noticeable.

MR. WARD: Okay.

[Slide.]

MR. HOLAHAN: One other thing I wanted to do before we went on the presentation of topics in the report, is to address the issues in ACRS' letter of last Fall. I'll address them briefly here, and then I think you'll see that the topics also come up through the rest of the discussion.

I basically summarized the comments in the report in the three areas -- containment closure, the representativeness of the PRAs and the use or lack of use of conservativeness in the PRA assumptions. With respect to containment closure, I think we've provided a lot more information than the Committee had seen before. It's included -- the summary is included in the report, and there will also be a presentation later in the day. So, I think that issue is pretty well addressed.

With respect to representativeness of the shutdown PRAs, you'll remember that the two that are going on from the research contracts are Surrey and Grand Gulf. I think we recognized when the program began, that we had a problem because if we wanted to deal with this issue in a reasonable amount of time, we couldn't start up any really full-scale PRAs and expect to have the results done by the time we wanted to take some actions.

So, what we've done is to try to supplement these two PRAs with what ever other PRA information and insights that we could acquire. You'll see in the report that there's a chapter on the existing -- other existing PRAs, some of which only address individual events and some of which are a lot more --

So, what we tried to do is, is at least establish a range of PRA results that we think is more representative of the entire U.S. industry than just these two studies would indicate.

MR. KERR: How can you persuade your contractors not to use conservative assumptions in PRAs?

MR HOLAHAN: I don't have that problem because they're not my contractors. We can discuss that this afternoon also.

MR. KERR: All right.

MR. HOLAHAN: I think as the user of the PRA, I think what we need to do is -- is not use the numbers. At least understand where the numbers came from and where there are conservatisms that you think, you know, pay for the -- inappropriate, you don't use them.

MR. KERR: But it seems to me that you then shouldn't ask the contractor to go through and get numbers for you, if you aren't going to use them, and I think that probably would make the PRA task much easier.

MR. HOLAHAN: Well, if you remember, the PRA was done in stages, okay, and it's the first stage that includes the conservatism, I think, basically associated with assuming operator errors or lack of recovery. That's not -- it's not the objective of the PRA to stop at that point. It just happened to be a historical fact that that's the stage that was available when we wei e trying to put the study together.

I think the Committee's made its view on this point pretty clear. I've gone as far as to read Dr. Lewis' book which addresses the delusion of conservatism.

MR. WARD: That's not a Committee position, by the way.

[Laughter.]

MR. KRESS: We haven't voted on that subject yet.

MR. HOLAHAN: I think the Staff is sufficiently sensitive to that point. In your handouts, you will see that there are a couple of other slides on these topics, but I think I've --

MR. KRESS: One question, Gary: Is there any intent to include low power shutdown issues in the IPE program?

MR. HOLAHAN: At this stage, there is not. I think you'll see there's a discussions in the end of Chapter 7 of the report. That's the one area in the report where we actually wrote down something that we don't recommend. In most cases, the issues that we're not making any recommendations on, simply didn't meet the threshold of being in the report.

But there were a couple of recommendations on that point, that it would be worthwhile to do shutdown, basically a shutdown IPE. I don't think that the real intent of the IPEs would be served by doing shutdown IPEs. If you recall what the program is supposed to do, it's really intended to address individual plant variability, especially on those issues where it's difficult to handle with generic type programs or regulatory requirements.

I think what we found in these studies is not that it's the plant-to-plant variability that's difficult to handle for shutdown. We think that broad generic programs like improved outage planning and improved tech specs will really get to the heart of these issues, and I think it doesn't leave a sufficient concern over plant-to-plant variability that an IPE on that issue is needed.

Now, I think we also want to say that we're not discouraging people from using PRA techniques or insights in outage planning activity because I think that's important and I think that the industry is moving in that direction. The IPE program, I think, is not needed at this time.

If there are not any more questions, what I'd like to do is to move on to the second item on the agenda, which is Technical Findings. Mark Caruso, who has been managing this program, and who also is the Section Chief in the Reactor Systems Branch, will deal with those.

[Slide.]

MR. CARUSO: What I would to do with this discussicn is basically go through the principal technical issues that we see shaping safety risks during shutdown. These are discussed basically to take you through chapter six of the report. And the --

MR. KERR: Are there issues other than technical issues that are going to come up? Was the term technical issue used to distinguish this from other issues, or did the technical just slip in there for no particular reason?

MR. CARUSO: I think, as opposed to regulatory issues -- how you deal with certain problems.

MR. KERR: Thank you.

MR. CARUSO: Those issues include outage planning and control, stress on pursuant programs that function during shutdown, operator training, technical specifications, decay heat removal, temporary RCS boundaries.

MR. KRESS: Excuse me, Gary. We are having trouble hearing you. Could you maybe move the mike up a little further?

MR. CARUSO: Completing the list, rapid boron dilutions, containment capability, fire protection, fuel handling and heavy loads and onsite emergency planning.

[Slide.]

MR. CARUSO: We think outage planning and control, having an outage program, is probably the most important issue to safety during shutdown, primarily because it's through that process or lack of that process that incidents can have their root. And it's also that process which will either ensure or make less likely the ability to mitigate such an incident, if you were to have it. For example, having mitigating systems, having -- being prepared, having contingency plans.

To look at this issue or to study this issue -- primarily we used our plant visit study that Gary talked about previously, where we went out and visited plants, looked at their programs, talked to the outage planners and those who develop, plan and control the outages. We also --

MR. KERR: Excuse me, Mr. Holahan mentioned a pilot team inspection at two plants. Is that what you're talking about, or is this something different?

MR. CARUSO: No. That's something separate. What I'm talking about here is that part of the shutdown, low-power evaluation, we asked for volunteers, essentially from different utilities to allow us to come to their facility for a period of about a week and meet with them to learn about the process of planning and conducting outages; something that the staff to this point had not been that intimate with.

MR. KERR: How many plants?

MR. CARUSO: Eleven.

MR. KERR: Eleven. Thank you.

MR. CARUSO: In addition to those 11, there were also several incidents that occurred during the year, which had implications for issues surrounding outage planning and control and those incidents were examined by augmented inspection teams. And we took those opportunities to also look at the programs at those plants too.

MR. KERR: How many of those were there?

MR. CARUSO: Two, I believe.

MR. KERR: Thank you.

MR. CARUSO: So, in looking at the programs that are out there, I think, one of the conclusions we came to was that the quality of the programs varied quite a bit. We saw programs where there was -- involved significant efforts in putting together -- organization, a documented set of procedures, which people would follow in planning and conducting the outage, oversight.

Many times, personnel in the QA Department or QA division, in some cases, we saw a significant involvement of onsite nuclear safety groups. In other cases we saw, basically, a process that was focused primarily on conducting the outage, getting the plant refueled, doing the maintenance work and coming back up, with safety not as visible as in other cases, where safety was basically addressed through meeting tech specs or, in many cases, going somewhat beyond tech specs in terms of ensuring availability of systems. So, there's quite a variation. But, I think, on the whole, we saw far fewer programs that really had some in-depth focus on safety during the outages.

Another activity that the staff was involved in was interacting with industry during this whole process.

Industry has recognized that outage planning control is of supreme importance for safety, and they --

MR. KERR: I'm sorry, what was the adjective that you used ahead of importance?

MR. CARUSO: I used the adjective, "supreme." In their evaluations over the years, they have developed a set of guidelines for planning and conducting an outage that puts significant emphasis on safety. They've -- in the current -- they put those initiatives in the guidelines out to all the utilities and the utilities have decided to implement them, and they're in that process now.

This set of guidelines is primarily a top level set of guidelines which discusses what's important and gives broad guidance in how to address important issues involving organization and management, planning, and also key technical issues like RHR capability, control of the switch yard, et cetera.

MR. KRESS: Mark, are those the guidelines we're going to hear about from NUMARC this afternoon?

MR. CARUSO: Yes.

[Slide.]

MR. CARUSO: We will hear about the guidelines in more detail, I suspect, this afternoon, as you just mentioned. The staff has their own set -- I wouldn't call them guidelines, but, I think, basically a set of elements for an outage program that we think are important. And in our -- later this afternoon or this morning and this afternoon, we'll be talking about the requirements that we are studying and evaluating.

In the area of outage planning and control, this is essentially a list of things that we would consider to be important in a program.

MR. LEWIS: Next time around, we'll spell principles correctly, I guess?

MR. CARUSO: I just got an F-4 on my graphics.

MR. WYLIE: A question, Mark: On your previous slide, at the bottom, you said that the industry guidelines being implemented provide high level guidance but lack detail. These are the details you're talking about that are missing from the industry guidelines?

MR. CARUSO: No, not necessarily. I think that many of these are incorporated in the industry guidelines.

MR. WYLIE: What about that Number 2 bullet, Clear Organizational Roles and Responsibilities; is that in the industry program?

MR. CARUSO: Yes.

MR. WYLIE: It is?

MR. KERR: The bottom bullet on the previous slide was not necessarily meant to be a criticism; was it? I thought it was just a statement of fact.

MR. CARUSO: The previous slide where I talked about programs lacking certain elements, that referred to what we saw in the field.

MR. KERR: I say, that wasn't meant to be a criticism, necessarily; was it? I mean, I thought it was just a statement of fact.

MR. CARUSO: Yes.

MR. HOLAHAN: Gary Holahan. Your reference is to the last line of the previous slide?

MR. KERR: The guidelines being implemented provides high level guidance but lacks detail for program development.

MR. HOLAHAN: Yes, I believe that was exactly the intent that NUMARC had when they initiated their program. It simply refers to the scope of their program.

MR. KERR: Okay, that's just a statement of fact on your part; isn't it, not necessarily a criticism?

MR. HOLAHAN: That's correct.

MR. KERR: That's what I thought.

[Slide.]

MR. CARUSO: Stress on personnel and programs during the outage is an issue that was raised by a number of original inspectors in the field, also confirmed in discussions during our site visits. Basically, the principal concern is that during the outage, there is a tremendous amount of activity going on, a large workload for operators, and because of the maintenance that's taking place, the configuration of the plant is changing significantly over the course of the outage.

And this produces stress in the sense of -- and I might use an example that one operation superintendent described to us that during power operation, the operators have all their equipment available to them, they know [illegible] what condition they're in, what configuration, what s[illegible] are available to mitigate an incident. In shutdown, [illegible]ngs changing often, with large volumes of [illegible]ance that's going on, it's to some degree, anxiety-provoking to not really know exactly all the time, what's there.

In looking at --

MR. KERR: Is the staff seeking a zero stress working environment during shutdown?

MR. CARUSO: No.

MR. KERR: What is the appropriate level of stress?

MR. CARUSO: That level of stress that operators are comfortable with, that can be tolerated, that doesn't lead to mishaps.

MR. KERR: You would be able to recognize it somehow?

MR. CARUSO: I think that would be difficult. We don't feel that overall this is excessive. It's been identified that it can be a problem. In some cases, I think in plants that we visited and people we talked to, there was not concern about stress. In other cases, there was. So, it can be a problem. It isn't necessarily a generic concern, but it can be a problem. It can be, I would think, a significant problem since much of shutdown and activities during shutdown, dealing with incidents will require actions by the operators' process.

To address this, the remedies are make sure that there's enough people to do the work, plan the work better. These are all -- have contingency plans. These are all elements of a good outage program, and we would see that an unacceptable stress condition could be addressed through proper planning.

MR. KERR: To say the stress is relieved by sufficient staffing levels, proper training of personnel, contingency plans for mitigating events, these are all good statement with which nobody could disagree, but how does one know when that's achieved? If the staff is looking for something specific, that doesn't seem very specific to me.

MR. CARUSO: I think you can't really know. There's not a quantitative goal here, but I think you get that with good management, and the performance would be the barometer.

MR. HOLAHAN: I think the underlying concern here is not the stress itself but what the stress results in, and so I think what the staff will monitor is not the stress on the operators, but will monitor the number and severity of events that are occurring. I think there's an item later one that we'll discuss as to monitoring of performance. So, it's sort of a results oriented program. I don't think there's any stress measure that you can follow.

MR. KERR: Thank you.

[Slide.]

MR. CARUSO: Operator training is especially important for shutdown conditions since -- from our reviews of experience, we've seen that most of the incidents that do occur during shutdown are to some degree, and in many cases in large degree, rooted in operational errors. Also, the mitigated accidents in many cases require significant action by the operators.

In looking deeper into the training for shutdown conditions, our assessment was the while it is included, it's not emphasized to the degree that power operations are.

MR. KERR: Is it the view of the staff that it should be emphasized more than power or equal to power operation?

MR. CARUSO: Well, I think it should be emphasized as much as power operation, and those aspects of power operation and shutdown operation that are critical to safety should be the ones that are emphasized. I'm not sure that I would want to get into the distribution or the observation --

MR. KERR: I assume that that first bullet is a criticism. It's emphasized last or perhaps it's just a statement of fact. I don't know.

MR. CARUSO: Yes, it's a statement of fact of what we found, that like many other things, like the discussion about the shutdown has been, to some degree, not focused.

MR. KERR: Okay, now is it likely that the staff is going to recommend that more emphasis be placed until the emphasis is about equal or until the emphasis is greater for shutdown risk, or have you decided yet?

MR. HOLAHAN: Dr. Kerr, I think the issue here is -- I think that item is a statement of fact, but I think it's also fair to say that the staff feels that there's been less emphasis than is appropriate on the shutdown. I don't think I would say that the amount of training, the number of hours or books read or whatever ought to be equal. Perhaps it ought to be less. I think the problem we have now is the difference between what we think is appropriate and what is out there is more obvious in a shutdown case.

MR. KERR: Thank you.

MR. WYLIE: Let me ask a question. I think Dr. Kerr has touched on something that's been bothering me a little bit. I know the focus of this and the scope is basically on shutdown and low power risk. It seems to me when you look at these things, that all these guidelines or recommendations are good, regardless of what power operation you're in. Now, is this covered anywhere else for power operation? These activities?

MR. HOLAHAN: I'm not sure what these activities are. You mean the training area of the whole --

MR. WYLIE: The whole shooting match. You're talking about activities during shutdown and low power operations, but it seems to me that all of these apply equally at the power operation.

MR. HOLAHAN: I think we feel that --

MR. WYLIE: Like communication and management and things like that. That is important. The control of activities on site during operations. If you look at some of these events that took place and that you looked at, such as loss of off site power, those events occurred at full power operations. Now, the scope seems to be that you've sort of drawn a limited scope around this operation here. It includes what's going on inside the plant, but some of these offsite power had to do with things outside the plant, the control of those activities or just equally well.

For example, to have a plant operating at full power, all units operating at full power and all of a sudden it turns that whole plant into a loss of off site power, and all units trip. It's a traumatic experience. It seems to me that these guidelines are just equally applicable to power operations.

MR. CARUSO: In many cases, that's true.

MR. HOLAHAN: I think what we found in general is that most of these areas have been addressed for power operation.

MR. WYLIE: I would suggest some have not, too.

MR. HOLAHAN: For example, the control of the switchyard is what I expect you're alluding to.

MR. WYLIE: Sure, that's right. There's nice words in both, you know, staffs' reports and the industry reports about management clearly identifying safety objectives and this kind of thing, but I find lacking a definition of how this is going to be accomplished within the organizational structures of the utilities, such that the other departments are doing the work. Communicate properly with the plant and are controlled.

MR. HOLAHAN: I think it's a fair observation that we may have identified some issues that may shed light on some topics for power operation as well.

MR. WYLIE: I think so.

[Slide.]

MR. CARUSO: Along with training, hand in hand is simulators. An issues had been raised as to -- or concern had been raised from the field that we're aware that simulators were really focused on, checked on, that they were not used in training at all. We looked into this and evaluated that concern, and basically what we found is that one, our requirements with respect to simulators are such that a capability is required down through cold shutdown, but not after the heat has been removed. In practice, we have found that in some cases, some facilities' simulators have been set up to look at incidents during shutdown such as loss of RHR, but that would be more the exception than the rule.

Again, I think in practice, what we found is that there's -- in general, there's been not a whole lot of analysis, thermal hydraulic analysis of upsets during shutdown, and that this is something that does need to be done in order to understand and create training programs to deal with these conditions. That will need to come first before writing codes for the simulators.

Probably more importantly, though, I think what we recognized and have concluded is that much of the action that will be needed to deal with incidents will be actions that outside of the control room, and not so much actions that are easily simulated with the simulator, and therefore, the emphasis in training is probably best placed towards an understanding of what needs to be done to mitigate the accident and bring the plant back to a safe condition.

[Slide.]

MR. CARUSO: Technical specifications for shutdown conditions. Through our evaluations and examination of the tech specs and also the work that was done in the Grand Gulf and Surry PRA's, as well as the accident sequence precursor work, I think we've found that while the current tech specs, standard tech specs to some degree address varying conditions during shutdown, i.e., what I'm driving at is water level where conditions with the cavity filled exists and are different from conditions where water level is at its normal level.

But there are other parameters and conditions that are not really dealt with in terms of tech specs, which can affect significantly the margins that are there. Decay heat rate, obviously early in the outage it's high. It affects the time available to mitigate an incident. We found in our analysis that very early after shutdown, two days or so, in some cases you have fractions of an hour before you get to boiling the PWR and reduced level down to the top of the active core, whereas if you're shut down for several months, those times become large, and that, in effect, is a larger safety margin.

Water level I mentioned. Right now, basically we look at cavity flooded and normal water level. In tech specs, we've addressed mid-loop operation and reduced inventory, which are not specifically addressed in the tech specs but have been addressed through Generic Letter 88-17, so we see that there are other conditions in water level that can significantly affect the margins available.

MR. MICHELSON: I have a question on using the tech spec approach. Tech specs were formulated in part on the basis of the equipment being considered as certain physical separation availabilities and things of this sort. The way the plant was divided up, we assumed everything was arranged in normal fashion, and if you lost a particular piece of equipment, you knew what to do.

What bothers me in the case of shutdown is that -- and maybe you can tell me if it's taken care of. The concern I would have is that the tech specs may say okay, Train A is the only RHR pipe I have. It's the only one I need for shutdown. However, it doesn't take recognition of the fact that there's a significant maintenance operation going on in the Train A area, but not related to the Train A pump because Train A pump because Train A pumps are located with a lot of other equipment in the Train A area. Now, how do you make sure that the maintenance operations are not affecting the hazards associated with that particular pump. The tech specs would normally account for this by saying the only thing out was one pump, and now you have to see what was the minimum equipment is needed, but that is not true here.

MR. CARUSO: I would say, we say in many cases a practice that basically dedicates -- well, the rule is you're performing a maintenance, all your maintenance, on one train at a time.

MR. MICHELSON: Is that a rule?

MR. CARUSO: No, it's a practice that we've observed at a number of utilities as part of their own program for conducting the outage. It's not guaranteed, and that concern that you've expressed is a very real one and why we think, you know, we may need to --

MR. MICHELSON: So you will eventually think about this some day as being a requirement. Will you limit the activity on the train that you're using for your minimum set for shutdown?

MR. CARUSO: I think there are conditions that may warrant both trains.

MR. MICHELSON: The whole concept of putting in fire protection is always based in part on the physical separation concept that says okay, I do have a fire. So what? But in this case, a fire in the Train A area, if

Train A is the one we're using for shutdown cooling, might be a little different picture.

MR. CARUSO: Yes.

MR. HOLAHAN: Could I add a comment to that point? Although we see some difficulties with the existing tech specs, some of which don't cover equipment that you think is important, and other which are perhaps ambiguous on the points you've raised, Dr. Michelson, we think that it would be prudent to improve the tech specs, but one of the reasons we think that outage planning is important is that the kinds of concerns you've raised, I don't think are dealt with best just through tech spec type controls, and I think that tech specs, which identify specific equipment and its support services, is important but it's really not enough to address the whole picture of, you know, what doors are open and what fire protection is available.

MR. CARUSO: I guess the second principal finding that we have is that in a number of the older plants which don't have standard technical specifications, we found that they don't have limiting conditions for operation at all, in some cases for RHR and for electrical systems. We believe that needs to be addressed. We are in the process, as we will be discussing later on today, of evaluating some proposed new tech spec requirements for shutdown modes.

[Slide.]

MR. CARUSO: To examine the issue regarding RHR capability for PWR's, we conducted a number of analyses, thermal hydraulic analyses which looked at losses of RHR under different conditions, and basically the loss of RHR can be a significant concern, as was, you know, discussed in Generic Letter 88-17. Basically in those analyses, I think that they point out that early in shutdown, you don't have a lot of time to deal with the incident. If you can get to boiling fairly quickly and reduce levels fairly quickly.

Some of the cases that we looked at, this first case here, the 1.5 hours is basically a case where the head is off and the system is open and you are essentially boiling away the water with no make-up.

The second case, the 15 minute case, is probably a bounding case in that here you postulate that you're not vented. You have nozzle dams in and no vents, which is probably very unlikely, we think, since we've asked people to insure vents in Generic Letter 88-17, and those recommendations have been implemented by, I believe, all plants. In this scenario --

MR. KERR: Let's see. Two hours after shutdown at full power, the heat is down to about one percent of full power, and according to my very simple arithmetic, if you let the water boil, it takes about 250 gallons per minute to remove decay heat at that point.

MR. HOLAHAN: That is approximately right. Actually, I think the numbers are actually probably a little bit less.

MR. KERR: So, one doesn't have to have a lot of -- it would take a little more than a garden hose, but not much more to supply the water needed if you're willing to let the water boil

MR. HOLAHAN: Right. I think what we've found is that the issues always seem to be is a system available. There seems to be very little question about the systems having enough flow rate, talking about 200 gpm. Most any system, whether it's in a low pressure injection system or high pressure injection system or even a fire water system, has usually got enough water if something is available.

MR. MICHELSON: The kind of events you worry about is when you're running an RHR for one reason or another, you start losing water rapidly in the RHR regions, and then you're pumping the water down until the RHR pump quits. You can uncover the core real quick this way.

MR. HOLAHAN: Well, you can pump down basically th hot light and cold light dry, and ther the rest of the time is boiling off the water in the vessel.

MR. MICHELSON: The rest of the time is all that's left for the boiling process.

MR. CARUSO: You can't shut off a pump that's pumping water out of the vessel?

MR. MICHELSON: A large pump of this type, yeah sure, you can shut it off as soon as you figure out what's happened and get to it. Sometimes it isn't apparent.

MR. KERR: Nobody is conscious of what the water level is with the head off?

MR. CATTON: That seems to be the problem over and over again.

MR. KERR: With the head off, people aren't sure?

MR. CATTON: That's right.

MR. MICHELSON: They could be standing there looking at the Tygon tube or whatever you might be using.

MR. KERR: If the head is off, they are refueling frequently and nobody's looking down and see what's happening to the water.

MR. CATTON: You got it.

MR. MICHELSON: The leak may be down in the basement.

MR. KERR: I'm not talking about where the leak is. I'm talking about where the water level is in the vessel with the head off. Nobody can see it.

MR. CATTON: It is amazing. You read some of these incidents, and the head's off.

MR. HOLAHAN: I think one of the things we found in our analysis is there were many situations mid-loop operation for a PWR, for example, where the amount of water is sufficiently low that it really doesn't make that much difference whether you pump the water out or not. There's not that much additional water beyond the water that's basically in the vessel below the nozzle. So, whether it's a few extra minutes or not, all of these events which turn into basically decay heat going into boiling the water become pretty much alike.

MR. CARUSO: The significant aspect of this 15 minute case is that you're not vented and you have some cold leg opening, and in that case, when you boil and pressurize the system, you dump inventory out that cold leg opening, and that contributes to the short time to get to uncovery. It's more likely that you'll have some venting and that you'll -- in looking at cases with some amount of venting needed to pressurize your safety valves or whatever --

MR. KERR: This is a case in which the head is not off.

MR. CARUSO: Right. You can come to some steady state pressure condition around or between 40 to 80 pounds, and in that case, you can basically be in a reflux cooling mode if your steam generators are full of water, but there is a concern that the nozzle dams that would be installed in that case may not be able to handle the pressure.

An issue that was evaluated following the Vogele incident was the availability of passive methods for decay heat removal which are important in a station blackout consideration. We've looked at those methods, primarily gravity feed of water from the cooling water storage tank or an ECCS accumulator, and also reflux cooling, whereby your steam generator is available to you, it's full of water. Your steam is entering the steam generator tubes after you've reached some sort of steady state pressure condition which has compressed the air from the tubes and allows you to have steam up in the tubes and be condensed on the surface, the tubes by the water in the steam generator, and then the condensate drops back down into the vessel.

We've examined those methods and found that they can be extremely important in terms of buying time for you to get your pumps fixed or whatever else needs to be done, although in the case of reflux cooling, it can be a problem if there are temporary seals somewhere in the reactor cooling system that won't take much more than 50 to 100 pounds of pressure. Probably the principal conclusion is that you need a certain level of pressure to get the process moving.

Another area we looked at was the licensee performance in response to Generic Letter 88-17. I addressed a number of concerns about decay heat removal. I think basically what we saw were mixed results. We have

seen people that are
-- utilities that are moving away from mid-loop operation; Shorter stays, in some cases not using it at all; emphasis on minimizing incidents during shutdown; add instrumentation. On the other hand, we've also seen continued events, losses of RHR during shutdown. We've seen instrumentation problems, so I think the reviews are mixed on the response to Generic Letter 88-17.

[Slide.]

MR. CARUSO: On BWR's, we think that RHR capability is somewhat better than PWR's. We don't have a mid-loop condition in BWR's. It can affect RHR capability. BWR's have multiple means for decay removal, a number of systems that can be used to put water in. For those reasons, I think we have found that from operating experience in terms of the frequency of events and also in the precursor analysis, I think you find there's just less of a frequency of losses of RHR and complications that can ensue.

MR. MICHELSON: Excuse me. What's this better water level instrumentation you're referring to?

MR. CARUSO: Well, the BWR's are designed with instrumentation to monitor levels in the vessel where in many cases, the instrumentation is somewhat better than the PWR's.

MR. MICHELSON: I'm not sure if you're talking about -- I'm not sure exactly what this is referring to. I thought vessel level is coming off the top head through one of the caps which, of course, has to be disconnected so you wouldn't be using that one. Is there another indication that has been added that is used during reviewing and that sort of thing?

MR. CARUSO: More what I was driving at with this bullet is if the instrumentation in the BWR's is connected to the protection system during the shutdown modes, we'll initiate.

MR. MICHELSON: What kind of instrumentation are you referring to that is operable during refueling?

MR. HOLAHAN: Remember we're talking about more than just refueling.

MR. MICHELSON: I know, but I'm thinking about refueling here. At least for refueling, it's not clear that they've got anything special. They do certainly otherwise.

MR. KERR: It is called eyeballing.

MR. MICHELSON: I recognize that, but eyeballs are not too good when you have to get the head loose and then nuts and so on. There are times when you can't see what you're doing and you do not have instrumentation to tell what you're doing.

MR. CARUSO: I was referring here to cases where your ECCS is operable, required to be operable, and the instrumentation, too.

MR. MICHELSON: During normal operation, they should be in fair shape.

MR. CARUSO: There are conditions during shutdown where the level of instrumentation and the ECCS are required to be operable, and in many cases, the losses of RHR and BWR's mostly tend to be cases where inventory is lost from the vessel.

MR. MICHELSON: But pressurized water reactors are in good shape, aren't they?

MR. CARUSO: Well, in the sense of seeing where you are, although experience seems to indicate that even though they do have that second means, I mean --

MR. MICHELSON: At mid-loop, the bets go off. They do also on the BWR because they lose a lot of the instrumentation unless someone has a new arrangement.

MR. HOLAHAN: I think we'll have to go back and look at that point. I'm not sure exactly what's available after they go to refueling.

MR. MICHELSON: It depends on how they connected up their level.

[Slide.]

MR. CARUSO: In performing the evaluation, in a number of cases, a number of issues came up that indicated practices during shutdown which involve temporary seals in the reactor coolant system. Frieze seals are used in a number of systems during shutdown to do maintenance when there is no other way to isolate the components. One particular case involved a frieze seal in the bottom drain line and BWR's that's used to do maintenance on that line. Nozzle dams are essentially --

MR. SHEWMON: Before you read that, can you tell me what fraction of those are done on ferritic piping or carbon steel piping?

MR. CARUSO: No, I can't tell you off of the top of my head.

MR. SHEWMON: Is there any insurance that there's always austenitic piping or stainless?

MR. CARUSO: I would have to --

MR. SHEWMON: Are there any restraints on what practices they use or do you recommend or anything required?

MR. CARUSO: Yes, there are guidelines -- I presume you're talking about the frieze seals?

MR. SHEWMON: Yeah.

MR. CARUSO: Yeah. There are guidelines on the use of frieze seals. EPRI has some guidelines, and I believe there's another industry guideline, both of which are referred to in the report. I don't think we brought a metallurgist to address those today.

MR. MICHELSON: Are those material guidelines or size guidelines?

MR. HOLAHAN: They are both.

MR. SHEWMON: There is one EPRI document here that is NP-163840 or 84D, I'm not sure which, and it's pretty good. It talks about you shouldn't cool things that are constrained, and it's more sanguine about -- it makes the statement that the transition temperature of pipe is always below minus 40 F. which I -- that they couldn't document, so it may be a guess for the average or most of them, but I guess I -- this is a good document, and I would kind of like to have some feeling that, indeed, the licensees know and are required to have had somebody be responsible for this material before they do things like this.

MR. HOLAHAN: I believe our report refers to that same entry report, and there also apparently is a Battelle Columbus laboratory report on the same issue.

MR. SHEWMON: I haven't seen that one. Thank you.

MR. CARUSO: I also believe this practice, the practice of free seals, and performing them is also addressed in the industry guidelines for outages.

MR. SHEWMON: What document is the industry guidelines in?

MR. CARUSO: Do mark 90-06.

MR. SHEWMON: Do we have a copy of that?

MR. KERR: Yes. We got it with our package.

MR. HOLAHAN: One aspect of this that has been a concern to the staff is that there doesn't seem to be consistent, industry treatment of what sort of activity this is, whether this constitutes a modification to the plant or not. Modifications are controlled by certain procedures and the need to do 59 reviews and all for a safety analysis and the like. There seems to be inconsistency on that part, so in addition to identifying what we think are reasonable guidelines, we want to make sure that there is some programmatic requirement that the utility understands that it has an obligation to go and do a safety review and addressed these issues when it does do this kind of activity.

MR. CARUSO: Our concern is that -- it's not clear to us that people have thought about what the response of the plant will be, the reactor cooled system will be under a pressurization condition with these seals in place. There just doesn't seem to have that analyzed in much detail. We've done some analysis. It's discussed in our report.

MR. KERR: Don't forget that our ability to hear you depends on how close you hold that mike.

MR. CARUSO: I'm sorry.

MR. MICHELSON: The last bullet was what you were referring to, I assume, and one of the things that people use in making safety evaluations nowadays are the PRS's. Do we have any feel for the probability of failure of frieze seals so I can go in and do some kind of a probability and consequence analysis?

MR. CARUSO: There is information available, and I --

MR. MICHELSON: I'm talking about the failure rate.

MR. CARUSO: We were briefed by Mississippi Power and Light on their outage plans for Grand Gulf several weeks ago.

MR. MICHELSON: Do they have enough failures to have a database?

MR. CARUSO: Well, there is some database. They showed us some figures that examined the probability for failure of a frieze seal. We haven't looked at it in detail.

MR. MICHELSON: They are certainly a little less reliable than the pipe itself, and we know the numbers on pipes.

MR. KERR: It's highly temperature dependent.

MR. MICHELSON: Oh, yeah, but it's really not that. It's the friction factors between ice, steel, and a lot of other things.

MR. KERR: It's also a function of whether your refrigeration equipment is operating.

MR. MICHELSON: It is a whole lot of stuff. I was just wondering, I would be surprised if we could do PRE's on frieze seals by now, but perhaps we can

MR. CARUSO: I think Gary was talking about the need for safety evaluations, and it's --

MR. MICHELSON: These are deterministic safety evaluations?

MR. CARUSO: Yes.

MR. HOLAHAN: Yes.

MR. SHEWMON: Let me add for the record that the NUMARC document is completely silent on the issue of my concern.

MR. MICHELSON: The materials?

MR. SHEWMON: The materials, what we do, the constraints, all of it.

[Slide.]

MR. CARUSO: Another issue that we evaluated in the program was potential for a reactivity accident involving a dilute water slug being formed somewhere in the reactor cooling system, and then when a pump is started, it's accelerated through the core, producing a large rapid insertion of positive reactivity. To look at this, we had Brookhaven National Lab do a study for us where they examined systems and operations during shutdown and startup to see the likelihood that a slug could be developed, and then tc look at the thermal hydraulics of having that slug moved frcm its initiation point 'nto the core, primarily looking at the degree that the ε.ug becomes dilute in transit and in the lower plenum from mixing with the existing borated water, and then examining the physics of slug moving through the reactor, calculating reactivity insertion and power excursion and energy deposition for the transient.

MR. KRESS: Those numbers on the 200 to 300, are those the same models that are used in the pressurized thermal shock mixing?

MR. CARUSO: Yes.

MR. KRESS: So they only involve the point of -- the mixing due to moving in the down cover and then turning up in the bottom?

MR. CARUSO: Primarily, I think, yes.

MR. CATTON: But that was thermal mixing, not mixing of a salt of some kind. That's quite different.

MR. KRESS: But it was turbulent, so I think you can probably infer the mixing of the sale.

MR. CATTON: I don't know. I'm not so sure about that. You know, you find sale --

MR. KRESS: It's not a very concentrated solution.

MR. CATTON: I'm not talking about that. It's the basis. If the basis was thermal mixing and you want to apply it to salt mixing, it's very different.

MR. KRESS: But the basis was entrainment as a thing, and then --

MR. CATTON: Yeah, but you know, they have these salt fingers in the sea that penetrate for hundreds of feet and you can sort of mix it up and then it settles right back out.

MR. KERR: At 200 parts per minute in concentration?

MR. CATTON: Don't get thermal mixed up with salt. They're quite different.

MR. KERR: The 200 refers to how much lower than the usual concentration that mixed amount has in it coming in, right?

MR. CARUSO: Originally there was a concern that if there's no mixing and wh[illegible] you have is a large, completely dilute water s[illegible]

MR. KRESS: It's like 3,000 parts per million lower than the standard, but by the time it does into the vessel, it's only 200 or 300 parts per million.

MR. CARUSO: We are talking about initial concentration of 1500, and that the analysis is indicating that it may be as high as 1200 as opposed to zero.

MR. HOLAHAN: This concern is associated basically with a startup where the core is heavily borated about 1500 ppms. So, it's a matter of reducing it from that point, and the question is how close do you come to criticality?

MR. SHEWMON: This stuff that has 1200 to 1500 in it that you're freezing?

MR. HOLAHAN: No, this is a different issue, different circumstances. Can I go back to Dr. Catton's comment? I think it's a fair observation, and I will go back to our contractor and discuss it. My suspicion is that in the time frame of interest of these sort of events, probably the thermal and physical turbulence that's controlling the mixing and not any diffusion sort of process, but it's a fair question. We'll go back and check on it.

MR. CATTON: You only need to take a look at the process. If you look at the density gradients, you can kind of mix the salt solution a little bit, and it will just settle right back out. The diffusion cooled --

MR. KRESS: Please identify yourself.

MR. RICHINGS: Howard Richings, Reactor Systems Branch. This was thermal mixing, and it was the same sort of thermal mixing models that were used in the pressurized thermal shock calculations by one of the same persons who was working on the pressurized thermal shock.

MR. CATTON: That's why I raised the question. Fusion of salt is different that --

MR. RICHINGS: The fusing of sale was not part of the modeling. It was all thermal mixing.

MR. CARUSO: It's still a fair question.

MR. CATTON: Well, that's what makes it a fair question.

MR. CARUSO: It's an important question, the degree of mixing -- you can make this problem go away if the concentration remains fairly high, you may not have enough reactivity to -- your insertion will not exceed the shutdown bank worth end, and you have your transient.

In addition to the work that was done at Brookhaven, we also looked back in history to see what other studies may have been done to look at this particular problem. We found that in the early 70's there was some analysis done for Westinghouse plants, which had loop-stop valves where they look at the potential for failure of the loop stop valves, where they looked at the potential for failure of the loop stop valve, or just simply an idle loop startup. When they had mistakenly filled the idle loop with unborated water, and they did those calculations with space-time kinetics, in three dimensions, and found that the excursion ones significant and would lead to some amount of fuel melting, but not large enough to rupture the vessel. It provides sort of a bounding kind of calculation, we think, on what the significance of this type of accident is.

[Slide.]

MR. CARUSO: In evaluating containment capability during shutdown, one thing we looked at was the significance of radiological source term as a function of time after shutdown and found that there still is a significant source term up to two days after shutdown. With the open containment in an accident, severe accident, there could be a significant release.

MR. KERR: What does the term significant mean in this case? I mean, does it mean you'd get fatal doses or just measurable? I mean, I'm trying to get some feel.

MR. CARUSO: I think comparable to incidents of power.

MR. CATTON: There are some numbers in the report.

MR. KERR: Okay. Just give me the page number roughly, and I'll --

MR. HOLAHAN: 630.

MR. KERR: Thank you.

MR. MICHELSON: Were you going to explain what that second bullet means?

MR. CARUSO: Yes. One of the concerns for BWR's is that with the drywall head-off, the containment becomes essentially the secondary building which is just generally an industry standard metal building not designed to take a significant pressurization, and we took some accident sequences involving steaming from the vessel and pressurizing the secondary containment to see at what point you lose it, and we found that his would be fairly rapid, on the order of five to ten minutes.

MR. MICHELSON: At what pressures did it fail?

MR. CARUSO: It fails, I believe -- in the analysis, we assumed a half a pound.

MR. CARUSO: These are blow-cut panels.

MR. CARUSO: Blow-out panels go at a half a pound, I believe.

MR. MICHELSON: Before you reached a half a pound, is that steam confined to the refueling floor, or are we assured that it's confined and not spreading into other parts of the building?

MR. HOLAHAN: No. In fact, you would expect the stand-by gas treatment system to be operating, which I think would -- and is included in the analysis -- that it would move some of that material around.

MR. MICHELSON: It shouldn't move around to the rest of the building, should it? I thought it would move it out but not to other parts of the building. But pressure could move it to other parts of the building. I just wonder what effect the steam from this source had on the equipment in the rest of the building, wherever the steam might penetrate to. That has to be a part of the analysis unless you show that the steam is confined to the refueling floor or vented up either through the blowout panels or through the stand-by gas treatment.

MR. CATTON: Is condensate on cold surfaces?

MR. MICHELSON: Some of the electrical equipment on floors below would not want to see condensable steam.

MR. CARUSO: One of the objectives was to look at containment environment with these calculations, but primarily from the point of view of working conditions inside containment, not at effects on equipment.

MR. MICHELSON: I think most plants have equipment that is pretty well sealed from the rest of the building, but I wouldn't want to vouch for that.

MR. CATTON: That 150 degrees is a volume average also. I suspect you're going to see 212 directly above the open vessel all the way to the ceiling, and maybe even along the ceiling. So, you're going to have a highly stratified environment, and 150 is an average. So, if you have equipment nigh up, it's going to get into more trouble than low down.

MR. MICHELSON: For a BWR, this is all done inside of containment. On the boiler, it's going on outside of containment. That is the concern because this other equipment you might like to continue to function is outside of containment.

MR. CATTON: In an experiment where there was a lot of steam in the containment in Germany, the crane didn't work anymore. It just -- all that condensate just ruined everything.

MR. MICHELSON: That's why I asked. Did it get lower? I'm not saying it does.

MR. CATTON: By the dripping of condensate --

MR. MICHELSON: The liquid gas, instead of venting it to the atmosphere, then you're in deep trouble in a hurry, but I'm not saying that that is the scenario. I assume they're looking at it.

[Slide.]

MR. CARUSO: One of the things we looked at was containment closure procedures being implemented per the Generic Letter 88-17, and identified a number of concerns about implementation of those procedures, which included using water seals in some cases for penetrations, basically under the premise that you're just trying to contain radioactivity. Such water seals would easily be blown out in any kind of pressurization incident.

In some of the procedures, the containment work environment hadn't been addressed at all in that actions were not being prescribed until you had significant steam inside the containment, and what we saw in the previous slide was that it would be difficult, if not impossible, to work effectively under those conditions, and containment closure activities would need to start significantly before you reach the boiling condition.

There were a number of cases where the paper procedures existed but it was clear in discussions that there really hadn't been a walk-through testing of the procedure. As we'll talk about later this morning, in some cases in our survey of information regarding containment hatch designs, we found that although the hatch was in place and had its minimum number of bolts installed, there still were gaps at the ceiling surface.

As we'll talk about later this afternoon, the containment concerns are being addressed by the proposed requirements that we're evaluating.

MR. WARD: They're being addressed by what, Mark?

MR. CARUSO: A number of proposed requirements that are discussed in chapter 7 report involving possible tech specs on payment integrity, improvement in procedures for closure, that sort.

MR. MICHELSON: At the time of shutdown, for instance, I might need a frieze seal on one of the connections to the submersion pool because I've got to do some work on the valve that hasn't been worked on. So I put a frieze seal on, and I rate the frieze seal according to the hydrostatic pressure, assuming that there's no pressure in the containment other than atmospheric. If you go through all of these things and decide that if something goes wrong I'll slam all of the doors shut and get pressurized containment, the frieze seal may be in deep trouble from the repressurization. Are we going into that kind of level of detail in these emergency procedures so they don't blow out other devices that are in there for other reasons at the time?

MR. CARUSO: I think in the past -- I mean, it varies from utility to utility, but I think in general in the past, you would have found fewer contingency procedures than more contingency procedures, but I think as we get more in tune with the need for pre-planning and planning for real contingencies, we'll see more things happening. For example, in our discussions that I mentioned before with Mississippi Power and Light, in their preparations and operation for the frieze seal, they had a giant crimper staged right there next to the operation. Unfortunately, they were working on a fairly small pipe, and the action would be if A and B didn't work, to crimp the pipe.

MR. MICHELSON: Maybe I'll ask my question a little differently. If you're going to provide for re-closing the containment, are we providing that the device is being worked on that are attached to the containment will take this new pressure, whatever it is, as a result of reclosure or are we just going to vent the containment to keep the pressure at atmosphere all of the time even after we've reclosed the doors or what? If you repressurize, people us plywood plugs when they want to take the ventilation valve out. It's a 30 or 40 inch valve. They just put a big plywood sheet over it while they're working on the valve. Those plywood sheets, of course, don't take much pressure. Are we planning on repressurizing the containment or just closing the doors?

MR. HOLAHAN: I believe we're talking about dealing with issues that could repressurize containment. I think that Generic Letter 88-17 took a step in that direction, although the guidelines in that letter were somewhat unclear, and there have been varying implementation on the part of the licensees.

MR. MICHELSON: Do you have a feeling for how much of a pressurization? You see, that decides whether you put a plywood plug on it or steel plug to bolt it down, that sort of thing.

MR. CARUSO: Yes. In developing those procedures, there needs to be some thought about conditions and the pressure loadings and what pressures will get to to make those decisions about what those procedures ought to be and what kind of facilities need to be installed.

MR. MICHELSON. Does 1449 address those kinds of issues about the degree to which containment might be repressurized?

MR. HOLAHAN: Probably not to the extent that would satisfy you.

MR. MICHELSON: Well, that's not a criteria. The question is is it covered there. Then I could look at it.

MR. HOLAHAN: I, in fact, was looking to see whether some of the containment analysis did include pressure analysis, and I don't see it.

MR. MICHELSON: I wasn't sure whether the intent was just to close the door so you didn't have the spread of activity or close the door so you could repressurize the containment.

MR. HOLAHAN: No, I think the intent is close the door so you can repressurize containment, and I don't think that we've faced the issue of whether that really means the full containment design pressure or just substantial capability

[Slide.]

MR. CARUSO: In the area of fire protection, we conducted a number of plant visits to understand the way fire protection is handled during shutdown. We're concerned about fires during shutdown because of an increased number of ignition sources and transient combustibles associated with work that's going on during the outage. We'll also take a look at our current requirements, and they are lacking in the area of shutdown, and because of that, we think that we need to revisit our requirements and insure that important systems for safety and shutdown are protected.

MR. MICHELSON: I would like to reiterate what I said to someone earlier today, and that is that one has to look at fire from a new viewpoint now, namely from the viewpoint of how do you decide what equipment needs to be operable normally for shutdown and then make sure it's separated from the postulated fires. Otherwise, the fire can be in the same room where the one RHR pump is that you're counting on for shutdown cooling.

MR. HOLAHAN: Yes, we agree. This is one of the areas that I must say surprised me in the analysis. I think there really is a sort of a hole in the regulation and how it deals with fire protection.

MR. MICHELSON: It doesn't deal with fire. It deals with flooding and so forth because there are many cases, and I think the San Onofre case where they opened the pump and the tide came back in and flooded everything else. I think that was a dual train room also, but I wouldn't want to swear to it. I think it was. You have many older plants. Older plants do not have great visible separation, and now it gets to be a real issue.

I wanted to know also how you deal with the two train system, one of which is needed at all times, including shutdown, how you ever maintain one train and have the other available. Then you talk about fire or anything else.

MR. HOLAHAN: I think it may vary from system to system. There's been some discussion about whether it's more appropriate to do maintenance of fire systems when the plant is at power.

MR. MICHELSON: Perhaps I missed my point. The point is that, for instance, in at least one plant in this country, and there may be more, has just two chilled water systems for the entire plant, two chillers. The fact is they are in the same room, and sooner or later, I've got to do maintenance on one, and I probably will do it during shutdown but at that time, I'd better not have a fire.

MR. KERR: What you do, Carl, is call up the NRC and ask for a two hour exemption.

MR. MICHELSON: It may take more than two hours to work on a 700-ton chiller.

MR. KERR: Then you work on it.

MR. CARUSO: You also can address that by having an alternate diverse source or method of cooling.

MR. MICHELSON: That's usually the -- most plants have more than two chillers. This particular one does not. They are in a tight bind in that regard.

MR. HOLAHAN: The thing that we've been sensitive to is not that all shutdown conditions are particular risk prone, but that some are substantially worse than others. If maintenance does need to be done on such a system, we're not saying that anytime during shutdown is a bad idea. There may be some bad times and some good times. You know, what might not make any sense to do when the plant is at mid-loop operation might not look so bad when the refueling cavity is filled.

[Slide.]

MR. CARUSO: We also looked at fuel handling and heavy loads during shutdown operations, and I think noted that not only the obvious which is it is during shutdown that you have most of your fuel handling, or all of your fuel handling, and your heavy loads movement. To look and see whether or not there were some problems that we hadn't seen in the past, we had indicated, I believe, at our last meeting with you that we would go back and look at this area. We've done that, looking at both the PRA's to see if there were any items identified there. Looking at operating experience also and from those looks, I think we haven't found any issues that we think have a high safety significance, and that's consistent with the fact that our requirements in this area were basically written for shutdown conditions.

MR. MICHELSON: Now, did your PRA's that you looked at, did they model the handling of heavy loads over an open core so I could use the PRA to think about it?

MR. HOLAHAN: I think the answer is no.

MR. MICHELSON: I would be surprised if any in the country have, but if they have, I'd sure like to read about it. So, I don't think you can talk about looking at the PRA and arriving at your conclusion.

MR. CARUSO: Although in the PRA's that were done, in developing the list of initiating events for the sequences, operating experience was examined in some detail, and I think based on that, there --

MR. MICHELSON: I'm pretty sure we don't have any operating experience wherein we dropped 50 tons of concrete into an open core or I think I would have heard of it by now. So, we have to look at much smaller experiences.

MR. CARUSO: Right.

MR. MICHELSON: There are certain steps within a PRA that I think could be written for such handling operations. I think you could do a PRA on it. It just has not been done. The experiences that we have are with little things like people putting the hook on and said they really didn't put the hook on, it slipped, or they got the thing caught trying to pull it out of the vessel. One of the pins unlatched and things of that sort. We have a lot of little experiences. We don't have any big ones because if we had, everybody would be aware of them.

I had a little problem in reading your new Reg. 1449 on page 6-36 at the bottom of the page. I agree with what it says, but I do not know -- I guess I don't agre with what it says. You have the right words, but something is a problem. It talks about the risk associated with heavy loads can be minimized by doing one of two things. You either minimize the probability of it happening or make sure the consequences are acceptable. I though risk had to look at both, the probability and the consequence. In other words, at low probability but at very high consequence if that might be a significant risk attributor. According to this, you don't look at both. Look at one or the other.

MR. HOLAHAN: It doesn't say look at one or the other. It says can be minimized by either --

MR. MICHELSON: Yeah, so I said okay, I want to minimize risks. I can minimize risk by just reducing the probability of the event, irrespective of its consequence? I sure can, I guess, from the viewpoint of probability. I have minimized it, but it doesn't make it an acceptable risk until I have the risk itself down to some acceptable level. I don't have to minimize it. I just have to get it down to an acceptable level. This approach here ignores completely consequences if I minimized the probability of occurrence.

MR. KERR: But that also will minimize risk.

MR. MICHELSON: Well, it certainly will, but it wouldn't make it acceptable necessarily. It will just make it minimal.

MR. KERR: Well, but it may make it small enough to be acceptable.

MR. MICHELSON: It may, but it says nothing in here about the size of the risk or whatever. It just says you've got to minimize it, and you can do it one of two ways. Either you reduce the probability or you evaluate and show the consequences.

MR. HOLAHAN: The approach we've taken on this issue is the same as on other issues, which is to say we have not done a PRA analysis, either probability or consequences, you know, for all of these concerns. We've look at that, and I think this is a good contrast with fire protection.

MR. MICHELSON: Have you done it for any of the risks associated with the dropping of heavy weight?

MR. HOLAHAN: No, because what we found is we don't think that there is a potential for this being a dominant event, and the reason is --

MR. MICHELSON: The reason is what?

MR. HOLAHAN: It doesn't have the characteristics of the other problem areas. For example, if you compare this to fire protection which we just discussed, we find that our protection, the regulations, the requirements, the practices, don't deal with shutdown very well, but we found that fue. and heavy loads are treated explicitly for shutdown, that there are single failure requirements and that there is analysis required. The other difference is, on heavy loads, we didn't find the history of problems in operating experience that we found in fire, and so we basically said it doesn't look like a problem, and on that basis, we said we don't think it's necessary to do detailed analysis.

MR. MICHELSON: I would agree with everything you've said if you'd given me some evaluation of what would happen if you dropped a block of concrete in an open core. If the consequences are not all that bad, you could probably follow your deterministic approach and it wouldn't be good enough, but I haven't seen anyone make the first step even to calculate a dropping of a shield plug and the dropping of a dryer and the separator which is about 70 ton loads, looking to see whether the lugs on the vessel will even support the drop when the dryer comes back down on top. I think you might find with the simplistic analysis it might shear them right off. You have to do some kind of simplistic analysis at least.

This seems to ignore constants and focuses on minimizing the probability of occurrence. That's good if I have a rough idea if the consequences are not way out of line. Risk is what I'd really like to see because that's really what we're talking about.

MR. SHEWMON: Mr. Chairman, have we come almost to our 10:15 break yet?

MR. KRESS: I think there's time for this one last slide on this subject and then we can break before we go into the switchyard stuff.

[Slide.]

MR. CARUSO: The last issue is on site emergency planning, an issue that was raised in the aftermath of the Vogele incident. We found basically that there's little guidance for emergency action levels during shutdown conditions. In some cases -- in cases where there have been incidents during shutdown -- I mean the existing levels had been used, and in those cases, we've seen primarily that there's been a conservative treatment. In the sense of declaring an alert when things are in pretty good shape, the example I'm recalling is an event at Oyster Creek where the cavity was filled and they had lost some of their emergency power and was not in a significant condition but still, to be on the safe side, chose to declare an alert.

In the future, we will be working basically with industry to come up with some guidance for developing these emergency action levels for shutdown conditions based on the shutdown risk studies that the staff has done and also those that are being worked on in industry.

MR. KRESS: Would this be a good time for a break and we can come to the switchyard --

MR. CARUSO: The switchyard discussion is only a few minutes.

MR. KRESS: Let's have a break. Let's be back about -- I declare a break. Be back about 10 minutes till, I guess.

[Brief recess.]

MR. KRESS: Are we ready to get started again? Gary?

[Slide.]

MR. CARUSO: The switchyard issue is, to my mind, was raised -- at least to my consciousness level in the Vogele event where the truck backed into the transformer. Since that time, there have continued to be incidents at plants involving activities in the switchyard and poor control of activities in the switchyard. In response to those events, we've issued some supplementary information notices in addition to an information notice that was issues following Vogele and also the discussion in the Vogele report, NUREG 1410.

Also, in the case of Diablo Canyon and Vermont

Yankee, we had augmented inspection teams evaluate these events. A third area or third item that we've done, the staff has done is issue an instruction to our inspectors in the field to examine shutdown plans and activities during the shutdown, emphasizing heat removal systems and electric power systems, primarily asking them to look for some complicated or different kinds of activities that could threaten to heat removal capability and electric power and provided them some guidance to do that. There is an emphasis here with electrical systems and activities in the switchyard.

We also examined control of the switchyard in our plant visits, and that's documented in Nureg 1449. We found that there were -- I would say minimal controls on most switchyards, a fence with a locked gate. In different utilities, the administrative control of the switchyear varied between the control room and outside the plant.

MR. KERR: I guess it doesn't matter how you attack a problem, but I have somewhat the same sensation of Mr. Wylie. It is not clear to me that this is a shutdown risk problem. It seems to me it has to do with the total operation of the plant. I agree it's an important problem.

MR. CARUSO: We would agree with that. I think the shutdown component is that there is a significant -- usually a fair amount of activity in the switchyards during shutdown, probably more so during power operation, although there have been incidents during power operation. I think the fundamental problem is in communications about what's going on and clear lines of authority on who's controlling what. It transcends shutdown.

MR. WYLIE: Well, it seems to me -- I don't think it matters a great deal where you get the information to draw conclusions, but it seems to me it would be a mistake to separate control of the switchyard during shutdown from control of the switchyard during power operation. In this one case, it seems to me it's really a total control problem, and you'd lose something by separating the two, or so it would seem to me. Well, the emphasis here, the words throughout this document -- and I've glanced over the industry document -- has to do with shutdown.

If you take that McGuire event, first of all, that switchyard is not part of the plant. If you went there, it's sitting on the other side of the highway some mile or so away. It could be 10, 20 miles away, and the question is what's the control of activities of the off site and connection to the grid at all times? The information notices sent out basically says that the transmission distribution department is supposed to communicate with the plant. That's about all it said. The problem that McGuire cause that problem was the fact that they had T&D on the job to do some work on the protective relay, and they did no planning of the work. They glanced over a few drawings and made a few changes, and it wasn't well planned or scheduled or anything, and they failed to tell the plant about it.

MR. CARUSO: Yes, it gets back to good planning and control the outage. All of the activities are going to affect --

MR. WYLIE: That's right. As I said earlier, I think these recommendations are good for any mode of operation. In fact, the real risk comes if you knock a plant off of full power, all units at one time.

[Slide.]

MR. CARUSO: This issue, I can assure you, is addressed in the NUMARC guidelines. They've come up with a number of guidelines to try and keep from having incidents which would threaten the offsight power capability during shutdown. Most of these guidelines are -- reflect good planning and control of activities, and they're not -- I think overall, the staff's conclusion about this particular subject is that it can be addressed with good planning and control, with evaluating your activities that could affect off-site power, and insuring that those activities are done in a way that doesn't and that for the activities that are ongoing, that the risks are well known to all and that there's communication between the control room and whosever working in the yard. We expect to see that be dealt with in the outage program, primarily in that it's being addressed in the guidelines that have been initiated. To follow up, we will continue to inspect as we are now, focusing on availability of electric power and activities in the switchyard during oranges.

MR. WYLIE: Let me ask you about that now. What is the boundary of the scope of the plant shutdown that you're talking about? I guess what I'm driving at is the fact that there's no requirement you even have a switchyard.

MR. CARUSO: Yes, many cases that are outside the protected area.

MR. WYLIE: Are they outside the plant boundary?

MR. CARUSO: Could be.

MR. WYLIE: Like McGuire, for example. I think it is.

MR. CARUSO: And I'm referring to both switchyard and transformer yard. Sometimes they're the same. Sometimes you're not.

MR. WYLIE: Well, let's not confuse the two. I mean, one's a transformer yard at the plant, and the other is a mile or so away or ten miles away. Could be, but they could still knock the plants off the line.

MR. CARUSO: I guess this is an issue where we agree with the concern, but it's not so easy to deal with the regulatory arena.

MR. WYLIE: I didn't say it was easy.

MR. CARUSO: I ink it would be hard to have specific requirements. I nk treated it in outage planning is probably the right place. Whether we can add something to our outage planning discussion that says more about the scope of what ought to be considered --

MR. WYLIE: Are you talking about shutdown [planning]?

MR. CARUSO: Right now, I'm talking about shutdown. Do you remember, there were a list of elements that we thought constitute a good outage planning program. That listed the same thing about scope. We could, perhaps, deal with scope. In other words, specifically draw out switchyear, but I'm reluctant to try to write the tech specs or any other sort of requirements that try to control that activity in detail. I think the issue of how do we carry this insight over into power operation is something we're going to need to think about for a minute. Maybe it deserves to be a generic issue on its own.

MR. WYLIE: It may be. That may be the place to put it. These guidelines are very good, regardless of what mode of operation you're in.

MR. SHEWMON: Does that mean you're happy?

MR. WYLIE: No, I'm not happy because I don't think we've covered it. We haven't covered power operations.

MR. SHEWMON: So, what do we do?

MR. WYLIE: Well, he suggested making a generic issue out of it.

MR. KERR: Would we write a letter and say that we think the staff has done a good analysis and has some suggestions, but we think they perhaps should be more broadly applied or something like that. That's our conclusion.

MR. CARUSO: Okay, that concludes our discussion of switchyard control, and next Tony D'Angelo from NRR is going to discuss the results of the containment hatch survey.

[Slide.]

MR. D'ANGELO: Good morning, gentlemen. I'm Tony D'Angelo. I'm in plant systems branch, and I helped gather the information for the containment hatch survey.

[Slide.]

MR. D'ANGELO: The hatch survey went out to all residents. The residents completed the form --

MR. SHEWMON: Back up for a minute. This was the question of whether these came in or came out with regard to pressure inside? Is that the question or what did the forum talk about?

MR. HOLAHAN: I think the ACRS raised that specific question about what did they look like, did they open in or out. In the context of our program, we really wanted, you know, a broader understanding of containment capability and the ability to close containments. We did that all in one survey.

MR. SHEWMON: And if I shut up, we'll learn what the survey asked in a few minutes or a few slides or what?

MR. D'ANGELO: That's correct.

MR. HOLAHAN: I think you will.

MR. KERR: I thought surely you were going to ask him if he had ever hatched a survey.

MR. D'ANGELO: If you would like, I have a copy of some of the completed surveys that some of the residents filled out, so you can get a feel.

MR. SHEWMON: Onward. I may get back to you.

MR. D'ANGELO: Okay. One of the things that the survey did ask, and we did it pictorially, is whether it was a pressure seating or pressure unseating hatch. So, that specific question was asked, yes. It went to all sites, that being power reactor sites, both VWR and PWR.

This last bullet here, we asked the resident if they were aware of any unusual things that the licensee had done or would do when they installed the hatch. What I mean beyond Appendix J is, you know, the licensee would normally do a Type A and a Type B. You know, Type A is the integrated containment test; the Type B would be the local and the hatch for the concentric "O" rin s. Beyond that, did they do anything special. That's what that point was.

[Slide.]

MR. D'ANGELO: It's a little tight. I apologize for that. One of the things we got back from the residents is that 69 of the hatches for the boilers and almost 90 for the PWR's are -- excuse me. This number here is about 52, and this number here is about 47, out of all of the plants, okay, total hatches, okay, are pressure seating hatches in that the hatch -- this is on the inside surface with an increase in containment pressure, we force the hatch closed. Of the 108 --

MR. WARD: When you said 52 and 47, you mean these percentages are right, is that --

MR. D'ANGELO: That's correct.

MR. WARD: Okay.

MR. D'ANGELO: The percentages are right. The total number of responses we got back was 108 plants, okay?

MR. HOLAHAN: Excuse me. Appendix B of the draft NUREG report lists each individual plant and data on each survey result.

MR. D'ANGELO: You can do the arithmetic from

Appendix B, and hopefully it will work out correct. Fifty-two of those plants needed either AC and/or air, compressed air to close in that, you know, most plants would typically have electric winches to raise and lower the hatch. I couple of plants use the polar crane, okay, so that's where the AC would come from. Compressed air, a couple of plans, especially the boilers,, the hatches are mounted on a dolly, and the dolly is inside the drywall on rails. That dolly is moved forward and backward towards the hatch sealing surface or away from the hatch sealing service into the drywall. That is moved by an air motor, so that's where the compressed air came from.

MR. MICHELSON: How many of these use inflatable seals?

MR. D'ANGELO: You mean like a bladder?

MR. MICHELSON: Yes.

MR. D'ANGELO: None.

MR. MICHELSON: You found no inflatable seals out there?

MR. D'ANGELO: That's correct.

MR. MICHELSON: Looking at PWR's and BWR's?

MR. D'ANGELO: That's correct.

MR. MICHELSON: On the equipment hatch?

MR. D'ANGELO: That's correct. They're typically what's called a dog bone seal or the concentric "O" rings, but they do not inflate. They're an elastomer, and they're inside a groove. Now, most of the hatches -- there are a couple out there that don't have this, but most of the hatches are concentric "O" rings. The annulus between the two is drilled and poured such that one could run an annulus pressurization test.

MR. MICHELSON: Yeah, that's right. That's how you can tell if it's sealed or not.

MR. D'ANGELO: Yeah, okay. But they don't inflate like a bladder.

MR. MICHELSON: You didn't find any inflatable seals?

MR. D'ANGELO: That's correct.

MR. MICHELSON: Okay.

MR. D'ANGELO: Okay, at 22 plants, the residents found that there was either a pre-existing procedure or a work request that dealt with closing of the hatch during the station black-out. That was one of the things that we asked the residents. You know, could they do it? Do you think they can do it? Do they have anything?

MR. KERR: What is the significance of a work request? Does that mean a work request to prepare a procedure?

MR. D'ANGELO: No, no, no. A work request to do the activity. There were a couple of residents who pointed out that the licensee did not have a pre-approved standing procedure to do this. What some had was an approved work request to go do work, and the work request basically said, you know, go take out the temporary services, move the hatch in place, and tighten it this way. So, with a work request as opposed to a procedure. That's my only point.

MR. KERR: So by definition, it was a work request but in other than regulatory, it might have been called a procedure.

MR. HOLAHAN: I think both are indications of pre-planning.

MR. D'ANGELO: That was my point. Maybe I shouldn't have separated the two.

MR. KERR: No, it's okay. I just wanted to understand what you meant.

MR. D'ANGELO: Our only point, sir, is there was a pre-planned document as opposed to hurry up and go do this, I think. This came out to something interesting. Twelve PWR's per the textbook did not require hatch in place during fuel movement. Now, the reason for this is 11 of these plants -- these are like the Byron, Braidwood, alisades, and this is all annotated in Appendix B by the way, except for one of these 12, the hatches -- this is the equipment hatch on the PWR. Those hatches open up to the fuel handling building. Per the FSAR and the safety analysis, if there's a fuel drop accident, the HVAC system in the fuel handling building can handle that. The hatch doesn't open up directly to atmosphere.

Now, the only one that's not like that that we found was San Onofre unit one. San Onofre unit one is a spherical containment. They do not have a requirement to have the hatch on during fuel movement, although they may, a resident told me.

All we're saying here is the tech spec doesn't require it, and the basis for not having that hatch on one, is that Songs-1, they move the new fuel into containment on a tow motor, and they do that across the top of the turban deck into the containment through the equipment hatch. That's the basis as stated for not having the hatch in place.

MR. WARD: But the significance with the other 11 where they're connected to the fuel handling building, is that -- that provides some level of confinement --

MR. D'ANGELO: That's correct.

MR. WARD: But it's not the level you'd expect from the containment?

MR. D'ANGELO: That's correct.

MR. WARD: Is that just a difference in pressure capacity, or it a fuel handling building actually leak tight?

MR. D'ANGELO: No, it's more like -- if you want, it's analogous to the reactor building when a boiler would stand by gas t eatment. It's just an eight track system.

MR. WARD: Okay.

MR. D'ANGELO: You know, the building -- it varies from tech spec to tech spec. Some plans --

MR. WARD: Control ventilation?

MR. D'ANGELO: Exactly. It's controlled ventilation.

MR. HOLAHAN: For the purposes of severe accidents as opposed to just containing a fuel drop, these 12 plants wouldn't provide the kind of protection that you would desire.

MR. WARD: Right.

MR. D'ANGELO: There is certainly no pressure retaining capability with that kind of arrangement.

MR. WARD: Okay.

All right.

MR. D'ANGELO: This was also interesting.

Three plants had fabricated temperature closure plates that they would install in place of the equipment hatch during refuelling. Two of them are essentially plates that go on the hatch and they have holes in it and they run temporary services through the holes, so it is more like a limited leak design, okay?

One plant, Indian Point II, had a fabricated hatch that has penetrations on it, okay, so the hatch is rated for three psid, across the hatch, and it has temporary penetrations for both fluids, compressed gases, and electrical penetrations and I haven't seen the drawing on that but as I understand it in talking to the resident and we spoke to the licensee also, it's actually a pressure-retaining hatch, be it only rated for 3 psid.

MR. WARD: What drove them to do that? I mean did these three units routinely use those temporary plates?

MR. D'ANGELO: The resident tells me yes. He has, he or she has seen them in place, yes.

MR. KRESS: Is this something they have each had since day one or some --

MR. D'ANGELO: I don't know.

MR. KRESS: -- part of their own history drive them to do this, or what?

MR. D'ANGELO: According to the resident, it's part of their own history. We didn't, you know, come in and ask them or tell them but as to why they made that decision, I do not know.

MR. KRESS: Is this covered in the NUMARC guidance document? Are there some guidance in there about --

MR. D'ANGELO: -- closure plate?

MR. KRESS: That closure in general.

MR. D'ANGELO: I don't know.

MR. HOLAHAN: I would have to go back and look but my recollection is that it is not, not specifically covered.

MR. MICHELSON: The other two PWRs had no rating on the pressure capability?

MR. D'ANGELO: That's correct. They are more like a limited leak design. They have holes and they run either a hose or cable through the holes. It's more like a limited leak design as opposed to a --

MR. MICHELSON: There's a real penetration?

MR. D'ANGELO: That's correct.

MR. KRESS: Is that thing likely to be more of a hindrance than a help if you had to really close, put the original hatch bach on in a hurry?

MR. D'ANGELO: Well, in the case of Indian Point, you know, if one could postulate that you won't get above 3 psi, then it's a regular hatch, okay? Now the other two, it's a limited leak design, so however you choose to view that.

MR. KERR: I think the answer is yes.

MR. KRESS: That's what I thought too.

MR. CARUSO: If I might just add, a couple of years ago I was involved in looking at one of these designs on a plant -- I think it was Millstone II that wanted to use it. They wanted it to be able to do sludge lancing in the steam generators at the same time. Tech spec said they needed containment so they just fabricated this plate and put custom design holes to run the sludge lance lines through and the gaps between the hose and the penetration were just built with foam and it was reviewed --

MR. WARD: So at the time the Staff bought off on that as satisfying a tech spec requirement?

MR. CARUSO: Yes. The basis was the fuel handling accident and it was reviewed to meet those criteria and it did and they were allowed to do that.

MR. MICHELSON: The assumption is no repressurization of the containment?

MR. CARUSO: That's right.

MR. HOLAHAN: Let me clarify my comment on the containment closure issue in the NUMARC requirements or in their guidelines.

There is a section on containment and it does address containment closure and basically calls for the utility to establish some plans to have containment closure but it doesn't have detailed guidance as to whether that means a hatch or a plate or these detail of issues.

MR. MICHELSON: Does it tell you whether to plan on closure for the purposes of repressurization or just closure, no repressurization? Makes a big difference in how you close it.

MR. HOLAHAN: Doesn't say.

MR. MICHELSON: Does it say how many bolts you have to have back in, a fraction of the number?

MR. HOLAHAN: No.

MR. MICHELSON: I could put a plate on with three, four bolts, I guess, have it hang in place.

MR. KERR: Well, in the context of existing regulations this is not entirely illogical, because remember the pressure retaining capability of containments is based on the large break LOCA. I think you are probably very unlikely to have a large break LOCA during shutdown.

MR. WARD: Well, if you think that's all containments are for is large break LOCAs --

MR. KERR: I am simply saying it is logical in the context of existing regulations.

MR. MICHELSON: You just have to decide what kind of a vent are you designing for? I dump a lot of hot water into the containment, you are going to get some repressurization like more than three pounds even.

MR. HOLAHAN: The Staff intends to address that in the context of tech specs for containment closure.

I think perhaps since NUMARC is going to make a presentation later in the day they could speak for themselves better on this point.

[Slide.]

MR. D'ANGELO: The last slide we have is we asked the residents to note anything that they thought was unusual and a couple of things that came out of that is there were two plants, Palo Verde and Prairie Island, that had run tests with the hatch in place with less than the total number of bolts in place on the hatch, okay?

These obviously are pressure seeding hatches, so they are inside hatches, okay?

In the case of Palo Verde, they ran a type A, so they pressurized the whole containment and they had the hatches designed for 32 bolts. They ran it with 8 bolts installed and they passed their type A.

The other plant was Prairie Island. They ran a type B, so they pressurized the annulus between the concentric O-rings of the hatch and they passed.

Now at Prairie Island we weren't able to find out how many bolts were in place. All we know is it was less than the total number of 12.

The only point was to demonstrate that the hatch seals quite well.

Now here there are three plants that have noticed that when they install the hatch with the minimum number of bolts in place for the tech spec, that being four bolts, that they have gaps in that the flanges don't mate.

MR. CATTON: Is that because the hatch is warped or something?

MR. D'ANGELO: I don't know that.

MR. CATTON: I thought I read somewhere in these documents that the design is supposed to be so that it mates with the minimum bolts.

MR. D'ANGELO: In one case here at Catawba it is a CB&I hatch. It is one of the larger hatches fabricated, okay, and the vendor -- in discussion in a generic sense, okay, this was not a conference call with the licensee present, so in a generic sense CB&I designs their hatches to seal with the four bolts. There is some flexibility but you have to understand the perimeter of a hatch has a thick ring girder around it. I mean typically it is four inches, so, you know, we are not talking a piece of flimsy sheet metal here. okay?

[Laughter.]

MR. CATTON: Not quite!

MR. D'ANGELO: Now the only other thing to note is that that particular hatch was field fabricated.

I don't know if that was the cause of the problem or not but it is an interesting characteristic of that hatch.

I don't know if it is warped or not. It was just an observation made by the resident and we're illustrating that.

MR. CATTON: Okay.

MR. D'ANGELO: SONGS-I, as we discussed earlier, they don't have a hatch in place because they load fuel through the hatch.

MR. KERR: When that says hatch seal does not make contact, does that mean it doesn't make any contact or that it simply doesn't make contact --

MR. D'ANGELO: In talking to the resident, if you go over to the hatch on the outside, because it's dished inward, and you look up, you will see areas.

MR. KERR: That's all I need.

MR. D'ANGELO: Not full 360 degrees, but you'll see areas.

MR. CATTON: For where the four bolts are, it's okay.

MR. D'ANGELO: I also have to add that those licensees have gone back and changed their procedures to add more bolts. Now, they've also gone back, in one case, on one unit, and they've added more total number of bolts to the hatch.

So if you look at Unit 1 and you look at Unit 2, same size hatch, but different number of total bolts. Unless you have any more questions, that's the end of my presentation.

MR. WARD: I gather from the report that the only thing the staff plans to do about this is to do something about tech specs.

MR. KERR: The staff, from the report, hasn't decided yet what they're going to do, have they?

MR. WARD: They said it's going to be dumped into the lap of the tech specs program, and I don't know what that means. What does that mean, Gary?

MR. HOLAHAN: Let me see if I can clarify. I'm not sure dumped in the lap is the way I would like that characterized. We think that outage planning may play some role in containment closure, but we think that this is probably an issue that we can deal with with tech specs.

We're talking about developing tech specs over the next few months to address containment closure and a number of other issues. These would not be in the context of the tech spec improvement program, which is basically a voluntary program, although we would expect that things we came out with would be added to that program.

We are at a stage where we are developing what we think are tech specs and we'll discuss the approach later, but we're going to look at a number of possibilities; in other words, a minimal number of tech specs, a little more reliance on a tech spec program, or more extensive tech spec programs.

We're looking at a spectrum of possibilities on what could be required, and we're going to subject those to the regulatory analysis to see which ones make the most sense in a cost-beneficial analysis.

MR. WARD: But I guess I'm more interested in what is sort of the strategy for tech specs. The revised tech specs would prohibit certain activities when the hatches are open or what?

MR. HOLAHAN: Yes. Let me give you an example.

MR. WARD: What activities?

MR. HOLAHAN: I think in the way the tech spec now says you cannot do refueling without containment closure, we would identify situations, like reduced inventory in a PWR, and say containment closure needs to be assured during mid-loop operation, something of th sort.

But the details need to be worked out, but it will be that approach.

MR. WARD: But you're going to take a look at what you've learned about risk and use that.

MR. HOLAHAN: Yes. Let me give you the extremes. I would think that for mid-loop operation in the PWR, we would like to have containment isolation. That basically means pressure-retaining capability for a severe accident.

On the other hand, we think that the work we've done to date would indicate that when the refueling canal is full of water and there's 23 feet and there's probably lots of time available, that no additional requirements are needed for containment closure.

MR. KERR: Would you want that independently on whether the vessel is completely de-fueled or only if the vessel has fuel in it?

MR. HOLAHAN: I think we'd only want it if the vessel had fuel in it. We're trying to draw the risk insights from the analysis done. Obviously, if the fuel isn't there, it doesn't make any sense to contain it.

MR. KERR: I would like to ask a question that has to do with the hatch survey. Is Mr. Ward satisfied finally to get the information he's been trying to obtain for some time?

MR. WARD: I have been very patient.

MR. KERR: I want to know. Is this what you wanted?

MR. WARD: Yes. This is the sort of thing that I'm really interested in what they're going to do about it now.

MR. KERR: I just want to settle one issue at a time. So you now have the information that you needed.

MR. WARD: I hate to make such a commitment to you, Bill.

MR. KERR: I think the staff deserves some credit for finally getting this information.

MR. WARD: I think so. To me, it indicates there is a problem out there and something needs to be done. I'd like to find out and have some assurance something is going to be done.

MR. MICHELSON: I'd like to ask the staff a question. I'm trying to determine under what circumstances I am allowed to remove the equipment hatch while the reactor is still intact and maybe even partially pressurized.

What do the reactor conditions have to be before I can even open the hatch?

MR. HOLAHAN: Do you mean the current requirements?

MR. MICHELSON: Yes. Do you mean I have to move fuel before I can remove the hatch?

MR. D'ANGELO: Are we talking about refueling now?

MR. MICHELSON: No. I'm talking about, for instance, I may have to go in and take a big cooler out of the thing, one of these air coolers. They're too big to go through it. You've got to take the hatch cover off.

MR. D'ANGELO: You can't remove the hatch unless you're in a mode that does not require containment integrity. You can't be in Modes 1 through 4.

MR. MICHELSON: You cannot be 1 through 4. Must be 5 or 6.

MR. D'ANGELO: Five, you can remove the hatch.

MR. MICHELSON: What are the restrictions on reactor pressure at 5? What reactor conditions can I have at 5?

MR. D'ANGELO: The mode conditions vary depending on whether they have the STS. Some of the plants have the older tech specs. But typically they're going to be less than 200 degrees F and they're not going to be pressurized less than 200, 250.

MR. MICHELSON: You're going to be a little pressurized at 200.

MR. D'ANGELO: You'll be less than 200 degrees F and on the Ps, there will also be a pressure requirement.

MR. MICHELSON: On the boilers there is just a temperature requirement to be under 200 degrees Fahrenheit in order to remove the equipment hatch.

MR. D'ANGELO: That's correct. But you can also do it in certain conditions in Mode 6. So it's Mode 5 and, at times, in Mode 6, Mode 6 being defined as de-tensioning.

MR. MICHELSON: Do you have to have the ability to quickly replace it for the case you're in Mode 5?

MR. HOLAHAN: Not currently required.

MR. MICHELSON: Do you think there's any need to have a requirement to replace the equipment hatch in Mode 5?

MR. HOLAHAN: For some circumstances in Mode 5, we do, and that's what we'll pursue in the regulatory analysis. But not necessarily all circumstances on Mode 5.

MR. MICHELSON: There are a number of things you can do in Mode 5 --

MR. HOLAHAN: That's right.

MR. MICHELSON: -- that may get you into difficulty.

MR. HOLAHAN: Yes. Could I clarify one point? This was an issue, I guess, Tony and I were discussing just yesterday. There is one additional circumstance where the system can be pressurized without the containment closed, and I guess that's basically doing a leak rate or a hydrostatic test on the vessel when the system is cold.

I think that containment closure is not required in those cases.

MR. D'ANGELO: That's correct. The example we were talking about was a boiler.

MR. MICHELSON: You have to be down to atmospheric temperature.

MR. D'ANGELO: That will depend on the mil ductility requirements of the vessel material, reactor vessel material.

MR. MICHELSON: It will still have fuel in the vessel.

MR. HOLAHAN: Yes, indeed.

MR. D'ANGELO: Absolutely.

MR. MICHELSON: It will be part of the normal design.

MR. KRESS: This is sub-cooled pressure, though. You're not saturating it.

MR. HOLAHAN: That's right.

MR. MICHELSON: I assume below 200, but that's what I was trying to find out; how much below 200. That's quite a release of hot water if you're at 100 degrees and you blow a pipe as a result of the pressure test. You have a pretty good blow-down driven by 200 degree water. Two hundred degree water blows down. It doesn't just sit there. It does a lot of flashing because it's at 200 degrees.

MR. HOLAHAN: I think our concern was more centered on breaking something or inducing a leak where you could drain water out of the vessel and actually see it flashing from these fairly low temperatures.

MR. MICHELSON: I just wanted to know. You'd always be below 200 degrees F. That's fine.

MR. D'ANGELO: Not always. That's what we discussed yesterday.

MR. HOLAHAN: I think the current requirement is yes.

MR. D'ANGELO: Currently yes.

MR. MICHELSON: So you're letting them go to a higher temperature?

MR. HOLAHAN: Actually, I believe that what we discussed yesterday is there is one boiling water reactor that has an exemption to that. The industry has asked for some relief on this point because as some of the vessels age, they have to do their tests at higher temperatures.

MR. MICHELSON: But will you require containment, then -- the containing factor.

MR. HOLAHAN: Yes. But there is one boiling water reactor which has asked for and been granted an exemption to their 200-degree mode definition which would require containment.

MR. MICHELSON: But they don't have to contain above 200.

MR. HOLAHAN: That's right.

MR. MICHELSON: That gets a little more interesting, particularly if they blow a pipe out in the process.

MR. HOLAHAN: Yes. But even in that case, I think we're talking about temperatures that are relatively close to 200 degrees.

MR. MICHELSON: Like what, 240?

MR. D'ANGELO: Typically, they're talking 250. So that order of magnitude.

MR. MICHELSON: The vapor pressure is 240 degrees.

MR. D'ANGELO: They would be above saturation temperature at one atmosphere.

MR. HOLAHAN: Of course, all the water doesn't flash when you're at 250. Most of that energy ends up --

MR. MICHELSON: Only a fraction of it.

MR. HOLAHAN: -- leaving a lot of water behind. I think, again, the concern on our part was the possibility of inducing a large leak in the system where there was no containment available. So that's something they were continuing to think about.

MR. MICHELSON: That was in a boiler? No. That was in a pressurized --

MR. D'ANGELO: It's a boiler, yes.

[Slide.]

MR. HOLAHAN: According to agenda, it's supposed to be 11:00. I see we're about 38 minutes behind. I think we will make up a little time this afternoon where we've allocated half-an-hour to discussing some future staff actions, which I think actually won't take that much time.

We might want to break after this presentation and move the 11:30 piece to after lunch. We'll wait and see how that works out.

What I am going to discuss is the issues which the staff has drawn out of the analysis done to date for which we think formal regulatory analysis is merited.

MR. KRESS: When you say formal regulatory analysis, are you talking about cost-benefit?

MR. HOLAHAN: We're talking about -- well, yes, but what we're really talking about is the requirement in 50.109 which says you should justify the cost of proposed substantial improvements. I guess there are really two tests. One is modifications or requirements for backfit should be substantial improvements, and their costs should be justified.

MR. KRESS: Does that mean you've made the judgment that adequate protection has been provided by the past regulations with respect to shutdown risks?

MR. HOLAHAN: Yes. We made that judgment and there is a statement to that effect in the introduction to the report.

MR. KRESS: Is there some criteria that you looked at and looked at the risks and decided based on this criteria, we can make this judgment, or is that something that is just based on your insights and your knowledge and engineering judgment type thing?

MR. HOLAHAN: There is no specific guideline or numerical criteria. It is judgmental. In effect, I think what we're saying is the same judgment that says that the current requirements are adequate is the same as saying we didn't feel that it was necessary to take immediate action to prevent the plants from doing any of the sorts of things that they're currently doing.

In my mind, those are the same tests, because if you don't have adequate protection, you need to deal with that immediately. I don't think there's a numerical criteria that goes with that. So in effect, it's judgmental.

MR. KRESS: It's a judgment call.

MR. HOLAHAN: It's a judgment call. The formal regulatory analysis also acknowledges that in addition to numerical cost-benefit analysis, there are other considerations that should be looked at.

Defense-in-depth is a principal. It's something that is recognized, even though numerically it doesn't show up in the analysis, and some other considerations.

So the report includes five areas on which we think formal regulatory analysis appropriate. As part of the process, we may be able to formulate proposed actions which combine some of those together. Particularly the third item, we may be able to fold some of those issues into an outage planning activity.

For example, one would expect that outage planning and control would involve training in procedures. We've called it out to give it special attention, but in formulating new regulatory requirements, we may actually be able to put those back together.

MR. KRESS: I seem to recall that you had another list earlier at the last presentation that -- I'm trying to find my notes. It included a couple of other things that I don't see on here.

MR. HOLAHAN: In effect, what we did in the process of coming up with these, we identified a number of issues to be studied. What I'm presenting now is those issues which, after having studied, we think are worthy of a fc mal regulatory analysis, that we're going to pursue them further.

The last time we met with the ACRS, we had taken our preliminary results and we had had a meeting among staff members and come up with a preliminary list. There were five primary ones and a dozen or so additional issues.

The lists are similar, which, to me, basically indicates that the issues we started out on were many of the ones we ended up on, but not every one made the l.st.

It was also a process in which some of the concerns, we felt, didn't need to be dealt with as specific issues, but could be dealt with in a general way. Outage planning, for example, we felt that an outage planning requirement could deal with switchyards and that a specific issue on a topic like that wasn't needed.

MR. KERR: When one uses the term "formal regulatory analysis," does that imply that this goes along with a draft regulation?

MR. HOLAHAN: It implies that it goes along with a backfit. The words "regulatory analysis" are called out in 50.109 and it gives some criteria for what you have to do. That's what it means.

MR. KERR: A backfit is not a regulation.

MR. HOLAHAN: Not necessarily, no. It could be a plant-specific requirement. It could lead to an order, for example.

MR. KERR: Indeed, it could lead, not necessarily in this case, but in some other cases, to saying to a plant although we did not initially require that you abide by this because you were built in 19-X, we now have concluded that you should.

MR. HOLAHAN: Yes. Absolutely, yes.

MR. KERR: Thank you.

MR. KRESS: The other two issues I was looking for, one of them was operator training and procedures, but I see it's back on the list.

MR. HOLAHAN: Yes.

MR. KRESS: It wasn't in the SECY that you presented to the Commission.

MR. HOLAHAN: It's not because it was left out. It was because it was, in effect, combined with the first item.

MR. KRESS: Yes, I see. It was part of that one.

MR. HOLAHAN: Yes.

MR. KRESS: The other issue was emergency planning.

MR. HOLAHAN: That's a matter of characterization, and I think what we've done is to take that issue, which we were calling a potential industry requirement, and basically moved it over and said it's better characterized as a staff action, that it's the staff reevaluating the guidance on emergency action levels than it is really imposing an additional requirement on the industry.

So I think the issue still exists. It's just been moved into what we think is a more appropriate characterization.

MR. KRESS: When you have this list of, say, a dozen issues that you've narrowed down to five or six, how did you decide which ones to cut of' and throw out? Was there some criteria we're using or you just look at them and say that doesn't look as important to us as some others?

MR. HOLAHAN: What we were looking for is some combination of a PRA analysis that came out with a high number or an insight that said there was a particularly sequencer component, a loophole of some sort in the regulations that said this is a topic that hasn't been dealt with very well, or operating experience that said either events like this or precursors of events like this have been seen.

So there is no one criteria, but it's those sort of combination of insights. The example we talked about this morning says fire protection seems to have these characteristics. Regulations aren't very strong. There have been fires. You can call the Brown's Ferry fire a shutdown event, if you like. And that it shows up in the PRA analysis, and that other events, in our view, an example that we did not carry from our longer list to the actions was the heavy loads.

We found that neither operating experience nor the existing regulations seemed to show that there was a weakness in that area. So it doesn't make the cut. So it is judgmental, but it's based on looking at a structured set of approaches.

MR. KERR: I think you said earlier that existing fire regulations do not cover shutdown. Is that a matter of practice or does the regulation somewhere say it only covers full power operation?

MR. HOLAHAN: The way the regulation is written, what it says is you should be able to take the plant -- basically, in Appendix R, it says you should be able to take the plant to a hot shutdown condition, and then later, and I think the timeframe is 72 hours, you should be able to take it to a cold shutdown condition.

But what happens is -- and the 72 hours allows for repair of equipment that might be out of service. What happens is in implementing that fire protection in terms of sprays and other fire protection equipment doesn't get put on the equipment that is being used to maintain the plant in its shutdown condition.

It's only the equipment that would lead you -- for example, protection is provided to auxiliary feedwater pumps, for example, but not to decay heat removal systems. The cabling, power supplies for the equipment used in shutdown is not covered, which means --

MR. KERR: No. My question is is that explicit in the regulations or implicit, or is it a matter of custom. Could one interpret the existing regulations to cover shutdown risk, or is there no way that could be done?

MR. HOLAHAN: I think there is no way that they could be interpreted like that. It doesn't explicitly say you don't need to cover shutdown, but the way it's written clearly leads you to a point before you get there.

MR. KERR: Thank you.

[Slide.]

MR. HOLAHAN: What I would like to do is just briefly discuss each of these five items. Outage planning and control, I think we've come -- I guess kind of confirmed what we suspected as much as a year ago, and that is outage planning and control is a very important element to shutdown risks; that we think it's such a central issue that it needs some regulatory treatment.

We recognized that outage planning and control really is what establishes the initial conditions for events during shutdown, and that technical specifications themselves probably are not the right approach for dealing with that issue.

If you compare the situation with power conditions, we really use technical specifications while at power, and we have not emphasized that the utility should have some additional sorts of controls for equipment availability. But in shutdown, the amount of activity that goes on and the variations and combinations of equipment that needs to be taken out of service for maintenance doesn't lend itself to a simple set of tech specs.

This is an area in which NUMARC has taken the lead. I think they'll discuss it this afternoon. I think their guidelines are resulting in improvements. But we think that because outage planning and control is going to continue to play a large role, that it's important that there be some regulatory framework that addresses that, and that's what we were going to propose.

The report really says that you can address this in a number of fashions, and we're going to look at -- one is you're going to have a general outage planning rule that says you should do good outage planning, and normally such a rule would be supported by a Reg Guide that says here's what we mean by it.

I think that, for example, if we were to propose a rule, the rule would say you need to do good outage planning, and the certain features that we think are important would really belong in a Regulatory Guide.

Alternatively, we will consider the approach used in the generic letter, which was basically ask licensees to make a commitment to have a strong outage planning program and tell us what the features are. I think technically the issue can be dealt with either through rulemaking, through a commitment from the licensees, or even through administrative type technical specifications.

Which of those approaches we take might very well be a policy matter that the Commission might want to decide on. I think technically the kinds of improvements that we're interested in can be made through any of those approaches. But these are the basic kind of features that we would like to see to improve the safety management of outages.

I think there are some utilities that are already moving very strongly in this direction. There are probably some programs out there already that probably have the features that we would like, although what we tend to see is even the better programs tend to have weaknesses in one or two areas that ought to be addressed.

MR. KERR: I want to make a comment which I hope won't be misunderstood, and I don't think it's necessarily contrary to what you have in mind.

I would hope that safety would receive serious consideration, but I also hope that economics and availability receive serious consideration as well. I think one of the strong economic factors in power plant operation is availability. Availability depends very much on the time spent during shutdown. I agree that this is an important safety situation.

I hope that in working out the appropriate regulations or whatever that an effort is made to do it in such a way that it does not automatically significantly increase the time required for shutdown.

I think it's feasible to do that. I hope it is feasible to do that, and I think that's -- I would hope the staff keeps this in mind and I expect you have already given it thought.

MR. HOLAHAN: Yes, sir.

MR. WARD: Bill, do you have a concern that the backfit rule analysis will not do the sort of job that you think needs to be done?

MR. KERR: I don't think I want to comment here on what I think of the backfit analysis.

MR. WARD: That is what it's intended to do, though, right?

MR. KERR: Yes. I have seen numerous examples of backfit analyses in the past, and that has some influence on my view toward the backfit analysis.

MR. WARD: So I would read your concern as a concern about how well accident analysis is done.

MR. KERR: Yes; how well it can be done. For example, it has to use quantitative results of something, and something that has been used in the past has been PRA. I have been told and I believe that the uncertainties in the PRAs that one does in this realm are very large.

To me, that means that the quantitative part of the backfit analysis has large uncertainties. This is not anybody's fault it seems to me, but I think it's sort of a fact.

MR. KRESS: When you looked at the compared outage planning at the site visits and come up with judgments about here's a good outage plan and here's one that's not a good one, in general, I seem to recall the good outage plans actually resulted in less downtime and less shutdown time and ended up getting back on-line faster.

So it is not incompatible with what Bill is trying to say, I think.

MR. KERR: It isn't, unless in the process of trying to get to planning, one becomes so tied up in regulations, recordkeeping and whatever that it actually increases the time that these already good plants have to spend. That's all I'm hoping for.

MR. HOLAHAN: What I would say to address both those issues is I think it's true that the better outage planning, from a safety point of view, that we've seen does, to some extent, seem to correspond to the better overall outage activities and not necessarily to long outages.

As part of the regulatory analysis, we will be looking at costs. And obviously if you lengthen an outage, the costs are so enormous that it very quickly swamps other considerations. At this stage, the best I can say is that's part of the analysis and we'll do the best we can.

MR. WARD: When someone says, or I guess it has been said that there is greater -- apparently, a significantly greater uncertainty associated with risk calculations for shutdown as opposed to risk calculations for operational mode.

Is that because of there is less experience with those analyses or is it because human action is a bigger component or what?

MR. HOLAHAN: I think it will exist even after there is more experience with the PRAs. I think it's related to human action, but it's related to two types of human actions. I think it's related to the kinds of situations and circumstances that plants are put into, which I think are more complicated and harder to predict, and also dealing with events is more operator-dependent because there are fewer automatic safety systems.

I think that makes it more difficult to do the analysis. I think you can call both of those human aspects.

[Slide.]

MR. HOLAHAN: Let me move on. I think a lot of these subjects we've already addressed, so I'm just going to touch on them lightly. Fire protection, we basically found greater likelihood of fire, fewer controls, less fire protection type equipment might be available.

The question is once you've discovered that you're unhappy with the situation, what should you do about it. The approach that we will be pursuing is to strengthen administrative controls and require fire hazard analysis to go along with shutdown activities.

This is in contrast to an Appendix R approach which basically says install hardware, like sprinklers and fire protection equipment. We think that that would probably be a very expensive approach, but that a good fire hazards analysis which would lead to fire watches, portable type fire extinguishers, to deal with the more vulnerable situations may be the most reasonable way of improving fire protection for shutdown conditions.

So that's the approach that we're going to look at.

[Slide.]

MR. HOLAHAN: In terms of operations issues, training procedures and contingency plans, improvements in those areas are things that we would like to see through broadening of the scope of Generic Letter 88-17.

If you remember, Generic Ietter 88-17 was a followup to the Diablo Canyon loss of decay heat removal event, and it focused primarily on pressurized water reactors in mid-loop operation. Some of the issues raised in 88-17 appear to have been beneficial, but the scope probably should have been more broadly approached.

We think that improved contingency plans are important. There was a lot of discussion about whether there should be formal emergency operating procedures to deal with loss of decay heat removal or situations in which you would drain water from the reactor vessel.

We basically come to the conclusion that emergency operating procedures are not necessarily the best way to do this, but that some type of contingency planning is appropriate. The exact approach we would like to see a little bit more flexible. Although something informal as an abnormal operating procedure may be appropriate for a loss of decay heat removal, something as simple as having a plug and a device to crimp a pipe may be an appropriate contingency plan to deal with a specific situation, like a freeze seal.

So rather than try to push all of the concerns into a formal emergency operating procedure arena, what we think is improved contingency plans should be appropriate to the kind of activities that are going on. This is an approach similar to that recommended by NUMARC in their guidelines.

An important element to doing contingency planning is understanding what you're protecting against, and I think associated with that contingency planning is the implication that you ought to do more safety analysis to understand how long does it take to drain water from a vessel, how long will it take to uncover a core if decay heat removal is lost.

So the contingency plans are tied to technical type analysis that hasn't been done in the past. I think that current analysis is helping the process.

MR. KERR: In that connection, I'd make what I don't think is a completely facetious suggestion. We refer to this as loss of decay heat removal. The real important thing is that you remove the decay heat from the fuel.

I don't think we have ever, except in the TMI-II case, had a situation in which we have had decay heat removal lost. It has been continually removed from the fuel. It may have heated up the coolant a bit, but the important part of it, which is to get it out of the fuel, has continued to occur.

I don't mean that -- I think this is an important precursor -- well, enough.

MR. HOLAHAN: I think I understand the point. Nature being what it is, the heat will come out and will go somewhere. The question is what has it done in the meantime. When we're talking about decay heat removal, we're talking about normal circumstances with heat removal from the fuel without loss of fuel integrity or changes in geometry.

One thing I might mention -- well, I guess we'll pick it up later under the staff actions. In the training area, we feel that, to a certain extent, utility training programs are driven by the kinds of questions and the kind of expectations established by NRC's license examiners.

MR. WARD: That's an understatement.

MR. HOLAHAN: So we think that as part of this process, we need to not only send a signal to the industry that says more training on shutdown is important, but we're going to factor it into our own training and exam processes.

MR. KRESS: When you do that sort of thing, that doesn't require a cost-benefit. You can automatically do that. It's not a rule or a backfit

MR. HOLAHAN: It's not a rule, but I think there's a judgment factor there. If we were to go out and basically test operators and say that they are required to know things and be able to do things which they previously weren't required to know or be able to do, I would say those are new staff requirements or new interpretations of old requirements and ought to be subjected to a regulatory analysis.

If it's a matter of additional emphasis on something that is already required, then I don't think that that's new. So there's a judgment call there.

MR. MICHELSON: What about if it's already required, but not being enforced in the past? Can you start enforcing existing requirements at any time? A lot of this is a case where you kind of looked the other way and got some agreements upfront that things could be done a certain way.

If you had a change of heart and decided to start enforcing what was a requirement, you could do that without a cost-benefit.

MR. HOLAHAN: Let me distinguish first between cost-benefit and regulatory analysis. Regulatory analysis might come up with the conclusion that this is required for adequate protection and that it is derived directly from the regulation. So cost-benefit may not be the issue.

I think there's a judgment factor there, too.

MR. MICHELSON: How about if it's a requirement and it just hasn't been enforced? Can you start enforcing it at any time?

MR. HOLAHAN: I think that is a sensitive issue, and I think that -- I don't think that the regulation addresses that, 50.109, the backfit regulation, doesn't address that.

But the NRC Manual chapter on backfitting and the charter of the CRGR basically says those sort of situations in which the staff wants to do things, to say activities which were formerly acceptable are no longer acceptable, that needs to be given some formal review and approval process.

MR. MICHELSON: I guess formerly accepted means that you just didn't enforce what was on the books.

MR. HOLAHAN: Yes.

MR. MICHELSON: So by default, you were accepting.

MR. HOLAHAN: Most of those cases are a matter of interpretation, and I think staff interpretations of what are required generically are subject to CRGR-type review.

[Slide.]

MR. HOLAHAN: In terms of technical specifications, I think we've mentioned it before. We are looking for improvements, especially in plants which have very little in that area. Containment, all those issues that go into decay heat removal, support systems such as AC power, and I think Mark covered basically these issues before.

This will come up once more. When we talk about our approach to the regulatory analysis, we've picked a couple of examples. Let me steal a little of that discussion and mention it here.

The staff's process and as part of the CRGR reviews, one of the things that needs to be looked at is no requirement. Do an assessment to say is it okay to have no new requirements. In addition to that, we are going to look at each of these potential areas with a number of possibilities.

So the technical specifications, we feel, it's probably more important to take those older plants which have no requirements for AC power or even for decay heat removal systems and bring those closer to the standard tech specs.

That's more important than upgrading the existing tech specs to deal more completely with shutdown conditions.

So we're going to look at a sort of staged approach; how much additional requirements and technical specifications are appropriate and cost-beneficial.

MR. KERR: Mr. Holahan, I'm puzzled by the language in the first bullet, where it is suggested that one ensure sufficient AC power sources available during high risk conditions.

I would have thought that the Station Blackout Rule was written to ensure sufficient AC power sources under all conditions.

MR. HOLAHAN: The Station Blackout Rule is based on loss of AC power from operating conditions, and that's basically the way the guidelines as to what needs to be available and how the analysis is done --

MR. KERR: So it's really an inadequate rule. Has the Commission been told that, that the Station Blackout Rule is inadequate?

MR. HOLAHAN: I don't believe our report says inadequate, if you use inadequate in a --

MR. KERR: I don't know how else to use inadequate except in a risk sense.

MR. HOLAHAN: We haven't said that it's inadequate. What we've said is that we think that substantial and cost-beneficial improvements can be made by improving AC power and other tech specs.

MR. KERR: But it seems to imply that one needs sufficient AC power sources during high risk conditions. It would seem to me it makes more sense to say one needs sufficient AC power to deal with risks so that the risk will be acceptable, and not that somehow you have to make AC power sources available.

It's almost as if you have to shift your AC power so that when risk is high, you make availability high; when you risk is low -- there's an anomaly here somewhere that escapes me.

MR. HOLAHAN: There is no intent for these words to mean anything different than the amount of AC power that should be available should be commensurate with the risk of the situation, and that should be judged by cost-benefit analysis.

MR. SHEWMON: Do you feel the current regulations with regard to plant shutdown do define it such that the resources are adequate for the risk? So far you've said you're in favor of motherhood most of the time, but you haven't, at least to me, got back to whether or not the current regulations for shutdown or what they say for shutdown are adequate.

MR. HOLAHAN: What was said is the current regulations, and that means the whole body of the regulations and the regulatory process and whatever activities have resulted in the plants being the way they are.

MR. SHEWMON: Apropos AC power. That's what we're talking about.

MR. HOLAHAN: Apropos AC power, I think, has left them in an adequate, but improvable condition.

MR. MICHELSON: Has anybody looked at station blackout for the case of being in a refueling at the time?

MR. HOLAHAN: Certainly that's addressed in the report. It's not addressed as part of the analysis required for the Station Blackout Rule.

MR. MICHELSON: The requirement, though, what I'm asking is has anybody looked at what would happen if they had a station blackout during refueling, and you're saying yes, it's covered in the report.

MR. HOLAHAN: Sure. It's in the PRAs. I think you'll see that a number of the specific PRAs focus on that issue. That's basically seen as one of the causes of loss of decay heat removal.

[Slide.]

MR. HOLAHAN: The fifth item that we're going to pursue as a potential new requirement is instrumentation. Generic Letter 88-17, we feel, made improvements in this area, but they haven't been as effective as we had hoped.

The recent Prairie Island event in which they lost decay heat removal because they allowed the level to get too low was basically the result of difficulties with the level measurement system, even after they had made the modifications that they felt implemented the 88-17 recommendations.

So we think that instrumentation deserves another look. The basic elements are coolant temperature and level, RCS pressure not so much for the refueling type cases, but for the mode changes, the startup and shutdown conditions.

MR. KERR: What does RCS pressure in control room mean? There will be an indication in the --

MR. HOLAHAN: Indication.

MR. KERR: And there is not currently indication of pressure in the control room?

MR. HOLAHAN: In PWRs, for example, there is an indication, but it would usually be on an instrument that has a zero to 3,000 scale. So it may very well be in such a portion of the scale that there's an instrument there, but it might not be very effective in telling you what you want to know.

I guess I don't intend to go through the entire list. We will basically be putting together a package of recommended improvements to instrumentation, in effect, similar to what was done in Generic Letter 88-17, which called for two level measurements and two temperature measurements, but we think an additional improvement is warranted.

MR. KRESS: If there are no more questions on this part, I think this would be a good time to break for lunch. It's an hour for lunch, so let's plan on being back about 1:20.

[Whereupon, at 12:20 p.m., the Committee was recessed for lunch, to reconvene this same day at 1:20 p.m.]

AFTERNOON SESSION

[1:21 p.m.]

MR. KRESS: I guess we're ready to go again.

[Slide.]

MR. CARUSO: In this session, what I would like to discuss is the regulatory analysis process that we're currently working on, with the ultimate goal of an analysis package that supports the proposed requirements to be imposed.

We're on a schedule of completing the analysis in the June timeframe, and, as Gary said, the package would have to go out for public comment. Basically, in doing the regulatory analysis, we're using the latest staff guidance for conducting an analysis of this type.

That guidance is being continually updated. The current version is as of December 1991. I think one important thing that I've noted from the guidance is that it provides -- it specifies fairly specific analytical requirements in terms of quantitative analysis to determine the values and the impacts associated with a given proposed requirement.

But it also allows quite a bit of latitude in terms of where there are uncertainties in PRA information, that you deal with that with qualitative engineering arguments. So I think that's especially important for the shutdown conditions that we've talked about today, because the PRA information we do have is somewhat limited.

We'll basically be using what is discussed in the NUREG report, which includes a number of PRA analyses that have been done for loss of RHR and loss of off-site power, station blackout sequences, as well as the precursor analyses. Basically, in the analysis, there are probably three key elements.

One is to identify a number of alternate solutions to your problem; in our case, a number of alternate sets of requirements that could achieve a substantial reduction in risk when implemented, and then evaluate those different sets, one, by looking at how much reduction in core damage frequency they yield, with a goal of trying to achieve a ten percent reduction.

This ten percent reduction, ten percent of safety goal is the criteria for which we are basically equating or basically saying that we can meet the backfit provision, the provision in the backfit rule which requires us to demonstrate substantial additional improvement from the requirements.

The guidance that we're using is basically a specified value of ten percent of the safety goal of ten-to-the-minus-four CDF per reactor year.

MR. WARD: So what do you do if it's a -- I know what you're saying, and this implementation of the safety goal is under discussion now, I guess.

But what do you do if it's an issue that is concerned with containment and not with the heat removal systems, the core cooling system?

MR. CARUSO: I specified one particular goal of ten percent of safety goal. But, in reality, the guidance examines the safety goal in terms of both reduction in core damage frequency and containment failure. There are various -- if you think you have core damage frequency and the estimated -- and conditional containment of failure probability, as your two-dimensional space, in various quadrants of that space, lead you to either proceed with requirements or stop with requirements or consider requirements at a high level within the staff.

I don't have the figure here, but --

MR. KRESS: I think Dave's question involves suppose you wanted a requirement that they have to be able to close the containment hatch within a certain amount of time or something like that.

Now, that doesn't impact at all on core damage frequency. Therefore, you have no way of knowing whether to include it or not include it in terms of the safety goal implementation plan.

MR. HOLAHAN: But it affects two other things. It affects the probability of large release, where the safety goal has basically identified ten-to-the-minus-six as a goal, and it affects off-site consequences, which are in the quantitative part of the safety goal.

So you can judge both of those and we can do that. But I think in addition to just doing that, I think we're going to have to make some judgments about the value of defense-in-depth, where you might want increased reliance on containment because of the great deal of uncertainty about what is the real number for core damage frequency.

So I think there's a quantitative part even of the containment analysis, but then there's a judgmental part, also.

MR. CARUSO: I think in practice what we are going to do is make an evaluation of reduction in core damage frequency. I think it will probably show that -- I mean, our examination of containment and dealing with containment will be primarily to look at the effects of requirements on removing the open containment.

With shutdown, the principal issue is that you have these severe accidents postulated in a situation that the containment is already open that we saw before. You may not be able to get it closed because of environmental conditions.

We're not so much, I don't think, focused on challenges reaching containment, although they're there with severe accidents, but there isn't that much more that's different with shutdown. In fact, it may be less of a challenge. But the principal containment issue in shutdown is requirements which remove the open containment situation or the pre-existing hole, if you will.

In addition to that, because of the uncertainties in the PRA aspects, just consideration of defense-in-depth.

MR. KERR: Let me make sure I understood your earlier statement. It is, in effect, in order to demonstrate that something is significant, if you can show that it has a delta of ten-to-the-minus-five in core damage frequency, it is deemed significant. Is that it?

MR. CARUSO: That's right.

MR. KRESS: That delta is counted from where is the baseline. The core damage frequency at power due to all --

MR. CARUSO: No. You have to make a baseline estimate essentially based on taking no action. That's the way it's been done.

MR. KRESS: Is that a delta for one sequence, then?

MR. HOLAHAN: Yes.

MR. KRESS: You look at that one sequence and see if you can change its delta by ten percent?

MR. HOLAHAN: What you are really looking at is one proposed action and its net effect.

MR. WARD: It could effect more than one sequence.

MR. HOLAHAN: It could effect more than one sequence.

MR. KRESS: But its net effect on the total core damage frequency, which includes all the sequences at power. That was my question.

MR. WARD: Yes, because the fix you're proposing might be doing something for power operation, as well as shutdown operation, is that what you're saying?

MR. KRESS: For example, if the total contribution of core damage frequency due to the low power and shutdown risk is already only ten percent of what it is at power, you would never do anything, then.

MR. HOLAHAN: If that ten percent turned out to be ten-to-the-minus-five, we would not do anything.

MR. KRESS: Assuming the one-times-ten-to-the-minus-four was a reasonable number, yes.

MR. HOLAHAN: And if you had enough confidence in that number that you felt that you could rely on it without any additional defense-in-depth or something, yes.

MR. WARD: HOw does confidence come into that? How does that fit into the cost-benefit analysis?

MR. HOLAHAN: It is a factor that goes into your judgment about whether you really want to pursue that issue or not. I think if the number came out exactly one-times-ten-to-the-minus-five and there were a lot of uncertainties, you may be more inclined to pursue an issue than if there was less uncertainty.

I don't believe it's numerically factored into the analysis.

MR. WARD: Even though that uncertainty meant that you might be requiring spending a lot of resources for no gain. That's the other side of the uncertainty. In the safety goal business here, we've talked about using central estimates or means or medians or whatever.

MR. HOLAHAN: Mean.

MR. WARD: Do you mean to use means or is it --

MR. HOLAHAN: We mean to use means --

MR. WARD: Except when you get exceptionally nervous or something, and then what?

MR. HOLAHAN: We mean to use means, but then to look at the uncertainties and to use that as part of -- as an additional consideration as to whether to strengthen an argument on an individual recommendation or weaken it.

MR. KRESS: Does this mean you have to wait for the PRAs to be completed before you do this?

MR. HOLAHAN: No. I think it means you use the best information you have available.

MR. KERR: Now, there seems to be implicit in this course of action the assumption that although there is a lot of uncertainty in the number itself for a particular sequence, that there is much less uncertainty in the delta, because the ten-to-the-minus-five us probably trivial in terms of the uncertainty in the number itself.

But if you compare before and after, then the assumption is that that delta has a good bit less uncertainty than the number itself.

MR. HOLAHAN: I think what happens is -- and I'm not sure that the mean value is as low as ten-to-the-minus-five. But if the mean value is low, then proposing to take an action really means that you're removing the uncertainty on the tail of that curve, because actually reducing a low number to make it a lower number is really not very effective.

What you're doing is you're reducing the likelihood of the tail being out in an area where you don't want it.

MR. KERR: But you're also assuming that you can indeed be fairly certain about the SIGN of the delta.

MR. HOLAHAN: Yes, sir. That's certainly part of the consideration, to look at the net effect.

MR. KERR: Part of the uncertainty in some of these things could very well be, it seems to me, an uncertainty in the SIGN.

MR. HOLAHAN: I don't think that we're proposing any items for which the net SIGN is in question. I don't believe that we're pursuing any really marginal type issues.

MR. KERR: I believe that you don't think that, and you may well be right. I'm simply saying that uncertainty, if there is a good bit of uncertainty, would not be strange that the uncertainty in the SIGN existed, as well.

MR. CARUSO: I think one interesting thing about shutdown is that most of the perceived uncertainty in a PRA from shutdown is from human factors and not being able to treat human factors as accurately as non-human factors.

Along with that, the sets of requirements or the types of requirements that we're talking about are requirements aimed at improving human factors and reducing risk by improving human performance.

MR. KERR: But, you see, you also are assuming that we have learned from our experience and we've learned the right thing. I think of some of our past experiences -- let's take the Brown's Ferry fire. What we learned from that apparently was that fire protection ought to be improved.

If you look at Brown's Ferry carefully, I think maybe what we should have learned is that operators ought to be trained to deal with unusual events, because what really saved Brown's Ferry was that those operators understood that plant well enough that they did some rather unusual things to keep the supply of water to the vessel.

Now let's go to TMI-II. What we learned from TMI-II was that operators ought to be trained to deal with abnormal events. I mean one accident too late, but what we should have learned probably is something quite different, and that is we ought to have an assured source of electrical power, because think of how much worse TMI-II might have been if there hadn't been electric power available.

We're sort of proceeding on the assumption that the past experience is going to guide us in doing the right thing in the future. My look at our previous experience doesn't make me as sanguine about that as I would like to be

MR. SHEWMON: So your conclusion for this situation today is what?

MR. KERR: There's a lot of uncertainty, to me, in the process that may be involved in reaching decisions, where we have a situation in which it appears to be that operator error or possibly operator positive contributions may make a significant difference in what happens.

I think there is a very large uncertainty in the contribution of operator error or operator positive contribution, what this may contribute to risk. I'm simply saying we need to proceed with a lot of caution in a situation of that kind.

MR. CARUSO: I think our concern for the uncertainty in this particular case is that in doing these evaluations and site visits, I think one of the things that we have identified is that there is a lot of territory in shutdown that hasn't been thought about and looked at.

Here's a situation where the understanding may not be there. As you pointed out in these other situations, it's been that that's been a source of the problem. But those are the kinds of qualitative arguments that will have to be made to support --

MR. KERR: For example, from what I've heard of Davis-Besse and the sad situation that existed there, had one been able to predict -- had one tried to predict ahead of time that the operators would have been able to jam something together that would get water into that plant, the probability of that occurring, I think the prediction of that probability would have been extremely low.

Yet, those guys did it and I think they did it because they understood the plant fairly well. They had no procedures, as far as I can determine, and we would have guessed that without procedures they would have not been able to -- in fact, they probably would have done the wrong thing.

I'm not sure that's much of a contribution.

MR. WARD: Mark, you're going on, I guess. I didn't think you talked about the other points, but the center one, talking about using best estimate information when a lable, let me ask you a question about that.

When the staff does cost-benefit analysis, as I understand, they use a number or they have to use a number like $1,000 for man rem avoided, either that or some other number or something else.

Do you regard that as a best estimate?

MR. HOLAHAN: Yes. Yes, he does.

MR. WARD: He does? Okay.

MR. CARUSO: I don't have a choice.

MR. WARD: Okay. What's your basis for that?

MR. HOLAHAN: Those are the rules of the game. That's the way the --

MR. WARD: That's a different statement. The rule says this is the best estimate or this is the number you use?

MR. HOLAHAN: It says when you calculate cost and benefit and you take these ratios, you should use best estimate value.

MR. WARD: And you wouldn't be breaking the rule, so you use $1,000; therefore, that must be a best estimate.

MR. HOLAHAN: You use your best estimate and compare it to the $1,000 per man rem goal.

MR. KRESS: Is that 1992 dollars?

MR. HOLAHAN: I believe that that issue is under consideration. I think it's 1980 dollars. There was a question proposed to the staff as to which dollars should be [illegible]ed, and I think it's currently under rev[illegible]ew as to how it [illegible]d be done. But I think there's a guidance document [illegible]er out or coming out on how to do that. It does make [illegible]me difference.

MR. WARD: [illegible] see what you mean. There's no question about the 1,000 being a best estimate. That's the guideline. [illegible]'s sort of like the safety goal.

MR. HOLAHAN: It's a guideline, but then the question is --

MR. WARD: In fact, it is the safety goal.

M[illegible] HOLAHAN: The question is what is the appropriate value to be used in comparing to that guideline. We're saying that it's best estimate.

MR. KERR: You have gone back and looked at the history of the way in which the $1,000 was arrived at, have you not?

MR. CARUSO: That whole subject is under discussion now, and, as Gary said, I think there's a position paper that's been examining whether or not that's the appropriate figure to use.

MR. KERR: In the Statement of Consideration that accompanied Appendix I, the Commission, I think it was the AEC at that time, said that they chose $1,000 because nobody had -- that was the biggest number that anybody had suggested. And they further said they were going to examine this in some detail to see if a better number could be arrived at.

MR. SHEWMON: Were they going to deflate it by whatever the number would be each year?

MR. KERR: I have seen no evidence that there has been a serious examination, but the Statement of Consideration at the time did say that.

MR. SHEWMON: Now could we go on to the next one?

MR. WARD: Yes.

MR. CARUSO: I think we're ready to move on to that next slide.

[Slide.]

MR. CARUSO: As I said before, part of the evaluation is to examine various alternate approaches to the problem. Those involve different methods for implementing requirements. In our discussions with the Commission to date, we believe that the ultimate implementation strategy may involve a Commission policy decision.

The various vehicles for imposing requirements that are under evaluation include a generic letter requesting action, the imposition of technical specifications, which we talked about previously, and a rule primarily, I think, in the area of an outage program, having a program with certain elements.

[Slide.]

MR. CARUSO: To give you some idea of where we are in that process and how we're doing it, these are not final sets and they're obviously not complete sets, either. Across the top is two of the areas of requirements that we've talked about; outage program, outage planning and control and tech specs.

The other ones that will be on there will be fire protection and instrumentation and operations, although we have talked about incorporating the operations in the outage program area.

Here, basically, are three different approaches to requirements which are graded in terms of degree of regulatory action. Essentially what we'll be trying to do is to identify sets which provide the protection, substantial additional protection with the least impact. That impact will primarily be, given the kinds of requirements we're talking about, operational flexibility, obviously time in shutdown or outage duration.

I think the tech specs are a good example in that the minimal -- well, before I talk about that, I should say that the one scenario that is not on here is the base case, which is no action at all, which would be to assume -- NRC would take no action and we would assume that things went on as they are now, making certain assumptions about what voluntary actions would be taken.

Industry has already taken an initiative and we would probably assume that that continues on, and that would be the base case. In the tech spec area, the first minimal involvement would be to say that we have a set of standard tech specs, which most have, but we also have plants that don't have those standard tech specs, and in the evaluations we've done, we've found that in a number of cases there are plants that don't have any tech specs for decay heat removal systems, and, in some cases, electric power systems.

In one particular case, we felt that the fact that there were no tech specs for the plant bore, to some degree, on an incident which occurred. So in a minimal sense, it would be to bring all plants up to a standard, the current standard that we have right now.

The moderate involvement would be to up the standard. In this particular scenario, it would be identifying shutdown conditions which we would classify as higher risk evolutions. This would be something like mid-loop operation or reduced inventory as opposed to cavity fill to 23 feet.

For those conditions -- or another example would be with temporary seals in place that blow out at 50 pounds. We would say in those kinds of conditions, we think the standard ought to be upped to something equivalent to Mode 1, for example. If you were in a condition where you were a few days shut down and you had temporary seals in place and you could blow them out and have a significant LOCA, then you should have as much protection as you would for another comparable LOCA at a higher mode, and identify specifications to treat particular conditions.

In the extensive regulatory action category, the approach could be to provide the LCO or the requirement for all time during the outage, and then look at it and say, well, when -- I have to do some maintenance in this period, how do I accommodate that within an LCO that says I always have to have two trains of this, at some point I have to deal with it. And you would deal with that through a longer allowed outage time.

So in the first case, it would be to specify conditions and put tighter specs on those conditions, and then the utility would then plan his outage around those conditions so that he could have that equipment operable.

Whereas, in the second one, it would be to put more restrictive requirements on for the duration of the outage, and then say, well, where do things need to be loosened to accommodate operations.

Those are two different approaches to addressing the issue of mitigative equipment availability during the outage. Clearly, one is, I believe, more restrictive than the other. They would have different costs associated with them and they would have different values associated with them, too.

So this is the sort of thing we're attempting to do in terms of coming up with a set of alternate solutions, and then evaluate those solutions in terms of their impact in costs to both the utilities and the NRC and the public, and their effectiveness in achieving substantial additional safety.

MR. HOLAHAN: Let me just make sure you understand what stage of analysis we're at. These are really examples that the staff is still developing as alternatives for the regulatory analysis. We wanted to share with the Committee the approach we're taking.

We don't expect the Committee to have an opinion for or against the staff's proposals when they're in this stage. I would expect that you would wish to see or maybe even meet again with the staff after our proposals are in concrete form, and there are specific tech spec changes or specific requirements on outage planning to discuss.

I wanted you to understand the approach that we are taking before we got too deeply into it.

MR. CARUSO: That was all I had on regulatory analysis, if there are any questions.

MR. SHEWMON: What is AOT?

MR. CARUSO: Allowed outage time. You have a requirement to have systems.

MR. SHEWMON: That's fine.

MR. KRESS: Is this the part where we're going to make up some time? We're about an hour behind at this point.

[Slide.]

MR. HOLAHAN: I only wanted to cover two final items. One is proposed staff actions which go along with the proposed actions for industry. These are basically things that the staff feels that we have learned from the study where we can do things better.

The first is improvements in the inspection program. We are currently doing pilot team inspections where a team of individuals has gone to plants to spend one week to look at the outage planning process and will spend one week looking at the implementation of that, of the actual outage itself.

The reason the pilot studies are being done is to determine whether we want to do this type of inspection or a modified type of inspection at all plants to address shutdown activities. The decision about how much more inspection to do or how to focus that inspection will also be made sometime this summer.

In addition, we want to provide some guidance on inspection of modifications, such as freeze seals, and to have our resident inspector staff, who are at sites, look at licensee activities when they are undertaking activities that modify the systems in an important way.

By our focusing more attention on issues like freeze seals, we find that -- at least we believe that that will assure that the licensees are putting more careful safety judgment into their treatment of these sort of unusual activities.

MR. KERR: Would these team inspections fall under the restriction that was recently placed on numbers of inspections per year or are these special inspections --

MR. HOLAHAN: Yes.

MR. KERR: -- that are outside that category?

MR. HOLAHAN: No. They would be under the same restriction.

MR. KERR: Thank you.

MR. HOLAHAN: The operator licensing program, I think we found that the staff in our operator licensing process has not focused enough attention on the shutdown activities. Guidance to the staff in doing the -- preparing license exams is contained in something called the Examiner Standards, which is basically a collection of questions and guidance on how to put together tests.

And we will be placing more emphasis on the shutdown operations in the Examiner Standards, and therefore, in the tests. I certainly don't expect to see a 50.50, but I expect to see more than what we have now, which is almost nothing.

One of the items that we want to pursue, and this is something that AEOD will be doing, is to put in place some mechanism for tracking performance during shutdown or some measure of safety so that we can tell whether the programs that we are putting in place and the actions that the industry has taken are really being effective, and to see whether improvements that we think we've seen recently are being sustained.

So we want some results-oriented indicator; not a performance indicator in the sense of the official performance indicator program where it's published every quarter, but it will be some way of monitoring whether loss of decay heat removal events are occurring less frequently or they're less severe. It will be that kind of measure. So that's being developed.

In emergency planning, this is the item that we had previously thought of as perhaps an industry action, but we've moved it to staff action, which is to develop better emergency action level guidance for shutdown activities, taking into account the amount of time they have available for operator action and being more realistic about those situations.

That's all I had to say on the proposed staff actions.

MR. CATTON: When I read through some of these documents, I sort of came to the conclusion that good instrumentation could have eliminated a lot of those events. Is that a proper observation?

MR. HOLAHAN: Yes. I think that's a good observation.

MR. CATTON: Are there any requirements for instrumentation?

MR. HOLAHAN: Generic Letter 88-17 has recommendations for instrumentation; two level instruments and two temperature instruments. It gives some guidance as to what sort of instruments they should be and what sort of independence there ought to be. We think that more improvements are probably appropriate.

MR. CATTON: If you had two level and you had temperature and it worked, the recent Vogtle incident wouldn't have occurred. I don't know what recent means. It just came in the mail. That's where they had three level systems and none were working. Is this 88-17 just not really enforced or it's not enforceable or what?

MR. HOLAHAN I'm not sure which one you're talking about. Are you talking about Prairie Island?

MR. CATTON: I just read it yesterday, where the level went down and they vortexed the pump and then they had trouble getting the pump operational again.

MR. HOLAHAN: I think it was Prairie Island.

MR. CATTON: Maybe it was.

MR. HOLAHAN: But let me comment in general. I think improved instrumentation would deal with a lot of these circumstances in which the operators basically put the plant into a difficult --

MR. CATTON: They just didn't know until it was too late.

MR. HOLAHAN: Right. I am told that in some times past, the operators used to judge the level in the hot leg by allowing the level to go down until they saw perturbations in the RHR pump, which I think is a good indication of low level in the pipe, but it's probably not a very prudent thing to do. We have improved from that statement. I think there's more than can be done.

MR. CATTON: At Prairie Island, they had the instrumentation, it just wasn't working.

MR. HOLAHAN: That's right.

MR. CARUSO: It was new and they weren't sure how well it was working.

MR. CATTON: They thought it was working. That was the problem. But it wasn't.

MR. CARUSO: They sent their key person to go figure out what was wrong with it. I think one point to be made here is with the stronger requirements on operability of these instruments. I think a lot of these cases -- yes, they had the instruments there and, yes, they met the generic letter, but there was some sort of problem.

MR. CATTON: You mean they don't have to work to meet the generic letter?

MR. CARUSO: They definitely should work.

MR. HOLAHAN: I think the generic letter recommendations were not all implemented with an equally quality and effective system at all the plants. I think some of them have done pretty well and others have not. I think the Prairie Island system had some weaknesses in it. For example, it had a common pressure measurement that fed into both systems, and two systems that were supposed to be independent, in effect, had the same common problem.

So we think that things have gotten better, but there is substantial room for improvement, and that is one of the issues we're pursuing.

MR. CATTON: Level is relatively easy to measure under those conditions. It's just surprising that these things continue to happen.

MR. HOLAHAN: Yes.

[Slide.]

MR. HOLAHAN: The one other thing I'd like to do is I'd like to mention where we go from here. The NUREG-1449 is out for public comment, and we will be having a public meeting in mid-April to get some feedback on the report.

The comment period doesn't close until April 30, but we are on kind of a tight schedule and we did want to sort of use a meeting as a mechanism for encouraging people to comment and also getting some early feedback as to people's reactions.

The regulatory analysis that we've been discussing is going to continue. The Level 1 and 2 PRA studies and research are still ongoing, and you're going to hear about that in a little while. The Indian Point 3 pilot team inspection will be finished next month, and that's the second pilot inspection.

Then basically putting the regulatory analysis and public comments into a NUREG report and the package of proposed requirements and running it through CRGR, perhaps another ACRS meeting and bringing it to the Commission in the summer of this year is the plans for the rest of the program.

If there aren't any questions, I think we're going to hear about the research efforts next.

MR. CATTON: You're only behind by 35 minutes. Significant gain.

MR. KRESS: Please proceed.

[Slide.]

MR. CUNNINGHAM: What we'd like to do this afternoon is summarize a little bit of what has been going on in the PRA efforts at research on these low power and shutdown studies.

[Slide.]

MR. CUNNINGHAM: We are going to try and squeeze in four people this afternoon to talk about this. I'm going to spend a little bit of time trying to summarize in the broader sense what's happening in the program, what we've accomplished in Phase I, and what we're going to be doing in Phase II.

Chris Ryder then is going to have a short presentation on the first part of the Level II/III analysis in Phase II. Then we'll turn to bigger presentations by Lewis Chu on the Surry Phase I results and what we're going to be doing in Phase II. Then we're going to finish off with the Grand Gulf Phase I results and the Phase II program by Donnie Whitehead of Sandia.

[Slide.]

MR. CUNNINGHAM: I will go back for a second to discuss the original objectives here, the objectives of the overall low power risk analysis program that we have. There's a Phase 1, which is intended as a screening analysis, where we try to provide some initial perspectives on -- if there were particular aspects of the whole broad regime of low power and shutdown operations that are particularly vulnerable.

We've come up with something called plant operational states. It's a more detailed description than the modes that are typically described. We're trying to identify particular ones of those that are vulnerable, particularly vulnerable.

MR. CATTON: When you go through this process, are you going to be able to somehow incorporate the impact of good planning? That was one of the things that was discussed earlier, the outage planning and what its impact would be.

MR. CUNNINGHAM: I think what we'll have here is a reflection of the outage plans as they exist in these plants today. I think in the case of Grand Gulf, we probably have a very good outage planning already. So we may see some differences between the two plants, if you will, depending on their type of outage planning.

A second objective was to characterize on a relative scale of high, medium and low the potential core damage frequency associated with the plant operational states and the individual accident sequences. We wanted to continue that a little bit further to provide an initial risk characterization with a real rough containment analysis, if you will, and then provide a foundation, a prioritization of the various operational states to continue into our Phase II analysis.

[Slide.]

MR. CUNNINGHAM: Phase II, which is what we started about the first of this year, again, is a more detailed PRA. This is more of the type like NUREG-1150 was or many of the industry PRAs over the last five years or so. Here we're trying to estimate the frequencies and risks associated with severe accidents, focusing now on particular plant operational states, compare these core damage frequencies and risks and perspectives with what has been calculated previously for full power operation, and to demonstrate the methods, to develop and demonstrate the methods for performing these types of risk analyses.

MR. KRESS: These are still mean values. You're not doing uncertainty in that part.

MR. CUNNINGHAM: Phase II has uncertainty analysis associated with it, as well.

MR. KRESS: Using expert opinion like they did in NUREG-1150?

MR. CUNNINGHAM: Yes. Probably not to the -- perhaps not to the magnitude as we did in 1150, but of that type, yes.

MR. CATTON: In one of the incidents I read about, the problem was that the guy couldn't find the valve to turn off because he didn't know what particular flow path was giving him a headache.

It seems to me that that's important. Is there any way that you can incorporate that into the PRA, that sort of thing? I mean, between knowing which valve to shut and having instrumentation to give you level, things like that, what's the PRA going to tell me, or can you incorporate these things in some way into the PRA?

MR. CUNNINGHAM: What you can come up with is information on the probability that he will -- given the procedures that he has and given the training that he has and what have you, you can get the probability that he will not correctly perform the needed action.

I don't know if that's the type of action that happened there, but --

MR. CATTON: I just remember one of the incidents, they were running around looking for the valve to turn off, to stop the draining, but they didn't know what pipe.

MR. CUNNINGHAM: I'm not sure. There are certain types of those errors that we can account for, again, depending -- I'm not sure of the specifics of it.

[Slide.]

MR. CUNNINGHAM: I would like to give you a quick summary or a very high level summary, if you will, of what I think we got out of the Phase I program, more along the lines of what you've been hearing about today in terms of contributions to the agency's low power evaluation, if you will, that Gary has been talking about.

Gary talked, I guess at the last meeting, and I've said it here already, I guess, that one of the things we figured out early on was that the traditional definition of modes of operation aren't necessarily well defined enough to do risk analyses and safety analyses.

So we've identified plant operating states that make more sense from a risk analysis point. I think he's reflected that in 1449. We've had a comparison here of what issues were identified as potentially significant in the risk analyses, these screening risk analyses, relative to the types of issues that the rest of the agency was identifying in the AEOD studies and the NRR studies and what have you.

I think Gary mentioned this this morning. There was nothing in particular that was identified in the risk analyses that wasn't identified already in the other parts of the program. So it's kind of a confirmation that the big issues had been identified, if you will.

A third thing, then, is a prioritization of plant operating states; again, some sort of a relative ranking of the importance of these different operating states, again, in a sense, showing the importance of, for example, the PWRs, mid-loop operation.

It also gives us a way, in terms of the detailed risk analysis, of proceeding by focusing on particular plant operating states. What you'll hear about in the detailed presentations are PRAs on specific operating states, mid-loop operation in the PWR, for example, rather than trying to do risk analysis across the whole spectrum of low power and shutdown operations.

[Slide.]

MR. CUNNINGHAM: Again, at a very high level, the Phase II program is really going to have three parts, as we see it now; a base case, what we call a base case Level I analysis, consideration of internal events, including fire and flood, seismic, something we're calling convention PRA, which you'll hear a little bit more about later, and an uncertainty and sensitivity analysis akin to what's in 1150.

We're defining a second part of which we called a comprehensive human reliability analysis, and, again, you can hear some more later about this. But what we're trying to do here is to -- this is kind of what I'll describe as an HRA that's kind of typical, if you will, of what the industry does today.

Here we're trying to take a step beyond that in certain areas, just deal with the uncertainties and HRAs and what have you. We can get into it more, if you like, later on.

The third part is a Level II/III analysis, with the first kind of initial analysis, and then followed up with a more detailed. This initial analysis is tied into the regulatory analysis that Gary and Mark were talking about a little while ago.

If you look at the PRAs that have been done in the past related to low power and shutdown operations, by and large, they have stopped at Level I. There is even less information on Level II/III type of analysis than there is on Level I. For that reason, we set up a quicker study to go over the next four or five months to fill in that particular hole as best we could, consistent with the timeframes that the staff, the NRR staff is proceeding with. Chris Ryder will talk about this a little bit more in a minute.

MR. KERR: Mr. Cunningham, on Page 2-11 of 1449, I find a couple of comments that seems to be irrelevant.

First, probability values estimated using these approaches are very uncertain. Unfortunately, these same probabilities significantly influence the conditional core damage probabilities estimated for the two more significant events, and, therefore, these conditional probabilities are also uncertain.

Then further down, operator response is probably the most important issue determining the significance of an event in shutdown, and until it is better understood, the relative importance of shutdown events compared to events at power cannot be reliably estimated.

I take it from this that you are going to develop a human error quantification method within the next four or five months. Can I assume that that is going to remove this uncertainty and that the importance of shutdown events compared to events at power can be reliably estimated at the end of that period?

MR. CUNNINGHAM: With respect to the two paragraphs, I think the first one is related to precursor analyses, which is kind of separate from what we're doing here.

MR. KERR: Precursor analysis pretty important in this analysis because it's about all you have.

MR. CUNNINGHAM: Yes. It's just separate from what we're talking about here. What I'm talking about here in the comprehensive HRA is in response to the second part, that we recognize that operator error and operator performance in these low power and shutdowns is probably more significant than it is in full pow r operation.

For that reason, we defined this additional step, if you will, to try to tackle that. That's not going to happen over the next four or five months.

MR. KERR: Is it reasonable for me to assume that the relative importance of shutdown events compared to events at power cannot be reliably estimated at the time that you have to reach some decisions?

MR. HOLAHAN: I would like to clarify the statement. The statement in the report is in the section on accident sequence precursors. What it refers to is comparison of accident sequence precursor results, power accident sequence precursor results for shutdown. It's a caution about comparing those.

You can ask the same question about the PRAs, but this particular paragraph wasn't meant to say that you couldn't compare good quality PRA results. I think that's a separate question.

MR. KERR: It seems to me that one has these same uncertainties about operator --

MR. HOLAHAN: That's true.

MR. KERR: It's just that it wasn't said here.

MR. HOLAHAN: I didn't want these words to be put in Mr. Cunningham's mouth because they don't refer to his study.

MR. KERR: So if I use the experience of Mr. Clinton, I didn't ask the right question, so maybe you should tell me what question I should have asked to get the answer to the question I should have asked. I guess that is do these same uncertainties apply to the PRA situation.

MR. CUNNINGHAM: Yes, sir. That's not going to change dramatically over the next four or five months.

MR. HOLAHAN: The other question you didn't ask is whether that leads to a conclusion that you can't tell whether shutdown or a power operation is more significant, which is the conclusion here, but I don't know that it's the conclusion for this PRA.

MR. KERR: But after this four or five month study, I'll be in a better position to make a decision as to whether it's still true.

MR. HOLAHAN: You can expect the question to be addressed again. I don't know if we'll know the answer.

MR. CUNNINGHAM: I'm a little confused now. I'm not sure which -- the four to five month study I was talking about --

MR. KERR: I thought it had to do with the develop human error quantification method.

MR. CUNNINGHAM: No. I mislead you, perhaps. The four to five month study that we're talking about is related strictly to Level II/III analysis.

MR. KERR: My impression from earlier conversation is that by about August of this year, one is going to have to reach some sort of decision about what to do about shutdown risks.

MR. HOLAHAN: Yes.

MR. KERR: And one would, it seems to me, feel more comfortable about the decision if one had some idea of the relative contribution of shutdown risk and risk at power.

MR. HOLAHAN: We will use whatever information, the best information available. The more information you have, the more comfortable you feel.

MR. KERR: Then what is this comprehensive HRA method? How is it associated with this since its results won't be available by the time you have to make your decision?

MR. CUNNINGHAM: It's not strongly related to the process right now.

MR. KERR: I'm sorry. I thought we were discussing things here that were associated with shutdown risk. You just tossed that in for additional information.

MR. CUNNINGHAM: It's related to it as an additional effort down the stream, related to shutdown PRAs. As a practical matter, in the timeframe that Gary is working with to proceed towards regulatory actions, we could not get a comprehensive PRA done.

MR. KERR: One could describe this as confirmatory research which will tell you maybe two or three years from now whether you made the right decision or not.

MR. CUNNINGHAM: You could describe it that way, yes.

MR. HOLAHAN: Yes.

[Slide.]

MR. CUNNINGHAM: Getting to the point we were talking about, we have the immediate milestones of the -- the Level II/III analysis to be done in May of this year; again, that part of it working in concert with what Gary has been talking about in terms of the regulatory analysis and potential regulatory actions.

The base case Level I analysis is going to be -- well, parts of it will be done starting at about August o this year, getting all wrapped up in probably January of next year with the uncertainty analysis.

MR. KERR: Over the history of confirmatory research that I can remember, originally, I think, the term was used to describe situations in which the staff was reasonably sure they had the right answer, but they really

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wanted to nail it down.

I have difficulty believing that that is the status of human reliability research. Which doesn't mean you can't still use the term, but it seems to me it has to take on a somewhat different meaning than it used to have.

MR. CUNNINGHAM: This may have a separate meaning or somewhat different meaning than in times past.

MR. HOLAHAN: Sometimes we use the term confirmatory research to mean confirming that your regulatory requirements are adequate and, secondly, quantifying some of the safety margin that you may have built in. This may be more effective in telling us something about the margins than it is about the underlying decisions.

MR. CUNNINGHAM: I guess I've covered this. What we'll do now is Chris Ryder from the staff will summarize a little bit more on the Level II/III analysis, and then we'll turn to the larger presentation.

MR. KERR: Let me ask one more question, and I'm not sure whether it's you that should respond to this or someone else.

On the facing page of Page 2-10, I find -- and I apologize for reading this long paragraph, but I don't know how else to do it. This statement, "In the quantification process, it was assumed that the failure probabilities for systems observed to have failed during an event were equal to the likelihood of not recovering from the failure or fault that actually occurred."

"Failure probabilities for systems observed to have degraded during an operational event were assumed equal to the conditional probability that the system would fail (given that it was observed degraded) and the probability that it would not be recovered within the required time period."

"The failure probabilities associated with observed successes and with systems and challenged during the actual event were assumed equal to a failure probability estimated by the use of systems success criteria and train and common mode failure screening probabilities with consideration of the potential for recovery."

What does that mean?

MR. HOLAHAN: I think that's standard accident sequence precursor methodology, which says what they do is they look at an event that actually occurred, but they want to make some judgment about what might have occurred. And whether a system failed or worked successfully during an event, they make some judgment about if there were an infinite number of such similar events, what would have happened.

So they're putting probabilities on things that were successes. They're saying maybe they wouldn't succeed all the time. Things that failed, they said maybe they would have been recovered in some of those cases.

I think this is exactly the same methodology used in all the accident sequence precursor work.

MR. KERR: Thank you for trying.

MR. HOLAHAN: I could refer you to the event trees.

MR. KERR: Maybe if I read it several times. I have read it about four or five times, but I will try some more.

[Slide.]

MR. RYDER: My name is Chris Ryder, and I am from the Risk Analysis Branch of Research, and today I will be talking to you about the status of Level II and III portions of the shutdown and low power analysis.

MR. KERR: Are the results of this study going to be made available by the time a decision has to be made about what to do?

MR. RYDER: I will get into some of that. I will tell you exactly what we will do.

MR. KERR: Okay.

[Slide.]

MR. RYDER: The objective for now is to calculate approximate consequences of an accident during a plant operating state. Right now we are doing what we call abridged calculations for regulatory decisions to be made early in the summer of '92.

MR. CATTON: I must have missed something. What does abridged calculation mean?

MR. RYDER: I'll get to that. I will get to that.

The study is based on, of course, screening analysis which we finished earlier, and because we only have rough frequency estimates which are used in a risk estimate, we will only be calculating conditional consequences. We decided not to use those rough frequency estimates from the Level I.

The duration of our study is four months. It began in January. The calculations are to end in April, and it is one month after that for documenting it.

In addition, we are viewing this study as a prototype for the more comprehensive PRAs that we will be doing later on when this is finished.

[Slide.]

MR. RYDER: There is a study at Grand Gulf and of Surry. At Grand Gulf we have what we call -- we are looking at plant operating state 6 which is an operating state just prior to when refueling begins. There the vessel head is off and we are just about ready to raise the water level to start refueling.

At Surry we are looking at a PWR version of plant operating 6, and that is mid-loop operation.

MR. CATTON: How good is the level instrumentation and temperature and pressure at those two different plants?

MR. RYDER: I'm not sure I can answer that question right now. I'll have to leave that to my contractors.

MR. CUNNINGHAM: Dr. Catton, it might be better to wait until the --

MR. CATTON: Well, what I'm interested is what I gathered from this was that instrumentation, knowing what's going on, was important, and methods to determine flow paths was important. And if people didn't know, they had a worse problem than if they did know them. I'm interested in finding out how you put this into the PRA.

That's why I asked him the question, if he's doing the PRA.

MR. CUNNINGHAM: He's doing the level 2. It may be better to talk to the level 1 people. They are coming next.

MR. CATTON: Maybe my next question should go to the level 1 person, then.

MR. RYDER: Many of those are level 1 issues. These deal with accident progressions, once coremelt has occurred.

MR. CATTON: Oh, okay, I'm sorry.

MR. RYDER: The products we intend to give to NRR are first a distribution of conditional consequences. We will also be telling them about key events in the accident progressions, timings of key events, and time windows, and the strong points and weak points of our analysis.

[Slide.]

MR. RYDER: This slide deals with what we mean by abridged.

We have a simple containment event tree. In the NUREG 1150 study, the containment event trees were as much as 70 top event questions. Here they are only about 10 top event questions.

We are doing what we call parametric source terms, which are small algorithms that compute source terms, taking into account uncertainty. That was a method that was developed in the 1150 study and is being carried over to here.

For calculating some more quantitative source terms for benchmarking these parametric source term algorithms, and for determining accident progressions, we are using the agency's source term code, called MELCOR.

MR. CATTON: What time step did you use with MELCOR?

MR. RYDER: [illegible] time steps are determined internally by the code. There's been several revisions to doing -- to fixing those algorithms that determine those, because in the past we have had problems with them.

MR. CATTON: I understand you can vary the source strength a factor of 10 just by twiddling the time step, and I'm just wondering how you decided which one to use.

MR. RYDER: We encountered those problems with other studies that we had, and we did get significant differences, as you noted.

In general, the smaller time steps improved the calculations. However, too small can also introduce some instabilities in the calculations and cause them not to converge. In efforts done outside our branch, a lot of those problems have been addressed over the past year to make the determination of those time steps better and more appropriate for the calculations.

I don't know exactly what value is used, and I do know it changes, the code changes, for instance, if it sees that nothing is happening.

MR. CATTON: So when you say parametric source term benchmarking, it could be the time step is the parameter?

MR. RYDER: I'm not sure I follow your question.

MR. CATTON: Okay.

MR. KRESS: Those parametric source terms don't even have time in them, do they?

MR. RYDER: That's right.

MR. KRESS: They're just strictly integral --

MR. RYDER: They are just integral releases, and they are used to account for uncertainty which the MELCOR code does not do.

MR. KERR: I don't think Ivan meant that they had time in them, but they had time step length in them.

MR. KRESS: Not the parametric ones, though, but the MELCOR will have time steps in it. I presume they will use MELCOR as a way to pick out the right mid-value or mean values for the parametric source terms, and then use the expert opinion to get some sort of distribution about that. So the time step will go in probably setting the means for those.

MR. RYDER: That's correct.

MR. CATTON: Like Zimmer.

MR. RYDER: We have a limited accounting of uncertainty. By limited, I mean we are only looking at a few branch point probabilities and a few input values at the source terms.

MR. CATTON: What is APET?

MR. RYDER: That is accident progression event tree. It's an event tree in the level 2.

The distributions that we assigned to do our limited uncertainty analysis are taken largely from the 1150 study with some modifications.

Consequences will have on-site consequences determined with correlations and offsite consequences determined with the agency's code for doing that MACCS

MR. CATTON: Has MACCS undergone peer review?

MR. RYDER: It has undergone quite a lot of review over the years. I don't know the extent of it, though.

MR. CATTON: If it's the agency code, then I suppose it has. Could you get that for me, Mark?

MR. CUNNINGHAM: It depends on your definition. There's been --

MR. CATTON: Any kind of review, has it been written up.

MR. CUNNINGHAM: There is a verification, line-by-line verification done by --

MR. CATTON: That's not what I'm talking about.

MR. CUNNINGHAM: Are you talking about --

MR. CATTON: I know you can make sure that the code is written as you think it should be written, but --

MR. CUNNINGHAM: The other work -- there is benchmarking of the code with other like codes, if you will, developed in the UK and in Germany, I believe it is. That work is going on now.

MR. CATTON: MELCOR underwent a peer review and

SCDAP is undergoing a peer review.

MR. CUNNINGHAM: Yes.

MR. CATTON: But MACCS is kind of the bottom line that you use. Is it undergoing a peer review of the same type?

MR. CUNNINGHAM: Not in the same process as the MELCOR review that's gone on for the last --

MR. CATTON: Is there any intention to do that?

MR. CUNNINGHAM: What we are going to do is see what comes out of this benchmark exercise that is underway now to try to identify where the problem area is, where the differences are, if you will, between the --

MR. CATTON: Code against code?

MR. CUNNINGHAM: Code against code, yes; three codes being compared, I think it is.

MR. KERR: Were these other codes benchmarked against MELCOR, probably?

MR. CATTON: Probably.

MR. KRESS: Chris, I missed the statement you said about when you get ready to do the uncertainties in the distribution of your source term parameters. You were going to use NUREG 1150 values or guidance.

The reason I bring it up is those values were the uncertainties that were -- distribution uncertainties about those parameters assumed full power operation and transfer through primary systems and certain heat-up rates, and the amounts of water available and things of that nature.

I was wondering, do you intend to redo all that with new experts, or are you just going to extract those and put them about the same factors?

MR. RYDER: We are actually going to use the distributions pretty much as they are. The reason why we are going to do that is because things like distributions on the decontamination factors for the sprays aren't going to change between full power and low power operation. We are going to be adjusting for things like vessel inventories when we apply various distributions like to the core/concrete interaction and whatever.

MR. KRESS: That's what I had meant. And for fission product release, you'd have to make some adjustments.

MR. RYDER: There are going to be some adjustments made as appropriate for those.

I should say, too, that in regards to the source terms, we have had an internal group that has been overseeing what we have been doing and giving their opinions on our source term methods, and this group consists of two people from Sandia, two people from Brookhaven, and another person who could not attend the last meeting we had from Battelle. They are just overseeing our methods and telling us where they think we should focus our resources.

But, yes, we are aware that there are some adjustments that we need to make in going from full power operation to low power operation.

Most of this, as I said, is an abridged study which will have assumptions and certain caveats to go along with it.

The schedule is that we will complete our calculations by the end of this month. On May 6, we plan to have the contractors present their results to the Staff, and on May 30th, we plan to have a report.

That concludes my presentation. If there are any questions I could answer?

MR. CUNNINGHAM: We are going to turn now to Dr. Lewis Chu from Brookhaven to talk about the summary of the phase I results for Surry and a description of what they are going to be doing in phase II.

[Slide.]

MR. CHU: My name is Lewis Chu. I represent the Level 1 PRA. I am presenting a progress report on Level 1 PRA of the PWR Low Power and Shutdown Accident Frequencies Program.

Like Mark had mentioned earlier, the presentation basically consists of two parts. The first part I will talk about some of the findings and some of the results of the level phase 1 study, and the second part of the presentation I will talk about phase 2 study, where we are and what we are doing at this time, and what are the remaining tasks that we are going to work on.

[Slide.]

MR. CHU: This viewgraph gives a little bit of the history of this project. We initiated it in the fall of 1989, but it was a limited effort. As times goes on, more and more attention was paid to low power and shutdown, and our level of effort grew.

In June of 1991, we had a presentation to the committee on the approach used in the phase 1 study. One issue that was mentioned was the quality assurance of the work. There is a senior consulting group that is formed that is providing high level guidance and that is reviewing the work of both laboratories, BNL and SNL. It shows three meetings that we had before.

Typically these are two days of meetings. We spend about a day and a half presenting to the SEG and the other half day is basically feedback and discussions with the SEG members.

The phase 1 study, phase 1 internal event study, was completed in June 1991. A few months later, the internal fire and flood analysis was completed, that is in October 1991.

In parallel to the fire and flood analysis, there was also a scoping analysis that was performed by Bob Budnitz and Peter Davis in June 1991.

MR. MICHELSON: Could you help me just a little bit. You are not doing a plant-specific analysis here, are you?

MR. CHU: Yes, we are using Surry as the plant.

MR. MICHELSON: It's going to be just good for Surry alone?

MR. CHU: Yes, I think that is the way our project is defined.

MR. MICHELSON: So this will be a Surry analysis only, not for shutdown anywhere else?

MR. CHU: Right. But I think some of the findings, as we come to them, I think they are --

MR. CATTON: You can only make statements like that if you sort out the impact of the person who is supposed to find that valve knowing about his system, and if you sort out the impact of poor instrumentation on the ability of the people to figure out what to do.

Some of those things, you can't make any generic statements unless you can separate those things. Are you going to be able to do that?

MR. CHU: I guess when we come to the highlights, the highlights defined in this that we have, I think most of them apply to other plants.

MR. MICHELSON: You have to be very careful, you may be sorting out generic problems that don't occur on Surry, but occur everywhere else. You know, looking at just Surry to do --

MR. CATTON: I don't think they're going to be able to make very many generic conclusions, because --

MR. MICHELSON: I wonder if he can make any, but perhaps --

MR. CATTON: The personnel who are running around in the building play such an important role.

MR. MICHELSON: These were very plant-specific considerations; we talked about flood, fire and seismic.

MR. CHU: Yes. We have not looked a lot at other PWRs. Our study is based on the Surry plant. And I can tell you some of the specific Surry features that make it more different than other PWRs.

MR. CATTON: Does Surry have good instrumentation to track what's going on during a shutdown?

MR. CHU: When they are in limiting conditions, they have two levels, diverse level instrumentation. One is the hard pipe system. I have a viewgraph; maybe I'll show that to explain a little bit about the configuration.

MR. CATTON: Don't let me mix you up. I'll wait till you get to it.

[Slide.]

MR. CHU: Maybe this is informative for everybody else. This shows the reactor vessel, the pressurizer, the pressurizer relief pin. When there are mid-loop conditions, the PORVs open so the pressurizer is open to the pressurizer relief pin. This is the standby system.

One end of it is connected to the Loop C cold leg. The other end is connected to the top of the pressurizer. On top of the reactor vessel, there is a standpipe that is also connected to basically the top of the pressurizer. In turn, it's connected to the PRT.

This standpipe, it's a section of pipe that you can see through. So locally you can look at the level in the vessel. Also, this level is also converted into electrical signals that get displayed in the control room. When the level drops to some setpoint, there will be an alarm in the control room.

MR. MICHELSON: Is that a glass standpipe?

MR. CHU: I think there's like a window that you can look through. That's my understanding.

MR. MICHELSON: It's a pipe with a window in it. Is that what it is?

MR. CUNNINGHAM: Yes.

MR. SHEWMON: Is it operating at primary pressure?

MR. CUNNINGHAM: No.

MR. CHU: In this case, the pressurizer relief pin is vented. So you're pretty much at atmospheric pressure. In addition to the standpipe system, there is ultrasonic level instrumentation. This is something that they added after Generic Letter 88-17.

It is located in one of the hot legs, I think. I don't remember which one. Basically, it gives you a level indication. So the range that it covers is limited.

Referring to your earlier question, which is when you're draining down, if the level is within the range of the pressurizer, they count on the pressurizer level instrumentation. When it drops lower, you go outside the range of the pressurizer. Then you have to rely on the standpipe.

Actually, there's a gap here between the pressurizer level instrumentation and the standpipe. So there's a short range in which there is no level instrumentation, but that's only probably for a very short period of time when they are draining that they don't have it.

In terms of the reliability of the level instrumentation, it seems to me during normal operation, they give you valid level indications. But when you get into an accident scenario, if your system is boiling, then you don't know what you're seeing.

MR. MICHELSON: That's with the head off, you mean. You aren't going to pressurize this much with a glass window in a standpipe.

MR. CHU: My understanding is this can withstand relatively high pressure. The weakness is that this section of the Tygon ruptures at 30 psi.

MR. MICHELSON: Yes. But the Tygon is only attached to the head. When the head is off, you don't have it, if I understand your drawing correctly.

MR. CHU: Right. But if you're boiling, I'm not sure you have steam.

MR. MICHELSON: I didn't know if you want boiling with the head off or boiling with the head on. Boiling with the head off.

MR. CHU: Yes. With the head down, then you don't get boiling.

MR. CATTON: If you boil with the head off, the standpipe is okay.

MR. MICHELSON: It should be.

MR. CHU: In the case of mid-loop conditions, you have --

MR. CATTON: I'm not sure it will be all that bad.

MR. MICHELSON: The biggest concern is you've got all those valves open, so you're sure the thing is working. When you have a dead ban and can't see anything happening, you don't know if the instrument is even in the line or not. Maybe one of those little root valves is closed. You've got at least four opportunities, I think I saw in the drawing.

[Slide.]

MR. CHU: Regarding the Phase II program, basically we had three projects, and my presentation basically covered the first part, Level I analysis.

[Slide.]

MR. CHU: In our Phase I analysis, these show the major tasks of the work. We looked at different outage types. Basically, we looked at plant experience and we grouped different outages into refueling outage, drain maintenance outage. In the drain maintenance outage, they go into mid-loop operation. Then there is maintenance outage in which they don't go into mid-loop conditions.

In the case of a refueling outage, we defined 15 plant operational states in terms of basically the power level, the activity, the reactor system, temperature, pressure, level. In the case of the refueling outage, there are two mid-loop conditions defined. One occurs early in the refueling outage. The second one comes after refueling operation.

Once we defined and characterized these plant operational states, the rest of the Phase I analysis -- basically, we go through the typical tasks of Level 1 PRA, such as initiating event analysis, development of event trees, doing screening quantifications.

We also have done a significant amount of work in terms of database development. This is in the area of estimating how much time they spend in each plant operational state, how soon they reach each plant operational state.

MR. MICHELSON: What kind of initiating events are you thinking about here?

MR. CHU: In the Phase I analysis, we're supposed to cover all types of initiators that we can identify.

MR. MICHELSON: You mean pipe breaks?

MR. CHU: LOCAs, in the case of a shutdown condition loss of off-site power, station blackout, support system failures. In case of low power, the types of initiators are similar to that considered in low power PRAs.

MR. MICHELSON: How about the case of maintenance problems where you, in essence, drain the system because you forgot to put the valve works back on before you opened the water system back on? Are those kind of events in there, too?

MR. CHU: The way we modeled it is that we did a survey of the research of LERs. We looked for existing reported incidents. If the type of event is reported, then we use it in our initiator frequency estimate.

MR. MICHELSON: Those have been reported, so I guess you must have included them, then.

MR. CHU: Yes.

MR. MICHELSON: What is the probability of that sort of thing happening? What did you use for a probability number in your analysis?

MR. CHU: Offhand, I don't know.

MR. MICHELSON: Because you read about it in an LER, that doesn't give you any reliability or probability numbers.

MR. CHU: Basically, it's in terms of there is this number of events in this amount of time. If we find one incident in 1,000 hours, then it's ten-to-the-minus-three per hour.

MR. MICHELSON: That's where you've got a particular valve being involved in a particular event. But how about just in principal an operator error or maintenance error being the leaving open of a pressure boundary. Is that the way you approach it and look at all pressure boundary events of that sort and then come up with a number?

MR. CHU: Yes. That's the approach. There could be incidents that, say, a system connected to the reactor coolant system has a leak, or, due to human error, you are diverting flow. This kind of event is counted as one occurrence that may lead to loss of inventory.

MR. MICHELSON: Is this in your Phase I report?

MR. CHU: Yes. That's in the part on LOCAs. It's one way of getting LOCAs.

MR. MICHELSON: What is the NUREG number? Where do I find this report?

MR. CHU: We have what we call a rough draft. It's not a report. It's not published as a NUREG CR.

MR. MICHELSON: Do you have a NUREG number for it when it does come out?

MR. CHU: Yes. For the January 1993 report, there will be a NUREG CR, but that's almost a year from now.

MR. CUNNINGHAM: Dr. Michelson, if you'd like a copy of --

MR. MICHELSON: It talks about reports in here.

MR. CUNNINGHAM: They were issued, but not published as NUREG CRs.

MR. MICHELSON: Okay. But they are something you can get.

MR. CUNNINGHAM: That's right. If you'd like a copy, we'll get it to Paul.

MR. MICHELSON: I would like a copy of the Phase I report.

MR. CHU: It's in the NRC Public Document Room, also.

MR. MICHELSON: I was really just trying to trace it.

[Slide.]

MR. CHU: This viewgraph is a summary of the issues that we identify in our Phase I analysis. One objective of the Phase I analysis is to try to find potential vulnerable configurations. Mid-loop operation, of course, is the well known one. In addition, temporary thimble tube seals is an issue that was recognized in NUREG-1410, the Vogtle incident report.

We did a probabilistic analysis to determine how significant this type of seal may effect the safety of the plant. On the items here, I have a few more viewgraphs that I go into a little more detail of these issues.

MR. MICHELSON: Did you include the freeze seals and their failure in this analysis?

MR. CHU: In the case of freeze seals, we count it as a way of causing a LOCA. In our LOCA frequency estimate, we have done that. We have included freeze seal failures. I don't think we have too many in our database, maybe just one or two, when we did it.

MR. MICHELSON: You define LOCA now as a drainage of the vessel, for instance.

MR. CHU: Loss of inventory.

MR. MICHELSON: Whatever.

MR. CHU: Yes.

MR. CATTON: Where does poor instrumentation enter into this?

MR. CHU: The instrumentation is not specifically modeled, but definitely it will effect the performance of the operators in their response to accidents.

MR. CATTON: Doesn't Level 1 carry you to the onset of loss of core cooling?

MR. CHU: Yes.

MR. CATTON: So you need to have that in there.

MR. CHU: It's like the Prairie Island event.

MR. CATTON: That's right. How would you deal with the Prairie Island event here?

MR. CHU: That's a way of causing loss of RHR.

MR. CATTON: I know what it is. But how do you deal with in these --

MR. CHU: It will be in the initiating event analysis. It is counted as one incident of loss of RHR.

MR. CATTON: It certainly wasn't the initiating event, though. The level went down for some reason and they didn't know it.

MR. CHU: Right. They were draining down. We do have an initiator that they over-drained. It is when they are draining -- they over-drained, for whatever reason. So the Prairie Island incident is one piece of data that can be used.

MR. CATTON: It's the whatever reason that I'm curious about as to how you're going to include it, because probably if they had good instrumentation, we would have never had an event.

MR. CHU: The way we treat is as one incident. There are quite a few incidents like that, in a way. That is, when they drained down, they over-drained, they had a loss of RHR. So that is treated as an initiating event.

MR. CATTON: You have generic data on loss of RHR where really it ought to say something about instrumentation.

MR. CHU: Yes. The cause may be inadequate level of instrumentation, but the way we treat it is just one piece of data.

MR. CATTON: I think I'm losing, so I'll quit.

MR. KERR: But won't the lack of or presence of good instrumentation effect the probability of an initiating event occurring?

MR. CHU: Yes. One way of looking at it is it's built into the data.

MR. KERR: It is not built into the data if it has not previously been there. This instrumentation at Prairie Island was a comparatively new development, wasn't it, or lack of it?

MR. CATTON: They had a little bit of everything, new, old, poor, and none of it worked.

MR. KERR: I think Mr. Catton is asking do you know enough about the instrumentation in the previous incidents to know whether it's included in the data or not.

MR. CHU: I am not sure I follow your question.

MR. KERR: These events happened.

MR. CHU: Yes.

MR. KERR: Would they have happened as frequently as they did if one had had good instrumentation, or does one know what instrumentation was there so that one could judge whether this frequency is characteristic of poor instrumentation, of good instrumentation or what?

MR. CHU: I think that kind of study can be done to answer the question, but we have not.

MR. KERR: You have not done it yet.

MR. CATTON: That particular question happens to have already been answered in 1440. You call out instrumentation. You call it out. Yet, the person doing your PRA doesn't seem to give it any consideration, separate consideration. Yet, it is one of the primary elements of this 1440. I happen to agree with 1440.

MR. KRESS: If all the plants have a spectrum of poor instrumentation up to good instrumentation and he's counting LERs for all plants, then I think he's probably right that it's implicit in the number of these events.

MR. CATTON: You're going to come out with a number for RHR, and one plant has poor instrumentation, another one has good instrumentation. The numbers should be dramatically different.

I don't think you should. Instrumentation is instrumentation. RHR is RHR.

MR. KRESS: You're not just looking at LERs at Surry, though. You're looking at all plants.

MR. CHU: We're looking at all PWRs.

MR. MICHELSON: Looking at events at other plants and then trying to use it as a Surry database, it doesn't work. You'll have an answer exactly the same as Surry.

MR. CATTON: That's right.

MR. MICHELSON: But you have no proof they are, in fact -- the remarks up there are exactly same, and, yet, they're using the event. I don't know if Surry is better or worse than Prairie Island.

MR. CATTON: It sounds to me like it's better if it works.

MR. MICHELSON: I don't know. How can you use Prairie Island information that was developed for Surry?

MR. CATTON: Unless you separate out instrumentation.

MR. MICHELSON: This thing might have happened at ten other plants, but it didn't get reported because the instrumentation worked. It was a non-event. It's a real event if he's going to count data this way.

MR. CATTON: So the number he's using is much higher than it should be.

MR. MICHELSON: I don't know whether it's higher or lower. It's no good, in any event. It isn't any good unless it's identical to what Surry has. Then I think you can go around the country and look at identical situations.

MR. CHU: Basically, the issue is whether or not you can use data from the population for a specific plant. Yes, I understand. You can argue that Surry is so good in instrumentation that this kind of event just cannot happen.

MR. CATTON: I'm not trying to make that argument. I'm just trying to get you to separate it into the same elements that are in 1440, so that when you finally get to a bottom line, you will indeed confirm or not confirm, because this is not going to lead you to anything that's confirmatory of anything.

MR. CHU: Maybe one statistical approach can be used. In this respect, it's a two-stage basing approach. Basically, you use the data from the population to come up with some kind of prior distribution for your plant-specific analysis. Then you use your plant-specific data to update it.

In that sense, you give best weight to the data that you collected from the population. You give more weight to the plant-specific data. This is kind of a way of addressing the issue of generic data versus plant-specific data.

MR. CATTON: It's a way of avoiding the issue is what it is.

MR. MICHELSON: What good does that do if you've only got a handful of events to begin with?

MR. CATTON: I don't know. I think it would be better to exercise engineering judgment at this stage and say if you don't have good instrumentation, you're going to have a problem, and define a problem as .1. You'd be better off.

MR. MICHELSON: Maybe .2.

MR. SHEWMON: Is it clear what "good" means? Is good new, is good instrumentation the operator knows how to work with? Is good something that shows what you want it show this time?

MR. CATTON: Something that measures level.

MR. MICHELSON: Something that's good enough to keep you out of trouble, I think.

MR. SHEWMON: Good in this case is level indication.

MR. CATTON: Yes. That's what we're referring to here. At the Prairie Island, they didn't know what the level was.

MR. MICHELSON: Good enough to keep you out of trouble.

MR. CATTON: Good is probably not the right word.

MR. CHU: Let me go on with the next item. In reviewing the Surry operating experience, we found that in the refueling outage, they isolate the reactor coolant loops for a very long period of time. So almost shortly after shutdown, going into refueling, they isolate the loops.

It's quite late in the refueling outage when they isolate the loops. This isolation of the loops, in effect, makes the steam generator isolated from the system. It becomes unavailable for heat removal.

The next item shows that the RHR system is a weakness in the pressure boundary. That is, initially, the RHR system is running. It has a design pressure of 600 psig, while the rest of the system supposedly can withstand 2300. It is a unique design at Surry that the RHR system is physically located inside the containment, and its only function, practically only function is to remove decay heat.

It is not part of the ECCS system. It's a separate low pressure injection system that's part of the ECCS system. So if you get into some kind of accident situation, the system pressure goes up, the RHR system is the first one that might be challenged. Of course, there are relief valves in the system that can potentially relieve the pressurization.

Later I will have a viewgraph showing some scenarios that can lead to an overpressurization of the RHR system.

MR. KERR: So the results of this study won't be generic to any other PWR, it won't be applicable to any other PWR.

MR. CHU: In this type of scenario, probably not. At many PWRs, they have auto closure interlock on the suction valve. So if the pressure goes up, the suction valve should shut and isolate the RHR system from the reactor coolant system. The Surry RHR system doesn't have this feature.

Second to last item, plugging of containment sump. In a shutdown condition, there tends to be people working inside containment. They bring in materials and equipment to do whatever they have to do. If you get into an accident situation, somehow you say you have RWST water dumping through the inside of the containment, depending on the scenario.

And you may have to go into recirculation. Then the issue arises that this containment sump may be plugged by the material or equipment that were brought inside the containment.

MR. KERR: What probability does one assume that plugging has occurred?

MR. CHU: We don't have solid data on that. In the analysis, we use .1 probability for plugging.

MR. CATTON: The probability is 95 percent that it was Paul Shewmon.

MR. KRESS: I think we're going to have to hurry this up a little bit. I don't want to discourage the discussion, but we're getting much further behind.

MR. CUNNINGHAM: Dr. Kress, maybe what we could do -- do you have an idea of a goal of when you would like to be through the Grand Gulf and Surry presentations? Then we can adjust accordingly.

MR. KRESS: Let's take a ten-minute break.

[Recess.]

MR. KRESS: You may continue.

[Slide.]

MR. CHU: I have a few viewgraphs that go into a little more detail of the highlights. Temporary thimble tube seals. By looking at the logbooks from the plant and also looking at the operating procedures used, we recognized there are time periods in the refueling outage they have this temporary seal in place and the reactor coolant system is closed.

So this is a configuration that can lead you to failure of the seals. Say you have a loss of RHR event, pressure buildup, you can cause failure of the temporary seals. Once that happens, in effect, you're having a LOCA at the bottom of the vessel and you can have core uncovery pretty quickly.

We're making use of this approximately ten days for refueling where we can come up with some frequency estimate of the scenario, and we found it to be significant.

[Slide.]

MR. CHU: This viewgraph simply shows the seal table, where the temporary seal is used. It is at an elevation approximately that of the vessel flange.

[Slide.]

MR. CHU: This viewgraph and the next one deals with a station blackout scenario. That can lead to overpressurization of the RHR system. Approximately six hours after shutdown, the RHR could be initiated. At this time, the decay heat is relatively high.

Because RHR is just initiated, the secondary side of the steam generator may be still steaming to the condenser. If we postulate in this condition, we have a station blackout, what would happen is the main steam trip valve will go shut on loss of power.

Also, the relief valves on the secondary side will fail closed. Given that RHR system is connected to the reactor coolant system, you don't expect the pressure on the secondary side of the steam generator to go to the setpoint of the safety valves on the secondary side.

Therefore, the secondary side of the steam generators are bottled up. So they are not very effective heat sinks for the reactor coolant system.

The other thing has to do with steam generators are -- auxiliary feedwater systems are initially isolated from the steam generators by closing some MOVs inside the containment. In a station blackout, of course, at first you don't have power to these pumps and it would be difficult to get to these valves because you have to enter containment.

The second to last item in this viewgraph is the operator action that can mitigate this accident. This is the operator action that we kind of borrowed from the procedure developed for full power operations.

In that station blackout procedure, the operators are supposed to locally open some manual valves that bypass the main steam trip valves, such that you establish a flow path from the steam generator to the condenser. This way, you are cooling the secondary side and the primary side can go into natural circulation.

We estimated approximately six hours; that is, the water originally in the steam generator can last approximately six hours. This will give the operator time to try to, say, recover power or try to restore equipment.

MR. KERR: Dr. Chu, we just had a basketball coach at the University of Michigan who said spare me the details, what was the score. I'm getting to the point of where I want to know what the score is.

MR. CHU: The bottom line?

MR. SHEWMON: Yes.

MR. CHU: I think this is a coarse screening analysis. In the case of this scenario, the frequency is not high because station blackout doesn't happen very often.

MR. KERR: So you throw this one out, right?

MR. CHU: No. I don't throw this out. A similar scenario can occur. In a shutdown condition, everything depends on operator action. You don't have to have a station blackout to get into a scenario.

MR. KERR: You have a screening analysis. Is this one in or out?

MR. CHU: It is in. If you have a loss of RHR event, if the operator doesn't do anything -- the next slide shows in an hour, you may overpressurize the RHR system. Therefore, in that scenario, the frequency of loss of RHR will be much higher than the frequency of station blackout.

MR. KERR: So this one is in because the operator may fail to do something. And if the operator had a higher probability of doing the right thing, it would be out maybe.

MR. CHU: Right. If they know -- if there's a small probability that they fail to carry out this action, then it will be out.

MR. KERR: So that's the key to this one, as to whether you screen it out or in.

MR. CHU: Right. The reason I mentioned this scenario is that it's more challenging. It's harder for the operator to respond. But similar things can happen when you have a loss of RHR. If the operator just fell asleep in an hour, then you're in trouble. The timing is not very short. In an hour, you can overpressurize the system.

[Slide.]

MR. CHU: If the operator failed to open the bypass valves, the system temperature and pressure goes up, and we go to the next viewgraph. In 42 minutes, the pressurizer will become solid due to the thermal expansion and relief valves will be challenged.

In this condition, the PORVs and RHR relief valves are the valves that can potentially relieve. But because of the high decay heat, you're creating steam in the vessel. The steam will not find its way to the relief valve right away. So you'll be relieving liquid. And the combined capacity of these relief valves is approximately 2000 gpm.

But because you have high decay heat, you can calculate the amount of steam created in the vessel. You will find the amount of steam is higher than what the relief valve is capable of relieving. Therefore, the pressure is going to continue going up. In our analysis, we postulate that the RHR system will be ruptured as a result of the core damage --

MR. KERR: I didn't understand. Did you say the amount of steam was that that would be generated by 2000 gpm of water?

MR. CHU: Yes. In terms of volumetric rate, it's much higher than that, maybe twice that.

MR. KERR: This is the decay heat almost immediately after shutdown.

MR. CHU: Six hours, 20 megawatts.

MR. KERR: Well, I just did a calculation this morning that convinced me that two hours after shutdown at a plant like Surry, about ' gallons per minute of steam would remove the decay heat. So I must have made a rather --

MR. CHU: But if you convert that to the volume, the volume of steam is much higher than --

MR. KERR: I'm talking about the number of gallons of water, and I thought you said it would take 2000 gallons of water to remove -- to convert it to steam to remove the decay heat. Did I misunderstand?

MR. CHU: No. The amount of -- the volume of steam that's created is much higher than 2000 gallons per minute.

MR. KERR: I guess I might have suspected that. I'm just trying to understand whether you calculated 2000 gallons per minute of water converted to steam, it would be necessary, or whether you were just talking about 2000 gallons of water that is still in the water state.

MR. CHU: No. You will be relieving 2000 gallons per minute of liquid. But like in your calculation, you said 200 gallons of water will be converted into steam. So you can figure out what that volume is. That's much higher than 2000 gpm.

MR. KERR: I would have suspected that.

MR. CHU: Basically, that's why we feel you lead to overpressurization of the system.

[Slide.]

MR. CHU: We have spent a significant amount of time digging out maintenance and availability data. This is done at a component level. Basically, we look at -- we try to identify the time equipment is taken out of service, and then we identify the time it is returned to service. The fraction of time the component is unavailable is the maintenance unavailability.

We plug it into our PRA model. In the typical PRA model, the assumption is that the maintenance event, the events are independent so that we can multiply the probability. We found that maintenance unavailability becomes important contributors to core damage.

Of course, the assumption that the maintenance events are independent is a big assumption. In Phase II we hope to have a better model to address that issue.

[Slide.]

MR. KERR: Better in what sense?

MR. CHU: The assumption that they are independent, the reality is that the plant practices may be such that they avoid -- it may be --

MR. KERR: In what sense is this going to be better? Is it more complicated?

MR. CHU: It's more realistic. For example, say you have Pump A and Pump B. We estimate each has unavailability of .1. Then the typical PRA model will say there's one percent chance that both pumps are down. That's not quite right.

If you look at the plant practice, it may happen that they never maintain both pumps at the same time.

MR. KERR: But I don't see how you are going to know what the correct answer is just by doing another study.

MR. CHU: We dug out the information from the shift supervisor's logbook. We get information like what is shown on the upper part of the viewgraph. Basically, we know the time the component is down.

MR. KERR: But do you think that this is going to be true for every shutdown or just true for that shutdown?

MR. CHU: We have to --

MR. KERR: I would be surprised if shutdowns always do the same thing every time. Wouldn't you?

MR. CHU: One may argue every outage is different, but we have to make use of whatever information is available.

MR. KERR: I know you do. I'm just trying to find out how you know that this additional study is going to produce results that are any more realistic.

MR. CHU: We will be able to eliminate that assumption that the maintenance events are independent. In that sense, it will be more realistic. That's what this viewgraph is intended to show. Basically, we do a somewhat time-dependent analysis.

For this initial time period, we know exactly which equipment is unavailable and we can find the conditional probability of core damage accordingly. At a later time period, more equipment becomes unavailable. The core damage probability increases.

MR. KERR: Mr. Chu, doesn't this depend on the schedule of maintenance for each different shutdown? Are you assuming that they're all the same?

MR. CHU: We looked at the logbooks for three refueling outages and we collected the information shown on this viewgraph. Our plan is to try to make use of that. We may supplement that with outage schedules that we have for the current refueling outage. In that sense, this kind of analysis is more realistic.

This scenario that we call the French scenario has been discussed earlier in the morning. I think I will just skip it.

[Slide.]

MR. CHU: The next few viewgraphs deal with internal fire, flood and seismic analysis. For fire and flood, we started by looking at two plant operational states, mid-loop conditions and refueling operations. We have done screening quantification for mid-loop conditions.

We make use of the location analysis that was done in the NUREG-1150 study. Basically, in that study, it was identified -- these are the equipment in the fire areas and these are the equipment who are capable of going through this fire area. So this type of information we have from the 1150 study.

In our screening analysis, we make the assumption that given a fire in this fire area, everything in the area will be failed. This screening process basically allows us to screen out some of the areas -- say, if you assume a fire occurs, it may have no impact on the plant operation, then we screen it out.

For some of the fire areas, such assumptions may lead to something similar to a loss of RHR event or it may lead to something like a station blackout event. Then we make use of the event trees that we developed internally in that analysis. We specialize it. Given we know there's a fire in this area, this is the equipment out, we take out that equipment and then we quantified the relevant event trees accordingly.

MR. MICHELSON: Do you start out with just one RHR train available during this shutdown period or is the requirement that there be redundant trains?

MR. CHU: The requirement is that the other train shall also be available.

MR. MICHELSON: And you're requiring now during shutdown to have redundant trains at all times.

MR. HOLAHAN: The current requirement is one RHR system operating and one available, but I think it only applies to the modes within reduced inventory. When the pool is full, you only need one RHR.

MR. MICHELSON: That's what I thought. It's not two, it's just one. Now, are you going to put your fire in that room where that one is?

MR. CHU: The RHR system is inside of containment.

MR. MICHELSON: Is that what you're doing? They're lucky. However, there are other things that can happen inside of containment. They have redundant RHRs, but they're both inside of containment.

MR. CHU: Yes.

MR. MICHELSON: I'm just not that familiar.j

MR. CHU: Two trains are inside the containment. The requirement is that they have one train operating. The other one is on standby.

MR. MICHELSON: But, see, their RHR is not the same.

MR. CHU: They're not at all.

MR. MICHELSON: But for the time when you really are shut down, it is the only means of core heat, isn't it?

MR. CHU: Right.

MR. MICHELSON: What kind of specification is that? Is it called a non-safety system or just non-ECCS?

MR. CHU: It's not a safety system.

MR. MICHELSON: The RHR is a non-safety system, but during shutdown, it's the only way. Do you know that since it is a non-safety, the electrical is also treated like a safecy system, water, air and all the other good things that make it work? Do we know if those are separated or is there a pinch-point at which they all pump together? In non-safety systems, they can come all together in terms of one electrical board.

MR. CHU: In terms of support systems, they are separated.

MR. MICHELSON: It's non-safety, but you have assurance that they're separated anyway.

MR. CHU: Yes. But we also know, I think, when one train is operating, the other train is isolated and there are manual valves that are closed.

MR. MICHELSON: That wasn't what I was concerned about. I'm going to maintain one of those RHR pumps during this time and I'm counting on the remaining one and I'm going to put the fire in that general area. I just wondered if that's the kind of analysis you've done.

MR. CHU: Yes. I think they are --

MR. MICHELSON: In that case, you may very well lose all RHR.

MR. CHU: Yes.

MR. MICHELSON: The question is how do you remove heat then. I didn't realize it was a non-safety RHR.

MR. CATTON: Do any plants have safety RHR? I don't think so.

MR. MICHELSON: Almost all of them do. This is about the only one that probably doesn't have a non-safety RHR.

MR. HOLAHAN: There are a few.

MR. MICHELSON: There are not very many.

MR. HOLAHAN: There are some boilers that also have -- they call it shutdown cooling.

MR. MICHELSON: Real old boilers, before they learned how to do this.

MR. HOLAHAN: I'd have to go back and look at how the requirements apply, but remember there is General Design Criteria 34 which addresses residual heat removal systems and requirements for them. Even when the system is not an ECCS system, it still has to meet GDC-34.

MR. MICHELSON: Does that require redundancy?

MR. HOLAHAN: It requires redundancy, but I'm not sure how the separation requirements fall out of that.

MR. MICHELSON: Redundancy generally means that it is indeed redundant, redundant services or whatever it takes to make it work.

MR. CATTON: It doesn't say anything about the redundant things being close together.

MR. MICHELSON: No, not necessarily. You've got to go to another GDC to find out the separation.

[Slide.]

MR. CHU: The results of the screening analysis are shown here. Basically, some of the fire areas were screened out, some remain, and many are the ones we will do a detailed analysis in Phase II.

MR. MICHELSON: Could you tell us roughly which ones remain? Is there a list of those?

MR. CHU: Yes.

MR. MICHELSON: There it is. Where is the RHR on it?

MR. CHU: The RHR is located inside the containment.

MR. MICHELSON: That's under containment.

MR. CHU: Right.

MR. MICHELSON: It would be interesting to see how you can take a fire in the one remaining RHR. I don't know their tech spec. You should be able to tell me all these things. I shouldn't have to speculate on any of these. But are they required to have more than one RHR during shutdown or when they're in refueling mode?

MR. CHU: Yes. The only time they maintain the RHR system is when the fuel is taken out of the vessel. We have looked at the outage logbooks and we have confirmed that. We have talked to the plant people on that issue, and that's our understanding.

MR. MICHELSON: They understand that they have to have redundant RHR, both loops available during refueling.

MR. CHU: Yes. The only exception is there is some kind of -- when they are shoveling the fuel, every hour in an eight hour period, they can, I think, stop the RHR system for an hour, something like that.

MR. MICHELSON: You either have the ability to remove the heat or you don't.

MR. CHU: In other situations, two trains of RHR are needed.

MR. HOLAHAN: We'll look into the specific requirements for Surry. It is different from a lot of other plants, so I'm not exactly sure.

MR. CATTON: How are you going to make generic conclusions?

MR. HOLAHAN: I think you can still have generic requirements, and it is a question of Surry has to come up with an implementation strategy that matches their equipment.

MR. MICHELSON: How did you pick Surry for this?

MR. HOLAHAN: I think it's a historical question that goes back to -- you know, it was used for 1150, and that made the information available.

MR. MICHELSON: Other PWRs were 1150.

MR. CUNNINGHAM: There were a couple of -- a couple of criteria, if you will, in the choice of our plans. One was availability of information already. Obviously, the five 1150 plants were real prime candidates for that. The other was willingness of the utility to cooperate. Some of the utilities didn't feel they had the time to be able to put into this Virginia Power and Mississippi Power & Light both were interested in cooperating and the two of them kind of drove us to Surry and Grand Gulf.

[Slide.]

MR. CHU: I continue to the Phase 2 study. The objective of the Phase 2 study is to estimate the core damage frequencies associated with accidents, initiated during mid-operations; and compare the estimated core damage frequencies, important accident sequences with that of power mid-loop operations.

The last bullet item, we will do the uncertainty analysis sensitivity calculations to determine the benefit of generic letter 88-17.

[Slide.]

MR. CHU: This vugraph shows the ongoing Level 1 tasks. In the case of database development, we are still working on the maintenance and availability data. We're working on the data for the initiating events.

In case of initiating events, we are taking another look at the data that we have compiled, looking into the categorization of those initiating events.

System analysis is a relative big task for this phase. Mainly, in the Phase 1 study, we make use of the fault trees developed in NUREG-1150

In Phase 2, we are doing detailed review of 1150 fault trees, and we modified i t so that it will be applicable for shutdown conditions.

In our Phase 1 analysis, we had made some simplifying assumptions regarding success criteria, regarding the scenario development. In this phase, we are doing some supporting analysis, so that we had better understanding of the accident scenarios, the time of them; and also, it will help in determining the success criteria that we can use.

In the case of system analysis, we review and modify NUREG-1150 fault trees, with the emphasis on dependencies and common cause failures. To account for the specific shutdown conditions, we modified the 1150 fault trees. So we have two sets -- kind of two sets of trees; one for power operation, one set for shutdown conditions.

MR. MICHELSON: How did you do this common cause failure? You said you're putting emphasis on it. How did you put emphasis on common cause failures?

MR. CHU: In the 1150 analysis, we are aware, some of the common cause failure models was putting at the later stage. They are not models in the system fault trees.

MR. MICHELSON: I thought this was something you were suggesting you were adding to what was done on 1150.

MR. CHU: Not in that sense. We mainly put it into the system model, so that it will be easier.

MR. MICHELSON: But it says: review and modify 1150 fault trees with emphasis on common cause failure. And I speculated that you were doing something beyond 1150 on common cause.

MR. CHU: There may be instances that we found there are, you know, common cause failures that were not Model 1150. We put them in. I don't think there is too many of those.

We have also developed a fault tree for the steam generator recirculation transfer system. Basically, this is a system that is taking credit for in the abnormal procedure, for loss of the heat removal. In the Phase 1 analysis, we didn't take credit for it. In Phase 2, we will.

The last bullet item has to do with unique configuration of electrical distribution system. Basically, when we look at the past experience, we recognize the situations, the cross-connect emergency busses in a shutdown condition. So in Phase 2, we tried to look into different unique configurations that the system could be in, due to test or maintenance. In doing that, we look at index to test or maintenance procedures, and by reading the index, make some judgment whether or not they may have to put the system in a different configuration. This is an interesting task. Again, it characterizes unique shutdown configurations.

Because in our Phase 2 analysis we are supposed to look at mid-loop only, most likely, these kind of unique electrical configurations don't take place when they are at mid-loop.

MR. MICHELSON: When you did your fire and flood analysis, particularly fire analysis, did you do something different to account for the additional ignition sources that you could have during shutdown, the additional flammable materials that you can have around and all that sort of thing? These are pretty well-narrowed in the normal fire analysis to what you're allowed to have during normal operation.

MR. CHU: The answer is yes. In terms of the fire frequency, we make use of what was done in the Seabrook study.

MR. MICHELSON: The which?

MR. CHU: Seabrook.

MR. MICHELSON: Seabrook.

MR. CHU: Seabrook has done a shutdown study. There they look at incidents that occur during shutdown; that they estimate at frequency. We basically used that frequency there, but it happens that they are estimating frequencies not too different than what was used in full power operations.

MR. MICHELSON: They've had some pretty good fires during shutdown as compared with normal operation, but maybe a statement of frequency might be the same. The severity has certainly been considerably greater during shutdown. They've had some pretty good ones inside and outside of containment. I would be very surprised that you had drawn the same conclusion for normal operations as to frequency and amplitude as you did for shutdown.

MR. CHU: In Phase 2 analysis, we are compiling a database for fire occurring during shutdown, and we'll come up with new estimates for that.

MR. KRESS: Dr. Chu, we can pretty well read the rest of your vugraphs. Is there anything else you would like to emphasize? We're running out of time quickly.

MR. CHU: I guess maybe I can just show one last vugraph. That will be it.

MR. KRESS: Okay.

MR. CHU: Supporting analysis, basically, there are assumptions made in our Phase 1 analysis. For example, in case of use of gravity feed from other RWST, we have selected a mission time of 24 hours. In our Phase 1 analysis, we make the assumption, if the flow path from the other RWST to the cooling system is available and the system is vented, then we say it's an effective way of removing decay heat for 24 hours; assuming nothing else is working.

In our Phase 2 analysis, we are doing some deterministic calculations to make sure that is the case.

Similarly, bleed and feed, again, this is one mitigating function that the operator could perform. We are doing some calculations to determine the timings, to determine how the system pressura temperature varies with time, and also, in doing that kind of calculation, we know what time the system pressure will be too high for the low head injection to inject. So this kind of calculation will help in our evidentiary development for the Phase 2 analysis.

I think I have used up all my time. I'm going to stop.

MR. KRESS: Thank you.

MR. CUNNINGHAM: Dr. Kress, I thought what we'd do is have Donnie Whitehead talk and stop absolutely at 4 o'clock or we can yank him off at 4 o'clock, if you like.

He thinks he can do it.

MR. KRESS: Good. Thank you.

[Slide.]

MR. WHITEHEAD: My name is Donnie Whitehead, and I have a presentation about the Grand Gulf Low Power and Shutdown Study. I am presenting the work of a lot of other individuals, so I just want you to know that I'm not the only one working on this project.

Basically, I'll have the same kind of overview as Louis Chu had. We'll just talk about the things that we have done, the results we achieved and where we're planning on going.

We'll have four areas that we talk about for the Phase 1 results, and we'll cover those very briefly.

[Slide.]

MR. WHITEHEAD: For the non-fire/flood/seismic analysis for Grand Gulf, there were 4,188 sequences from 34 initiating events, quantified. When we quantified them, we were left with 1,163 sequences. These broke down into three categories. The categories, where we had about 26 percent in the potentially high category; 30 percent in the potentially medium category; and 44 percent in the low category.

[Slide.]

MR. WHITEHEAD: Another way of looking at it is looking at the distribution within each plant operational state, because one of the things that we wanted to gain out of this analysis was which one did we need to look at in detail. Looking at this, you can see the various breakdowns. What we did was we looked at things like this, and we identified for our Phase 2 analysis that we would do plant operational state 5, and the numbers here bear us out. [POS] 5 appears to be the most important, if you consider both number and the number that happened to appear in the high category.

MR. KRESS: Was 5 the mid-loop operation?

MR. WHITEHEAD: [POS] 5 for G and Gulf corresponds basically tao coal shutdown mode of operation.

MR. KRESS: There's no mid-loop in the Grand Gulf?

MR. WHITEHEAD: There is no mid-loop operation for Grand Gulf.

MR. MICHELSON: Does high suggest high consequence? Is that what it's supposed to --

MR. WHITEHEAD: No. High is our ranking for potential core damage; high, medium and low. Not consequences.

MR. MICHELSON: Potentially at high consequences?

MR. WHITEHEAD: No, these are not consequences here.

[Slide.]

MR. WHITEHEAD: The results from the analysis indicated we had basically two kinds of initiating events that were important: loss of instrument air and loss of decay heat removal. The instrument air occurred in all POSs except for 7; decay heat removal in POS 4, 5 and 6.

[Slide.]

MR. WHITEHEAD: Configuration scenario insights, two were identified as potentially important, and if you remember the previous vugraph, that was POS 5 and POS 6.

Then other important things is the importance of safety relief valves from the point of v ew of pro iding an alternate means of removing decay heat by going water solid in your system.

MR. KERR: That first bullet on the safety relief valve says that two of those were capable of removing decay heat with liquid water.

MR. WH TEHEAD: Right, going water solid. Right. Additional insights --

MR. KERR: In the PWR, if I remember a Westinghouse Plant, three were not -- of course, those are different size valves, I guess, but three were not adequate to remove decay heat and water.

MR. HOLAHAN: I don't remember the numbers, but the sizes of the valves are substantially different. These are probably six- or eight-inch safety relief valves, and PORVs are much smaller; three inches or so.

MR. KRESS: It says something like 14 relief valves on it?

MR. HOLAHAN: The number of valves?

MR. KRESS: Yes.

MR. WHITEHEAD: Grand Gulf, I believe there are 20.

MR. KRESS: Twenty.

MR. WHITEHEAD: Yes, sir.

[Slide.]

MR. WHITEHEAD: Additional insights include for decay heat removal. CRD can provide sufficient makeup if you go to steaming; about 200 GPM or something like that. Other ways of removing decay heat, they're all listed here. I won't really go into those.

The only one that I do want to point out is the fact that there is a potential for overpressurizing the shutdown cooling piping, but this is really only a concern in POS 5, where the head is on and the high pressure isolation is bypassed. In POS 4, the high pressure isolation is active. In POSs 6 and 7, the vessel head is off, so it's impossible to pressurize.

MR. MICHELSON: In the vugraph, the top one that you can see there, the reactor water cleanup let down, you say, will match after refueling. Did you mean during refueling or after?

MR. WHITEHEAD: It depends upon how long your refueling activity occurs. Somewhere around --

MR. MICHELSON: Let's make it easier. How about at the beginning of refueling?

MR. WHITEHEAD: No, no. It doesn't have the capability.

MR. MICHELSON: Somewhere between the beginning and en., it starts being adequate.

MR. WHITEHEAD: Approximately 30 days into a refueling outage.

MR. MICHELSON: I thought it was a little than after.

MR. CATTON: How long does refueling last?

MR. WHITEHEAD: Grand Gulf typically averages something around 45- to 50-something days.

MR. CATTON: Forty-six weeks.

[Slide.]

MR. WHITEHEAD: The fire analysis, we did the analysis on one POS for demonstration purposes, and we chose POS 4 initially because we thought it was going to be the most important one. The process is still valid. It's just that the final results turns out that 5 and 6 might be more important than 4.

Anyway, we identified several accident sequences. We were able to truncate approximately half of those, and we ended up then with the distribution as you see here.

There were none in the potentially high frequency category. They all were in either the medium or the low category.

MR. MICHELSON: Did you look separately at shutdown as far as ignition sources and flammable materials, and so forth, inventory?

MR. WHITEHEAD: Yes. In the screening analysis, we assumed 1.0 for the fire frequency in each zone. In the detailed analysis, as Lewis mentioned, we will be developing or updating a database that exists, where we will actually calculate the frequency.

MR. MICHELSON: What is your flammable inventory during maintenance? Different than during operations; significantly different.

MR. WHITEHEAD: You're absolutely correct, yes.

MR. MICHELSON: Do you differentiate?

MR. WHITEHEAD: We're examining the fires that have occurred, and we're basing our frequency upon historical data.

MR. MICHELSON: But you don't look at the fires that have occurred. You look at the inventories that are present and, hopefully, haven't burned many of them. So you really have to look at the inventory, not the fire.

MR. HOLAHAN: As part of the staff's activities to decide whether it was important or not, we sent our senior fire protection engineer to two plants while they were shut down, to walk around the system, walk around basically the decay heat removal systems, to see what sort of additional combustible material was there.

MR. MICHELSON: That is the only place you look for fire potential, decay heat removal.

MR. HOLAHAN: In this case.

[Slide.]

MR. WHITEHEAD: We did the same type of screening analysis for the flooding, and, basically, we ended up, again, with most of the sequences occurring or being classified as potentially medium in their frequency.

[Slide.]

MR. WHITEHEAD: A seismic scoping evaluation was conducted, and, basically, the gist of this whole vugraph here is the fact that above a certain peak ground acceleration, you can be reasonably assured that core damage would occur.

I'll just preface this or modify this by saying that all of the work that was done for Grand Gulf was based upon assuming that Grand Gulf had generic fragilities for their components. In the study that's coming up on this, that will be examined, to see if that's actually the case.

MR. MICHELSON: For Grand Gulf, are those RHR pumps the only pumps in the corner rooms, and they have the bulkhead doors and so forth, with that design?

MR. WHITEHEAD: Grand Gulf has -- there are three loops of decay heat removal that are normally used: the two RHR pumps and a set of alternate decay heat removal pumps. This gives them basically, if you will, three loops to provide decay heat removal capability. That capability is maintained by separation.

MR. MICHELSON: The question is, what else is in the rooms besides RHRs? Are they dedicated just to RHR, these three areas? You must have three areas, I guess, if you have physical separation.

MR. WHITEHEAD: I'll have to get that information for you later.

I think, really --

MR. MICHELSON: The same question is asked earlier. If you got the equipment down for maintenance and you're down to your one pump, which I suspect is all Grand Gulf has to have, and they're doing work in that room on other equipment, then you begin to get into the hazard picture, but I don't know if that is their case or not. If it's purely dedicated RHR and you don't go in and disturb the room, then you're okay.

MR. WHITEHEAD: Basically, the rest of my presentation is just the same kind of stuff that Lewis presented. It talks about where we're at in our Phase 2 analysis and things like that. So, I mean, this is all the unique stuff that I would have to present.

MR. KERR: Have you run into any big surprises so far?

MR. WHITEHEAD: Not particularly. The only two things that are -- one thing that was of interest to us, and we are now including in the Phase 2 analysis, was the fact that the recirculation system, whether it's operating or not, it turns out to be of some importance in the analysis. In the screening analysis, we assume that you didn't have that capability. Here in the Phase 2 analysis, we're explicitly modeling that capability, and so we'll see how that turns out.

MR. KERR: Thank you.

MR. MICHELSON: This is reactor recirculation?

MR. WHITEHEAD: Yes.

MR. MICHELSON: Why is it important?

MR. WHITEHEAD: It provides mixing of the water in the core region for decay heat removal capabilities.

MR. MICHELSON: You're talking about extremely low power levels by this time. Why is it important then?

MR. WHITEHEAD: The question of concern has to do with the fact, that for Grand Gulf, if you do not have either level raised to the natural circulation point or you have your recirc pumps on and operating and if they fail for some reason, you, in essence, sever the tie between the two regions for removing decay heat. That makes the recirculation pumps potentially important.

MR. KRESS: Thank you.

Is there someone here from NUMARC?

MR. MICHELSON: I hope it's not importanc, Ivan.

They've got to be able to cool these things without recirc pumps, like 1-percent power or 2-percent power. So, when you're down and on refueling, where you're down to a small fraction of 1-percent power, it escapes me as to why the recirc pumps would have to be on.

If it was really important, they would be safety-graded, of course, but it's not.

[Slide.]

MR. PIETRANGELO: Good afternoon. My name is Tony Pietrangelo. I'm here on behalf of NUMARC and the nuclear industry. I'd like to thank you for the opportunity to address the subcommittee today on this issue.

As the cover slide indicates, I'm here today, my real purpose, to talk to you about industry activities, to address shutdown plant issues and to help you have an understanding of what we've gone through over the past year and what we're doing.

It is not my purpose today to comment on the staff's proposals in NUREG 1449. I'll touch on that later in the presentation, but at this point, it would be premature for me to speak to those positions for industry, and comments on the document are in the draft stage right now.

[Slide.]

MR. PIETRANGELO: I'll briefly go over the background of what we've been doing in the past year or so that led to the development of NUMARC 91-06. I hope that you all have a copy of the document. If not, we'd be happy to send some more to the committee.

MR. BOEHNERT: We have them.

MR. PIETRANGELO: After background, I'll touch on the intent and content of NUMARC 91-06 and then talk about the associated shutdown management initiative, which was the formal industry position taken by the NUMARC Board of Directors.

Following that, I'll talk a little bit about a coordinated industry approach, which includes NUMARC activities, activities by the Institute of Nuclear Power Operations and the Electric Power Research Institute, summarizing those and telling you how they all fit together to address shutdown concerns. Then finally, I'll have a few conclusions from the presentation.

[Slide.]

MR. PIETRANGELO: As I'm sure you will recall, this event was driven by a couple of different things, but primarily by shutdown events that have been occurring in the industry over the last several years. What also spurred industries' interest in this was the results of some of the PRA studies that came out over the last few years, but our main focus and concern was on the events. They raised concerns with both the NRC and the general public about the ability of licensees to effectively manage their outage activities, and it erodes that confidence in utilities. Executive leadership determined that it was a generic concern that we had to do something about it.

NUMARC was chosen because it is a generic concern, and we could effectively coordinate the industry activities and provide a unified interface with the NRC.

As we do on a lot of our priority issues of what shutdown is, we form a working group to help us carry that mission forward.

MR. KERR: I get the impression that your principal concern was in the erosion of utility confidence. You weren't concerned about safety, because you didn't think it was a safety issue?

MR. PIETRANGELO: No, there are some safety concerns associated with it, but it's driven by the frequency of events that have occurred.

[Slide.]

MR. PIETRANGELO: As I said, we formed the Shutdown Plant Issues Working Group, and this slide speaks to the membership for that group. It's chaired by Harry Keiser, who is the Senior VP of Nuclear, Pennsylvania Power & Light Company.

We decided we needed a broad membership for this group, to get a lot of important perspectives to the table for discussion. This included executives, managers and supervisors. I think we have three VPs on the group, several plant managers, a few ops managers, a lot of technical support people, engineering people, licensing people. There are 16 utilities, also, that span all five US NRC regions. A broad spectrum of plants represent the working group, from early vintage plants to some of the later vintage.

We also have representatives from each of the four NSSS owners groups. They had already done a lot of activity, particularly in response to generic letter 88-17. So, rather than reinvent the wheel, we wanted to build on the work that had already taken place through the owners groups.

In addition, we have representative from both EPRI and INPO, to take advantage of the insights we could gain from those organizations.

[Slide.]

MR. PIETRANGELO: This final background slide speaks to the working group activities over the past year.

MR. MICHELSON: Will you define "working group"? Is the working group these 22 individuals? They do all the work then? They don't get other engineers? These are high level people you're talking about. Do they do the work themselves?

MR. PIETRANGELO: The way NUMARC functions is we have a small staff here in Washington, and what we tried to do is take advantage of the resources of our membership, and those individuals bring their entire organizations and draw on the expertise throughout the industry through them.

MR. MICHELSON: These people bring other people with them?

MR. PIETRANGELO: No. We have action items and work associated from each of the meetings, and we hope our members will use the resources of the utilities and the vendors and the other organizations and bring that to the table with them for the discussion. That's the NUMARC process.

As I said, the working group had seven meetings in 1991 and one in 1992, and we also had a lot of interaction with the NRC staff.

The basic way we approached shutdown was to take input from the utilities on the working group, INPO, EPRI, the owners groups and draw from the regulatory perspective of the staff. Through INPO, the primary input through them was a review of past shutdown events over the last 10 years, trying to draw on that experience, to see what was important, what was happening a lot and how it was being dealt with.

From EPRI, we gained the analytical insights of some of the PRA work that's been done over the last couple of years. The owners groups provided input through a survey of their membership on maintaining key safety functions during shutdown, what practices they were using beyond tech specs to address a lot of the concerns and issues that were coming up.

In our meetings with the staff, it became evident, and we both, I think, came to the same conclusion after a couple of months of looking at this problem, that outage planning and control was going to be a major issue. And in those interactions with the staff, we both concluded that proper outage planning and control could enhance safety during shutdown.

The staff suggested to us that industry was in a much better position to address outage planning and control concerns, because we had the expertise in the industry to draw on, to effectively address that. We agreed that we were in a better position to do that, and basically that led to the development stages of NUMARC 91-06, which focusses on outage planning.

MR. KERR: One of the things that the staff reported in some of the material available to us was that there is a considerable variation in at least what they viewed as the way in which various utilities carried on their shutdown operations. Some they considered the high quality, and some they considered not very good. Did your working group look at that fact of the problem?

MR. PIETRANGELO: Yes. We did try to glean the good practices that were out there from the utilities on the working group.

I think there was another conclusion, that it wasn't the process so much of how they plan to control outages, but what things they were considering in the outage planning and control process.

Outages are different. We're not a standardized industry. Some people are driven, their critical path, by refueling; some by modification --

MR. KERR: I didn't make my question very clear, I guess. Did you look to see whether, in the view of the working group, there was a considerable variation in quality of the way in which outages were conducted?

MR. PIETRANGELO: No.

MR. KERR: At least I got the impression that the staff did reach that conclusion.

MR. PIETRANGELO: We did not reach that conclusion.

We think outages are conducted differently. There was no subjective judgment made at all.

MR. KERR: I'm asking whether you even looked at that question as to whether there was a wide variation in quality.

MR. PIETRANGELO: No. I think we came in with the assumption in the working group that there was room for improvements, just based on the number of events that have occurred. So that was one of our mandates from NUMARC Board, was to see where we could improve as an industry, how we conduct our outages.

MR. KERR: I was trying to get some idea of where the improvement was needed, whether it was needed by everybody or whether there were some people who were already doing a pretty good job and others who were not.

I'm not trying to get you to identify them, if that's the case, because the problem is different. It seems to me, if everybody is doing about the same job and everybody needs improvement, that's one approach. If there's a group that is doing a very good job, they can serve as models for the rest of them.

MR. PIETRANGELO: The way that came up in the working group's discussion is that no one stood up and said I do outage planning and control better than anybody else, and I think I've got all the problems licked. I think the events that have happened have showed that even good performers -- Prairie Island, that just happened, is a good example of an outstanding utility that was still vulnerable to an event. So no one was immune to these kind of things, and I think the thought going into the working group's deliberations was that we could look at this as an industry and no one could say that they were better than anybody else in a particular area.

Once we concluded that outage planning and control would be the focus of the document, we set out to develop 91-06. We developed an extensive action plan that was approved by the working group, that, step by step, took us through the NUMARC process. That includes getting review from our management committee and executive committees, getting review from the NRC staff and from the utilities, and all the way through a November board meeting and subsequent issuance of the document and workshops.

We laid that out approximately six months in advance, shared that with the staff, with the basic intent that they would know what the industry was going to do before they began to consider any further regulatory action.

We succeeded in accomplishing that plan, I think. We haven't slipped anywhere, and we've delivered the document on time.

The process used to develop NUMARC 91-06 was taking a subcommittee of the working group, and that was about eight people out of the 22, to develop the drafts and using the input from INPO, EPRI and the owners groups.

There were several drafts worked up by the subcommittee. They were reviewed by the working group at subsequent meetings until we got a final draft ready to send out to all the utilities in the industry as well as the NRC for review and comment. That process came to a head in October and November. The document was very well-received by the industry, such that we didn't think it needed much change, and the document was finally issued in '91.

As part of developing the document, the other thing the working group had to consider was what industry would do with that document once it was issued; and recommended an industry initiative to use those guidelines as an assessment. I'll speak more to that in a little bit.

[Slide.]

MR. PIETRANGELO: The next slide gets into the intent of the document itself. 91-06 is not a prescriptive how-to document on how to plan and conduct outages. We didn't think that was necessary. Utilities have been planning and conducting outages for a long, long time.

What was needed was to add a safety perspective to that planning and control activity. The threshold we used in developing the guidelines was really based on preventing and mitigating events, not on preventing and mitigating core damage. So it was a much lower threshold we were trying to get at, given that what was driving this issue are the events that had been occurring.

The guidelines are structured as a framework for utilities to conduct an assessment of their outages. This is tied to the initiative that tells them to use the guidelines to do this assessment.

The second bullet really gets to the heart of the document, and that is to extend defense in depth to shutdown operations. If we could summarize the previous problem very briefly, what was occurring before was that most outage planning and control organizations were primarily relying on operations department during shutdown, to maintain a safe condition in the plant. In turn, those operators were primarily relying on technical specifications to make sure they were in a safe condition.

What NUMARC 91-06 speaks to is the outage planning and control process, getting those same defense in depth philosophies that we use into the shutdown mode of thinking. So there is some cultural change that has to occur through this process.

The other thing we tried to capture in 91-06 were the major vulnerabilities which we termed shutdown safety issues in Section 4, that we gleaned from all the insights and event reviews and interaction with the staff.

All of that is tied to improvements in outage planning and controls.

MR. KERR: Excuse me. I'm not sure that I know what you mean by address, but if it means what it normally means, I would assume that before one could address, one would have to identify them.

MR. PIETRANGELO: They are identified in the section. What we mean by address is take that vulnerability and how are you going to account for that in your outage planning and control.

MR. KERR: So you feel that you've identified all of the vulnerability issues.

MR. PIETRANGELO: We think we've identified the major vulnerabilities, and we did get some concurrence on that point from the staff in their review.

MR. KRESS: Okay.

[Slide.]

MR. PIETRANGELO: The next thing I'd like to do is talk about the content of the document and really focus in on the meat, which is Sections 3 and 4.

Section 3 addresses outage planning and control. What these bullets are, are really what we think are the things or attributes that contribute to enhanced safety during an outage.

I'll give you an example of one and not give you examples of all six of them here. What we mean by providing defense in depth, if you go through the guidelines in that particular subsection, we talk about establishing the structure systems and components that are going to carry out your key safety functions during shutdown.

Secondly, you try to optimize your safety system availability. Do maintenance on the diesel later in the outage instead of doing it when you're at reduced inventory conditions, as an example.

The third guideline was to ensure the functionality of that equipment. After you do your preventative maintenance or you mod, what are you doing to assure that that system will perform its intended function. This was another element of defense in depth.

A fourth was to protect the available equipment that you are relying on during the outage, to ensure that it will remain available.

The last item in that section are procedures to mitigate the loss of key safety functions.

As you can see, all these elements speak to outage planning and control and involve a real multi-discipline approach to doing this activity.

[Slide.]

MR. PIETRANGELO: The next section is shutdown safety issues. We categorized these major vulnerabilities or issues by the key safety functions that are necessary during shutdown.

I think in this morning's example, in Mark's presentation, you saw on power availability, there was a subsection on control of switchyard activities. Now, I think there were five or six items listed there on things you should do with regard to control of activities and then tying it back to the key safety function of power availability.

I think that section was very representative of the level and detail that's in the entire document. It's not prescriptive, but it's a high level consideration, things you need to think about when you're planning and conducting the outage.

There was also a question with regard to containment this morning. That section, I believe, 4.5 in the document, the focuses on containment is barrier to efficient product release. What the guidelines state is that you should have a procedure for containment closure, consistent with the loss of decay heat removal section -- I believe that's an earlier part of Section 4 -- to consider the environmental conditions, pressure, temperature, et cetera, and it also touches on having some methods for evacuating containment in the event of increased radiation levels.

That was, I think, the key points that we addressed in that section.

[Slide.]

MR. PIETRANGELO: Those are the two major sections of the document. What this led to -- and this gets back to the working group's recommendation -- was what we call the shutdown management initiative. It was recommended by the working group and approved by NUMARC's Board of Directors on November 20, 1991. What that means is on our Board of Directors, we have executives from each of the 50 nuclear utilities in the industry, and it requires an 80 percent vote to make the initiative binding on all the utilities.

The initiative past, and it was considered, I think at that point, the right thing to do for industry at that point in time. It was high recognition that we had a problem that we had to address. At this point, the document was not even an issue yet. The draft had gone out in September for review. We didn't have to make a lot of changes to it, but the utilities and the executives were comfortable that the document was correct and would get at the heart of the problem. So, before even seeing the final document, the Board was asked to consider this initiative.

I paraphrased the language that was on the ballot that day. What the initiative does is ask utilities to conduct the assessment, using the guidelines, and to implement any improvements resulting from that assessment, to be implemented for outages started after the end of the year.

Just from the Board discussion, some of the working group utilities and their executives commented during that discussion that they were already implementing the guidelines and doing the assessments using earlier drafts of the document, and one thing we found from tha discussion or gleaned from that discussion was that the utility could meet th intent of the guidelines without significantly changing their outage duration, such that you could improve or enhance safety with no impact on the economic end of the outage. That was very encouraging, and it gave the right message, I think, to the other utilities, that that was kind of our ultimate unwritten objective. It was to enhance safety without having a negative impact on overall availability.

[Slide.]

MR. PIETRANGELO: The next thing I'd like to talk about is the coordinated industry approach. As I said in the beginning, NUMARC's role on a priority issue is to coordinate industry activities and provide the interface with the Nuclear Regulatory Commission.

I've already talked about the first two items with NUMARC 91-06 in the initiative. There were two other activities; one we've done and one we'll be doing.

The third bullet there was: conducted the

Shutdown Assessment Workshop. On February 13th and 14th in New Orleans, we had the Shutdown Assessment Workshop. It was attended by 175 individuals representing all the utilities, a number of the vendors and owners groups, et cetera. We also had NRC participation at that workshop through Bill Russell.

The intent of that workshop was to enhance our members' understanding of the guideline, both the intent and content, and also provide a lot of examples from the working group members on interpretation and implementation of those guidelines. Based on our feedback from that workshop, we believe it was very successful in kind of giving you between-the-lines understanding of what those guidelines were intended to do.

The final bullet here, we have not disbanded the working group after the guidelines were developed in the initiative past. We are using the working group to coordinate the industries' comments on NUREG-1449.

We have had a working group meeting this past March 19th to begin that process. We're in the middle of it now. Comments are being drafted. We have a review process through the working group. We'll also be sending final drafts of those comments out to the entire nuclear industry for their information.

We suspect that the owners groups and some individual utilities will submit their own individual comments in addition to the comments submitted by NUMARC on behalf of the industry.

[Slide.]

MR. PIETRANGELO: NUMARC is not the only industry organization addressing shutdown concerns. This slide, basically, summarizes what the Institute of Nuclear Power Operations activities are with regard to shutdown.

Clearly, INPO's role and element addresses the long-term aspect of this issue, and that's striving for excellence. We don't stop when we meet some minimum standard. INPO's role is to keep the pressure on and to continue that drive towards excellence. They are doing this in a number of ways.

The first bullet speaks to communication through their workshops. Last year, there was an Outage Experience Workshop that only dealt with significant shutdown events in the last several years. They had an Outage Managers Workshop last August. At the CEO conference that they have in November, shutdown was an agenda topic on that as well as at the Plant Managers Workshop.

This year, they're combining the Outage Managers and Plant Managers Workshops to specifically address shutdown concerns.

They also have a Senior Nuclear Plant Managers course that spends a lot of time on shutdown; and also, their publications through the Nuclear Network, they've published the strengths of what they've seen through their outage review visits. Some of their magazines and articles and such have served to increase the awareness of shutdown concerns.

The outage review visits, just to characterize that, it's kind of halfway between a formal INPO evaluation and an assistance visit. Thirteen were completed in '91. Seventeen are planned for this year. These outage review visits focus on outage safety and equipment reliability.

There was some earlier discussion this morning about: Is a short outage safer? Is a longer outage safer? Based on INPO reps' discussions at our working group, what they're looking at is for what you've planned, how long did it take you to do what you planned. Did it take you the time you thought it would take or did you significantly overrun that? They would look at that as an indication that the outage planning and control function could be improved, if you're going well beyond what you planned for those activities. These review visits, I think, will eventually be rolled into their normal evaluation process.

The third bullet here speaks to their outage management guidelines. There is a document, INPO 89-017, that addresses all aspects of outage management. The revision that should be issued this spring, I believe, will include appropriate guidance from our document. Like I said, their role is the longer-term aspect.

NUMARC 91-06 is to use for the assessment per the initiative approved by the board, and it basically expires at the end of the year. The assurance comes from INPO, rolling this guidance into their guidelines that exist into the future.

They will also add any insights gained through their outage review visits in the revision to the guidelines.

[Slide.]

MR. PIETRANGELO: EPRI has also had a lot of activity with regard to shutdown. ORAM here stands for Outage Risk Assessment and Management program. I think the first bullet speaks for itself.

They're trying to develop additional tools to assist utilities, plant and control outages. There's a few documents that are in draft form right now that should be issued within the next month or two. This includes surveys of BWR and PWR plant personnel on their shutdown safety practices, and also, they have two contractors working on safety assessments of PWR and BWR.

I've seen drafts of those reports. They support the guidance that's contained in NUMARC 91-06. They go into a lot more detail about the major vulnerabilities.

In addition, there's some other documents and software tools EPRI is working on that will also support utilities improving their outage planning and control.

MR. KRESS: Are those safety assessments, PRAs?

MR. PIETRANGELO: No, they are not full-blown PRAs. No.

[Slide.]

MR. PIETRANGELO: Finally, the conclusions we'd like to draw on all this, there is an extensive industry activity to address shutdown plan issues, and it's primarily focused on outage planning and control.

It took us a long time to get to a coordinated industry approach on this. There were a lot of concerns, both from the working group and from some of our other utility members, that the three industry organizations were overlapping in some points. We did, I think, in the overall resolution, through the NUMARC Board, got everybody's piece to fit together, where they're all complimentary, and that was our objective all along. So we think these actions will eventually improve outage planning and control.

The second bullet speaks to the time utilities need to implement the initiative and also benefit from some of these industry activities. The initiative deadline is the end of this year. EPRI's products should be available by the end of the year. ıs I said before, the INPO activities will continue onward.

We shouldn't kid ourselves that all these activities are going to stop shutdown events from occurring. I spoke to the cultural change before that has to occur. It is taking place now.

I think it's a reasonable expectation to see the frequency of events come down with time and to see that utilities are mitigating these events and handling them better than they have in the ı st.

The results will be performance, as it usually is on any issue. But there's going to need to be some time there to implement this approach.

Finally, we do think that our common objective will be served with enhancing safety during shutdown through complimentary actions of the staff and industry. That's been our objective all along. We've told the staff that consistently, and we continue to believe them.

That's all I had.

MR. KERR: You haven't said anything about PRAs or specific risk analysis. This is not meant to be a criticism of what you have said. It seems to me it's been a presentation.

I wondered if you, your working group or somebody had looked over some of the PRA-related information, which the staff has assembled and which concludes that shutdown risk is a significant contributor to total risk.

I could conclude from what you are doing that you think it's a significant problem, but have you attempted to look quantitatively and see whether you agree with the assessments that have been made about quantitative contributions?

MR. PIETRANGELO: We tried to rely on some of the past work that EPRI had done to get those analytical insights. What came out of those reflected what we were seeing as the major causes of the events.

Now, reduced inventory conditions seems to be the dominant contributor, and the PRAs confirm that. I don't think the staff, thus far, has come up with different conclusions or surprises, as you asked about before.

This gets back to the complimentary approach. There were some people that wanted industry to do their own PRAs when we started out. The staff had already started their studies, had the utilities involved and had support from the owners groups. We didn't want to be redundant to what the staff was doing and do another set of PRAs.

MR. KERR: No, I just wondered if you had looked at them.

MR. PIETRANGELO: We relied on EPRI, the previous EPRI work, and we didn't do any new work in that area.

MR. CATTON: That was in 1983; wasn't it?

MR. PIETRANGELO: No. I think it is NSAC '83 and '84. I don't know the specific dates, but if memory serves me right, it's '85 or '86.

MR. CATTON: 1982 or '83 is where I first heard about it.

MR. KERR: I'm also curious as to the priority of this sort of thing. I remember, as you do, that in this recent survey, a year or so ago, a lot of utilities thought that they were already overburdened with regulatory requirements. This is going to be some additional burden. Where does it fit into the scheme of things? Is it number one priority at this point? Is that a question that has an answer? Maybe it doesn't.

MR. PIETRANGELO: I think the way I would answer that today is that we do think there are some things that could be done to address these concerns. We're not saying the concerns are justified at all. We do think it's an important issue and have treated it that way.

Our approach is that with regard to regulatory burden, our objective is for the staff's actions to compliment the actions that industry have undertaken.

I will give you a little bit of sense of our review of the comments from the working group meeting. We do think there are some things the staff can do that effectively compliment industries' efforts. There are other things that the staff is proposing that we do not think compliment industries' efforts. Our comments will reflect that.

MR. KERR: Thank you.

MR. WYLIE: The guidelines, basically, is a set of good practice guidelines that are basically that, with no defined responsibility for carrying them out. It's left up, I guess, by the individual utilities as to how they'll implement these.

In the case of most plants, I guess the plant manager or the vice president of the plant is the person that you put your finger on that's responsible for implementation of these guidelines.

MR. PIETRANGELO: That's who the document was targeted at, by the way, also, was senior plant management. That's who we wrote it for, because, really, we're talking -- I think the improvement, at least as viewed by the executives, is that we need to improve outage management, and that's why the document was targeted at senior plant managers.

MR. WYLIE: There are several of these though, that are corporate-wide recommendations, like communications of safety philosophies and the control of off-site power and switchyard activities, which may not be part of the plan.

Is there any discussion as to how these would be carried out?

MR. PIETRANGELO: You're right. We are leaving it up to the individual utilities to do that. Our guideline that addresses -- all we're saying is that you should have an administrative policy for control of the switchyard. Now, how you implement that at your utility is your management decision.

MR. WYLIE: Of course, you may not even have a switchyard.

MR. PIETRANGELO: That's correct.

MR. WYLIE: But there are some recommendations in here about controlling maintenance on lines during shutdown, which means that you're going to have a certain amount of communication --

MR. PIETRANGELO: You're absolutely right.

MR. WYLIE: -- within the organization outside of the plant.

MR. PIETRANGELO: That's correct. And I remember a discussion about that point in the working group. The key point is that the control room is aware when, let's say, your T&D people are doing something on your system that could impact your plant.

Typically, those organizations are not part of the nuclear family that runs that station. Okay?

MR. WYLIE: Right.

MR. PIETRANGELO: That is a problem, and it was recognized.

Now, how you administratively control that, do they call you before they go out and do it, do they have to come to you, to get your authorization to do that specific work, those decisions on implementation are left up to the management of the utilities.

We didn't feel we were in a position with the working group to tell them how they should implement that.

MR. WYLIE: Certainly, NUMARC could make a recommendation as to that regard rather than leaving it undefined.

MR. PIETRANGELO: There's a lot of sensitivity to having NUMARC tell you how to run your business.

MR. WYLIE: They're all in the same business.

MR. KRESS: Are there any other questions from the members?

[No response.]

MR. KRESS: Does the staff want to make any last-minute observations or comments?

MR. HOLAHAN: With respect to the NUMARC program?

MR. KRESS: Yes. Or with respect to the whole thing.

MR. HOLAHAN: With respect to the NUMARC program, I guess, we have worked closely with NUMARC. We've had about four public meetings, I believe. I can't count them exactly. We do feel that their program has been very useful. It looks like a well-thought-out program. We think it is beginning to make a difference. For the role that they have chosen, I think they've done a good job.

From the staff's point of view, we still have a concern about how this guidance will be implemented at the individual plants. I don't consider that a criticism of NUMARC's activities, because they chose not to go into that as part of the scope of their activities.

I would say the staff is pleased with what NUMARC has done. We think it perhaps doesn't answer all the questions of outage planning and control area, but it certainly goes a long way in the right direction.

MR. KRESS: One question I might have is, you're getting ready to go into your regulatory analysis phase and possibly make some recommendations. Will you continue to interact with NUMARC on those at some point along the line?

MR. HOLAHAN: Yes. In effect, what we're doing is we've made the report available for public comment, and we intend to have a public meeting. We understand that NUMARC wishes to participate in those processes. So, as part of the public comment process, we expect a few more meetings and, certainly, comments from NUMARC.

MR. KERR: Does the staff ever say, informally or formally, to the industry, "Here is what we would like to see accomplished. How do you think is the best way to go about doing this?," or is that maybe not politically correct to operate that way?

MR. HOLAHAN: I am not sure how it's said, but we do have public meetings at which the staff suggests what activities it thinks the industry ought to be involved in. NUMARC makes some suggestions as to what it's willing to undertake. Somewhere in that process, I think at least in this case, an agreement came about that part of what the staff wanted to see accomplished is something that NUMARC wanted to do. So, in this example, I think it's worked.

MR. KERR: Thank you.

MR. KRESS: I think now we're at the point where we're going to talk about what to do tomorrow, and I believe we could go off the record now.

[Whereupon, at 4:45 p.m., the meeting was adjourned.]

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

NAME OF PROCEEDING: ACRS Plant Operations

DOCKET NUMBER:

PLACE OF PROCEEDING: Bethesda, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Marilynn Estep

Official Reporter
Ann Riley & Associates, Ltd.

NRC STAFF PRESENTATION TO ACRS SUBCOMMITTEE ON OPERATIONS

SHUTDOWN RISK PROGRAM

APRIL 1, 1992

PRESENTERS: GARY HOLAHAN, NRR; MARK CARUSO, NRR;
TONY D'ANGELO, NRR; MARK CUNNINGHAM, RES;
LEWIS CHU, BNL; DONNIE WHITEHEAD, SNL

ACRS SUBCOMMITTEE MEETING ON SHUTDOWN ISSUES

TOPICAL AGENDA

TOPIC	PRESENTER	SCHEDULE
INTRODUCTION	GARY HOLAHAN	8:45 - 9:00
TECHNICAL FINDINGS	MARK CARUSO	9:00 - 10:00
CONTROL OF SWITCHYARD	MARK CARUSO	10:00 - 10:15
BREAK		10:15 - 10:30
CONT. HATCH SURVEY	TONY D'ANGELO	10:30 - 11:00
REG REQUIREMENTS	GARY HOLAHAN	11:00 - 11:30
REG ANALYSIS APPROACH	MARK CARUSO	11:30 - 12:00
LUNCH		12:00 - 1:00
FUTURE STAFF ACTIONS	GARY HOLAHAN	1:00 - 1:30
STATUS OF RES PRAs	MARK CUNNINGHAM BNL AND SNL	1:30 - 2:30
BREAK		2:30 - 2:45
INDUSTRY PRESENTATION	NUMARC	2:45 - 3:30

SHUTDOWN RISK PROGRAM
STATUS

- TECHNICAL STUDIES COMPLETE

- NRR EVALUATION OF KEY ISSUES AND OTHER ISSUES COMPLETE

- TECHNICAL FINDINGS AND CONCLUSIONS IN NUREG-1449 (DRAFT FOR COMMENT) AND COMMISSION PAPER

- PILOT TEAM INSPECTIONS INITIATED

SHUTDOWN RISK PROGRAM
MAJOR TECHNICAL STUDIES

- REVIEW OF OPERATING EXPERIENCE (AEOD)
- PLANT VISITS (NRR)
- ACCIDENT SEQUENCE PRECURSORS (NRR/SAIC)
- LEVEL 1 PRA COARSE SCREENING (RES/BNL/SNL)
- PWR LOSS OF RHR ANALYSIS (NRR/RES/INEL)
- RAPID BORON DILUTION (NRR/BNL)
- CURRENT REGULATORY REQUIREMENTS (NRR/SAIC)
- INTERNATIONAL EXCHANGE ON SHUTDOWN ISSUES (NRR/SAIC)

ACRS LETTER OF 08/13/91
ISSUES FOR STAFF TO ADDRESS

- CONTAINMENT CLOSURE
  - NUMBER OF PWRs WITH PRESSURE-SEAT HATCHES
  - NUMBER OF PWRs WITH PRESSURE-OPEN HATCHES
  - SITES WHICH CAN CLOSE HATCH WITHOUT AC POWER

- REPRESENTATIVENESS OF SHUTDOWN PRAs
  - HOW WELL DO SURRY AND GRAND GULF PRAs REPRESENT PWR AND BWR POPULATIONS
  - TO WHAT EXTENT CAN THE PRAs BE USED IN MAKING REGULATORY DECISIONS

- CONSERVATIVE ASSUMPTIONS IN PRAs
  - DO NOT USE; CAN LEAD TO FLAWED REGULATORY DECISIONS

RESPONSE TO 08/13/91 ACRS LETTER
CONTAINMENT CLOSURE

- REQUESTED INFORMATION OBTAINED FROM SURVEY OF RESIDENT INSPECTORS

- SURVEY RESULTS DOCUMENTED IN NUREG-1449

- SURVEY RESULTS TO BE PRESENTED LATER THIS MORNING

RESPONSE TO 08/13/91 ACRS LETTER
REPRESENTATIVENESS OF PRAs

- STAFF AGREES PRAs NOT REPRESENTATIVE

- STAFF EVALUATION BASED PRIMARILY ON EXPERIENCE, PLANT VISITS AND ANALYSIS; PRAs NOT CRITICAL

- PRA AND PRECURSOR INSIGHTS PRIMARILY CONFIRMATORY

- RANGE OF CDF ESTIMATED FROM COMPLETED PRAs AND PRECURSOR RESULTS

RESPONSE TO 08/13/91 ACRS LETTER
CONSERVATIVE ASSUMPTIONS IN PRAs

- CONSERVATIVE COARSE SCREENING STUDY NOT BASIS FOR REGULATORY DECISIONS

- PURPOSE WAS TO ENSURE THAT POTENTIALLY IMPORTANT SEQUENCES WERE IDENTIFIED

- CONSERVATISM BEING REMOVED IN REFINED LEVEL 1 STUDY

NUREG-1449
TECHNICAL ISSUES

- OUTAGE PLANNING AND CONTROL
- STRESS ON PERSONNEL AND PROGRAMS
- OPERATOR TRAINING
- TECHNICAL SPECIFICATIONS
- RESIDUAL HEAT REMOVAL CAPABILITY
- TEMPORARY RCS BOUNDARIES
- RAPID BORON DILUTION
- CONTAINMENT CAPABILITY
- FIRE PROTECTION
- FUEL HANDLING AND HEAVY LOADS
- ONSITE EMERGENCY PLANNING

TECHNICAL FINDINGS AND CONCLUSIONS
OUTAGE PLANNING AND CONTROL

- OUTAGE PLANNING AND CONTROL EXTREMELY IMPORTANT TO SAFETY; IMPROVEMENTS NEEDED
- QUALITY OF PROGRAMS VARIES WIDELY
- SAFETY CONSIDERATIONS OFTEN MINIMAL
- MANY PROGRAMS LACKED:
  - FORMAL POLICY AND SAFETY CRITERIA
  - INDEPENDENT SAFETY REVIEW
  - USE OF SAFETY ANALYSIS AND RISK INSIGHTS
  - FEEDBACK OF EXPERIENCE
- INDUSTRY GUIDELINES BEING IMPLEMENTED
  - PROVIDES HIGH-LEVEL GUIDANCE BUT LACKS DETAIL FOR PROGRAM DEVELOPMENT

OUTAGE PROGRAM
STAFF'S ELEMENTS

- CLEAR SAFETY PRINCIPALS
- CLEAR ORGANIZATIONAL ROLES AND RESPONSIBILITIES
- CONTROLLED PROCEDURE FOR PLANNING PROCESS
- PRE-PLANNING FOR ALL OUTAGES
- STRONG TECHNICAL INPUT FROM ANALYSIS
- INDEPENDENT SAFETY REVIEW OF THE PLAN AND MODS
- REAL TIME SAFETY INFORMATION DURING OUTAGE
- CONTINGENCY PLANS AND BASES
- REALISTIC CONSIDERATION OF STAFFING NEEDS
- TRAINING
- FEEDBACK OF EXPERIENCE TO PLANNING PROCESS

TECHNICAL FINDINGS AND CONCLUSIONS
STRESS ON PERSONNEL AND PROGRAMS

- STRESS PRODUCED MAINLY BY:
  - LARGE WORKLOAD
  - RAPIDLY CHANGING PLANT CONFIGURATIONS
- STRESS RELIEVED BY:
  - SUFFICIENT STAFFING LEVELS
  - PROPER TRAINING OF PERSONNEL
  - CONTINGENCY PLANS FOR MITIGATING EVENTS
- RELIEF IS BEST ACHIEVED THROUGH GOOD OUTAGE MANAGEMENT; NUMARC GUIDELINES SHOULD BE EFFECTIVE IN THIS AREA

TECHNICAL FINDINGS AND CONCLUSIONS
OPERATOR TRAINING

- TRAINING AND EXAMS EMPHASIZE SHUTDOWN LESS THAN POWER OPERATIONS

- LICENSEE TRAINING FOR SHUTDOWN WILL EXPAND AS RESULT OF IMPROVED OUTAGE PROGRAMS

- GUIDANCE FOR NRC EXAMINERS WILL EMPHASIZE SHUTDOWN MORE AS TRAINING PROGRAMS GIVE MORE EMPHASIS TO SHUTDOWN

TECHNICAL FINDINGS AND CONCLUSIONS
SIMULATORS

- NRC REQUIRES SIMULATOR CAPABILITY DOWN TO COLD SHUTDOWN UNTIL HEAD IS REMOVED

- SIMULATORS NOW USED BY SOME TO TRAIN FOR PLANT RESPONSE TO SHUTDOWN ACCIDENTS

- SIMULATORS HELPFUL, BUT OFF-LINE T-H ANALYSIS MUST COME FIRST

- NON-SIMULATOR TRAINING FOR ACTIONS OUTSIDE CONTROL ROOM ALSO NECESSARY

TECHNICAL FINDINGS AND CONCLUSIONS
TECHNICAL SPECIFICATIONS

- CURRENT STANDARD TECH SPECS DON'T FULLY AND CONSISTENTLY RECOGNIZE VARIATION IN SAFETY MARGIN WITH SHUTDOWN CONDITIONS
  - DECAY HEAT RATE
  - WATER LEVEL
  - RCS INTEGRITY
  - AVAILABILITY OF MITIGATION SYSTEMS
  - CONTAINMENT CLOSURE

- SOME OLDER PLANTS DO NOT HAVE BASIC TECH SPECS FOR RHR OR ELECTRICAL SYSTEMS

- STAFF IS EVALUATING IMPROVEMENTS TO TECH SPECS
  - RHR
  - ECCS
  - AC POWER
  - PWR CONTAINMENT INTEGRITY

TECHNICAL FINDINGS AND CONCLUSIONS
PWR RHR CAPABILITY

- EXTENDED LOSS OF RHR CAPABILITY CAN LEAD TO CORE UNCOVERY IN RELATIVELY SHORT TIME
  - 1.5 HOURS (RCS OPEN 2 DAYS AFTER SHUTDOWN)
  - 15 MIN (NO VENT, CLD LEG OPEN, 8 DAY)
- PASSIVE METHODS FOR RHR CAN BE VERY EFFECTIVE IN DELAYING OR PREVENTING A SEVERE ACCIDENT BUT PROCEDURES AND TRAINING ARE LACKING
  - GRAVITY FEED FROM RWST AND ACCUMULATOR
  - REFLUX COOLING
- LICENSEE PERFORMANCE IN RESPONSE TO GENERIC LETTER 88-17 MIXED

TECHNICAL FINDINGS AND CONCLUSIONS
BWR RHR CAPABILITY

- FREQUENCY AND SEVERITY OF BWR EVENTS LESS THAN THAT FOR PWRs

  - BWRs DON'T ENTER "MID-LOOP" CONDITION
  - BETTER VESSEL WATER LEVEL INSTRUMENTATION
  - BWRs HAVE MULTIPLE AND DIVERSE MEANS FOR DECAY HEAT REMOVAL

- LOSS OF RHR IN BWRs NOT SIGNIFICANT SAFETY ISSUE AS LONG AS MITIGATIVE EQUIPMENT IS AVAILABLE

TECHNICAL FINDINGS AND CONCLUSIONS
TEMPORARY RCS BOUNDARIES

- TEMPORARY BOUNDARIES IDENTIFIED INCLUDE:

  - FREEZE SEALS
  - NOZZLE DAMS (PWRs)
  - STEAM LINE PLUGs (BWRs)
  - INSTRUMENT TUBE PLUGS

- FAILURE OF SEALS CAN RESULT IN NON-ISOLABLE LOCA

- ECCS, INCLUDING RECIRC, NEEDS TO BE OPERABLE FOR MITIGATION

- SAFETY EVALUATIONS FOR TEMPORARY SEALS NEED TO BE PERFORMED

TECHNICAL FINDINGS AND CONCLUSIONS
RAPID BORON DILUTION

- DILUTED WATER SLUG IN RCS POSSIBLE BUT UNLIKELY
- CONCENTRATION IN SLUG ONLY 200-300 PPM LESS THAN RCS CONCENTRATION DUE TO MIXING
- SLUG CONCENTRATION MUST BE LESS THAN 1/2 OF RCS CONCENTRATION (1500 PPM) FOR FUEL DAMAGE
- WESTINGHOUSE CALCS BOUND CONSEQUENCE WITH SOME FUEL DAMAGE BUT NO RUPTURE OF VESSEL

TECHNICAL FINDINGS AND CONCLUSIONS
CONTAINMENT CAPABILITY

- OFFSITE DOSES SIGNIFICANT 2 DAYS AFTER SHUTDOWN FOR OPEN CONTAINMENT

- BWR SECONDARY CONTAINMENT CALCULATED TO FAIL AFTER STEAMING

- PWR CONTAINMENT ENVIRONMENT
  - 150 DEG F 1 HOUR AFTER BOILING
  - SELF CONTAINED BREATHING RIG NEEDED
  - DOSE LEVELS WOULD REQUIRE USE OF RESPIRATOR

TECHNICAL FINDINGS AND CONCLUSIONS
CONTAINMENT CAPABILITY

- WEAKNESSES EXIST IN CONTAINMENT CLOSURE PROCEDURES IMPLEMENTED PER GL 88-17
  - USE OF WATER SEALS
  - CONTAINMENT WORK ENVIRONMENT NOT ADDRESSED
  - NO WALK THROUGH OF PROCEDURE
  - SOME "CLOSED" HATCHES HAD GAPS

- CONTAINMENT CONCERNS ELIMINATED IF CONTAINMENT CLOSED OR ASSURED TO BE CLOSED PRIOR TO RELEASE OF STEAM

TECHNICAL FINDINGS AND CONCLUSIONS
FIRE PROTECTION

- PLANT VISITS INDICATE HIGHER LIKELIHOOD OF FIRE DURING SHUTDOWN
  - INCREASED IGNITION SOURCES
  - INCREASED TRANSIENT COMBUSTIBLES

- CURRENT NRC REQUIREMENTS DON'T COVER FIRE PROTECTION DURING SHUTDOWN
  - SRP GUIDANCE FOR HAZARDS ANALYSIS
  - DHR SYSTEMS EXEMPT FROM APPENDIX R TO ACCOMMODATE MAINTENANCE

- STAFF EVALUATING ADDITIONAL REQUIREMENTS

TECHNICAL FINDINGS AND CONCLUSIONS
FUEL HANDLING AND HEAVY LOADS

- STAFF REVIEWED EXPERIENCE, PRAs AND CURRENT REQUIREMENTS; SURVEYED REGIONAL OFFICES
  - CURRENT REQUIREMENTS WRITTEN FOR SHUTDOWN CONDITIONS
  - NO NEW SAFETY ISSUES IDENTIFIED

- CURRENT PEQUIREMENTS ARE ADEQUATE

TECHNICAL FINDINGS AND CONCLUSIONS
ONSITE EMERGENCY PLANNING

- INDUSTRY GUIDANCE FOR SHUTDOWN EALs CURRENTLY NON-EXISTENT

- CURRENT EALs FOR SHUTDOWN VARY WIDELY AND HAVE BEEN OBSERVED TO BE CONSERVATIVE

- STAFF WILL WORK WITH INDUSTRY TO ISSUE NEW GUIDANCE BASED ON SHUTDOWN STUDIES I.E A REVISED NUREG-0654 (EXPECTED IN SPRING 1993)

CONTROL OF SWITCHYARD ACTIVITIES

- EVENTS CAUSED BY SWITCHYARD ACTIVITIES HAVE CONTINUED TO OCCUR SINCE THE VOGTLE EVENT

  - MCGUIRE 2/91 (AT POWER)
  - DIABLO CANYON 3/91 (SHUTDOWN
  - VERMONT YANKEE 4/91 (AT POWER)
  - PALO VERDE 11/91 (SHUTDOWN)

- STAFF ACTIONS

  - INFORMATION NOTICES (90-25, 91-81, 92-13)
  - AUGMENTED TEAM INSPECTIONS
  - OUTAGE INSPECTIONS (TI 2515/113)
  - NUREG-1449 EVALUATION

CONTROL OF SWITCHYARD ACTIVITIES

- INDUSTRY ACTION

  - GUIDELINES (NUMARC 91-06) FOR CONTROL BEING IMPLEMENTED INDUSTRYWIDE:

  1) ESTABLISH POLICY FOR ADMIN CONTROL
  2) SPECIAL PRECAUTIONS WHEN NEAR POWER LINES
  3) EVALUATE FOR SINGLE FAILURE VULNERABILITIES
  4) PERIODIC INSPECTION BY SAFETY PERSONNEL
  5) NO MAINTENANCE DURING SENSITIVE CONDITIONS
  6) DON'T USE YARD FOR STORAGE OR LAYDOWN

- NRC STAFF CONCLUSIONS

  - ENSURE SWITCHYARD COVERED IN OUTAGE PROGRAM
  - CONTINUE TO INSPECT

CONTAINMENT HATCH SURVEY
SOURCE OF DATA

- SURVEY SENT TO RESIDENT INSPECTORS AT ALL PWR AND BWR SITES

- INSPECTORS WERE ASKED TO NOTE HATCH TEST METHODS BEYOND APP. J

CONTAINMENT HATCH SURVEY
PRINCIPAL RESULTS AND OBSERVATIONS

- MAJORITY OF HATCHES ARE PRESSURE SEATING (67% FOR BWRs & 86% FOR PWRs)
- 52 NEED COMPRESSED AIR OR AC POWER TO CLOS
- 22 CAN CLOSE HATCH DURING STATION BLACKOUT (INSPECTOR FOUND PROCEDURE OR WORK REQUES
- 6 PWRs DO NOT REQUIRE HATCH INSTALLED FOR FUEL MOVEMENT
- 3 PWRs HAVE TEMPORARY PLATE INSTALLED DURING FUEL MOVEMENT (ONE RATED FOR 3 PSID)

CONTAINMENT HATCH SURVEY

ADDITIONAL OBSERVATIONS BY INSPECTORS

- 2 PLANTS RAN APPENDIX J TEST WITH MIN NUMBER OF BOLTS INSTALLED

- 3 PLANTS HAVE NOTICED HATCH SEAL DOES NOT MAKE CONTACT WITH FLANGE SURFACE WITH MINIMUM NUMBER OF BOLTS INSTALLED

- SAN ONOFRE 1 LOADS NEW FUEL THROUGH HATCH

SHUTDOWN RISK PROGRAM

ISSUES FOR FORMAL REGULATORY ANALYSIS

1. OUTAGE PLANNING AND CONTROL
2. FIRE PROTECTION
3. OPERATIONS, TRAINING, PROCEDURES AND CONTINGENCY PLANS
4. TECHNICAL SPECIFICATIONS
5. INSTRUMENTATION

SHUTDOWN RISK PROGRAM

ISSUES FOR FORMAL REGULATORY ANALYSIS

1. OUTAGE PLANNING AND CONTROL

- OUTAGE PLANNING AND CONTROL SO CENTRAL TO SHUTDOWN SAFETY THAT SOME REGULATORY INVOLVEMENT WARRANTED (POSSIBLY BY RULE)

- QUALITY IMPROVEMENTS IN OUTAGE PROGRAMS WILL:

  - REDUCE FREQUENCY OF INCIDENTS
  - REDUCE STRESS ON PERSONNEL
  - IMPROVE INCIDENT RESPONSE CAPABILITY

SHUTDOWN RISK PROGRAM
ISSUES FOR FORMAL REGULATORY ANALYSIS

2. FIRE PROTECTION

- DURING SHUTDOWN:
  - CHANCE OF FIRE GREATER
  - FEWER CONTROLS IN EFFECT
  - LESS EQUIPMENT MAY BE AVAILABLE

- NEED SHUTDOWN FIRE HAZARDS ANALYSIS WITH FOCUS ON DECAY HEAT REMOVAL SYSTEMS

- ADMIN CONTROLS SHOULD BE STRENGTHENED TO IMPROVE FIRE PREVENTION AND PROTECTION (AS PART OF OUTAGE PROGRAM)

SHUTDOWN RISK PROGRAM

ISSUES FOR FORMAL REGULATORY ANALYSIS

3. <u>OPERATIONS, TRAINING, PROCEDURES AND CONTINGENCY PLANNING</u>

- BROADEN THE SCOPE OF THE GL 88-17 RECOMMENDATIONS

- IMPROVE CONTINGENCY PLANNING AND ABNORMAL OPERATING PROCEDURES THROUGH MORE RIGOROUS TECHNICAL BASES

- INCORPORATE SAFETY CONSIDERATIONS IN OVERALL TRAINING ON SHUTDOWN OPERATIONS

SHUTDOWN RISK PROGRAM

ISSUES FOR FORMAL REGULATORY ANALYSIS

4. <u>TECHNICAL SPECIFICATIONS</u>

- IMPROVEMENTS BEING DEVELOPED TO:
  - ENSURE SUFFICIENT AC POWER SOURCES AVAILABLE DURING HIGHER RISK CONDITIONS
  - ENSURE ADEQUATE DECAY HEAT REMOVAL AND INVENTORY CONTROL CAPABILITY DURING HIGHER RISK CONDITIONS
  - ENSURE CONTAINMENT INTEGRITY IN PWRs DURING HIGHER RISK CONDITIONS

SHUTDOWN RISK PROGRAM

ISSUES FOR FORMAL REGULATORY ANALYSIS

5. INSTRUMENTATION

- EXTEND GL 88-17 RECOMMENDATIONS BEYOND REDUCED INVENTORY CONDITIONS IN PWRs AND TO BWRs IN THE FOLLOWING AREAS:

  - CORE COOLANT TEMPERATURE
  - LEVEL INDICATION (PWR ONLY)
  - RCS PRESSURE IN CONTROL ROOM
  - ADEQUACY OF RHR MONITORING
  - ANNUNCIATORS AND ALARMS
  - REFUELING CAVITY LOW LEVEL ALARM

REGULATORY ANALYSIS

OVERVIEW

- USING LATEST STAFF GUIDANCE FOR REGULATORY ANALYSIS AND SAFETY GOAL IMPLEMENTATION

- QUANTITATIVE COST/BENEFIT ANALYSIS USING BEST ESTIMATE INFORMATION TO THE EXTENT AVAILABLE

- SUPPLEMENTAL CONSIDERATIONS TO ADDRESS UNCERTAINTIES AND DEFENSE-IN-DEPTH

REGULATORY ANALYSIS
IMPLEMENTATION

- EXAMINE VARIOUS APPROACHES AFTER TECHNICAL DECISIONS HAVE BEEN MADE

- IMPLEMENTATION STRATEGY MAY INVOLVE COMMISSION POLICY DECISION

- POTENTIAL STRATEGIES:

  (1) GENERIC LETTER
  (2) TECHNICAL SPECIFICATIONS
  (3) RULE(S)

REGULATORY ANALYSIS
EXAMPLE SETS OF REQUIREMENTS

REGULATORY ACTION	OUTAGE PROGRAM	TECH SPECS
MINIMAL	COMMISSION POLICY STATEMENT CALLING FOR PROGRAM	IMPOSE CURRENT STS ON ALL PLANTS
MODERATE	REQUIRE PROGRAM BY RULE OR ADMIN TECH SPEC; INSPECT FOR COMPLIANCE	APPLY MODE 1 LCOs IN LOWER MODES DURING HIGHER RISK EVOLUTIONS
EXTENSIVE	REQUIRE PROGRAM; APPROVE SPECIFIC OUTAGE PLANS; TEAM INSPECTIONS	APPLY MODE 1 LCOs ENTIRE OUTAGE; RELAX AOTs TO DO MAINTENANCE

SHUTDOWN RISK PROGRAM
PROPOSED STAFF ACTIONS

- INSPECTION PROGRAM
  - TEAM INSPECTIONS
  - INSPECT FOR 50.59 EVAL OF FREEZE SEAL
- OPERATOR LICENSING PROGRAM
  - REVISE EXAMINER STANDARDS FOR MORE EMPHASIS ON SHUTDOWN OPERATIONS
- ANALYSIS OF OPERATIONAL DATA
  - DEVELOP MONITORING PROGRAM INCLUDING INDICATOR OF PERFORMANCE
- EMERGENCY PLANNING
  - DEVELOP EMERGENCY ACTION LEVELS FOR SHUTDOWN CONDITIONS

SHUTDOWN RISK PROGRAM
FUTURE ACTIVITIES

- PUBLIC MEETING TO DISCUSS NUREG-1449
- CONDUCT REGULATORY AND BACKFIT ANALYSIS
- CONTINUE TO FACTOR RESULTS OF SHUTDOWN RISK PROGRAM INTO ADVANCED REACTOR REVIEWS
- CONTINUE LEVEL 1 AND 2 PRA STUDIES IN RES
- PILOT TEAM INSPECTION AT INDIAN PT 3 (5/92)
- DEVELOP DECISION PACKAGE AND REVIEW WITH CRGR, ACRS AND COMMISSION BY MID-1992

Advisory Committee on Reactor Safeguards

Plant Operations Subcommittee

April 1, 1992

INDUSTRY ACTIVITIES TO ADDRESS SHUTDOWN PLANT ISSUES

Tony Pietrangelo

NUMARC

OVERVIEW

- o Background
- o NUMARC 91-06
- o Shutdown Management Initiative
- o Coordinated Industry Approach
- o Conclusions

BACKGROUND

- Industry and regulatory concerns driven by shutdown events and PRA studies

- NUMARC coordinated industry activities and provided interface with NRC

- NUMARC formed the Shutdown Plant Issues Working Group

BACKGROUND

Shutdown Plant Issues Working Group

Chairman

- Harry Keiser
  Senior Vice President - Nuclear
  Pennsylvania Power & Light

Membership

- 22 individuals
- Executives, managers and supervisors
- Broad spectrum of plants
- NSSS Owners Groups
- EPRI
- INPO

BACKGROUND

Working Group Activities

- o Reviewed input from utilities, INPO, EPRI, Owners Groups, and NRC staff

- o Concluded that proper outage planning and control could enhance safety during shutdown

- o Developed NUMARC 91-06

- o Recommended an industry initiative associated with NUMARC 91-06

NUMARC 91-06

Guidelines for Industry Actions to Assess Shutdown Management

Intent

- o Provide a framework for utilities to assess current practices for managing outages

- o Extend the defense in depth safety philosophy to shutdown operations

- o Address major vulnerabilities present during shutdown conditions

NUMARC 91-06

Content

Outage Planning and Control

- o Integrated management
- o Providing defense in depth
- o Controlling level of activities
- o Contingency planning
- o Training
- o Outage safety review

NUMARC 91-06

Content

Shutdown Safety Issues

- o Decay heat removal capability
- o Inventory control
- o Power availability
- o Reactivity control
- o Containment

SHUTDOWN MANAGEMENT INITIATIVE

Commitment by nuclear utilities to:

Assess current practices, using NUMARC 91-06, to plan and conduct outages.

Improvements adopted as a result of the assessment will be implemented for outages started after 12/31/92.

COORDINATED INDUSTRY APPROACH

NUMARC Activities

- o Developed and issued NUMARC 91-06

- o Board of Directors approved initiative

- o Conducted shutdown assessment workshop

- o Coordinate industry comments on NUREG-1449

COORDINATED INDUSTRY APPROACH

INPO Activities

- o Communication through workshops, conferences, courses and publications

- o Outage review visits

  - 13 completed in 1991
  - 17 planned for 1992

- o Outage management guidelines

  - revision will include appropriate guidance from NUMARC 91-06 and insights gained through review visits

COORDINATED INDUSTRY APPROACH

EPRI Activities

- o ORAM program will provide additional source documents and risk management tools for utility use

  - Surveys of BWR and PWR plant personnel on shutdown safety practices (NSAC 173 and 174)

  - Safety assessments of BWR and PWR risk during shutdown operations (NSAC 175 and 176)

  - Other documents and PC software to aid outage planning and control

CONCLUSIONS

- o Industry actions will result in improved outage planning and control

- o Utilities need time to effectively incorporate improvements resulting from industry activities

- o Complementary industry and NRC actions can effectively enhance safety during shutdown

Overview of RES
Low Power and Shutdown Risk Analysis

Mark A. Cunningham
Office of Nuclear Regulatory Research
301-492-3965

April 1, 1992

Overview of Presentation

- o Summary of Phase I and Phase II Program (M. Cunningham, NRC)
- o Phase II Level 2/3 Analysis (C.Ryder, NRC)
- o Surry Phase I results, Phase II program (T-L Chu, BNL)
- o Grand Gulf Phase I results, Phase II program (D. Whitehead, SNL)

Objectives of RES Risk Analysis Program

Phase I: Screening risk analysis

- Provide initial insights as to any particularly vulnerable plant operational states,

- Characterize on a high, medium, or low basis the potential core damage frequency contribution associated with individual accident sequences,

- Provile a preliminary risk characterization associated with these accident sequences,

- Provide a foundation upon which the detailed Phase II analysis could focus its efforts.

Objectives (cont.)

Phase II: Detailed PRA

- o Estimate the frequencies and risks associated with severe accidents initiated during plant operational modes other than full power operation,
- o Compare the estimated core damage frequencies, important accident sequences, risks, and other qualitative and quantitative results of this study with those of accidents initiated during full power operation (as assessed in NUREG-1150), and
- o Demonstrate risk analysis methods for plants in other than full power mode of operation.

Summary Results of Phase I Program

- Identification of plant operating states
- Comparison/confirmation of significant issues
- Prioritization of plant operating states

Summary of Phase II Program

Base Case Level 1 Analysis

- o Internal events, including fire/flood
- o Seismic
- o Conventional HRA
- o Uncertainty/sensitivity analysis

Comprehensive Human Reliability Analysis

- o Develop human error quantification method
- o Conduct HRA quantification and estimate associated uncertainties
- o Develop insights regarding the contribution of human performance to plant risk

Level 2/3 Analysis

- o Initial abridged analysis
- o Follow-up detailed analysis

Phase II Schedule

- Level 2/3 abridged analysis: May 1992
- Base case Level 1 analysis: January 1993
- Comprehensive HRA methods recommendations: December 1992

Status of Level 2 and 3 Low Power and Shutdown Risk Study

Presentation to ACRS on
April 1, 1992

Christopher Ryder,
PRAB/DSIR/RES
(301) 492-3959

I. Objective: To calculate approximate consequences of an accident during a plant operating state

A. Abridged calculations to support regulatory decisions to be made in early summer of 1992

B. Based on Phase 1 CDF coarse screening estimates - only conditional consequences

C. Duration of abridged Level 2 and 3 study - 4 months

D. Provide information base for subsequent PRA

E. Subject POSs
   1. Grand Gulf: POS #6 (vessel head off prior to raising level to refuel)
   2. Surry (PWR): POS #6 (mid-loop)

F. Products to NRR:
   1. Distributions of conditional consequences
   2. Key events of accident progressions
   3. Event timings and time windows
   4. Strong points and weak points of the analyses

II. Attributes of the study

A. Simple containment event tree

B. Parametric source terms

C. MELCOR calculations for
   1. Accident progression modelling
   2. Parametric source term benchmarking

D. Limited accounting of uncertainty
   1. Branch point probabilities of APET
   2. Source terms

E. Consequences
   1. Onsite - correlations
   2. Offsite - MACCS

III. Schedule

A. April 30, 1992: Complete calculations

B. May 6, 1992: Results presented to NRC staff

C. May 30, 1992: Report: executive summary style, 25 pages

PWR LOW POWER AND SHUTDOWN ACCIDENT FREQUENCIES PROGRAM LEVEL 1 PROBABILISTIC RISK ASSESSMENT

PROGRESS REPORT

Presented by

T-L. Chu

Department of Nuclear Energy
Brookhaven National Laboratory
(516) 282-2389
FTS 666-2389

Presented to

Advisory Committee on Reactor Safeguards

April 1, 1992

bnl
aui

OUTLINE OF PRESENTATION

- Overview of Presentation
- Phase 1 Study Objective and Approach
- Phase 1 Study Highlights
  - Vulnerable Configurations
  - A Station Blackout Scenario
  - Maintenance Unavailability
  - Startup of a RCP after Improper Dilution
- Fire and Flood Screening Approach
- Seismic Scoping Study
- Phase 2 Study Scope and Objective
- Status of Level 1 Internal Event Analysis
  - On-going Tasks
  - Remaining Tasks

STATUS OF PWR LP&S PROGRAM

- Initiated in Fall 1989 with limited effort
- Senior Consulting Group Meetings

    March 1990
    January 1991
    November 1991

- Phase 1 Internal Event Analysis Report - June 1991
- Phase 1A Report with Fire and Flood - October 1991
- Presentation to ACRS - June 1991
- Phase 2 Program for Mid-Loop Operation

    Level one with Fire, Flood and Seismic - January 1993
    Abridged Level 2/3 Analysis - May 1992
    Comprehensive HRA Methodology Development - December 1992

PHASE 1 STUDY APPROACH

- 3 Outage Types
- 15 Plant Operational States for a Refueling Outage
- Initiating Event Analysis
- Event Tree Development
- Screening Quantification Methodology
- Simplified Human Reliability Analysis
- Data Base Development
- Grouping of Accident Sequences
- Screening Fire, Flood and Seismic Analysis

HIGHLIGHTS OF THE COARSE SCREENING ANALYSIS

- Vulnerable Configurations at Shutdown
  - Mid-loop operations
  - Temporary thimble tube seals
  - Isolation of the reactor coolant loops (loss of secondary as a heat sink)
- RHR System Is a Weakness in the RCS Pressure Boundary
- Failure to Recirculate due to Sump Plugging
- Maintenance Unavailability

HIGHLIGHTS OF THE COARSE SCREENING ANALYSIS

(Continued)

- Temporary Thimble Tube Seals
  - Temporary seals are used at the seal table when the flux thimble tubes are removed prior to refueling
  - Design pressure of the temporary seals is at 30 psia
  - Approximately 10 days per refueling, the temporary seals are in place with the RCS closed
  - Any pressurization event during this time can cause a LOCA and subsequent core uncovery

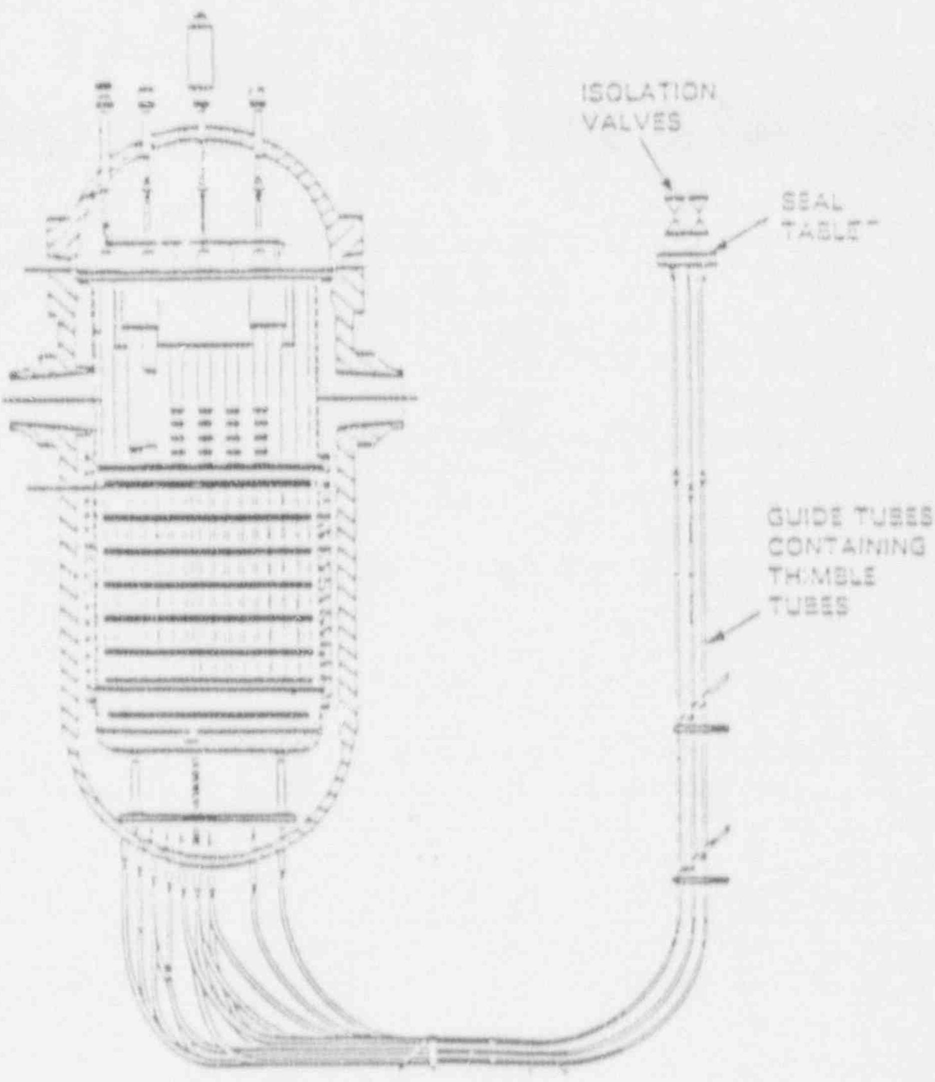


Figure 8.17 Thimble Tube Configuration

HIGHLIGHTS OF THE COARSE SCREENING ANALYSIS (Continued)

- Station Blackout while RHR is Initially Operating
  - Approximately 6 hours after shutdown, RHR may be running
  - Decay heat rate would be at 20 MW
  - Main Steam Trip Valves (MSTVs) are open - steaming to condenser
  - Secondary Relief Valves have high set point, fail closed and cannot be opened manually due to the blackout - secondary bottled up
  - Auxiliary Feedwater System is isolated from the Steam Generators by closed MOVs inside containment
  - Operator fails to locally open the bypass valves around the MSTVs
  - Primary system temperature and pressure increase

HIGHLIGHTS OF THE COARSE SCREENING ANALYSIS

(Continued)

- Station Blackout while RHR is Initially Operating
  - Pressurizer becomes solid at 42 minutes
  - PORVs and RHR relief valve are unable to relieve the steam generated in the vessel
  - RHR system ruptures leading to a LOCA and core damage

HIGHLIGHTS OF THE

COARSE SCREENING ANALYSIS

(Continued)

- Maintenance Unavailabilities

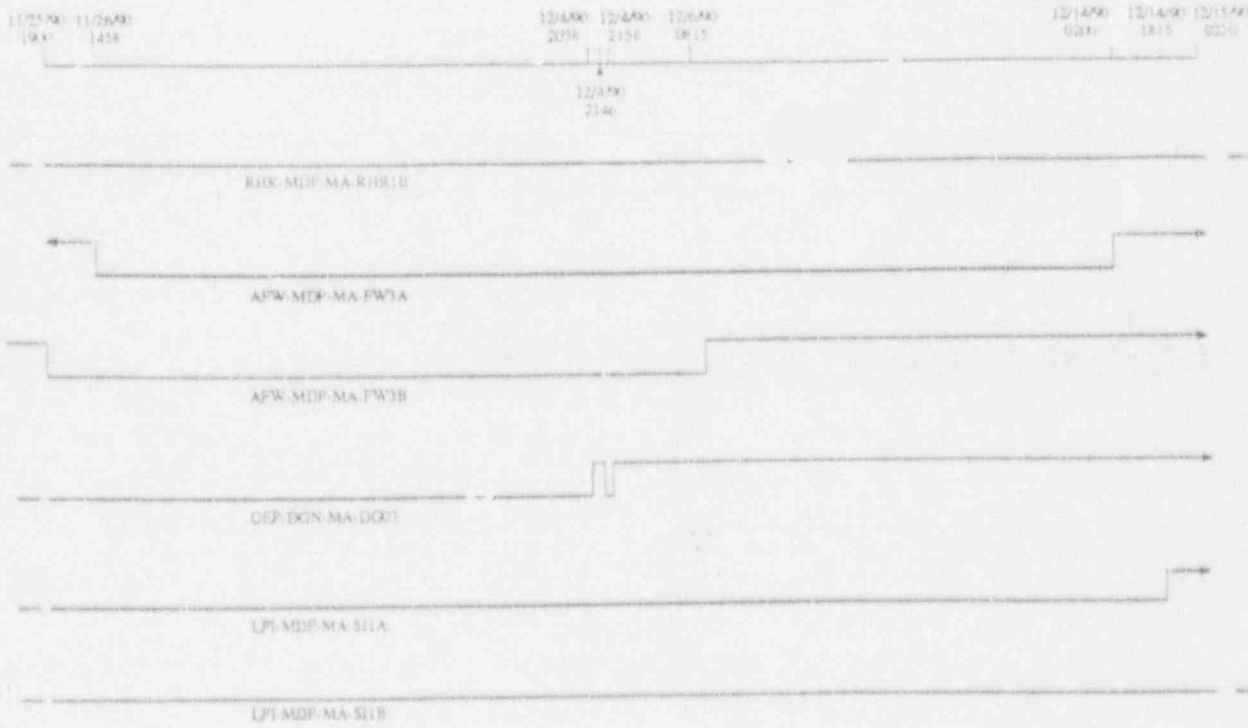
  - High maintenance unavailabilities have been estimated during shutdown

  - The plant model reflects the situation that simultaneous maintenance of redundant equipment is not directly prohibited

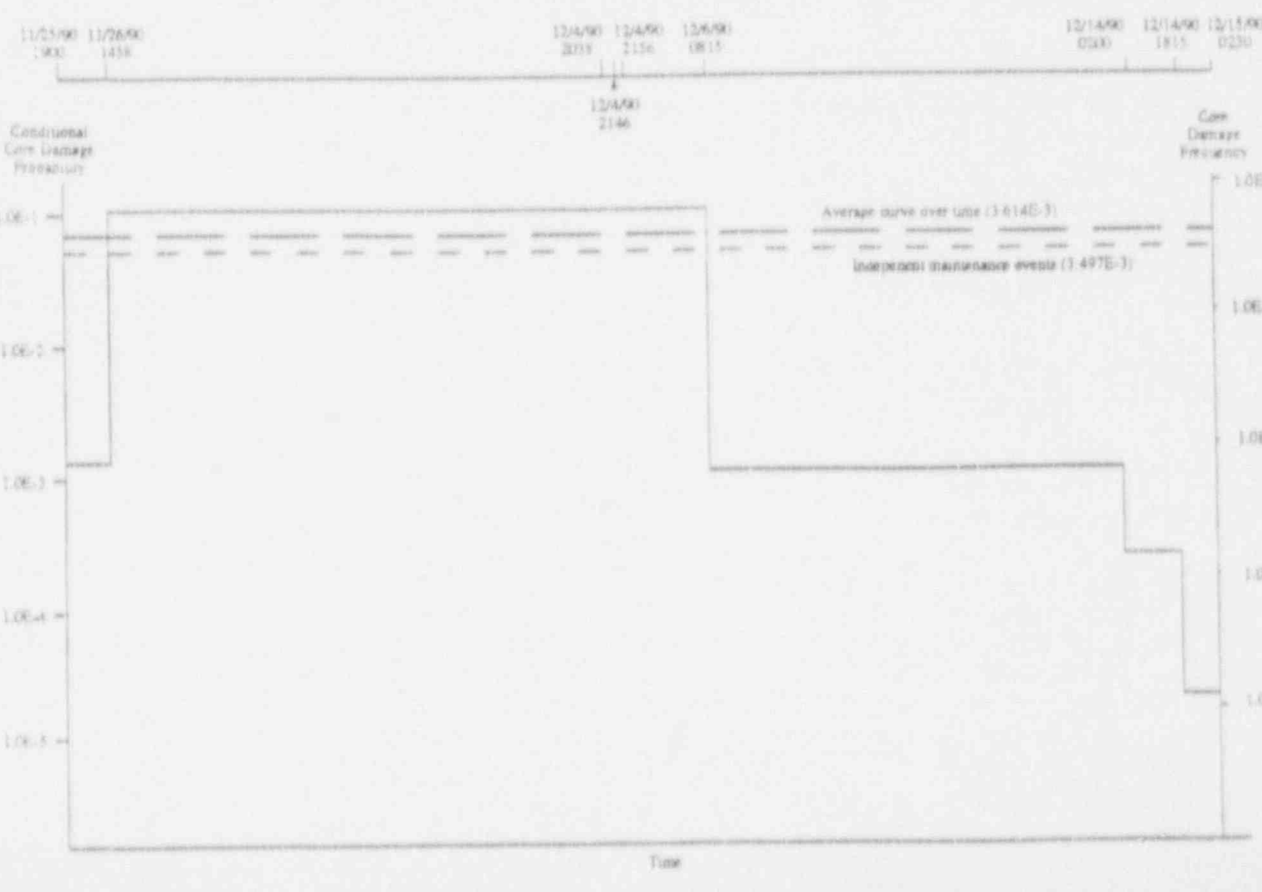
  - In the screening analysis high core damage frequencies resulted from the above

  - A more realistic model will be developed as part of Phase 2

Downtime of Selected Components in POS 12 of Oct. 1990 Outage



Time Dependent Analysis of Conditional Core Damage Probability in POS 12 of Oct. 1990 Outage



STARTUP OF RCP AFTER IMPROPER DILUTION
"THE FRENCH SCENARIO"

- Startup mode with dilution from CVCS
  - Primary grade water going into VCT charging pumps take from VCT into RCS
- Postulate loss of offsite power (LOSP)
  - RCPs trip, charging pumps energized from emergency bus
- Assume unborated water does not mix well
  - Diluted region forms at RPV lower head
- RCP is restarted by operator
  - Diluted slug of water passes through core causing power excursion and core damage

FIRE AND FLOOD SCREENING ANALYSIS

- Two plant operational states were chosen: mid-loop and refueling
- Screening quantification was done for mid-loop operations
- Based on NUREG-1150 location analysis
- Relevant event trees were quantified assuming everything in the area failed
- Fire Progression and Suppression was not modeled
- Collection of information needed for detailed Phase 2 analysis

FINDINGS OF FIRE ANALYSIS

- Surry's implementation of Appendix R lacks emphasis on shutdown conditions

  - Credit was taken for replacement of RHR and CCW pump cables within 72 hours of fire
  - Credit was taken for use of SG safety valves for secondary relief when SG PORVs are failed by fire
  - Credit was taken for use of auxiliary shutdown panel to control the plant. This panel does not have control for the RHR pumps. (Local Control is Available in the Emergency Switchgear Room).

FINDINGS OF FLOODING ANALYSIS

- Turbine building has potential of large flood
- Flood dikes, floor plugs, and anti-reverse flow device may be removed in an outage
- Pipe tunnels are potential pathways for flood propagation

AREAS THAT SURVIVED THE SCREENING ANALYSIS

	Fire	Flood
Cable vault and tunnels	✓	
Emergency Diesel Generator Rooms		
Emergency switchgear and relay room	✓	✓
Control Room	✓	
Containment	✓	✓
Auxiliary Building	✓	✓
Fuel Oil Pump House Rooms		
Safeguard Area	✓	✓
Vacuum Priming House		
Turbine Building	✓	✓
Fire Pump House		

SCOPING SEISMIC ANALYSIS

(Future Resources Associates and PRD Consulting)

- Both LLNL and EPRI Seismic Hazard Curves were used
- Surry Seismic Fragilities from NUREG-1150
- Loss of Offsite Power Event Tree Developed in Internal Event Analysis Was Used
- Simplifying Assumptions Were Made
- Dominant Seismic Induced Failures - Offsite Power, CCW HX, RWST, EDG.

OBJECTIVE AND SCOPE OF PHASE 2 STUDY

- Estimate the core damage frequencies associated with accidents initiated during mid-loop operation.

- Compare the estimated core damage frequencies, important accident sequences, and other qualitative and quantitative results of this study with those accidents initiated during full power operation.

- Perform uncertainty and sensitivity analysis to evaluate the benefits of Generic Letter 88-17.

ON-GOING LEVEL 1 TASKS

Data Base Development

Re-examine Initiating Events

System Analysis

Supporting Thermal Hydraulic Analysis

SYSTEM ANALYSIS

- Review and Modify System Fault Trees Developed in NUREG-1150 Study with Emphasis on Dependency and Common Cause Failure

- Modify NUREG-1150 Fault Trees to Reflect Shutdown Conditions

- Develop New Fault Tree for Steam Generator Recirculation Transfer System

- Identification and Characterization of Unique Configurations of Electrical Distribution System

SUPPORTING THERMAL HYDRAULIC ANALYSIS

- Determine Timing of Accident Scenarios as a Function of Decay Heat.

- Bleed and Feed in Mid-loop Conditions

- Gravity Feed from RWST

- Reflux Cooling

REMAINING TASKS FOR MID-LOOP PLANT OPERATIONAL STATES

- Finalize Event Trees
- Quantification of Accident Sequences
- Plant Damage State Analysis
- Uncertainty and Sensitivity Analysis
- Comprehensive Human Reliability Analysis Method Development

SUMMARY

- Phase One was successfully completed with important scenarios and issues identified.
- Phase Two is on schedule with the following milestones:

• Level 1 Point Estimate Report	August 1992
• Level 1 Point Estimate Report (with Fire and Flood)	October 1992
• Comprehensive HRA Method Report	December 1992
• Final Report with Uncertainty Analysis	January 1993

- Plant Operational States other than Mid-Loop Remain to be Analyzed.

SUMMARY OF THE GRAND GULF LOW POWER AND SHUTDOWN STUDY

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Don Mitchell	Jeff Yakle
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Presented to ACRS on April 1, 1992

920401-1

OVERVIEW OF PRESENTATION

- Highlights of Phase 1 Results
- Phase 2 Status Report
- Summary

920401-2

Highlights of Phase 1 Results

- Non-Fire/Flood/Seismic Screening Analysis
- Fire Screening Analysis
- Flood Screening Analysis
- Seismic Scoping Evaluation

NON-FIRE/FLOOD/SEISMIC SCREENING ANALYSIS

- Number of sequences analyzed
  - 4188 accident sequences from thirty-four (34) initiating events were quantified.
    - 1163 sequences survived truncation at 1E-8 (28%)
    - 3025 sequences truncated (72%)
- Sequences surviving truncation grouped into three categories
  - Potentially High - 303 sequences (26%)
  - Potentially Medium - 351 sequences (30%)
  - Low - 509 sequences (44%)

NON-FIRE/FLOOD/SEISMIC SCREENING ANALYSIS
(Continued)

- Distribution of sequences within each Plant Operational State (POS).

POS	HIGH	MEDIUM	LOW	TOTAL
1	0	20	87	107
3	0	9	68	77
4	44	199	245	488
5	178	76	47	301
6	77	33	48	158
7	4	14	14	32
TOTAL	303	351	509	1163

920401-5

NON-FIRE/FLOOD/SEISMIC SCREENING ANALYSIS (Continued)

- Potentially important initiating events
  - Loss of Instrument Air
    - Occurs in all POSs except POS 7
  - Loss of Decay Heat Removal (Shutdown Cooling mode of the Residual Heat Removal System or Alternate Decay Heat Removal System)
    - Occurs in POSs 4, 5, and 6

NON-FIRE/FLOOD/SEISMIC SCREENING ANALYSIS
(Continued)

- Configuration and Scenario Insights
  - Two POSs identified as potentially important.
    - POS 5 (Cold Shutdown to Refueling when water level raised to steam lines), and
    - POS 6 (Refueling with water level raised but upper pools not connected).
  - Safety Relief Valves
    - For decay heat removal two were required for water solid operation while only one was required for steaming.
    - One required available at Cold Shutdown (Plant Procedure).
    - None available during refueling (steam line plugs in place) but vessel is open.

NON-FIRE/FLOOD/SEISMIC SCREENING ANALYSIS (Concluded)

- Configuration and Scenario Insights (Concluded)
  - Decay Heat Removal
    - CRD can provide sufficient make-up for steaming in POSs 4, 5, 6, and 7.
    - RWCU Letdown and CRD Make-up can match decay heat after Refueling.
    - Low core region level prevents SDC from removing decay heat.
    - Two of three LPCI needed for Large LOCA in POSs 4, 5, 6, and 7.
    - One of three LPCI needed in POSs 1, 2, and 3.
    - Overpressurization of SDC Piping
      - Only of major concern in POS 5 when head is on and SDC High-Pressure Isolation is by-passed.

920401-8

FIRE SCREENING ANALYSIS

- Number of sequences analyzed in POS 4
  - 692 accident sequences from sixteen (16) initiating events were quantified.
    - 373 sequences survived truncation (54%)
    - 319 sequences truncated (46%)
- Sequences surviving truncation grouped into three categories
  - Potentially High - 0 sequences (0%)
  - Potentially Medium - 106 sequences (28%)
  - Low - 267 sequences (72%)

920401-9

FIRE SCREENING ANALYSIS (Concluded)

- Potentially important initiating events

  - Loss of Decay Heat Removal (Shutdown Cooling mode of the Residual Heat Removal System or Alternate Decay Heat Removal System)

  - Loss of Component Cooling Water

- Fire Zone Analysis Results

  - 287 Fire Zones identified for Grand Gulf.

  - 89 (31%) Fire Zones remained after initial screening based on equipment location.

  - 59 (21%) Fire Zones remained after the vital area analysis (30 Fire Zones screened out).

920401-10

FLOOD SCREENING ANALYSIS

- Number of sequences analyzed
  - 792 accident sequences from six (6) flood scenarios were quantified for POS 4.
    - 243 sequences survived truncation at 1E-8 (31%)
    - 549 sequences truncated (69%)
- Sequences surviving truncation grouped into three categories
  - Potentially High - 0 sequences (0%)
  - Potentially Medium - 133 sequences (55%)
  - Low - 110 sequences (45%)

920401-11

FLOOD SCREENING ANALYSIS (Concluded)

- Flood Scenario Information

  - 76 potential Flood Scenarios identified

  - Six (6) Flood Scenarios quantified

  - Two most important potential scenarios occur when Plant Service Water piping fails in the Northeast corner and along the North wall of the Auxiliary Building at the 93 foot level.

920401-12

SEISMIC SCOPING EVALUATION

- Conclusions from Budnitz and Davis scoping evaluation study

  - Loss of offsite power will occur at a peak ground acceleration (PGA) of > 0.3g (ceramic insulator failure).

  - At PGA of > 0.5g, failure of large tanks will cause failure of the Control Rod Drive (CRD) and the Firewater (FW) emergency systems.

  - At PGA of > 0.7g, failures of Standby Service Water (SSW) (on which the emergency AC system depends) will cause failures in almost all emergency systems except RCIC. This inevitably leads to core damage accidents in all shutdown POSs.

  - At PGA of > 0.8g, failures of the batteries, leading to failure of the emergency DC system, will cause failures in all emergency systems, including RCIC, in any were to have survived the failure at 0.7g of the SSW and emergency AC. Again, this inevitably leads to core damage accidents in all shutdown POSs.

  - In POS 4, 5, 6, and 7 human errors (probability 0.01) can lead to core damage conditions for earthquakes below 0.7g.

920401-13

SEISMIC SCOPING EVALUATION (Concluded)

- Results from Budnitz and Davis scoping evaluation study
  - Total core damage frequency for all seismic-induced accidents would be categorized in the low core damage frequency category.
  - Accident sequences can occur in all POSs.

920401-14

PHASE 2 STATUS REPORT

- Level 1 tasks underway or completed
- Remaining tasks

LEVEL 1 TASKS UNDERWAY OR COMPLETED

- Select first POS to be analyzed in detail
  - Initial work will concentrate on POS 5 during a refueling outage. This POS was selected since it appears to be the most important POS based upon the Phase 1 coarse screening results.
- Reexamine Initiating Events
  - Based upon knowledge gained during the Phase 1 work one additional initiating event has been identified. This event is loss of the operating recirculation system.
  - The frequencies have been updated to remove conservatisms and to incorporate new data sources.
  - The phenomena of multiple initiating events has been investigated.

920401-16

LEVEL 1 TASKS UNDERWAY OR COMPLETED (Continued)

- Success Criteria
    - Various aspects of success criteria have been re-examined.
        - One SRV versus two SRVs for "water solid" alternate decay heat removal.
        - How availability of recirculation system affects sequence progression.
        - How status of containment (i.e., opened high, opened low, closed) affects sequence progression.
        - How availability of MSIVs affect sequence progression.

LEVEL 1 TASKS UNDERWAY OR COMPLETED
(Continued)

- Event Trees
  - Existing event trees have being modified to incorporate knowledge gained from the Phase 1 Analysis.
    - A question concerning the status of Recirculation System has been added were appropriate.
    - A question about the amount (i.e., fraction) of time a particular system operates during the POS has been added as necessary.
    - A question concerning the status of the Main Steam Isolation Valves has been added as necessary.
    - Questions about additional systems necessary to help mitigate consequences of core damage accident sequences have been added.

920401-18

LEVEL 1 TASKS UNDERWAY OR COMPLETED (Continued)

- Fault Trees
    - Existing fault trees are in the process of being modified.
        - To differentiate among the various initial conditions
        - To incorporate additional knowledge
        - To more fully model certain failure events
        - To incorporate additional human factors interactions
    - New fault trees are being constructed.
        - Recirculation system
        - MSIVs

920401-19

LEVEL 1 TASKS UNDERWAY OR COMPLETED
(Continued)

- Fire zones identified during Phase 1 have been examined to determine whether or not a fire in the zone would cause failure of the required equipment.

- Information on automatic suppression and fire barriers has been obtained and will be incorporated into the fault trees.

- The existing Sandia Fire Data Base is in the process of being updated with information through the end of 1990.

- Contract support from a fire suppression engineer is being obtained. This engineer will produce estimates of the reliability of the fire suppression systems used at Grand Gulf.

LEVEL 1 TASKS UNDERWAY OR COMPLETED
(Continued)

- Access to the preliminary Grand Gulf IPE flooding information has been obtained. This information along with additional information has been reviewed to determine how it might affect the analysis of floods during POS 5.

- A reexamination of the flood scenarios identified in Phase 1 is underway. This reexamination may reduce the number of potential flood scenarios that will have to be examined during Phase 2.

REMAINING LEVEL 1 TASKS

- Produce frequency estimates for both the Fire and Flood Analyses based upon the current information.

- Perform a Flood Propagation Analysis.

- Quantify all accident (i.e., Non-Fire/Flood, Fire, and Flood). This quantification will include consideration of operator recovery actions.

- For the fire zones that remain after quantification, COMPBRN calculations will be made to determine if a fire in a fire zone can actually cause failure of the pertinent components.

- Using the additional information obtained from the COMPBRN calculations, the fire induced accident sequences will be requantified to produce the final fire sequences.

REMAINING LEVEL 1 TASKS
(Continued)

- PDS Analysis

  - After obtaining the final point estimate frequencies for the fire sequences, all sequence cut sets will be sorted into the appropriate PDSs and the frequency of the PDSs will be determined.

- Interim Documentation

  - Once the PDSs have been developed and quantified, a report will be produced that documents the point-estimate results of the Level 1 analysis through the completion of the PDS analysis.

- Uncertainty Analysis

  - After the PDS analysis has been completed, an uncertainty analysis of all accident sequences including seismic sequences will be performed.

920401-23

REMAINING LEVEL 1 TASKS
(Continued)

- Final Documentation

  - Upon completion of the uncertainty analysis, a report detailing the results of the complete analysis for POS 5 will be produced.

SUMMARY

- Phase 1 was successful.
  - Interium results provided to NRR.
  - It provided a mechanism by which to prioritize the detailed work of Phase 2.
- Phase 2 work will concentrate on POS 5 occurring during a refueling outage.
- Phase 2 work is progressing on schedule.
- Documentation is planned as follows
  - Point-estimate through PDS analysis
    - Non-Fire/Flood 8/31/92
    - Fire/Flood 10/15/92
  - Final through Uncertainty 1/31/93

920401-25