ACRST-1638

UNITED STATES
NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF: DOCKET NO:

DECAY HEAT REMOVAL SYSTEMS

MEETING

ORIGINAL

LOCATION: WASHINGTON DC PAGES: 1 - 149

DATE: JANUARY 28, 1988

Heritage Reporting Corporation

Official Reporters
1220 L Street, N.W.
Washington, D.C. 20005
(202) 628-4888

PUBLIC NOTICE BY THE

UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The contents of this stenographic transcript of the proceedings of the United States Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards (ACRS), as reported herein, is an uncorrected record of the discussions recorded at the meeting held on the above date.

No member of the ACRS Staff and no participant at this meeting accepts any responsibility for errors or inaccuracies of statement or data contained in this transcript.

UNITED STATES NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

In the Matter of:

MEETING OF THE SUBCOMMITTEE ON DECAY HEAT REMOVAL SYSTEMS

Thursday,
January 28, 1988

Room 1046
1717 H Street, N.W.
Washington, D.C. 20555

The above-entitled matter came on for hearing, pursuant to notice, at 8:30 a.m.

BEFORE: MR. DAVID A. WARD
Research Manager on Special Assignment
E.I. du Point de Nemours & Company
Savannah River Laboratory
Aiken, South Carolina

ACRS MEMBERS PRESENT:

MR. CHARLES J. WYLIE
Retired Chief Engineer
Electrical Division
Duke Power Company
Charlotte, North Carolina

DR. CHESTER P. SIESS
Professor Emeritus of Civil Engineering
University of Illinois
Urbana, Illinois

MR. CARLYLE MICHELSON
Retired Principal Nuclear Engineer
Tennessee Valley Authority
Knoxville, Tennessee
and Retired Director, Office for Analysis
and Evaluaton of Operational Data
U.S. Nuclear Regulatory Commission
Washington, D.C.

DR. CARSON MARK
Retired Division Leader
Los Alamos Scientific Laboratory
Los Alamos, New Mexico

MR. JESSE C. EBERSOLE
Retired Head Nuclear Engineer
Division of Engineering Design
Tennessee Valley Authority
Knoxville, Tennessee

CONSULTANTS:

P. Davis
I. Catton

ACRS COGNIZANT STAFF MEMBER:

Paul Boehnert

NRC STAFF PRESENTERS:

Jerry Mazetis
E. Chelliah

I N D E X

P R O C E E D I N G S

CHAIRMAN WARD: The meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards Subcommittee on the Decay Heat Removal Systems.

I am David Ward, the Subcommittee Chairman. The other ACRS members in attendance are Mr. Ebersole, and Mr. Mark, Mr. Michelson, and Mr. Siess will be here I believe. Mr. Wylie is here, Charlie.

Also in attendance are two ACRS consultants, Mr. Catton and Mr. Davis.

The purpose of the meeting is to continue our review of the NRC staff resolution for USI A-45. Paul Boehnert is the cognizant ACRS staff member for the meeting.

Rules for participation in today's meeting have been announced as part of the notice of the meeting, previously published in the Federal Register on January 13th, 1988. 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 herself or himself and speak with sufficient clarity and volume so that she or he can be readily heard.

Before we go to the advertised speakers, I want to make a couple of comments to the members. A-45, of course, has been proceeding along at its measured pace for many years. We seem to be approaching a resolution. I had hoped that in

advance of this meeting, we would get some documentation, draft documentation, from the NRC staff with some more specific information on the resolution position they are proposing.

We haven't gotten that. We have had indications of approximately what the position is going to be, and I think we will hear more about that today.

We don't intend to go to the Full Committee with this in February since we didn't have written material and time is kind of short, but I am kind of reluctant to see the thing drag out too far and so depending on what we hear today, I may propose to you that we go to the Full Committee in March even though we may or may not have any further formal documentation from the staff in the interim.

If we hear enough today so that we think it would be useful for the Full Committee to have to form some sort of consensus our own position on resolution of the A-45, then I will propose that we go ahead and try to do that in or at least begin to do it in the March Full Committee meeting.

One other thing, and we are going to hear about this today, but I wanted to call your attention to something. There was a, and I think we saw this sometime ago, an industry group I guess under the auspices of EPRI and the Westinghouse owners group and through NSAC, the NUCLEAR SAFETY ANALYSIS CENTER, published a report, NSAC1-113, which was their review

of the risk analysis of decay heat removal that had been done for the Point Beach plan by the NRC staff contractors. Using essentially the same inputs that the staff contractors had used, they came to some rather different conclusions.

I asked our consultant, Mr. Davis, to review the report and make some sort of accounting and assessment of the differences, and he has done that in a report which I think has been available to you. His report was issued January 11th. You probably got that at home. If not, it was attached to the meeting notice that Mr. Boehnert put out I believe, so we may be discussing that and may have a few questions for Mr. Davis also in that part of the meeting.

Any other members have something they would like to say before we start out?

MR. MICHELSON: Yes, I had one small comment. I think we use the term dedicated decay heat removal, and I think that when we use the term each of us has in mind something maybe a little different than the next person as to what do you mean by dedicated heat removal?

It is not clear to me that the Committee has a position on what they mean. It is not clear to me that the staff does, and maybe some time during the day today we could get a clarification of exactly what kind of a system does the staff have in mind? It is covered a little bit in the NSAC document. It is covered a little bit in the Point Beach

document. I would like to know what does the staff really have in mind when they are thinking about evaluating dedicated decay heat removal?

CHAIRMAN WARD: Well, I think, you know, since dedicated system is part of one or two of the options, I think that it would be appropriate when they describe those for you--

MR. MICHELSON: Just to clarify for sure exactly what they have in mind because it is a little different than I think the Committee has, along the lines the Committee has been thinking, although I am not sure of that, either. We never really got into it. we just kept using the term without necessarily defining it.

MR. EBERSOLE: Since that came up, I would like to add to it one of the most difficult problems is to identify the conditional state at the time of entry, decay heat removal system into service, because I know quite well, for instance, accommodate a large LOCA, I don't think it will, yet it might accommodate a small one or certain other transients or upsets, but it is not going to be all-encompassing in its capabilities.

CHAIRMAN WARD: Dedicated system concept.

MR. EBERSOLE: Will have boundaries of performance that we need to identify.

MR. WYLIE: In that regard, maybe we need to

redefine what the objective to dedicated heat removal system is. I mean what are you trying to accomplish?

MR. EBERSOLE: Right.

MR. WYLIE: Maybe they could comment on that. I think I've got my idea. Certainly mine doesn't include LOCAs.

MR. EBERSOLE: Not any at all?

MR. WYLIE: Not at all.

MR. MICHELSON: This is something we certainly do have a mixed mind on in the Committee and I'm not sure the staff has one mind on it, and that's what I am kind of curious to find out.

CHAIRMAN WARD: I assume they know what they mean by it

MR. MICHELSON: I assume so.

CHAIRMAN WARD: The system.

MR. MICHELSON: I just want to make sure that I understand where they are coming from.

CHAIRMAN WARD: Okay. Thank you. Let's--the first speaker for the staff will be Warren Minners.

MR. MINNERS: Well, I just want to make a few introductory remarks. Jerry Mazetis will be giving you a presentation which will be a summary I guess of the regulatory analysis which we are now working on and have in draft form and will try to provide you, but in this measured case of A-45, I guess we have gone along more than is usual in sharing

with the ACRS the resolution of the issue before the staff has all of its positions lined up, and I have no problem with that. In fact, I think it is a good procedure. I just want to remind the ACRS that what you are hearing is, you know, preliminary stuff, and don't expect us to stand up and defend it to our last breath.

We also will later on have a discussion of the EPRI-Westinghouse owners group analysis of Point Beach which I think is an important question of is decay heat removal a problem? And industry has asked that question and I think we are obligated to answer it, and the purpose or one purpose of the case studies was to answer that question--what is the risk to failure of the decay heat removal function? And once again, what you are going to hear is going to be very preliminary. We haven't discussed this stuff in detail with our contractor. We haven't had a meeting with the people who did the report, so this is all again very preliminary stuff.

I would, since Carl brought it up, I would like to address this point. I'm not sure that you have to define very well what the decay heat removal system would be to address the issues, but at this point we are trying to address the issue, not trying to address fine technical detail. The question comes that any reasonable dedicated system is going to cost a lot of money, and is it worth it? And that's the question I think we have to be focusing at this point rather

than any technical design details of decay heat removal. Dedicated systems are described in the case studies and those are the systems that were used for making a cost estimate. So I think we do have a very specific idea of at least one system. That doesn't mean that has to be the system, but that's the one we used as an example for doing the cross-studies, and I think they are described in fairly good detail in the case study.

Unfortunately, we didn't bring any of that material with us so I can't flash it on the screen, but maybe later on, Jerry could give a description of the system, so with that cautionary note that this is all preliminary information, I would like to discuss it with you free and technical discussion, and why doesn't Jerry go ahead? <PHAZ> <PHAZ>.

CHAIRMAN WARD: Thank you. Jerry Mazetus.

DR. MAZETIS: My name is Jerry Mazetis, with the Reactor and Safety Issues Branch in Research, and I'm sorry to say that the new task manager, Dr. Woods, has reported sick call this morning, so I will fill in for him, and forgive the rough edges on the slides.

(Slide)

DR. MAZETIS: This slide is intended to refresh our memory on some of the background on how we got where we are, and it goes way back. It actually seems like yesterday to me, but even before TMI, there were concerns of decay heat

removal, concerns being discussed and debated in-house, and TMI essentially served as a springboard to formalizing a variety of decay heat removal issues, some of which were implemented post-TMI with some corrective actions related to decay heat removal components.

However, there was still as a result of discussions post-TMI in-house through ACRS various tack forces and commissions, still recommendations that high priority be given to further study of improving the shutdown decay heat removal function.

The studies the past seven years conducted by Sandia focusing on six power plants were included to cover a special emergency such as fire, flood, seismic and sabotage.

Not too long after TMI, when a lot of these concerns had been documented, USI A-45 was formally identified and approved in 1980, and the key questions focused on A-45 was do current designs provide the reliability needed to meet the safety goals, core damage frequency guidelines of safety goals, and are there improvements to the decay heat removal function in operating plants which aren't cost effective?

(Slide)

MR. MICHELSON: Question--if you don't really define what you mean by dedicated decay heat removal very explicitly, how do you do the evaluation of the improvements that, and risks that come from adding a decay heat removal of undefined

state? How do you go about doing that?

DR. MAZETIS: Sandia years ago when the plants were selected and some ground rules were made, Sandia and the staff agreed on a certain level of detail to one of their alternatives. As I will show later, there are six alternatives that were costed out in the past seven years in the case studies, one of which is a so-called dedicated heat removal system where certain system assumptions were made in order to cost the components out, and essentially the system--and perhaps later on this morning Sandia can get into more details--but the system is a, an aux feedwater type system, separate from the normal auxiliary system in a separate structure along with a certain amount of makeup capability, and the makeup capability is limited to the small breaks that were analyzed in the studies.

MR. MICHELSON: What I didn't find but what I was somewhat interested in is well, how does high pressure decay heat removal show up? If I were to build high pressure decay heat removal dedicated system, if I were to put in inside containment versus outside containment, how does that show up and so forth?

Was that kind of work done, or did you just pick one system which was really nothing more than an additional auxiliary feedwater and additional high pressure makeup?

DR. MAZETIS: The makeup, the assumptions, as you

know, for small breaks, my recollection is the system was capable of handling small breaks.

MR. MICHELSON: Two hundred gallons; it is capable of 200 gallons a minute.

CHAIRMAN WARD: You are talking about small, about a--

MR. MICHELSON: High pressure makeup for whatever reason.

CHAIRMAN WARD: High pressure makeup.

MR. MICHELSON: That's what they show. And another auxiliary feedwater pump, 200 GPM on high pressure and 1200 on auxiliary. I think that was it. And you know, is that what we have in mind, or is there other systems? And I wanted to see a discussion of other kinds of systems and how they would appear. This may not be the best option.

DR. MAZETIS: Sandia may have a comment. Dave? Dr. Ericson from Sandia.

DR. ERICSON: There was a comparison of high percent RHR, these kinds of shutdown systems done, and that was published in the '83 studies on decay heat removal.

MR. MICHELSON: That was '83, though, and I was--

DR. ERICSON: This was selection as a result, this approach was selected as the way to, as the result of those studies.

MR. MICHELSON: Showed this to be the cheapest.

DR. ERICSON: This was a, based on those studies, this was a reasonable way to go.

MR. EBERSOLE: I would like to ask a question. You are obligated by law in fact to accept a hodgepodge of designs. And you consider them here, six of them. I would expect in the course of your investigation you would find substantial differences in dealing with decay heat removal from plant to plant, from type of plant to type of plant.

I was somewhat enthusiastic about the GSAR 2 new PPS which approached in my view pretty close to what might be called the decay heat removal system of extreme simplistic character.

In your course of assessment, did you characterize these differences or degrees of difficulty as you wing through the plants, and ascribe to them whether, you know, this one or that one needed it more or less?

DR. MAZETIS: As you will see in subsequent slides, one of the reasons, maybe the main reason being considered for not backfitting the dedicated heat removal system or for that matter any hardware right now is the fact that there was this variety of plant-specific differences that was significant in the results of the study.

As you will see in two or three slides, that it was, a major part of the risk vulnerabilities for decay heat removal was seen to be in the balance of plant area.

MR. EBERSOLE: What bothers me there is that because you have this composite assignment, you find, you may find that if you can't find it is applicable to all of them, you won't apply it to any of them. And I think that's a mistake.

DR. MAZETIS: Yes, I agree, and we think we proposed a path that will try to avoid the situation of ending up with nothing.

In this slide, we go over the objectives of A-45 which was to--this bullet--determine the adequacy of decay heat removal in existing plants for achieving both hot shutdown and cold shutdown conditions; developing and evaluating again alternative method for improving the reliability of the decay heat removal function; assessing the value and impact of alternative methods following the backfit rule; and establishing new requirements, if needed, to reach the decay heat reliable compatible with our interpretation of the core damage frequency guidance goals.

(Slide)

DR. SIESS: What is your interpretation?

DR. MAZETIS: I think what I was referring to there was the discussion of avoidance of significant release of radioactivity of ten to the minus 6 and backing off to produce a, an interpretation of core damage frequency in the area of ten to the minus 5th.

DR. SIESS: I'm sorry. Ten to the minus 6 for large

release and then you back that down to ten to the minus 5 for core damage frequency?

DR. MAZETIS: Right, because you have to.

DR. SIESS: Core damage means core on the floor?

DR. MAZETIS: Core damage, core melt frequency, core damage frequency because on top of that, you have to add the containment failure probability.

DR. SIESS: Core damage means what? Core on the floor? Or TMI?

DR. MAZETIS: I don't think we have identified either way. I'm not sure.

MR. MINNERS: I think it means core on the floor, Dr. Siess, but as you know, we can't differentiate in a PRA between those, but I think, I mean when you get to the minus 6 we take it a factor of ten for the containment and that means core on the floor.

DR. SIESS: Core on the floor and you say we don't know enough from our research to establish any relationship between severe core damage like TMI and core on the floor?

MR. MINNERS: Well, I didn't mean to be that extreme. I think in the PRAs that are done, we don't make the distinction, but no, I think there is in the research, in fact part of the accident management program is to try to have some procedures for controlling the phenomena between core damage and core on the floor.

DR. SIESS: Yet you think we know enough to state that the additional probability of containment failure given core on the floor is approximately one 10th, which is what you are using to get from the ten to the minus 6 back to the ten to the minus 5, but that you are not able to put a conditional probability of core on the floor given some severe core damage.

MR. MINNERS: Well, these are very rough numbers. I mean there is not a lot of precision --

DR. SIESS: Factor of ten is a guess, but it is just, it is, just seems interesting that we know enough to apply that factor on containment failure; with all the research that we have done, we can't put any kind of a factor at all on the conditional probability between core damage and core on the floor.

MR. MINNERS: Well, I think you probably could. If people were pushed into it, people would be willing to make some guesses, but it doesn't seem worthwhile because the PRA methodology document doesn't do that. You do a PRA, you just say you lose cooling and don't really say that this results in core damage or core melt or whatever.

DR SIESS: Why are we doing all that research?

MR. MINNERS: To try to get some accident management procedures that we can go and, and give guidance to operators that when they do start to get core damage they will be able

to do something about it. I mean the purpose of the research is not to do PRAs, although that's a useful function, but what you want to try to do is have something at the plant and that's my view of why we are doing research is accident management.

DR. SIESS. You think that view is shared by the people doing the research? That's a very interesting statement. I am inclined to agree with it. But--

MR. MINNERS: Since we have one of the research laboratories here, I won't embarrass him by asking him why he is doing the research. I don't know. I can't speculate why. I presume that they understand that part of the purpose of the research is for accident management. I mean certainly there is a lot of effort now to try to have accident management. We had one lab write up a report on I insight for severe core damage accidents with a very purpose of trying to make people and operators aware of what the phenomena are; maybe something happens, that they will be able to respond more intelligently to it having the background information.

DR. SIESS: I am not disagreeing. I think that's great, but you did state that the purpose wasn't to do PRAs.

MR. MINNERS: Not completely to do PRAs. That's one purpose, but I think from our view if you really want to increase safety, that research has to be applied in accident management procedures.

DR. SIESS: Okay.

CHAIRMAN WARD: Jerry, before you go on, you know, on the last chart, you talked about the, being compatible with the core damage frequency goals specifically.

DR. MAZETIS: Right.

CHAIRMAN WARD: You seem to come up with a number of ten to the minus 5th for that.

DR. MAZETIS: That's the number being discussed now that may appear in the reg analysis.

CHAIRMAN WARD: That's the number that you are using in the reg analysis. Do you intend that to be--but that's not necessarily the number that is being discussed in the safety goal policy implementation?

DR. MAZETIS: No. I am saying that was an interpretation of the guidance in the safety goal. That's being discussed in the staff to use as a screening tool.

CHAIRMAN WARD: Another interpretation of the guidance in the safety goal which is yet not completely formed is ten to the minus 4th core damage frequency. So why, I don't know how important this distinction is in what you do, but why have you chosen to, seemingly to hang your hat on ten to the minus 5th instead of ten to the minus 4th?

DR. MAZETIS: All I can say is that in our discussions with the--as you will see later, we are working closely with the IPE severe accident group, with the

individual plant examination evaluation program, and that's compatible with their thinking right now. I don't know. I don't know why the, I can't explain the difference between what the current thinking is compared to previous thinking at ten to the minus 4th. All I am saying is right now, with A-45 and the thinking on screening tool, it's going to be, it is compatible with the thinking in the IPE severe accident group, and it looks like the numbers being discussed are ten to the minus 5th.

DR. SIESS: It bothers me that the decisions that can cost hundreds of millions of dollars are going to be made on an interpretation, rather fuzzy one, of the safety goal that presumably was promulgated by the Commission to give us some guidance what is safe and what isn't.

Are we ever going to get better guidance on what the safety goal really is in terms of things that are meaningful in a plant, hardware, or procedural or whatever? Whether it is ten to the minus 5 or ten to the minus 4, we make a tremendous difference in the amount of money that is spent to meet it.

DR. MAZETIS: I agree. I hope the Commission reads your statement in the transcript.

DR. SIESS: You know, we are still trying to interpret a large release. We have got a fair amount of fuzziness around it. Ten to the minus 6th was pretty explicit

but the large release, we have had at least four different definitions of it that I know plus a couple more maybe. And then the factor of ten, this Committee suggested as a goal for containment reliability, but I don't know of any data that tells us overall it is a factor of ten or that it is a factor of ten for all reactors or that is just an average.

CHAIRMAN WARD: This--well. Chet, there is a meeting with, another subcommittee is meeting with another branch of the staff on February 9th to talk about this, but you know, in the meantime, these user programs of the safety goal are having to go ahead without safety goal implementation being finished so it presents a problem and I think it could be a serious one.

DR. SIESS: We are setting ad hoc safety goals as we go along.

CHAIRMAN WARD: Neither this program nor the IPE program should be setting its own safety goals because there is a program which is intended to do that for the full agency.

MR. MINNERS: The staff operates in the vacuum.

CHAIRMAN WARD: Right. Pete, you wanted to say something?

MR. DAVIS: I guess I have problems with trying to translate the probability of a serious release into a core damage frequency. I don't know of any PRA that has come out with a core damage frequency less than ten to the minus 5th,

and furthermore, if one examines the PRAs that are available, you find a very wide range of conditional containment failures given a core damage frequency. For example, Seabrook, Seabrook PRA has a core damage frequency in excess of ten to the minus 4th, but the conditional probability of containment failure is less than ten to the minus forth, so that plant meets the safety goals with considerable margin but certainly would not even come close to your ten to the minus 5th core damage frequency.

Other plants, some PWR, do I believe approach a factor of ten conditional probability of containment failure. The point is I guess you can't, I don't think you can establish a ten to the minus 5th core damage frequency and apply it to all plants as appears to be what you are trying to do here. I realize there is more work that needs to be done in this area, but I think that it is going to be a problem to establish ten to the minus 5th as the, as at least an informal criteria for core damage frequency.

MR. MINNERS: What you are suggesting, Pete, is that we have different goals for different plant designs?

MR. DAVIS: Well, I think you about have to if you are going to use core damage frequency. You need also to look at the capability of the containment. I don't have an answer, really, but I think that--

MR. MINNERS: I think the discussion is not focused,

and the other question is that core damage frequency by itself you have, can have a number. The Commission has stated in the safety goal policy statement that they don't want to have any more core melts, so that also gives some kind of guidance to the staff.

CHAIRMAN WARD: Ten to the minus 5th satisfy that?

MR. MINNERS: I think so.

MR. DAVIS: I don't know of a plant out there --

CHAIRMAN WARD: That is interesting.

MR. DAVIS: If that in fact is the requirement, I think most plants are going to need some kind of modifications because if one looks at the PRAs, as I said, I don't think that there is a plant out there that meets ten to the minus 5th or less.

MR. MINNERS: I agree with you. If--we had the same problem in, ATWS okay. The unavailability of the SCRAM system hasn't changed over ten years. The only thing that changed this ATWS was the goal. Start at ten to the minus 7th, and when it finally got to ten to the minus 5 we declared victory.

MR. DAVIS: The initial safety goals had a core melt frequency requirement of ten to the minus 4, and I thought that was based in part on consideration of the existing population and how long they were going to operate, and then looking at what the probability should be to gain some assurance that you wouldn't have one over the remaining

lifetime.

MR. MINNERS: That got deleted for some reason, so somebody didn't like it.

MR. DAVIS: Now you are using --

CHAIRMAN WARD: No, it might be coming back in in the implementation policy.

MR. MINNERS: It is a very useful discussion because the staff is at sea as to what is, the goals to be attained, so it is a question that really has to be answered and discussed and some decisions made.

MR. DAVIS: I think there should be a core damage frequency goal, and I think that ten to the minus 4th is a reasonable value for it, but I don't think other people agree with that.

CHAIRMAN WARD: I wouldn't say that. I think that the ACRS letter of when was it, last April I guess, which the commissioners have told the staff to use in large measure for development of the implementation plan, has that sort of a number in it.

MR. DAVIS: All right.

DR. MAZETIS: Yes, sir.

MR. EBERSOLE: After you get done with the core damage frequency or the severe release probability, it is unclear to me now how you get to the money question because there is two kinds. There is the physical damage to the

public, the man rim, there is the loss of resource which is substantial.

I, in my own view, it would take a view of both of these, and a view as to how this loss will be borne. It is going to be borne by the public, the rate payers, and we have a public consideration and loss of resource.

If it is borne by the corporate entities, that's another picture. They can bear it if they wish. I think you should look at both of these, whether it is borne by the public or borne by the corporate structure, and come to grips with whether you are dealing with a public problem there or a private one.

MR. MINNERS: We have done that, Jesse. We don't feel that we can tell people how to make decisions, how they do it, but we have tried to present all of the facts, so we have all of the different costs cut every which way you want to. In fact, maybe it is too complicated. If you want to ask about a cost, we have got it.

MR. EBERSOLE: Great. That will come to the front then.

MR. MICHELSON: Question -- you said in your second bullet that you evaluated such systems for vulnerability to fire, flood, seismic, and sabotage.

Are we going to discuss later today in a little more detail what might be some serious shortcomings about the way

in which you do that evaluation?

DR. MAZETIS: I suggest --

MR. MICHELSON: The effect upon perhaps the usefulness even of your proposed changes?

DR. MAZETIS: Let me respond to that in two parts. The direct answer is we didn't plan on it, and no, because as Warren indicated, you don't have the benefit of our regulatory analysis yet, what discusses the details of these areas, and that it probably is more appropriate to give you a chance to take a look at the details and at that time, we can come down again sometime within the next month or so and discuss the details with the Committee.

MR. MICHELSON: Is that the intent, David, to have another subcommittee meeting when we get the regulatory analysis?

CHAIRMAN WARD: Sure.

MR. MICHELSON: Then I will just hold until then.

MR. MINNERS: I am not sure.

CHAIRMAN WARD: You have seen a lot of that stuff in the past.

MR. MICHELSON: I have seen it also in this NSAC-13, and I have a number of comments about the, the superficial way in which we treat fire in a PRA and to a great extent, flood, internal flooding and so forth.

MR. MINNERS: If the Committee would like to have a

meeting on document studies and discuss the methodology, I guess that could be arranged. I mean that's all laid out for you, Carl.

MR. MICHELSON: I have no problem with that. I just want to go on record as do we believe our fire PRAs that we have been doing? If you do, then there is something wrong. There is something wrong with your head.

DR. SIESS: There is something wrong with you if you believe them.

MR. MICHELSON: And if we don't believe it, then is what you are proposing going to solve the problem of fire vulnerability and how do you know it when your analyses are so superficial? I just have a problem knowing that we really are improving the situation at all with your proposed dedicated decay heat. I am not saying you are proposing, but if you did go to the dedicated aux feedwater, for instance, how do we know that is any less vulnerable from fire than what we presently have when we do such a superficial analysis on our present situation? Just an inquiring question.

CHAIRMAN WARD: Carl, maybe--excuse me just a minute, Jerry. Maybe at the end of the meeting today we as a committee need to discuss whether, I guess because of the long time laps that is necessary, to go back over some of the ground that we have -- went over.

MR. MICHELSON: What is really happening is we are

beginning to understand the problems a little better I think, and that what we knew in 1983 is quite a bit different than what we know today, and it might even be more interesting in another month or so after we get the results of the current look at the vulnerabilities to fire which are coming up in a March meeting.

CHAIRMAN WARD: I see. Let's--Paul, remind me, let's talk specifically about that at the end of the meeting.

DR. MAZETIS: Maybe I should mention, remind the agenda plan today really has three speakers. Dr. woods had planned to give the overview leading into where we are into the current reg analysis, and how that relates to the submittal by NUMARC of the EPRI owners group study for Point Beach. We had two speakers to talk about the details of their review of that report, E. Chelliah and Dave Ericson from Sandia laboratories, and as Warren also indicated, there has not been really any give and take yet amongst these individuals, so there may be some redundancy and overlap in what you hear from these gentlemen. Also in the audience we have some other staff members that may be familiar with the reports that they can respond to some questions perhaps.

(Slide)

DR. MAZETIS: This slide goes over scope of the A-45 program to evaluate decay heat removal systems needed to respond to transients and small break LOCAs, and as we have

said over the years, this study did not include large break LOCAs or ATWS, and several other areas such as pressurized thermal shock. Also included were an assessment of systems vulnerability to fire, flood, seismic, and insider sabotage where sabotage again was, vulnerability of decay heat removal systems to the insider, and which explicitly did not cover physical security method or the outside or attack from external areas.

MR. MICHELSON: What did it cover then on the question of sabotage? How did you evaluate insider vulnerability in some kind of a quantitative way so that you included it in the risk/benefit evaluation which is what you were doing?

MR. MINNERS: I don't know how to answer that. I don't think there is a short answer to that question.

MR. MICHELSON: I don't think there is an answer to it.

CHAIRMAN WARD: Short answer, it wasn't evaluated quantitatively, but it was qualitatively.

MR. MICHELSON: What does that do for risk/benefit?

CHAIRMAN WARD: They don't use that directly. As I recall, you don't use that directly in the risk/benefit computation.

MR. MICHELSON: When you get the risk/benefit you ignore sabotage?

DR. MAZETIS: It wasn't ignored.

MR. MINNERS: Excludes sabotage.

CHAIRMAN WARD: On a page alongside --

MR. MICHELSON: The inference here is somehow you evaluated it, and I just don't think you did much on it really.

CHAIRMAN WARD: I don't think --

MR. MICHELSON: If you did, I didn't find a discussion of it anywhere.

MR. EBERSOLE: You say consider. That's a very large word. To me, I hope it means you noticed the vulnerability notably of certain systems and you then, at least you conceived something like crash buttons that would block out the potential for that vulnerability to close in on a safe shutdown. I don't know whether you did that or not.

DR. MAZETIS: Perhaps Dave could amplify, but it was, there was, in order to cost out certain aspects of the different alternatives, there were certain assumptions made about insider sabotage probability, and there was no in-depth studies on likely types of probabilities given certain configurations. For costing out. There were certain gross assumptions made.

Dave, do you want to amplify on that?

DR. ERICSON: I think that's the key point. As we did with several other things, and as the staff has done in

the regulatory analysis, some things are presented as a range for the decision-maker to make his own choice. What quantification we did in the sabotage analysis, where we felt systems were particularly vulnerable, we can discuss in a closed meeting, not in this meeting. We did some conditional analyses, Mr. Michelson. We did not say the probability is. We said if you believe it is--

MR. MICHELSON: Is that written up somewhere?

DR. ERICSON: Those reports are now being, they are appendices to the individual case studies and they are at the printer's now.

MR. MICHELSON: We will see those shortly.

CHAIRMAN WARD: We have had drafts of those, haven't we?

DR. ERICSON: Several of them you have had.

CHAIRMAN WARD: Maybe not for each of the ones, but you may have not participated in those subcommittee meetings, Carl.

MR. MICHELSON: Most of them, but not all of them.

CHAIRMAN WARD: We heard about it. I would like to point out that everyone else in the audience has to use a microphone when they speak from the audience, but Dr. Ericson doesn't because we can hear him.

DR. ERICSON: Good!

DR. MAZETIS: Okay. Refresh our memory with the

A-45 studies, considered several plants, excuse me, six plants, and the idea at the time years ago was to select a group that represented each NSSS vender to try to cover a range of decay heat removal configuration, and architect/engineers, and the, of course, as always when you are looking for plant-specific data, it depends on the cooperation and the interest and how busy the utility is at the time of the data needs.

Document studies themselves are all completed, as you know, and have been published this past year in the form of six NUREGs for each of the six plants. The more recent being last August, St. Lucie, and the next report from the contractor is going to be a compilation or consolidation of the findings for each of those six plants sometime early this year when we get that published so I would expect that most people wanting to know the details of the studies would focus on the last report, and to use these as references as needed rather than going right into reading six reports that are three inches thick each.

CHAIRMAN WARD: What about the sabotage analyses that are in appendices? What is the status of those?

DR. MAZETIS: There is some discussions of the methodology in each of these reports and Appendix I, as you have seen, is left out of the report. I think Dave just mentioned that he is pulling together--

DR. ERICSON: Those are in the final sign-off and printing process now, Dave. We should see those within the next month or so much.

CHAIRMAN WARD: So they will be coming out as six separate reports?

DR. ERICSON: They are a safeguard information appendix to each of the case studies, that is correct. They have to be handled separately in our view.

CHAIRMAN WARD: How will that be dealt with in the summary?

DR. ERICSON: Some of the detail of why it is particular things are vulnerable are left out.

MR. DAVIS: I have a related question. On your slide under the selection criteria, you didn't list what I thought was the primary selection criteria, and that is determination of a potential vulnerability to decay heat removal.

DR. MAZETIS: Yes. You are right. I should have mentioned that that, the criteria up on the slide was after a group of maybe 80 or 90 plants that were initially looked at. There was a larger group that was felt to be candidates of trending toward the more vulnerable plants in decay heat removal and out of that group, this was the other criteria.

This slide is, goes over a summary of the findings that you will see in the six case studies where the

probability--the first bullet. The probability of core melt due to decay heat removal function failure is between two and three, averages between two and three times ten to the minus 4th per reactor year total for decay heat removal, including internal, external causes.

The second bullet indicates that, an inside observation that support system failures turned out to be a significant contributor to the core melt probability, particularly emergency power, service water, component cooling water areas.

MR. MICHELSON: Excuse me. On the support system failures, were those related to just simple equipment failures or were those related to the external event problem?

DR. MAZETIS: Both.

MR. MICHELSON: Both, yes, but can you give me some kind of feel? Was it predominantly equipment or was it predominantly external event effects or was it about half and half or something?

DR. MAZETIS: Depended on the plant. It varied from plant to plant.

MR. MINNERS: I think, as a very rough thing, Carl, half of the core melt frequency in decay heat removal was internal and half was external, what are called external events.

MR. MICHELSON: The support systems, those are much

more vulnerable from external events perhaps than some of the other equipment. I don't know. Generally from experience it seems that they are, if you do a analysis. I just wondered if that is how you came out. So it is 50/50 roughly?

MR. MINNERS: It varies from plant to plant a lot of--

CHAIRMAN WARD: As I recall on the six, it is a range from 20 to 80 percent.

MR. MICHELSON: It never did tell me whether it was coming from the support system effects or whether it was coming from the main line equipment effects. Didn't tell me whether it was the decay heat removal system or was it the electrical power to the decay heat removal that was causing that.

DR. MAZETIS: In each of the case study reports and also to be repeated in the summary for each plant, there is a list of the vulnerabilities, the specific system vulnerabilities. For example, for Point Beach, I know there were about 11, and that's a reference where you could get that information. We can maybe the next meeting where we get into a discussion of some of the specific numbers for each case study, we could get into that in as much detail as you like. The observation of, again from insights from the study, redundancy, concerns or lack of redundancy, sharing of systems, support system level, contributed to the risk

significantly for some of plants, including independence, separation and physical protection of redundant safeguard trains. Risk from fire, flood, seismic, and sabotage again depending on the plant, was significant. And so that the bottom line you will see that a large number of these areas--I want to make this point now because it leads into the next couple of slides--did vary quite a bit from plant to plant, and was plant-specific.

MR. EBERSOLE: Every time you use the term redundancy it brings up the vision of two carbon copies of some function that have common mode potential failures. You don't mention diversity and SCRAMs or sub-systems or even the word at all. Is that deliberate? You don't think diversity is significant?

DR. MAZETIS: No. Diversity is significant, but I think that the redundancy, vulnerability comes from observation of walk-throughs at the site, for example, which did see sharing of components and systems, and certain systems that are supposed to be redundant trains are located in the same space side by side, that kind of thing.

MR. EBERSOLE: Another aspect of failure, you are talking about functional plant, not to deliver some sort of service in general, you know, step function to zero service of water pressure, air pressure, voltage, whatever; do you consider failure to embody also interactive effects like one

pump, for instance, stalls another pump because they can't operate in parallel, or excessive pressure of voltage or frequency as modes of failure or for that matter, a very typical one is failure in the sense of oscillatory performance rather than total step failure?

DR. MAZETIS: There was a--maybe Dave can amplify, but there was, I consider what you just went through in the area of common mode concept where the common causes were considered in the studies, and the specific failure rates depended on the system. I don't know what they are, but there is a discussion on what our assumptions were for common cause failures.

MR. MICHELSON: Could you clear up for me a general question? For instance, we went through a great deal of efforts under Appendix R to affix spreading rules because of fire vulnerabilities, and we performed certain fixes that were reviewed by the regulators and so forth, and now after having done all of that, we go with you and we do this analysis now, these various plants under this A-45 program, and find some plants have an extremely high vulnerability to fire.

Does that mean that Appendix R fixes weren't good enough or because the numbers are also fairly high, the probabilities are fairly high? Does that mean that we just didn't do a good enough job or we didn't do the analysis right to begin with or what happened that says that after all the

looking and fixing and reviewing and inspection, and whatever, that we still ended up with high vulnerability on some plants? What went wrong?

MR. MINNERS: I think that's your characterization. That is high vulnerability. I mean--

MR. MICHELSON: It is fairly high. Ten to the minus 5 range is fairly high, and 60 percent of the risk contribution in that plant was fire and spreading, but that percentage doesn't mean much. It is the actual magnitude that counts. It is a fairly high magnitude. Some way on pipe breaks, you know, fire water header, well, that was supposed to have been looked at way back in 1973 when the Gene Busso letter went out and so forth. No energy pipe breaks are supposed to be looked at. They shouldn't be high contributors if they had been looked at carefully and properly reviewed and fixed.

MR. MINNERS: I don't agree with that assessment. I think on the fire thing people looked at it; it was, said well, okay, we have given an exception to the full requirements and not have to have spray system. We realized that entails some extra risk, we find it acceptable and when you do the PRA, that quantifies the number.

Now I guess you can look again and say is that whatever it is times ten to the minus 5 acceptable or not?

MR. MICHELSON: If it is acceptable, then why are we

even thinking of adding any additional hardware or whatever to correct the problem? You would think that we already buy off on the numbers, there is nc reason to worry about the problem further.

MR. MINNERS: Well, one of the problems is, Carl, is that when you add up all of the ulnerabilities in the plant, okay, that may be something that you want to fix. That's a question you have to answer.. Whether you want to go at these individual things and fix them or whether you want to take the big fix and take care of it all.

MR. MICHELSON: What bothers me a little bit is that it isn't just a fix. It is a fix again proposition. We have already fixed it once I thought. Didn't the Appendix R work? And now we go back and fix it again because it is a big contributor yet to risk? If it isn't, then we don't do anything I would think.

MR. MINNERS: I think it is prudent to go back and look at what you did in the past and say hey, did I do it right? I know more now. I have methods of analyzing it, had more operating experience, should I do something about it. I don't think just because the case study came out with two times ten to the minus 5th for vulnerability that says that it should be fixed. I certainly think it puts it up as a candidate that people ought to think about.

MR. MICHELSON: What puzzles me a little bit is I

guess we just didn't quite understand the problem well enough to fix it right the first time which was presumably the Appendix R work, which is fairly recent work.

DR. MAZETIS: This slide gets into the current summary of where we are in the staff regulatory analysis, which is in essence, of course, a translation of the completed contractor activity, Sandia, into a staff position, and you may recall that in, on September 26th, 1986, we provided a pre-decisional rough draft of the case studies in a regulatory analysis format, and we presented it to you in a closed session, and we described the six alternatives that were being considered. At the moment, we have a, an updated version, revision that is being prepared that will again describe, describe the same six alternatives, and as you heard a couple of months ago from my boss, Brian Sharon, that the thinking still is to propose a resolution focusing on the thrust of alternative 2 that is described in, described in the regulatory analysis, which in essence is a plant-specific studies, PRA studies.

And just to refresh your memory here, the six alternatives were the first one, no action. There was a discussion of, there will be a discussion of no action, and obviously if it is determined that the NRC, NRC/Sandia studies are too conservative, then that may be justified. In other words, if the EPRI owners group type of study is concluded to

be a more appropriate or more correct, then probably you will end up in this arena.

MR. MINNERS: Like Pete said, that is also a problem of goals. Depends what goals are selected. You pick two times ten to the minus 4, I agree with you, you don't have to fix anything.

DR. MAZETIS: Alternative 2, of course, we are focusing on as a proposal would direct the resolution and merit to marry it with the severe accident program, in particular individual plant evaluations.

Alternative 3 --

CHAIRMAN WARD: Could I ask you a question about that? When this was--let's see. In September '86 when this list was, first alternatives described, I don't recall that, I mean I recall alternative 2 was some sort of limited scope PRA, but I don't recall that it was explicitly tied to IPE at that time, because that wasn't very well defined.

DR. MAZETIS: You are right, and this next draft is being updated to reflect the marriage of A-45 or actually not A-45 specifically. It is going to be decay heat removal per se, to the severe accident program.

Alternative 3 was a, a list or composite of modifications that were focused on the cost-out that were common, more or less common vulnerability seen in the six plants.

Alternative 4 was focused on two areas for PWRs. It was feed and bleed, by cost/benefit on feed and bleed and for BWRs venting the containment.

MR. EBERSOLE: Call out a non-parallelism or in those two aspects, feed and bleed.

DR. MAZETIS: These two?

MR. EBERSOLE: Right. There is a large mount of homogeneity in those being in the same place. Feed and bleed does not accommodate containment heat removal, and I, whereas containment venting does.

Do you mean containment feed and bleed and still removing heat from the containment via heat exchangers as is normally done? Of course you do. And containment venting, doesn't that always incorporate open cycle boiling out of the primary vessel that is blow-down? So to really make that--

CHAIRMAN WARD: Feed and bleed.

MR. EBERSOLE: To feed and bleed is open boiling out of the vessel for PWR, but it does not get rid of containment heat whereas the BWR with open boiling contained venting does the whole thing. And I think that ought to be, you know, the differences ought to be stressed. Do you follow me?

DR. MAZETIS: Yes. I think they are identified in each case study, a description of the process that was costed out.

MR. EBERSOLE: The former is not as comprehensive as

the latter.

MR. MINNERS: PWRs don't need heat removal with their big containments.

MR. EBERSOLE: That's a statement that I find very interesting.

MR. MICHELSON: That is.

MR. MINNERS: They don't need it for a long time. They are built to take a large break LOCA, okay, so they can go a long time before you have bit of a problem.

CHAIRMAN WARD: Pressure pool can, too.

MR. EBERSOLE: Sure.

CHAIRMAN WARD: It is the same capacity.

MR. MINNERS: I agree with you. They are different systems. They are not the same system, but to say that one is bad and one is good --

CHAIRMAN WARD: No. I think that Mr. Ebersole is pointing out that, I mean the BWR already has the feed and bleed, and under this you are adding to it a means of getting the heat out of the, you know, abnormal situation out of containment by containment venting. For the PWRs you just are introducing feed and bleed and there is no provision for the second step.

MR. EBERSOLE: Exactly. They are not homogeneous objectives.

MR. MICHELSON: Could you clear up for me then a

point? Don't most PWRs have the inherent capability now of feed and bleed? A few do not I know, but don't most have it already?

MR. MINNERS: No. Most, yes, there are some CE plants that don't have PORVs.

MR. MICHELSON: Don't the majority already have the hardware and the capability? Maybe not yet the instruction or whatever?

MR. MINNERS: They all are supposed to have the procedures for feed and bleed, but they have--

MR. MICHELSON: Most of them already have feed and bleed.

MR. MINNERS: their capability is different degrees. They have sized PORVs.

CHAIRMAN WARD: Reliability of the capacity is different.

MR. MICHELSON: That's what I am trying to get down to. Is the reliability differences a matter that you can't get removal of the decay heat by feed and bleed or what?

CHAIRMAN WARD: Both.

MR. MICHELSON: Depends on what point in time then you are talking about. You are talking about five minutes after the event or talking about an hour after the event or whatever? Most of them have feed and bleed capability within reasonable times.

DR. MAZETIS: The importance--it may be of interest, Carl, to take a look at the importance if you were focusing on feed and bleed, for example, to each of the case studies. It varied, of course, with each plant as to its contribution to reducing core melt frequency because the individual accident sequence varied from plant to plant and its contribution to overall core melt frequency varied from plant to plant, so for one plant, this may not have been very important. For another plant, it may have been very important in reducing core melt frequency.

Again, the last two alternatives were the two versions of dedicated decay heat or hot shutdown capability, and cold shutdown capability where the last one included both hot and cold shutdown capability.

MR. EBERSOLE: Again, there is a disparity. You look at the designs. I don't know what you mean by hot, but in the case of the boiler, at 220 degrees you can zimmer forever if you vent the containment. And I don't know whether you call that hot or not, but it certainly is not hot to, you know, pressurized context, the depressurized boiling system, with the body containment pressure.

Ed, is that hot shutdown?

DR. MAZETIS: I guess this terminology is probably more appropriate for the PWR where, where the intent would be to--this was a system that did not have the capability, this

dedicated system in a separate structure, did not have the capability to continue the plant into cold shutdown. It was in essence the aux feedwater capability with a limited makeup for small breaks, and it was only after you added the shutdown heat removal heat exchanger type pump, heat exchanger structure that we costed out the additional dedicated cold shutdown heat removal.

MR. EBERSOLE: One system, of course, has a capability prior to core damage, just direct boiling. The other requires exchangers because of the coolant activity. And it requires, you know, multi-step path to get to atmosphere.

You don't develop these differences in these alternative 5 and 6?

DR. MAZETIS: No. No. There wasn't really much detail. You may recall that initially we had planned to just cost out five alternatives where the A-45 studies did not intend to cost out the additional capability for long-term decay heat removal, and it wasn't until toward the end of the exercise that it was decided to do our best to tack on the costs associated with adding a cold shutdown capability, so there were some gross assumptions made.

MR. EBERSOLE: Cold shutdown capabilities involve sensible heat removal with heat exchangers and pumps.

DR. MAZETIS: Yes.

CHAIRMAN WARD: Jerry, could I go back? Leave that, the feed and bleed for PWRs again. As I recall the six case studies, well, none of them showed feed and bleed to be as important as perhaps was expected at least by some people before the studies, but there was variability in the importance.

DR. MAZETIS: Yes, there was variability.

CHAIRMAN WARD: My question, was that variability due to the fact that, the variability and capability for feed and bleed in the various plants, or was it due, just due to the fact that the need for feed and bleed didn't enter into any actual sequences? Do you see what I mean?

DR. MAZETIS: My recollection, it is probably more the latter because where you had a plant that maybe had a poor aux feedwater system, with poor reliability, the numbers were not too good, feed and bleed really came out looking great and the contribution of feed and bleed to reducing overall core melt frequency looked more significant than the other plant. You had a great aux feedwater system, so it came into sequences like that. That's why it varied mainly from plant to plant.

CHAIRMAN WARD: It could be in those two plants, the actual capability to feed and bleed could be essentially the same. You would still --

DR. MAZETIS: Sure.

CHAIRMAN WARD: Okay.

(Slide)

DR. MAZETIS: This again from in the reg analysis that you will see in the near future, emphasizes that for the decision-maker, that it gives him calculations using three methods, and it actually may confuse the decision-maker more than clarify. Anyway, the methods that were presented --

CHAIRMAN WARD: Might confuse them. It still might lead to a better decision.

DR. MAZETIS: If he understands the three methods; as you will see in the reg analysis or you have seen in earlier versions, that the three methods are A, avert a, considering averted off-site costs only; B, considering averted off-site plus on-site costs; and C, all the above plus the effect of after-decisional special considerations such as the possibility after an accident of reactors being shut down in moratorium or other unquantifiables and using these three methods, you will see and you have seen in reg analysis that, that depending on which method you use, you may come out with a different answer.

You use method A, it is possible that alternatives 2, 3 and 4 from the previous slide may be cost effective for some plants. If you use method B, of course, now the same alternatives may be cost effective but they would be more cost effective. And of course, if you use the additional, it is

very possible averted costs of these special considerations in method C, even alternatives 5 and 6 may be cost effective for some plants.

MR. EBERSOLE: In the evolution of these costs, did you give consideration that in the application of say alternatives 5 and 6, you could cut back on the extremely complex and substantial investment in protective features that you could either soft pedal or eliminate which is put there now to cover the extended vulnerability of the plants?

DR. MAZETIS: That is certainly a possibility, but the ground rules had to be laid in order to cost things out.

MR. EBERSOLE: So you didn't go back and say if you did this then you didn't have to do fourteen other things?

DR. MAZETIS: No.

MR. EBERSOLE: Why isn't that a substantial--

MR. MINNERS: I thought it was surveillance or something we thought could be cut back.

MR. EBERSOLE: What about QA, and safety category, categorization, et cetera, in peripheral systems which are now all over the place?

DR. MAZETIS: For example, for alternate 5 and 6 the assumption was made. It was installed as safety equipment.

MR. EBERSOLE: I know, but you didn't, you didn't take advantage of going back and including up all the peripheral equipment which had to be safety categorized

because they formed a part of the overall vulnerability of the plant?

DR. MAZETIS: No. No.

MR. EBERSOLE: Those savings would be substantial.

DR. MAZETIS: Well, in essence that's alternative 2 now. Remember alternate 2 were, the rationale for choosing alternate 2 is that here is six plants, and here is for each plant what we see as ten or 11 vulnerabilities to their existing plant, and so we costed out for alternate 2 value impact, a backfit if that plant had backfitted those vulnerabilities, so in that sense, we considered improving the vulnerabilities we found, so it is covered in the scope of alternatives.

Yes, sir?

DR. MARK: Value impact analysis is a numerical thing. It is arbitrary as may be. You still put in a thousand dollars as if it had anything to do with the man rem and so on.

But how you can even, how you can allow yourself to talk about a value impact analysis based on unquantifiables escapes my imagination.

That's just a judgment to me. It may be that the method C says we should do it. It will be important to do it. It has got a big point or something, but you can't possibly put it in the bracket of saying it is cost effective.

You can put a number on sabotage. It is either one or zero or it is something in between, and the whole list there. It is a value judgment, and I'm not objecting. It,may be worth doing, but it can't be called cost effective.

DR. MAZFTIS: My response to that is yes, there is a lot of uncertainty and vagueness to these areas that I have listed in method C, and we included them because when we asked ourselves the question should we ignore them, the answer was no. That's the decision-maker has to cover, include the spectrum of considerations, and although we may not have as good a handle on all these areas as we have other areas, it's something that shouldn't be ignored, so that's why I was including that.

MR. MICHELSON: Question -- the proposed dedicated aux feedwater plus high pressure makeup arrangement, was that considered alternative 5?

DR. MAZETIS: Yes.

MR. MICHELSON: Thank you.

MR. KNIEL: Jerry, could you list which one, which ones were quantified in the alternative C moratorium, quantified in three different ways as I recall, or four different ways?

DR. ERICSON: That is correct.

MR. KNIEL: Put the slide back up again on the--which of the ones were quantified and which weren't?

DR. ERICSON: Okay. Sabotage in the conditional sense allowing you to make the judgment of what likelihood is, but a range was included. The moratorium was quantified in several ways. The resolution or cut was made at the economic impact of the resolution of the other generic issues. Both of those had dollar values assigned. We did not do those. The staff did those.

DR. MARK: What you are saying is that they are all subjectively filled in?

MR. MINNERS: Sure.

MR. KNIEL: We did actually make some dollar values.

DR. MARK: You invented numbers to go with them.

DR. ERICSON: I wouldn't say we invented them, Dr. Mark.

MR. KNIEL: I think the moratorium thing was treated fairly cleverly because we handled it in one, was it three different ways or three different ways, right, so you had your choice of how you wanted to look at it.

DR. MARK: That's what I have been saying.

MR. KNIEL: Fine.

MR. MICHELSON: How did you treat the generic issues then, and there are quite a few of them, and in A-47, A-17 and so forth?

DR. MAZETIS: Excuse me?

MR. MICHELSON: Proceed. You are going to tell me.

DR. MAZETIS: What that means is we looked at the 50 or 60 or however many there are generic issues, and using judgment, for example, one of them was A-44, Station Blackout, conditioned on the, a backfit of alternative 6 which was the dedicated heat.

MR. MICHELSON: Why don't you take a more difficult one like A-17, which you haven't even resolved yet? That, was that included in this or was that ignored at this point?

DR. MAZETIS: I don't recall the specific ones that were included. There may have been about a dozen that are discussed or were considered and--

MR. MICHELSON: Did you look at the unresolved ones or only the resolved ones? Maybe that would help.

DR. MAZETIS: I think we looked at all of them, but we concentrated in order to come up with a reasonable judgment, as to what the outcome would be, concentrated on those, that some resolution was already perceived on paper.

MR. MICHELSON: One of the big ones that keeps coming up as the system interaction A-17, I don't know how you would possibly handle that at this time,

MR. MINNERS: Didn't quantify it.

MR. MICHELSON: Certain of the generic issues were left out of the quantification?

DR. MAZETIS: That's right.

MR. MICHELSON: Okay. Thank you.

DR. MAZETIS: As I indicated earlier, the alternative 2 is what the reg analysis will focus for future potential improvement of decay heat removal systems where the basis or the reasons that we came up with this proposal is that the studies, the case studies again showed that a large number of the risk contributors are plant-specific because they lie in support systems, balance of plant areas, not in NSSS specific areas.

Also use of method C which perhaps could justify even alternative 5 or 6, goes beyond value impact methods previously documented for unresolved safety issues and generic safety issues, and also the insights gained from the six case studies and the EPRI owners group analysis is planned or expected to become guidance to licensees as the severe accident program progresses, and licensees, if what is expected is implemented, turn to their plants for examining for severe accident vulnerabilities.

CHAIRMAN WARD: Now we have seen your reg, the results of much of the regulatory analysis, but I'm, I have lost track of what form or when. Did we see a rough draft report or did we just see your earlier --

DR. MAZETIS: You saw a rough draft report that we submitted to you prior to the closed session in '86.

CHAIRMAN WARD: Okay. Have you changed or have you done any new work since then or--

DR. MAZETIS: There has been no change to the contractor's findings, no, but the change is, is going to be in the draft proposed resolution in terms of more definitive as to what direction we feel the A-45 program should take, that you didn't have at that time.

CHAIKMAN WARD: Right. Okay.

MR. MINNERS: The numbers have changed because we have made errors, and we have made little modifications, but the general idea is the same thing. It is only minor changes.

DR. MAZETIS: I think at that time most of the results of the studies had been completed but they hadn't, they hadn't been published yet in final form, and it could have been there was some finetuning.

CHAIRMAN WARD: Yes. Well, they are still not published in final form, are they?

DR. MAZETIS: Yes. The six case studies from earlier form are in six NUREGs that have been published for the plants.

CHAIRMAN WARD: The case studies are?

DR. MAZETIS: The case studies.

CHAIRMAN WARD: The regulatory analysis is what I am talking about.

MR. KNIEL: No.

CHAIRMAN WARD: That's what I was talking about. We saw before the September meeting, a rough draft report I

thought of the regulatory analysis. Or am I dreaming?

DR. MAZETIS: No. You did, and I agree that the major part of that draft remains in tact in terms of the technical findings. I mean they haven't changed. There may have been some finetuning of the numbers, but--

CHAIRMAN WARD: What is the status of that report?

DR. MAZETIS: Okay. The status -- did you add something to that question?

CHAIRMAN WARD: No.

MR. MINNERS: Wanted to know what the status was of the regulatory analysis.

DR. MAZETIS: As I indicated earlier, that the next revision is essentially in the typewriter, and our plan is sometime within the next couple of weeks to get it distributed internally so that within the next month or two, at the outside, ACRS probably would be a contributor to commenting on that report.

DR. SIESS: May I ask a question? What guidance has the staff had from the Commission on the fact that it should be included in the value impact statements?

DR. MAZETIS: Well, there is a backfit rule that we have tried to follow with its references to various value impact NUREG guidance that have been published by the staff the past several years, and so the format of this regulatory analysis will track with other recently, other recently

submitted backfit analyses. For example, more recently A-4; it follows in general the same backfit format as the A-4 format.

DR. SIESS: Is that an answer to my question?

DR. MAZETIS: Anyone have a better answer?

MR. MINNERS: The only explicit guidance, any written guidance that I know you have we have gotten from the Commission, is the backfit rule which lists half a dozen or so specific factors that should be considered in factor analyses, and also has an indirect statement something like in any other relevant factors or something like that.

DR. SIESS: Does that give you guidance on off-site versus on-site?

MR. MINNERS: No.

DR. SIESS: Moratorium?

MR. MINNERS: No.

DR. SIESS: So we are operating in an area where we don't know what the safety goal is and don't know what the values and impacts should be? Making common law.

MR. MINNERS: Well, I guess the direction that I would take is one of reasonableness. I think you ought to discuss all of the relevant significant factors, and I don't think anybody can disagree with that. I don't see any reason for excluding any information except on the basis that it is irrelevant or insignificant.

DR. SIESS: So you would you say include everything?

MR. MINNERS: Then the decision-maker is going to make his decision on whatever basis he wishes. I have no way of controlling how the decision-maker is going to make--

DR. SIESS: Who is the decision-maker?

MR. MINNERS: The Commission I presume on the USI.

CHAIRMAN WARD: Could we take a--

DR. SIESS: You would propose to give the Commission a regulatory analysis that covered the range of strictly off-site up through on-site and moratoria and let them decide?

MR. MINNERS: I think they can handle that.

DR. SIESS: You said it. I didn't!

CHAIRMAN WARD: So in other words--

MR. MINNERS: We have had an opinion from OGC on on-site costs, but I haven't heard anything from the Commission on it.

CHAIRMAN WARD: Well, if you look at your three A, B and C, methods for value impact analysis, I mean isn't it clear that C, isn't C clearly outside of what would be intended under the backfit rule?

MR. MINNERS: No.

CHAIRMAN WARD: That isn't clear to you?

MR. MINNERS: There is introductory statement in the backfit rule which says you should consider all relevant factors.

CHAIRMAN WARD: You don't think, I mean you have made the determination I guess that neither A, B nor C is particularly favored for compliance with the backfit rule? I mean I guess I --

MR. MINNERS: If I am making the decision, okay, I would look at method C and I would weight the different factors as to how much I believed them. I would consider--everybody thinks about moratorium. It is ridiculous not to say that. It is a possibility.

CHAIRMAN WARD: What would the backfit rule require? I mean what would the lawyers say?

MR. MINNERS: What it would require, it has six factors which are basically implementation costs and averted off-site costs, and occupational exposure.

CHAIRMAN WARD: So that would be B?

MR. MINNERS: That would be A. That would be required. You have to at least address those things. Now in addition to that, the backfit rule as I read it let's you go beyond that and consider other, what I would say is relevant significant factors.

CHAIRMAN WARD: Okay. And you say that could then go as far as B and C or C?

MR. MINNERS: To me, it goes as far as C, sure. Moratorium is a serious consideration and all we have done is done some number manipulation to try and give you a better

perspective on it. No intent to say that our calculations of cost of a moratorium are any estimate of what the actual cost would be. Just trying to give some perspective.

Sabotage is the same question. It is a matter of belief. I agree with Dr. Mark. There is no way of knowing what the probability for sabotage with them is, but if you are going to make some estimates you are going to have the balance of cost of sabotage from, against your assessment of risk. It is going to be a very subjective assessment, but it is still going to have to be balanced.

CHAIRMAN WARD: Thank you.

DR. MAZETIS: This slide is really a review of some of the considerations that are now being given. Obviously it is not cast in concrete yet, but this will give you a feel for the implementation, and as we try to implement the thrust of alternative 2, how we are going to do that specifically.

Again, the idea is to require plant-specific reliability analyses to try to focus on plant-specific vulnerabilities, and two questions that are being debated are should, should it be part of IPE or should it be separate PRA requirements concurrent with the IPE program? And there are pros and cons to each as you can see here.

One question we are wresting with now, I really don't have the answer for, is if we marry it to IPE, does it mean we have to require a more rigorous or more thorough PRA

methodology than what is being currently contemplated for the utilities to use on IPE?

Also not a small consideration is, is somewhere down the road should the staff get involved in either some kind of limited audit efforts or in overall review of these analyses? So that I guess up front here we are thinking there should be some commitment, if we expect to get something, some safety improvement out of the idea of marrying to IPE A-45, there should be some kind of a commitment to review downstream these analyses as a minimum on an audited basis.

MR. MICHELSON: Question--if you elect the IPE route, will you be expecting them to look in sufficient detail to understand the effect of fire, flood, external, internal, wind storm, et cetera, which is a part of the question? Would that be now brought--I know IPE can't. I didn't look too closely at those areas. Maybe I am mistaken.

MR. MINNERS: If you mean the IDCOR method, that doesn't include external events, but my understanding of the severe accident policy statement is that it says explicitly that external events should be considered.

MR. MICHELSON: So you are thinking IPE will include a sufficiently careful examination of external events to satisfy this criteria?

MR. MINNERS: We have some people looking at what we should consider in the external events.

MR. MICHELSON: From what I have heard today, that would have to be sort of a ground rule if you are going to cover these events by the IPE approach?

MR. MINNERS: I said we are investigating how much external events should be included in IPE, and I guess a decision hasn't been made on what is going to be in IPE.

MR. DAVIS: On the previous slide, that item under the separate requirement?

MR. MINNERS: Where are we, Pete? Slide 8?

MR. DAVIS: Nine.

DR. MAZETIS: Here?

MR. DAVIS: Yes. It indicates you would require, if it is separate, A-45 resolution is separate, this would require each licensee to perform two separate analyses, and I guess that's true.

However, I don't see that that is a significant problem because I don't think anything they would do under A-45 could not also be used in the IPE. Is there something more to it than that?

DR. MAZETIS: No. I guess the idea was that if they were required under the IPE program to go into their plant and employ a certain methodology to look at the total plant vulnerabilities and that they finished that study and concurrent with that there is a requirement to do the same thing but focusing on just decay heat removal in a more

rigorous PRA methodology, it may be an additional burden, and redundant to what they did under IPE, but what you say is true. They may be able to use something they learned from IPE or vice-versa, but it would be two separate burdens on the licensee to respond.

MR. DAVIS: Well, they might be separate, but they wouldn't be independent.

MR. MINNERS: At least double the paperwork.

MR. DAVIS: Okay. Well, to me, that doesn't seem like a significant disadvantage.

MR. MINNERS: It is quite possible, too, depending on what order you did it, you seem to be suggesting if we did A-45 first that could be used in IPE or vice-versa.

MR. MINNERS: That might not be the case. If IPE didn't include external events, and that's not a decision made yet, then it might not be enough.

MR. DAVIS: No. I am not suggesting it wouldn't be enough, but what they would do would be applicable to at least internal events part of of A-45.

CHAIRMAN WARD: At least if a licensee knows he is going to have to do both of these things, whatever they are, he should be able to organize his effort.

MR. DAVIS: Avoid duplication.

CHAIRMAN WARD: Yes. But if you come out with instructions for doing an IPE next month and eight months

later come out with instructions for doing something under this, that could cause licensees a lot of problems it would seem to me.

DR. MAZETIS: Okay, and the last two slides kind of shifts gears into the next couple of speakers, where maybe now we could point to the submittal by EPRI and the owners group on Point Beach which is the same plant, one of the plants that NRC/Sandia studies concentrated on, and you might ask the question, well, if we are going the way that I just described in our reg analysis why bother? I mean this document may be a nice piece of information to have, but why bother with resources of reviewing this document?

I guess that's a good question, and our current thinking is that when the IPE generic letter is published, we would not lose what we have learned on A-45 the past seven years. There is planned and explicit address of, focuses on decay heat removal in the IPE exercise, and we perceive it perhaps as an additional appendix on what we have learned on A-45 through the case study analysis plus in this particular case, the whole breadth of the picture on some additional insights provided from others in the industry and hopefully by the time it is published, some staff comments in the IPE program as to where, what agreements we have had with NUMARC and where our disagreements still lie so that the utility as he goes through this severe accident program and starts

looking in his plant can get some specific guidance for decay heat removal vulnerabilities on where to focus his resources and where the areas perhaps for his plant would contain the more vulnerabilities, where the soft spots are and so forth.

So we think there is something to be gained by continuing to the dialogue which is planned with the NUMARC sometime within the next one or two months to interface with NUMARC to discuss in essence as you will see a need for additional understanding as to why certain assumptions were made, so that we could at some point down the road form an opinion as to what we feel are the better assumptions. And as I indicated earlier, you might ask is the alternative 1 or the no action, do nothing, justifiable? And again, if the EPRI PRA is, turns out to be correct, and if yo if you like it, and you think that Point Beach was a bounding plant, then again you may think, may end up in this box where doing nothing is justified, but I don't think as far as the staff is concerned that obviously this early that we are convinced that either of these are correct. We have this dialogue to go through on the NUMARC studies, better understand the basis for a lot of their assumptions.

MR. MICHELSON: Clarification--when you talk about the EPRI PRA, do you mean the NSAC-113?

DR. MAZETIS: Yes.

MR. MICHELSON: Okay. Thank you.

CHAIRMAN WARD: Jerry, it seems to me that the first one is a, reasonably determinable, that is, the differences between the Sandia PRA and the EPRI revision of that. You know, that's what you are going to discuss. Maybe you can resolve those.

DR. MAZETIS: Yes.

CHAIRMAN WARD: But the second one, how are you ever going to figure out whether Point Beach is a bounding plant or not?

DR. MAZETIS: We are not intending to do that. All I am saying is if someone is asking himself and is convinced that doing nothing is justifiable, as far as the staff is concerned, this may be the bases for them believing that. All I am saying is we disagree. We are not convinced yet that that rationale has a basis.

MR. WARD: Okay. You are saying your position is alternative 1 is not justifiable?

DR. MAZETIS: That's right. Exactly.

CHAIRMAN WARD: Maybe they can convince you on the first part there, but it looks tough on the second one.

DR. MAZETIS: I doubt it on the first part, too, after preliminary interface with some of the analysts, but you will hear that in a couple of minutes.

(Slide)

DR. MAZETIS: And my last slide is--you have seen

this table before. It is just a lead-in to the next presenter, from the EPRI owners group document. You can see the difference for the up-front end of the document, the core melt frequency, where the major differences are identified and focus more on the first four areas where you can see the, they are in some cases a large difference between NRC/Sandia reports and the EPRI owners group report.

So that completes my presentation, and Mr. Chelliah is the next presenter with 15, 20 minutes discussion of what his observations are so far, and again I remind you that he has not yet closed. There have been no give and take with his observations with Sandia, nor with NUMARC, so there may be a little overlap here.

CHAIRMAN WARD: Thank you very much. Let's take a break until 10:30.

(A brief recess was taken.)

CHAIRMAN WARD: Our next speaker is Mr. Chelliah of the Research Office.

DR. MAZETIS: If I can just make a brief comment, I notice from your agenda that you had an additional gentleman, Dave Pyatt, scheduled, and we would like to have his area, which is the back end of the calculation, deferred as far as an actual presentation, but have him available if questions come up, so really we have got two speakers left, Mr. Chelliah and Dr. Ericson, who probably we could get through before

lunch.

MR. CHELLIAH: Good morning. My name is Chelliah. I am from the Risk Analysis from Research.

(Slide)

MR. CHELLIAH: As the, as part of this decay heat removal study, the lab, Sandia Laboratory, they performed the decay heat removal type of PRA on the Point Beach facility on the power in cooperation the EPRI. They performed the reanalysis of this particular Sandia study with the EPRI, phone company, of the Point Beach facility in cooperation with the EPRI; they performed the limited review of this Sandia study. They have provided us the reanalysis the staff looked into, and we have the preliminary comments here.

In summary, the EPRI report claims that their core damage frequency estimate just allocated to decay heat removal is lower than the Sandia estimate. What we have done here in the presentation is to provide you with a summary differences on all the accident sequences. Here I would like to put the ACRS members to read the sequence. There are a couple of pages on the back side. I have described the sequence with, what this means. Also I will explain to you as I go through here.

Here we have two estimates, that is Sandia National Lab, EPRI estimate. And we have here three major bullets I would like to explain one at a time, and I will also try to

say whether we concur or don't concur.

First the sequence, the frequency of failures. You can see the difference in the frequency estimate. The first difference comes from the frequency in the EPRI study. Basically here what they did, they looked into the Sandia frequency, the smaller frequency; it covers wide range of break, varying from .3 inches all the way up to 1.6 inch, 2 inches. It includes all the failures, all those things.

What the EPRI did, they did look into the experience, the operating experience. They have decided that those breaks involves the smaller ones, so what they did, they assigned the small LOCA frequency about 1.five inch, which would--accordingly they are just doing this frequency.

MR. MICHELSON: Question--what data base did you use to determine small break frequency?

MR. MICHELSON: Or what did Westinghouse use or whoever did the work?

MR. CHELLIAH: Yes. In this particular report, there is also one, in the report it is indicated that they used Westinghouse operating experience I assume.

MR. MICHELSON: Westinghouse, every time some utility has a small break, does Westinghouse somehow get informed or become aware of it and put it down in their data base? Is that the way it works? Or are they just pulling out some numbers and playing around with them? They are real

legitimate scientific data base that they maintain small break LOCA?

DR. MAZETIS: I think you are asking some of the questions that when we get with NUMARC that we would expect to gain a better understanding of what the basis for their numbers are.

MR. MICHELSON: You haven't done that yet?

DR. MAZETIS: However, Sandia could address the basis for the numbers in the six case studies if you want to get into that.

MR. MICHELSON: That's a good place. What at Sandia--

DR. ERICSON: Generic data base published in the procedures guide.

MR. MICHELSON: Where did it come from?

DR. ERICSON: Accrued by the staff and by the community over a number of years.

MR. MICHELSON: I have seen some of those numbers. I am no PRA expert, and the first to admit it, but a lot of numbers I have seen in the past seem to not have a good scientific base, but rather some, early on they were assumptions because they didn't have good numbers and they began to become accepted even though they weren't necessarily scientifically based. I just wondered, you are using the same numbers everybody else is using? Is what you are saying?

DR. ERICSON: That is correct.

MR. MICHELSON: And how do our PRA people feel about that? Are they satisfied those are good numbers, or just the numbers everybody uses?

MR. DAVIS: According to the EPRI report, the small LOCA frequency that was used by Sandia was dominated by some pump seal LOCA data that is in an internal NRC memo which I haven't seen, and according to the EPRI report, most of those breaks were pieces of small data that would not require recirculation, and that at least my understanding is the basis for the large difference in initiated frequency.

CHAIRMAN WARD: Mr. Ericson, is that right? The data you used--

DR. ERICSON: He says what I understand to be in the report. I disagree with him. And the S2 data that is published includes all of small break LOCAs below one and a half inch, doesn't throw some of them out. In fact, if you take what is in the EPRI report, the five additional events cited, I think that is correct. Then you come up with something like three times ten to the minus 2 if you add those into the data base they talk about.

MR. CHELLIAH: One point, Dr. Michelson--the EPRI--

MR. MICHELSON: I am not quite finished with the question yet.

MR. CHELLIAH: Okay. I'm sorry.

MR. MICHELSON: If the pump seal LOCA is a dominant contributor, which I think is what you are saying, then the NRC is aware of that, it is their data base, is that what you are saying? You said it was an internal NRC memo, so really the NRC is the custodian of small break LOCA predominant contributors at least. And so you people are the ones that are the experts and have the good data base on it I guess. That's what I thought I heard.

MR. DAVIS: According to the report, the data that was in the memo was based on a search of LERs.

MR. MICHELSON: Now we are getting a little closer. And does NRC maintain a small break LOCA data base which they keep current on all of these? They find, of course, the pump seal is made to contributor. I don't think I necessarily disagree, but you people are the custodian and I can go and find out who is maintaining this data base and see how they do it?

DR. MAZETIS: Joe--

MR. MINNERS: Joe, you guys--

MR. MURPHY: I am unaware of formal data base.

MR. BOEHNERT: Would you identify yourself, sir?

MR. MURPHY: Joe Murphy from Research; I am unaware of a formal data base in terms of someone surveying the OERs once a month and adding that in.

MR. MICHELSON: I am unaware of it, too. That's why

I was a little surprised. I am, I am not going to argue if that's what everybody thinks is the source.

MR. MURPHY: There was a search done a couple of years ago, on the pump seal LOCAs, and that information was in the memo that was referred to and that has been used in a lot of PRAs sponsored by the staff.

Now there is a standard policy in doing a PRA that the analysts usually do surveys of EORs. If they see an unusual pattern of behavior, they go back and analyze the data more explicitly, but AEOD may do some formal data base, the basic organization for gathering and maintaining the data base for the agency. They may have something explicit in that area, but I'm not aware of it.

MR. MICHELSON: I am not either, but I will go back and ask them again for a current answer. Thank you.

MR. EBERSOLE: Ask you a question? First I want to thank you for characterizing these sequences because it blows my mind to try to remember them. So in the first one there, you have in the explanation it is a small LOCA followed by failure of low and high pressure recirculation systems.

MR. CHELLIAH: Yes.

MR. EBERSOLE: I thought a PWR, for that matter BWR, really has no problem with recirculation since it has natural convection and the problem is one of makeup to hold pressure so you would have a thermal differential to carry the heat to

the secondary side.

I don't know why I say failure of low and high pressure recirculation system. You have got one in natural convection. I can see a problem in actually supplying the pressure to make up the leak to hold the pressure up so you can transfer heat.

DR. MAZETIS: I think--this is a different terminology, recirculation.

MR. EBERSOLE: You are going on out to recirculating the water. I am talking about the presence of the secondaries.

MR. MICHELSON: Are you defining small LOCA for BWRs differently than for PWRs? By definition it is the makeup of the normal, beyond the makeup of the normal system I think is the definition of small break LOCA, and it is very large break.

MR. MINNERS: What difference does it make if we define it differently?

MR. MICHELSON: Makes quite a difference in what kind of systems are going to address it.

MR. MINNERS: Small break LOCA medium, and we do large break LOCAs.

MR. MICHELSON: You said 2 inches was the range of your small break LOCA. I think it is considerably bigger than that for the boiling water reactor?

DR. MAZETIS: My recollection is that was about the size for the PWR case study. Perhaps Dave could correct me if I'm wrong.

DR. ERICSON: I can't pull it out of the top of my head.

MR. EBERSOLE: You are taking heat out through the exchangers. You have got for even the boilers, I mean the steam generators--

MR. CHELLIAH: Yes.

MR. EBERSOLE: Degraded state in the first place; you have lost the secondary.

MR. CHELLIAH: The point is the EPRI analysis assume that is the, is needed for breaks more than 1.five inch breaks. Accordingly, they are just small LOCA frequency, so that is one of the difference here.

Dr. Michelson, going back to your question, the PRA does provide a document of all the reported small LOCA events, including the Zion and the Robinson event, and some of the small leaks varying from 20 GPM all the way up to hundred GPMs. It does provide some documentation. If you are interested, you can look into the NSAC-60 report.

The second difference is the modified common cooling water success criteria. Basically what it is here, the EPRI, they did look into the cooling system configuration and associated cooling by common cooling water system, but their

claim is this. The CCW provides seals rather than it provides the cooling, so the claim is this particular system is not really needed during the injection phase of this particular sequence up to one hours. Accordingly, they have, the frequency here has accounted for some removal dependency due to the CCW system. We do concur with the plant-specific details.

We need some additional information on some of the test data on this seal performance related to why it doesn't fail during injection, why it would fail only after one hours because we have more than two-hour time sequence from the time so basically we do have that, but we need some additional information here.

The third one is really--

CHAIRMAN WARD: How much would that change the numbers?

MR. CHELLIAH: I don't have it here. The difference, added to the other thing they have here.

DR. ERICSON: Eighty-six percent of the difference in the small break LOCA frequency, in the two numbers; above the CCW and the service water balances are very minor contributors. CCW is like 6 or 7 percent.

MR. CHELLIAH: This is the load balancing. Basically this particular sequence used as the hour, there are three series pumping each unit at Point Beach. What EPRI

claims based on data, review of their procedures, related to this system, there are two, it is not meant to--operator has reduced some of the heat load. It is not needed so that they can live with the one hour satisfactory, so accordingly, there are some redundancies. That is also one of the reasons we went down.

We do have some other differences which I did not list. They did look into some human ratio. One of the things that this frequency involves is the operator failure to establish recirculation following the event. You have two hours to go. The Sandia, they used something like three minus per demand. EPRI claims that there are, 1 E minus 4 would be more appropriate based on the procedures. They have not provided any human analysis. Right now we do, we need more analysis on that particular operator failures.

There is one more on the sequence--the tank, because two hour, you are going to dump the water. What they are saying, you bleed from the tank; this particular area you bleed through the tank from spent fuel or you can bleed through the tank, okay, bleed the tank spent fuel or use the boric acid storage tank, about a hundred thousand gallons.

EPRI basically claims that the Point Beach facility, they do have procedures which dictates in case of water is 60 percent, 30 percent, you can do all these accidents, so based on the plant-specific procedures and training which are in

place, they claim, they have taken some--that's also a contributing factor. Other thing, too, you can see the sequence.

The next sequence is--

MR. DAVIS: Excuse me. A question--have you come to a conclusion about whose frequency of small break LOCA is more valid for this case? I don't believe you said whether you agree or not.

MR. CHELLIAH: We do contend the EPRI's frequency because we did look into it--you don't need these below 1.5 inch break. They are right. It is right. We do agree with that.

Now the second sequence is really that loss of off-site power sequence, basically Station Blackout sequence.

DR. MAZETIS: Excuse me. Again, if you ask the same question of Dave when he gets up here, you may or may not get the same answer, and I just want to point out that the staff has yet to close the loop on interfacing back and forth.

MR. DAVIS: I understand. Thank you.

MR. MICHELSON: Question--if you have a safety relief valve go through an operation and stick, is that considered a small break LOCA under this business?

DR. MAZETIS: Yes. PORV open air, sticking open.

MR. MICHELSON: Those kind of events do not occur as frequently as pump seal failures? Or if not, why does pump

seal failure dominate the data base?

MR. CHELLIAH: Dr. Michelson, we do have the sequence. We will come to that. We do have a sequence to answer your question.

DR. ERICSON: That is not the initiating event. The stuck open PORV is not the initiating event; subsequent event after transient.

MR. MICHELSON: That's why I asked the question. Is it considered a small break LOCA? What you are saying is that only if the pipe breaks first is it in this table in the way it is presented, but a small break LOCA may be involved in some of the other events. The fact is it was a fairly high probability.

MR. MINNERS: It is event T3QD1D2!

MR. MICHELSON: I really think it is there. That's why I asked the question. I thought it would have been considered a small break LOCA, but I see why such logic is you are looking only at the initiator, finding it that way.

MR. CHELLIAH: The second sequence is basically loss of off-site power, the failure of--the L is the failure of aux cooling. I'm sorry--secondary cooling, and E is the, really the failure of feed and bleed, so this sequence is really dominated by some of the Station Blackout concerns, failure combinations. There is some difference you can see close to--there are two major differences here. Updated initiator

frequency, loss of off-site power frequency. The Sandia study, they use something like about .zero 8 per site year based on one of the reports, NUREG 1032. At EPRI they did look into the plant-specific operating experience. We did have one event over there in the sixteen-year operating history, so they are just going accordingly.

The second one is really a very important one I thought in my view. They added, like they said in the report, they added one of the third time class battery system, seismically qualified. Basically, some start and control failure probabilities, safety equipment, because this particular sequence frequency is really dominated by the battery common mode failure, so this would help now, so they have not provided us--we do concur with this one. We don't have much detail what they did, how they did all these things. We need some information from EPRI, but basically we do concur.

There is some other difference also other than these two bullets. EPRI, what they did, they did look into the common mode failure analysis of the D cells and batteries reported in the Sandia. They used a somewhat different method. For example, in the Sandia study we used factor for the common cause failure of common mode failure of the diesels. EPRI, they started using one of the multiple failures. There is a difference, about three difference on

the diesel common mode failure. So that comes into this sequence frequency.

MR. EBERSOLE: Did they add an engine-driven DC charger by any chance?

MR. DAVIS: Just batteries; site qualified.

MR. EBERSOLE: They just added more battery capacity?

MR. DAVIS: It is an independent battery.

MR. EBERSOLE: Rather than putting a small engine-driven charger which has indefinite capacity, storage life; well, okay.

MR. CHELLIAH: We need more detail on what the battery does exactly, you know, where does it hook up, all of these things. I think Sandia is going to discuss the data we have on this particular item.

So basically, we need some information on this particular bullet.

The third and fourth sequence is really transient where you have main feedwater is available. The Q is the stuck open, the relief valve, and these are the recent failures and here is the injection failures.

EPRI, they look into this sequence carefully. Their claim is they did look into some of the Westinghouse, some of the operations performed by Westinghouse. They came to the conclusion as long as you have main feedwater available, you

don't get into this situation because--I'm sorry--because you don't reach first to the relief valve set point. Therefore, you go on to something, so they are, according to their analysis, the sequence shouldn't exist, so they did not comment.

MR. EBERSOLE: That exit is a transient involving a stuck open PORV and failure of recirculation systems.

The main feedwater system is assumed to be initially available. Well, and that says no need for recirculation, and that's right, but there is a distinct need for pressurization and supply capability to deepen overpressure on the primary side against the secondary system. Are you with me?

MR. CHELLIAH: Yes.

MR. EBERSOLE: I have both to have a thermal gradient--maybe you can pull secondary down to 29 inches of vacuum. Does it involve that? You have got to run downhill. Is that what is contemplated, that you will run the secondary pressure down as the primary pressure declines?

MR. CHELLIAH: Okay. Answering your question, Dr. Ebersole, we don't have much detail because if you look at the EPRI analysis, they did not even draw a branch point when you come to this particular event.

MR. EBERSOLE: It implies they are going to transfer to the secondary somehow, when they say no need for recirculation.

MR. CHELLIAH: But their claim is this valve is, won't reach that set point as long as you have initiating feedwater available, so they say you will be able to cool down with the existing, the other ejection systems.

MR. EBERSOLE: Feedwater is not worth anything unless you can get heat from the primary to the secondary, and that requires a gradient in temperature and that requires a primary system be at higher pressure than the secondary.

MR. ERICSON: If you accept the argument that Q doesn't occur, there is no loss in primary, primary stays pressurized.

MR. EBERSOLE: Fine if it does that.

DR. ERICSON: That's their argument.

MR. CHELLIAH: The question that we are taking basically, here is the similar situation as well as here. The injection is failing, falling this particular event, so you are in the same argument. If the valve doesn't open, you don't bleed the water from the primary system. Basically it is a logical sequence according to them.

Right now the question of what position we are taking, we do agree with them, but I think they have to show that the specific analysis for this facility, falling back to some of the analyses or typical Westinghouse analyses to some raising pressure, we haven't seen yet in the report. This is part of the verification of the criteria. Basically we do, we

agree with them.

CHAIRMAN WARD: You are saying you agree on both of those cases?

MR. CHELLIAH: Yes. Then this sequence, the fifth sequence, is very important sequencew. The T is really loss of feedwater event.

MR. MINNERS: We have a little.

MR. VANDERMOLEN: Harold Vandermolen from Risk Analysis Branch--the ruling means we agree with them contingent upon seeing the thermohydraulic calculation. We are not accepting this unconditionally.

MR. CHELLIAH: That's right.

MR. VANDERMOLEN: I want to make that clear. When we say we agree, we agree contingent upon some type of receiving thermohydraulic calculation verifying that assumption. Follow me?

CHAIRMAN WARD: Right. Thank you for the clarification.

MR. CHELLIAH: As part of PRA review we have to verify the criteria so we have to look into those calculations.

This fifth sequence is a feedwater event followed by the stuck open, the relief valve.

MR. MICHELSON: Which relief valve? That has got a Q in it also.

MR. CHELLIAH: I will explain that. Okay. Such sequence also exists in EPRI. They do have some estimate. Have, sometimes have difference. The major difference is the revised PORV probability. I think here it needs a little explanation. When there is, Sandia did, performed their study, based on the information available to them, what they assumed here, the safety valve will open because the PORV is the block valve.

Also they made assumption that 7 percent of the time they do open, and they are just also, they gave critically the blocked valve failure. Probably accordingly they computed Q in, but the EPRI, they did look into this particular event under the associated calculation performed by Westinghouse.

What their claim is, if you get the feedwater event, the only way you can reach the set point, the PRA set point the PRA set point is with the number 35 pressure, PSIG. This is based on the flow mismatch betweem the primary and secondary system so they say that there is only 1 percent of the time the valve will challenge because of the rising pressure. So accordingly, they computed this Q. They did also give credit to the blocked valve failure on the PORV. According to them, it will not reach the set point which is over 2485 PSIG. That's a big difference over there, so basically some sense here so they assumed 7 percent of the time it will open. But what the licensee claims based on

their operating experience and the Westinghouse with calculations, is only 1 percent of the time it will challenge because of the flow mismatch.

We do agree with the EPRI position but we need some additional bases under the assumption 1 percent, how they got--we need some bases on that, but we do concur with that position.

Then the last sequence, this is companion sequence here, that's the failure here, the small LOCA followed by the injection failure, so you have this particular bullet, place it here; also this one because this affects it as well, the LOCA frequency. And also doing the injection phase, the CCW is not needed because it prevents the seal rather than the cooling, so that bullet goes into this risk we estimate.

MR. EBERSOLE: Let me ask you a question. You have got some pretty low numbers up there, like ten to the minus 8. Isn't there a school of thought that says as you go up--

MR. CHELLIAH: Mine he is 79.5.

MR. EBERSOLE: As you go up, rather go down in probability like this, that there is a progressive deterioration of the reliability of these numbers because of common mode especially in complex systems, and so as you run down this scale of probability, your accuracy really declines and everything gets rather fuzzy at about ten to the minus 5th, or 4th.

MR. CHELLIAH: Well, yes. We do agree. When you go to minus 7, you do have substantial amount of uncertainty. In fact, right there the S2 frequency is the frequency itself because here we are talking about break and 1.five inch, the sequence, because the same initiating frequency is assigned here, so in absence of data, you know, light water reactor, you do have uncertainty.

MR. EBERSOLE: A cry for super-simple systems that don't have so many elements to have unreliability.

MR. CHELLIAH: The D1, D2 here, we are talking about the LOCA rejection. These systems are ECCS system. Sandia has modeled extensively common mode failures. We need to look into that. That's factored in here. .

MR. MICHELSON: I am still trying to sort out the small break as opposed to a relief PORF safety valve being open.

The revised PORV probability you show there is really the probability of that having experienced a transient. The relief, the PORV rather will also open. Does it mean it sticks open or remains open indefinitely? Is that what that probability is supposed to be, or just the probability it opens?

MR. CHELLIAH: No. This Q is, it is the joint probability of two events. Not only this will fail open, but also this includes some critical for unblocking the blocked

valve.

MR. MICHELSON: It is the probability that it opens and the flow path remains open for some reason, is that right?

M... CHELLIAH: Yes.

MR. MICHELSON: When does the flow path finally terminate, or is that yet another calculation? See, relief valves have been known to open at high pressure but reclose. In fact, many of them will reclose at low pressure. The LOCA does not go on forever. In fact, it gives you a worse situation than if the thing remained open.

Do you have any probability for experiencing an isolated small break LOCA which might be a worse situation by far than continuous one?

MR. CHELLIAH: Maybe Dave probably?

DR. ERICSON: The argument is event Q is open, and sticks open. It doesn't reclose.

MR. MICHELSON: Never recloses; the real world history is that it is a rarity to ever have a relief safety valve stick open.

DR. ERICSON: When you take that into account, the numbers get very small.

MR. MICHELSON: But the event changes significantly when, for instance, you have a small break LOCA terminated at the time when you are now using it as heat removal, it suddenly ceases to be the heat removal, and you have to

establish communication with the steam generator again. And now it gets real sticky. Now you have got a refuel problem and a natural convection problem, and so forth, regenerated which wasn't there as long as the small break LOCA procedure. That's what TMI did really. They had a small break LOCA for a while in terms of open PORV and later they terminated the break, and it creates a whole new situation at the wrong time. I just wanted to make sure I understood what your probability you plugged in. Thank you.

MR. CHELLIAH: Okay.

(Slide)

MR. CHELLIAH: So the previous slide says some of the sequences. The Sandia study, it is very detailed study. That's my thinking with respect to the other, comparable to some of the industry performed historical analysis on the flooding and seismic events and fire events, and also they did some on the wind analysis and they don't dominate here. So the EPRI, they did also review some of the Sandia study sequences. First one is flood sequences. This is basically, the sequence here is really there is fire in the main pipe. It is running on the top of the room, so basically they have postulated the pipe break and releasing something like about 2,000 GPM type flood, what they call moderate flood, and so it is going to result in the failure of the pump. The failure mode was really the spray failure mode.

Sometime back, Dr. Michelson, you asked me a question is there the system failure, how this failure as opposed to random failures? Here the spray failure mode, so basically, if you lose the water system, the water does provide cooling to the PCS. Basically you will see a transient now. Also water cools some of the safety equipment like the pump and HVA pump so basically they postulated sequence frequency of this.

Now EPRI frequency you can see is almost more than three. Some situations, there are two bullets. First bullet is very, very important. In the estimating this frequency, Sandia, they assigned something like 2 E minus 2 of frequency for the flood frequency for the fire in the pipe. Basically that frequency is not really a pipe frequency. That frequency is what they did look into generic experience. They have extracted what they call moderate flood, 2,000 GPM flood. minus 2 frequency. What the EPRI claims, no, that's not the way to calculate.

MR. MICHELSON: Excuse me. From any kind of a break that would give 2,000 GPM? Is that what you are were saying? They look for 2,000 GPM breaks of moderate energy pipes I assume?

MR. CHELLIAH: yes.

MR. MICHELSON: That is correct.

MR. CHELLIAH: Which is beyond the isolation

capability in that room, flood isolation capability in, like a draining all those things. So they did some careful review on that.

CHAIRMAN WARD: That's a lot of floods, isn't it?

MR. CHELLIAH: I haven't seen that facility. Water pumps sitting there are going to be affected according to them. They will tell more explanation in the latter part of the presentation.

What EPRI claims is that 2 E minus 2 frequency is not appropriate. What they have suggested is this. Postulate the pipe break frequency of the pipe failure, and then postulate the sequence, so the EPRI data turned integral formula which uses not only the pipe failure rates, also some of the quality factor, dynamic load factor, all those things. Something like frequency of, flood frequency, something like about 4 E minus 5 type frequency. So right there they are the magnitude difference on the frequency.

We did look into some of the Point Beach review, water failure in pump room, 1E minus 4 type frequency, at the point we are taking. We do the EPRI matter, but we need more data to assess the reasonableness of the flood frequency because it is still meeting that frequency a little lower. Also we believe the other frequency is a little higher. That's our position right now.

MR. EBERSOLE: There is a confusion factor in the

matter of identifying floods. Does--as the maximum credible flood or possible flood. There is a flood that overruns grade, which is much higher probability.

DR. ERICSON: We are talking internal, Mr. Ebersole.

MR. EBERSOLE: It is all internal? Sorry.

MR. CHELLIAH: Pump room, we are talking about internal flood here. In the pump room we are talking about. Did I say sitting on the room? We are talking internal flooding.

MR. MICHELSON: When people talk about flood, there are various ways that one type of person talks about flood on the floor, what the elevation rises to and whether the equipment is affected. Other people talk about a flood in an upper floor and the water cascading, running, dribbling and whatever down the lower floors.

Which kind of flood are we talking about here that was evaluated?

DR. ERICSON: This is essentially a spray problem, not submergence. This main is above--the pumps have a certain credibility credited to them for existing even outside. We took that into account. The break we postulated was sufficient to cascade water on to the pumps, not to--

MR. MICHELSON: All of them?

DR. ERICSON: Any one of them or any combination of them.

MR. EBERSOLE: Why don't we say something besides flood because--

DR. ERICSON: We did call it spray study.

MR. MICHELSON: That particular problem took a unique break I think.

DR. ERICSON: Take a break about those pumps, that's right.

MR. MICHELSON: And that narrowed the probability quite a bit because it is much lower probability of unique break than general break.

DR. ERICSON: The point is all six of those plants see at least 15 feet of the header, and now you are into part of it. That the point.

MR. MICHELSON: We will get to it later. We will get to it.

MR. EBERSOLE: The more general context of flood, do you find plants that large have capability to drain the various areas compatible with the largest source they might see from a sewer pipe? Has that been designed into the plants or not?

DR. ERICSON: We do not do detailed analyses of drains. We looked to see if ruptures in specific rooms could submerge or affect that pump in general, particularly Point Beach. It just goes away, returns out doors, and this sort of thing. You just can't pond it.

MR. EBERSOLE: Great. I am not sure that is always the case.

DR. ERICSON: In this case it is. You can't find any place you can contain water inside.

MR. CHELLIAH: So going back to the previous question, Dr. Michelson, you realize your question is whether any support system failure other than random failures is due to external event? Yes, they did identify the failure, spray failure mode, but I think right now we think that 2E minus 2 frequency is a little higher, the EPRI estimate of 3E minus 5 on the pipe break frequencies a little lower. We need more data from them right now EPRI. THAT's the position we are taking right now.

On the seismic events, the Sandia, they did perform very detailed study on seismic events. Basically what they did, they made use of some of the program. Also they doubled up detail of, for various structures and components, and this is estimate. Three types of sequences; I have listed out on the fourth page some loss of feedwater sequences and some small break LOCA type sequences.

EPRI did look into--when I say look into, they sort of did the scant type analysis because they have not performed detailed analysis of what they did like Sandia, but there are three points I would like to mention. One is the RWST tanks here, they are refilling the tank during a seismic event. Now

this particular tank is called very low DBR in plant, something like .192 median G as opposed to some other kind like .8 or more than 1 G, so that claim is here that according to EPRI, that tank will not catastrophically fail. Take about 30 minutes to deplete the water, so they started giving some credit to refill within the time, you know. At the same time, also refilling the CST, the condensate storage tank, for the secondary site cooling, they took some credit. Here we do, we agree with the EPRI's plant-specific process for seismic events, but I think here we are going to look into very carefully this particular tank. We are finding very unusual, somewhat unique design feature here in this plant. We need some more additional information on this.

Of course the third plan, second, third plan, 1E system, we do agree with the EPRI, some of the yearly blocker type sequence frequency comes along here.

Sandia, they have some similar ones there on this particular one.

Here the EPRI, what they claim, they have doubled up more site specific results using some improved technique. They have not provided the curves, so we have to make some provision here. We need some management information looking to the curve, how they double up on all those things, but basically we do agree, plant-specific, to estimate the plant-specific seismic frequency on looking at those decay

heat removal problems. We are doing that, but we need more data on that.

The final one on the fire events, Sandia, they did perform some limited study on this looking into various, looking into fires in various critical zones. Here the fire is limited to only transient combustible fires. We are not talking about panel fire or the cable fires like what you see in typical PRAs, the first code PRAs. So within that limitation, they came up with this 3E minus 5 frequency. EPRI did look into--you can see this. It needs some explanation. One of the bullets I thought, the difference here, how you estimate the initiating frequency for fire, Sandia, what they did, the Sandia is consistent with the state of art PRA matter, basically looking at the historical experience, report on fires, and then looking into the amount of available materials in each critical zone and they estimated the fire frequency. That's what Sandia did.

Now EPRI, they started deviating from their practice which they followed in other sequences. That is, they didn't make use of the historical experience. What they did, they went to each room like the LW pump room. They postulated just one fire even though the plant doesn't, may have any specific operating experience, and they started estimating the fire frequency based on operational experience, and based on so many critical zones, so they came up with substantial lower

frequency.

We do not agree with that estimate. We agree with the original estimate. This is based on the consistency with the other review of the PRA review practices.

Then the second bullet, second and third and fourth item here, the EPRI, they did look into plant-specific, they identify one of the second train, halon system. I guess the Sandia, they do also agree. They just have probability according to here. And then here, the revised halon system failure probability; Sandia, they looked into some experience, some general experience. Here the EPRI, they did look into some non-nuclear facilities, some facilities like the Rocky Flat, all those things. They came up with something like a one in 17 halon failures, so they had halon system failure probability as one of the automatic systems went down so that's taken care of here.

Also there is some human failure probability. They took some additional credit, additional credit for the AWL plant. There is, I realized it is not switch gear room here; the AMWP pump room at Sandia. They assigned something like one in ten chance that you can affect the turbine-driven pump by opening the steam visible valves following the fire at the LW pump. We don't know how far they are located. I'm sure Dave could tell.

What Sandia is, what EPRI is saying, these pumps are

located far apart. The pump is located far apart from the motor-driven. They have cut down that probability something like .zero 3 by a factor of three. We do not go with that kind of assumption. This is primarily because this, there is some core melt timing involved. Depending on the fire damage, if the core damage has to dry out the steam generator, dry out, and core damage has occurred within about 30 or 40 minutes, probably the original estimate is probably .1, which you see in other PRAs also.

In other words, if there is a slow fire, if you take about two, three hours, then probably we can say that the EPRI estimate could be justified, a little different situation here. It needs little more detail from EPRI in this case, so basically here what we are saying the staff did look into various contributing factors to the difference of the factor of 30 in EPRI estimate.

What we think right now that the Sandia estimate is higher, but it is not lower like what EPRI says. It could be somewhere--we are not quantified. We need additional information. We have asked them for a meeting. After that we will be able to requalify and tell where we stand.

That concludes my presentation.

MR. MICHELSON: Question--on the fire protection of Point Beach, is it all manual, or is it automatic sprinklers? And if so, what type or what--it wasn't clear in the reports

when they talked about manual mitigation, so forth, whether or not it was automatic backed by manual or just what it was. Could you tell me?

MR. CHELLIAH: The way the PRA analysis was done using--

MR. MICHELSON: What is the plant? I don't care about the PRA analysis. What is the provisions in the plant for fire protection and particularly say in the area of the auxiliary feedwater pumps?

MR. CHELLIAH: It has got both, manual as well as automatic.

MR. MICHELSON: Does have automatic sprinklers?

MR. CHELLIAH: Halon system.

MR. MICHELSON: They are using Halon for fire protection around the aux feedwater pump?

DR. ERICSON: The pump room, that is one of their main cable routing rooms. That's why it is an issue.

MR. MICHELSON: It is a cable routing, okay.

MR. CHELLIAH: Yes.

MR. MICHELSON: They back the halon with hand-held hoses?

DR. ERICSON: If I recall, that's true.

MR. MICHELSON: Each pump is in its own separate compartment.

MR. ERICSON: It has a wall, but it is a common

room.

MR. MICHELSON: Ten foot wall?

DR. ERICSON: Eight foot, six to eight foot.

MR. MICHELSON: There is a very similar arrangement in number of other plants except a lot of plants use water sprinklers over those pumps.

DR. ERICSON: In this case, there is considerable cabling on either end of the room running through the room.

MR. MICHELSON: This was the case, too, that that's why the staff made them put sprinklers in the room and sprinklers are a real problem like you talk about fire anywhere in that area because the heat and smoke propagate to the sprinkler system and it thinks there is a fire there and it will spray all the aux feedwater pumps and it is no different than that header break that you talked about earlier. You have seen a pretty good example of that lately on something else.

MR. CHELLIAH: Thank you.

CHAIRMAN WARD: Okay. Any other questions? Have you got any comments you want to make now?

MR. DAVIS: No, I don't.

CHAIRMAN WARD: Your plans now, you have left us, you know, hanging on an opinion here on a number of these, so your plans are to work with who in resolving these

DR. MAZETIS: Again, our near-term goal is, as I

have discussed with Jerry Nyles yesterday, of NUMARC, is to sometime over the next month or so, meet with them, the staff meet with them, with Sandia, and discuss these various areas of differing views or need for additional information and understand the basis for th.r numbers.

Now it is not obvious to me that we necessarily are headed in the direction of coming up with a new number per se. Right now, I think our objective is just to understand the reasons for the differences. That's our primary objective, so that eventually, any insights that we gain from this interface with the industry can be disseminated to the rest of the utilities.

MR. MICHELSON: Did the industry make any real attempt to look for financials that you might have left out of your analysis that perhaps should have been included?

DR. MAZETIS: I noticed there were a couple of places in the report where they explicitly pointed out several areas of possible non-conservatism in the Sandia study. Maybe Dave has some comments on that later, but in answer to your question directly, my observation is yes, they did.

MR. MICHELSON: Are you picking up on those to go back to see if perhaps you should revise your numbers upward to reflect these, this lack of conservatism?

DR. MAZETIS: Again, I'm not sure our objective is to change any numbers in the future.

MR. MICHELSON: If you were to change any numbers, you would then re-evaluate some of these perhaps inadequate conservatisms as well as where they pointed out maybe you were too conservative?

DR. MAZETIS: Not necessarily to re-evaluate them, but to identify for the benefit of whoever wants to use the guidance from these studies, to identify that this is an area that they should either explore further, or use new numbers.

CHAIRMAN WARD: Parallel question to Mr. Michelson--what about areas of incompleteness that their study--did their study suggest any, you know, new sequences or things that the Sandia study had missed?

DR. MAZETIS: Other than the couple of areas where they mentioned because a sequence may have been overlooked or an assumption may have been overlooked the sequence implied, maybe not conservative, I don't remember anything that was significant that sticks out in my mind from the report. Does that answer your question?

CHAIRMAN WARD: Yes, I think so. Okay. Thank you, Mr. Chelliah. Now let's see. Mr. Ericson, so you are going to kind of cover the same?

DR. ERICSON: Mine will be very short. It has all been covered.

CHAIRMAN WARD: Let me point out to the Subcommittee, I think what we have to consider here is not

just the specifics of each case, figuring out whether a particular number ought to be adjusted one way or the other, but rather that you know, part of the basis for the decision-making in this whole USI is the understanding of risk in these six plants, to the extent they represent, you know, the total population of plants out there, to the extent that they can. And so I think we have got to be, think about the process here as a means of providing information for the essential decision-making as well as the, just the specifics of this particular case.

DR. ERICSON: Well, I said that partly in jest and partly seriously. I have a number of these introductory vugraphs I am just going to flip through because we talked about much of it before.

(Slide)

DR. ERICSON: For those of you who don't know, I am no longer with Sandia, but I am still involved with the A-45 study. Mr. Adams, who is here, has been very much involved in looking at the EPRI work and comparison with what we did originally.

Just to reiterate, the objectives we set out to do were to set some--and the point I would like to make, we were interested in the industry perspective in these objectives, to try to get as broad a view as we could during this study, and therefore, from day one, we tended to use generic data in the

available data bases unless there was some overriding reason at that particular point in time to use plant-specific data.

The limits were, as had been stated, to--we only looked essentially at the small LOCA and the transients. We were looking only at DHR, and although again we had specific plants, we were trying to get some broader perspective.

Now the EPRI report deals specifically in the analysis with Point Beach. Stated objective is to get the best estimate of Point Beach risk from an industry perspective. And I think that's, that's the important thing. It is from their perspective.

I think we should mention that they did no original fault tree analysis. Started with the fault trees that were reported in case study. They did not go back and redo all of those. They did use this risk management query system which is a way of, developed by SAI, of storing event trees, fault trees, system cut sets, and data, and it allows you to ask questions. If I change the quantification, what is the result? And these can be very useful tools. One has to be very careful in doing this. I feel that you have to be careful how much you change, because when the original fault trees are solved, when the reductions are made, you make certain assumptions or review assigned certain values, and if you go back and completely eliminate systems or make gross changes, gross changes in values, you may be led astray.

I don't think that has happened here. I think we are all right and that they are all right in using it in this particular application, but it is a caution again in the broader perspective as we look toward what industry may be asked to do as part of the resolution package.

(Slide)

DR. ERICSON: All of this has been mentioned before. Let me put some numbers with this and I will come back to them again. but new, the internal core melt which includes the long-term Station Blackout, the reduction is a factor of 50, but if you look at this, the big issue or the biggest contributor in this reduction is that small LOCA frequency that we have talked about. The small LOCA reduction takes about 50 percent of the frequency, and then if you add to it the changing relief valve, about 80 percent of the differences is accounted for by those two, so while these other issues were addressed and are addressed in their, in the EPRI report, there are one or two things that dominate.

Same way here, and I will just skip through this one and come back to some of these comments on the specific issues. In particular, for example, if you look at the details of the analysis, the biggest difference in the fire is caused by the credit given for suppression reliability. We had a per train of .2. They have something on the order of ten to the minus 3, so when you start multiplying those

through, that's your big player. I will say some more about that.

MR. EBERSOLE: May I ask you a question back on the other slide? You had in your accident, you dismissed large LOCAs and other things but you did include small ones.

DR. ERICSON: That's right.

MR. EBERSOLE: Now implicit in that, although I haven't heard anything about how you are going to design a decay heat removal system, is presumably that it will have to have a replenishment system for PWRs, but it really won't have to have any for boilers because they are going to cool by evaporation anyway.

DR. ERICSON: We did include one that has the capability of that.

MR. EBERSOLE: They add I am sure quite a bit to the cost as you have to cope with a small LOCA. In other words, you have got to provide makeup to get transfer in a PWR whereas it is only a part of the normal evaporative process in the boiler.

DR. ERICSON: The capital cost for the high pressure pumping equipment are not the major factor.

MR. EBERSOLE: It is not?

DR. ERICSON: It is the civil costs associated with building those separate buildings and tank and water supplies. If you look at the details, in fact, as an instance, the BWR,

we looked at it without some high pressure makeup, and I think the cost was like 80 some million and it was another million and a halk to put a high pressure pump in one. The BWR had been designed, much of the civil costs that just gobble you alive on the add-ons.

MR. EBERSOLE: All right.

DR. ERICSON: The results, these have been mentioned before; overall the factor of 30. Additionally, they relooked at the core melt or at the containment performance, and the consequence sometimes another factor of seven, and some increases in costs, and we will come back to touch just briefly on those today.

(Slide)

DR. ERICSON: I will skip the next one. We have talked about the general forms of the accident sequences, transients and small LOCAs, and we have although not specifically listed it as such, the real reasons for the differences are this removal of the CCW in the objection phase; the changing frequencies for various transients, very low numbers for, lower numbers for Point Beach, the cross-connect capabilities and then operator or human error factors in which there is some changes, some areas of disagreement.

CHAIRMAN WARD: The second one dominate, right?

DR. ERICSON: In the internal, that's a bigger, the

initiating event frequencies are multiplied. When when you change those by order of magnitude, you have a tremendous impact on the obvious.

MR. DAVIS: Excuse me, James. Put that slide back up.

DR. ERICSON: Yes.

MR. DAVIS: The biggest single difference in the two studies was the flooding sequence. Now you are talking about internal only?

DR. ERICSON: This is pretty much internal.

CHAIRMAN WARD: Yes. But what is--this is all internal, isn't it?

DR. ERICSON: These are internal, yes; initiating, yes.

(Slide)

DR. ERICSON: Let me--some things I think we need to talk about, some of which we have already talked about, and those of you who have heard me for four or five years know I am always willing to talk about something again.

First, the timeliness of data; in this review, and in several other outside reviews that have taken place over the, for the case studies, we have frequently been chastised for not using data that was available in 1986. Well, I'm sorry. We did the study in 1984 and 1985. It took us a year to get it printed, but that's life in this business, as you

all know. So we are dealing with snapshots. You can't continually update just because the new piece of data came out yesterday. It just, you just can't do it.

Plant characteristics, in my view, to some extent, this study deals with a different plant than we dealt with. There are seismic one, new seismic one batteries. Now it was said they were added. I don't know whether they added or replaced what was there. I can't tell from what they say in the record, quite frankly. That's an issue that we have to discuss with them, as has been pointed out.

The other area that we will talk about, human effectiveness and recovery actions--we have been accused from day one of being very conservative with our recovery. I would suggest to you that the EPRI analysis is very optimistic. Let me give you some specifics. Question of whether a plant will feed and bleed? Now as has been pointed out in the bottom line, whether they do or do not doesn't make a big difference in the core melt frequency when you talk about what operator will or will not do. Davis-Besse, they could have, but they didn't. This report says we talked to a couple of operators and they said they would have no hesitancy. I'm sorry, gentlemen, I have had technicians for many years working for me and I also taught school, and people who have been through training know what the school solution is. If you have asked them in the classroom what are you going to do, they will give

me, better give me the right answer or they flunk.

What they will do at 3:00 in the morning with, as our former colleague Mr. Reed used to say, the world turning brown, I don't know. I am more sceptical than those who did the study. The times is available. Those are things that are discussable and we will be discussing those.

Modification costs--I am surprised that there is such a difference in the cost as I will come back to that in in a minute. So in general, to that extent it was a different plant. I think this is a key issue, and I heard the word "correct" used here a couple of times this morning. I don't think anybody in the PRA business, and I hope Mr. Davis will agree with me, knows whether they have got quote, the correct answer.

CHAIRMAN WARD: That is a good place to pause.

(A discussion was held off the record.)

DR. ERICSON: Wouldn't you agree, Mr. Davis, this is the crux of some of our discussion, what is correct or what is not correct? I wish we had, could go to the grade book and get the right answer!

At times, I think even with the new emergency response guidelines, though, we agree and understand they are very specific. At this point I am not sure we have enough experience with them to really know what performance will be.

And in our review, and again I think it was--

MR. MINNERS: The new guidelines for this plant?

DR. ERICSON: In general, but certainly here, and in this particular review, and again as we said preliminarily we haven't had a chance to interact, because you have got to study a report a long time before you know what questions you want to ask or you are going to waste a lot of time. There are times we are not sure exactly what data was changed and where. That is we know pretty much, but in the details. This is then success criteria, this has been commented upon. The EPRI document, EPRI owners group document, says you don't need it for cooling, but in almost all the other PRAs that generally have been used, so this is a point we need to discuss.

The balancing of service water, what they have presented certainly sounds like a reasonable thing to do and if the procedures exist and it can be done, we would expect that it does get done.

Human reliability quantification, they make the point they have reduced the failure to initiate feed and bleed one times ten to the minus 3. One times ten to the minus 3, that is because they believe we have, the individual event activity, or criteria in our study, was one times ten to the minus 3, but they argue that we have summed those and summed it erroneously as a point we need to discuss, several times, and this is one place they make the point that there are many

people in, many people in the control room following the event so something is, so the action has been sure to be taken. Does the mere presence of lots of people mean something will get done? That's something we can discuss.

MR. MINNERS: And here we are!

DR. ERICSON: I can show you lots of places where lots of people were there and nothing happened.

MR. EBERSOLE: Like the Browns Ferry fire, it took them six hours to put water on it.

DR. ERICSON: The reduced failure to initiate sump recirculation, as a matter of fact we acknowledge that in the study because we originally were going to require some redundancy and went back and said no, we don't need to. We were assured the training cases and we have suggested maybe another alarm, but then did not make any changes.

The reduced failure to depressurize, the big issue here is not in the baseline values, but the application of stress factors, and I would not claim to be a human reliability analyst or specialist. We multiplied and you can see the difference is a factor of five that we had there for a stressful situation.

MR. EBERSOLE: Has the operator, did you look at the matter of what the operator can see, validate, that he should depressurize?

DR. ERICSON: We did not, not in our study. Again

remember we did not do a detailed HRA. We used the--

MR. EBERSOLE: I can't find, see does the information flow to him that says that's the last bit I need, now blow it?

DR. ERICSON: We certainly did not look at that.

MR. EBERSOLE: I think it is hard to find.

DR. ERICSON: I think they have, I think in the EPRI as I recall, the way they worded this thing, they have looked at that somebody said A, B, C and D, not in the report, but I think in the procedures that now exist in the ERGs, in fact one of the EPRI people may comment, it gives you a specific point as to what to look for in the, in those new procedures, because they are symptom oriented. And then they have used the new--not new, but SAI approach to the time reliability correlation and in some cases additional actions which we might comment on later.

Just to refresh your memory, though, we have been repeatedly accused of only using one recovery. We do in fact have two before two hours. If you include loss of feedwater, either recovering the off-site power or loss of feedwater plus another after two hours, we have had that plus two other things.

The study, owners group study looked at the number of options available, the time that they felt required to perform any given action, whether it existed in the procedures

or not, and whether there had been training on it, so their application of recovery I would say is certainly more plant-specific and allows for more flexibility.

MR. EBERSOLE: May I ask you in the particular case of the boiler, the staff says that loss of containment heat removal, they believe every boiler has a means to vent the containment to prevent disastrous overpressurization before the core is hurt.

Are you with me?

DR. ERICSON: Yes.

MR. EBERSOLE: You find that to be true or not, in terms of equipment and procedures? I don't think it is.

DR. ERICSON: I am shifting gears, Mr. Ebersole, because we were not--you keep jumping to the BWRs and I haven't looked at those in a while.

MR. EBERSOLE: That has been a curtain that is lifted. Oh, yes, you can dismiss the--

DR. MAZETIS: Of the six case studies, two of them were BWRs.

CHAIRMAN WARD: Sample is only two of--

MR. EBERSOLE: Okay. You only had the two.

DR. ERICSON: We gave credit for limited venting.

DR. MAZETIS: Limited examination of procedures observing the credit could be given for that.

MR. EBERSOLE: Can you, did you find the equipment

to be present and the procedures there?

DR. MAZETIS: The procedures were there, but I just don't remember about the details of the equipment.

MR. EBERSOLE: Conflict is whether in fact even the equipment is there or not.

MR. MICHELSON: Or if the equipment will function under the conditions that will likely exist at the time venting is required.

DR. MAZETIS: I know that wasn't.

MR. MICHELSON: If they won't, then the procedures and equipment are worthless because these can't function.

DR. ERICSON: The next slide just recaps those recovery actions that we had in our, in the case study we did. We covered off-site power, main feedwater, battery common cause, battery faults, diesel, and then other things that one can do from the control room or things one can do locally without spelling those out specifically.

In the EPRI owners group analysis, again, as was mentioned earlier, the refill of RWST which would allow you to stay in injection mode because you have additional water, I think for internal events if indeed that plumbing system allows you to do that, I would certainly accept that. I have a little trouble with someone telling me that refilling the RWST is a recovery action for a seismic event. We will come back to that in a minute. Cross-connecting buses, those

cross-connects do exist. Manual control turbine drive aux feedwater pump, they take considerable credit for this now because of the new batteries, allowing, giving the supply even though it has to be done locally.

MR. MICHELSON: Have they ever operated those pumps under that condition? Have as a test?

DR. ERICSON: I do not know.

MR. MICHELSON: Does anybody know? It would be a fairly--if it is, it is purported to be not that difficult. I have talked to some people on the side as to how difficult it may be, but I just wondered if does it--have the staff ever known of anybody that has actually demonstrated?

DR. ERICSON: There is one. I can't think of which plant it was. I have read a report where they, indeed the fact went in and ran some of the stuff manually.

MR. MICHELSON: That is the way to put it to bed in a hurry. Otherwise I hear conflicting stories, maybe very equipment specific. The real problem is control, of course. It is all done manually, they can't feed back fast enough to vent the trips.

DR. ERICSON: I guess the other one, recovery from common mode failures, they relied heavily on. AEOD study that said significant numbers could be recovered and so they applied, reduced some of the common mode stuff apparently somewhat arbitrarily.

(Slide)

DR. ERICSON: I think we have beat this one to death at this point. The small break LOCA frequency as to what you count or don't count, we will be discussing that more with them. As has been pointed out, it does make a significant difference.

The PORV, the relief valve PORV LOCA situation, I guess I would have to agree that the arguments they present, as the staff has pointed out, when we ourselves take a look at the thermohydraulic analysis, we made, certainly accept that Q or that event as not having occurred given that feedwater is present so that you have got a transfer mechanism for the heat to circulate, reasonable argument.

MR. MINNERS: What is RCMF?

DR. ERICSON: Reduction core melt frequency.

MR. MICHELSON: This statement doesn't pertain I guess to boiling water reactors? Is that what you are saying?

DR. ERICSON: We are dealing specifically in our comments here with Point Beach, Point Beach only.

MR. MICHELSON: Okay. Thank you.

(Slide)

DR. ERICSON: I might, I would make the comment in the small break LOCA frequency, this study uses a lot of Westinghouse data and Westinghouse topical reports that so-called WCAPS, to make their point, but the small break

frequency argument is not for a Westinghouse plant. They use Oconee, and I don't think that's a Westinghouse plant, but it is a smaller number.

(Slide)

DR. ERICSON: Common cause failure rates, they have used a number significantly less than ours, taking exception to our use of beta factors in some places. They talk about a design review and that certainly is the method that Carl Flemming has argued for, still that you really need to look at those things, and yet I don't believe based on the way I read this, the EPRI record, that they really did those detailed design reviews on this plant but have used similar sorts of things, and certainly they did use significant amounts of data from the Millstone 3 PRA.

(Slide)

DR. ERICSON: You can see very quickly that significant differences come in in the batteries. For example, other pumps are down by about a factor of three. The combination of motor driven and turbine driven aux feedwater pump is down order of magnitude and those do have their effects promulgated through the system, and I think this is an area where we will want to have considerable discussion with those folks as to how their numbers were arrived at.

MR. MICHELSON: Clarification on common cause--are you dealing here with the common cause perhaps being seismic

cr flood or a fire, et cetera?

DR. ERICSON: In those numbers, no. Those were--

MR. MICHELSON: Purely equipment?

DR. ERICSON: Equipment failures; in the seismic analysis we did a correlation, though, so that if the pump was in the same room, they both fail, that sort of thing. We certainly understand that they have installed new batteries now and where batteries exist in our seismic sequences, they may have an effect, but it does not appear in the report as we have analyzed it thus far where they looked at these new batteries at the two, three and four times SSE levels where there are significant seismic risks.

The refueling water storage tank failure and recovery, I think it has already been mentioned, but I will mention it again. The RWST at Point Beach is unique. I can best describe it as a smokestack. It is very tall, and very short in diameter. Our people have done the fragility analysis. They are convinced that tank will fail relatively catastrophically when it goes. When it buckles, it will buckle. So I am not sure you can refill it.

I would also suggest somewhat humerously but very seriously when you talk about recovery actions in seismic events in 30 minutes, I don't think you have ever been in an earthquake. Things are pretty chaotic in those first 30 minutes, and--

MR. MICHELSON: When dealing with the RWST failure, catastrophic, potential catastrophic failure, are they looking also at the flooding effects of the water release?

DR. ERICSON: They did not, but that thing will dump a lot of water in places you don't want it.

MR. MICHELSON: The piping arrangement coming into it, there may be a cavern underneath that tank with the piping in it.

DR. ERICSON: This tank could get back up in aux building.

MR. MICHELSON: Runs into potentially interesting situations.

DR. ERICSON: This tank could get water back to the aux building.

EPRI has argued seismic hazard curve conservative for factor of two for low accelerations, three to five for high accelerations. We disagree. They have not reanalyzed this particular site. Our approach was to normalize curves to the frequency at the SSE, look at local attenuation factors, local soil, column effects, to get the curve. In talking with our seismic people, they feel that our numbers will be, would be very consistent with the complete site specific curve if one were to take the techniques that now exist and do it, which would take you probably three or four man months in time to generate that analysis.

MR. MINNERS: Low accelerations below SSE?

DR. ERICSON: They said conservative at one to, factor of two at 2 to 3 SSE and factor of five above as I recall.

MR. EBERSOLE: That tank is the source of highly borated water. To simply shut down the--

DR. ERICSON: There are, the reactor makeup water is also available on site.

MR. EBERSOLE: Is it better off than this?

DR. ERICSON: As I recall, it is a squatter tank. Again, the question of how much your recovery action in early on in seismic; we were asked earlier did they identify things that we had? Yes. And this is a specific example. Turns out the way Point Beach opens the CSTs intertied, so if you lose one, you have lost them both because the valving is locked open between them.

MR. EBERSOLE: Did you find out by any chance as we did at Diablo Canyon the emergency manuals fall over the floor, you couldn't find them in seismic events?

DR. ERICSON: Well, I haven't looked at the book racks in the control room, so I don't know the answer to that question.

Internal flood, as has been pointed out earlier, the significant differences in the, occurs in the frequency that is used. We used a generic flooding frequency room by room

for aux buildings. EPRI has used a pipe frequency, break frequency correlation by Thomas, which they use and then recompute, or estimate the pipe break frequency for the pipe, service water pipe, over those fire, water pipe over those service water pumps.

MR. MICHELSON: Do you know what that number is approximately? Pipe break frequency I guess per foot of length or something?

DR. ERICSON: Oh, P--no. This one is a computed number, and when you use their numbers, this is the 3.7 times ten to the minus 5 number.

MR. MICHELSON: Per unit length of pipe?

DR. ERICSON: Isn't unit length. It is on a--here it is, right here--1.8, one ten to the minus 8 per year per cube. These are the quality factors I would call them.

MR. MICHELSON: What is cube?

DR. ERICSON: Relates to how thick and how big the pipe is.

MR. MICHELSON: So you, somehow that is a per foot of pipe, isn't it? And then you multiply by--

DR. ERICSON: Q is ratio of--you look at this product to pipe diameter in feet, times length in feet, divided by thickness squared.

MR. MICHELSON: If I have a hundred such lengths, it is a different probability than if I only have one such

length.

DR. ERICSON: Q is dimensionless parameter.

MR. MICHELSON: How do you convert it into, to reflect the number of total length of pipe that you have in your plant?

DR. ERICSON: That Q is based on this three-foot lengths. See, EPRI argued that there was only one three-foot section of pipe that could affect you in this particular situation.

MR. MICHELSON: They are doing--okay.

DR. ERICSON: For that specific location, one three-foot.

MR. MICHELSON: That's a strange--

DR. ERICSON: We don't understand that because we feel that the pumps can see anywhere from ten to 15 foot. That's a point of discussion.

The other problem I had, quite frankly, when I looked at this correlation and went back to the reference, I find that what EPRI reports in the document is not what I found in the original reference. There has been modifications made to it that are not documented. The original work by Thomas doesn't use a dynamic loading factor but uses factors related to age and design learning.

They have used a restricted pipe length only three feet which we need we have to discuss that with them why they

feel it is only that three-foot length, and these two are related and the definition in terms in the equation, so we have, some discussions have to take place on that correlation.

MR. MICHELSON: How did they treat the non-seismic piping that could produce floods versus the seismic that could produce floods? Did they treat those as any different than probability of failure?

DR. ERICSON: The only one that was computed was the one we argued, fire main water. They used this as an empirical relationship based on data, on industry-wide data.

MR. MICHELSON: Only pipe in the whole plant that could give them a problem if it broke? Is that the idea?

DR. ERICSON: Our argument was that given, looking for internal flood sources, this was the one we found. Whether they went and looked for others, I don't know, one of the reasons being, for example, there are significant rooms at Point Beach which have big service water pipes but they are in guard pipes, so if the pipe ruptured, it would go outside the room.

MR. EBERSOLE: Tell me, there are three high pressure pipes at least, in a PWR, there is more in others. That have a substantial different potential in others. It is the, I will pick--well, the first one is the steam line that feeds to, the steam to the steam-driven aux feed pump. That is service area either pressurized up to the valve or right up

to the stop valve. I don't know. Two other reactor water clean-up systems; if those pipes break, the effect of break is regressive; if the flow continues on out into the machinery area, disables the whole damn plant.

One must place dependence on valves operating in an unusual and untested and not in a statistically verified mode. Did you go to that level detail?

DR. ERICSON: For clean-up, for example, we did not.

MR. EBERSOLE: What about steam on the aux feeds?

DR. ERICSON: No. Steam on aux feed can't cause a spray or flooding; causes steam, so we did not look at it.

MR. EBERSOLE: Saturates the whole electrical network in the plant. It is a Turkish bath. Everything shorts out.

MR. ERICSON: If it is in the right place; no, we did not look at the steam lines, that steam line.

MR. EBERSOLE: Those happen to be focal points of severe potential.

DR. ERICSON: In the area of containment, success criteria, EPRI argued and the owners group argues that primary system leakage in small LOCAs do not place a significant load on containment, and I think Mr. Minners made that same comment a while ago. They look at recovery. The report says we used criteria for large LOCA. To some extent, that's right. We said originally in the studies that we would use the RESMAP

approach because we did not have the resources at the time to go into detailed containment performance.

We did, however, modify that as the NUREG 0956 and other reports were coming out, the 1150 work, and reduced the failure probabilities; we have something like a 55 percent non-failure probability for the large containment, so we did not do it sequence by sequence the way EPRI has, and I cannot comment on theirs because at this point we have not had the opportunity to get back through all of those yet.

They provide a comparison of using 95 and BMI 2104, the IDCOR data, their judgment, and using our baseline case of .3 times WASH-1400 for the source terms, and get this range of values. You may recall that we, we had an estimated person reactor year of something like 38 I think is what we report in our report based on our analysis and the 3.3 times WASH-1400 numbers.

(Slide)

DR. ERICSON: We have to do some more comparison and work on that one. We have not done that yet.

Cost estimate differences, failure to consider all design requirements for specific aspects of modification, I think this is, refers primarily to the add-on system.

Failure to account for existing structures and/or buried piping in cable, frankly I find this one very puzzling that they raise this issue since after we did our conceptual

designs we went to the plant, walked through the plant with a plant staff, asked if we could do this, can we do that, will this fit there, and what are your local labor costs and what is your experience? So to tell us that we haven't done that and we are way off, I don't understand.

Failure to account for iteration between initial design and final installation, and then they argue cost experience and installing new batteries, quite frankly, we have not explored all of this. I am very, very puzzled by it since the architect/engineer who did this work does this kind of thing for the industry all the time, and I know they were very conscientious about checking their costs to make sure they weren't optimistic because somebody might ask them to bid on them, and so it is puzzling just why we have such a marked difference.

DR. SIESS: Was there a time difference?

DR. ERICSON: The EPRI report doesn't say anything about time, but we were used, we used 1985 dollars and even if you use 1987, I don't think labor rates and that sort of thing have changed that much in the last two years.

CHAIRMAN WARD: Is that what you mean? Okay.

DR. ERICSON: In fact, some areas, it is cheaper now than it was before.

One other thing we have looked at, though, is this question of human reliability and emergency procedures, and

there is a NUREG that came out last year that suggests that emergency operating procedures can markedly improve, and perhaps reduce core melt by as much as 12 percent and that there are synergisms. I have no reason to argue with that, and--

CHAIRMAN WARD: What NUREG is that? Who wrote that?

MR. ADAMS: Idaho.

DR. ERICSON: Are you familiar with that one?

DR. SIESS: Did you mean what you said by factor of 1 percent? This says factor of one eighth up there.

DR. ERICSON: Isn't that 1 percent?

DR. SIESS: That would be 88 percent if I reduced it by--

DR. ERICSON: Reduced it by eight, that is 12 percent.

DR. SIESS: By an 8th.

DR. ERICSON: That's what it said.

DR. SIESS: That's practically nothing.

DR. ERICSON: Well, I have learned one has to be very careful when people talk about reduced by factors of, and that sort of thing.

DR. SIESS: I would multiply it by an 8th if I just read it and hadn't heard what you said.

MR. ADAMS: I think you multiply it by one 8th, Dave.

DR. ERICSON. Eighty-eight percent, okay; I haven't gone through the whole report yet. We have to be careful of that.

DR. SIESS: Twelve percent, you forget about it. Wouldn't even make the slide.

CHAIRMAN WARD: Okay.

DR. ERICSON: There is one slide.

CHAIRMAN WARD: Also, well, whether it is, if it is 12 percent, I don't want to say this. If it is 88 percent, I guess I do want to say it, so I don't know. I don't want to take the time. But I don't know what sort of study this was, but you know, reports we have had about the efficacy of EOPs is that it is, maybe it is good in a theoretical study that INEL might be doing, but as far as EOPs, that is actually in the hundred and some plants, there is some question about whether they are doing any, much good or how uniform that good is spread around the plant.

DR. ERICSON: I think your latter point is certainly valid. I think it will depend very much on staff, on management attitudes, that sort of thing. Even with the best of procedures, I think, you know, we can talk about simulator experience, but somehow that just isn't quite the same. You know; if you make a mistake on a simulater, can always go do it again.

MR. ADAMS: That EG and G report at Idaho,

high-level report on the on-site assessment of the effectiveness and impacts of upgraded emergency operating procedures.

MR. MICHELSON: What is that name again?

MR. ADAMS: On-site assessment of the effectiveness and impacts of upgraded emergency operating procedures.

CHAIRMAN WARD: Carl, this is another subject, but I think--

MR. MICHELSON: What is the NUREG number?

MR. ADAMS: 4617.

CHAIRMAN WARD: It is on the sheet.

MR. MICHELSON: I missed it. I'm sorry. I'm sorry.

CHAIRMAN WARD: This is kind of another subject, but your subcommittee was going to look at this matter.

MR. MICHELSON: Yes. I have got it.

DR. ERICSON: Let me close with the following additional general comments that aren't in your package. Quite frankly, in the review process, this one and others, one of the problems we have had is people misquoting what we did. This report says we considered only transient combustible fires. That is incorrect. We have responded at least to four different times when people have said that.

We only used a calculation of a transient combustible to bound the amount of energy in fires. The frequency, locations are all done by separate analysis. I get

frustrated and I know our analysts do, too, when that keeps happening.

MR. CATTON: What about the comment about acetone being everywhere?

DR. ERICSON: That is not what we assumed. The prior frequency in a room is a function of the historical data for those kinds of rooms. The acetone fire was only looked to see if a fire of certain intensity could propagate to cables and propagate to something else, and I see Mr. Busley smiling over there. He knows what I am saying. The best estimate analysis, EPRI claims to have a best estimate analysis. There is no discussions of uncertainties.

DR. SIESS: Uncertainties in the best estimate or uncertainties in the--

DR. ERICSON: Uncertainties, how good is that best estimate? We have used a conservative number. If you look at the results coming out of, that have come out of NUREG 1150, and every other PRA where a detailed propagation of uncertainty is taking place, the 95 ard five are a long way from the best estimates or means.

CHAIRMAN WARD: So you are saying that your PRA numbers are not what you would characterize as best estimate or--

DR. ERICSON: We called them point estimates based on available generic data. We also gave you some discussion

of the potential effects of uncertainties, but we did not propagate uncertainty through our analysis.

CHAIRMAN WARD: But did you cover uncertainty by using conservative, purposefully conservative assumptions?

DR. ERICSON: No. We did not say now let's take the top number. What I am saying is in our analysis we have used the generic data which has some conservatism in it I will argue, and we have presented it as a point estimate using generic data; no more or no less.

DR. SIESS: What is the difference between that and what EPRI did now?

DR. ERICSON: Their argument is best estimate, I interpret to mean they have looked at all the data they can get their hands on and then selected or arrived--

DR. SIESS: You don't mean best estimate the way you say point estimate?

DR. ERICSON: No, because in the point estimates we did not dig into all potential possible data bases. We did not get deeply into the human, into the EOPs as they did.

DR. SIESS: Maybe I don't know what best estimate means. I thought best estimate was the statistical term that gave you the most likely value out of a universe of values.

DR. ERICSON: That would be a definition.

DR. SIESS: Is that what they mean by best sometime?

DR. ERICSON: I assume so.

DR. SIESS: In other words, value like a mean or median or something.

CHAIRMAN WARD: Some attempt at a central estimate.

DR. ERICSON: Some sort of central estimate.

CHAIRMAN WARD: My impression is that is what most PRAs are intended to try to do.

DR. ERICSON: We treated them as a means whenever we could.

DR. SIESS: And your best, your point estimate quantitatively, how would you describe it?

DR. ERICSON: We used mean values from the generic data bases.

DR. SIESS: Incidentally--

CHAIRMAN WARD: So why is there a difference? I mean I don't understand.

DR. ERICSON: Because they haven't used mean values from published generic data bases. They have reworked those values and massaged them to get what they consider as the best estimate for this particular plant.

MR. MINNERS: Didn't we use median values for the seismic part?

DR. ERICSON: Yes. There is a, the problem there is it is off by about a factor of three as a result.

MR. MINNERS: Mean value is accepted.

DR. ERICSON: That's right. That's a good point.

We owe you a piece of paper that is somewhere in the--you will get in.

CHAIRMAN WARD: The difference isn't so much that their analysis characteristically used, you know, central best, median, mean, values, and yours didn't, but rather they used data bases or whatever that were specific for this particular plant and you didn't in some cases?

DR. ERICSON: Well, in some cases they have chosen to use other data, to change the generic data, and the small break frequency is an example. The values they use are not Point Beach specific. They were derived for Oconee, and that's the number of the Oconee report. They adopted that argument and so used that number, so--

DR. SIESS: Mr. Chairman, I think it is very important that we get a copy of that slide because it is the only slide he has used that has the word "uncertainty" on it. I just didn't believe anybody could get through any discussion of PRA FOR that long without the word uncertainty.

MR. MINNERS: You almost made it!

DR. ERICSON: Schucks! I should have left this one off and I would have set a record!

And the other thing that I think needs to be commented about the report is that this report deals with more than just the Point Beach study. Significant comments are made about what is presumed to be the NRC decision on this

matter and not the Point Beach specific report.

As Mr. Mazetis has said, we will be in an iterative, not necessarily iterative process, but interactive process with the EPRI owners group people to understand the source of numbers, and argue and fuss about why we use different numbers.

MR. EBERSOLE: Can you talk a little bit about a matter that is somewhat in detail? Do you recall the GDC-19 required early on the establishment of points of control from the plant at places outside the containment. That resulted in a rash of extension cords stuck out all over the place from the main control room into these discrete other areas, thus extending the fire vulnerability.

It is recognized now that those are regressive circuits and we ought to cut them all out because now we can take care of damage in the control room rather than just a stink in it.

Did you look at vulnerabilities from fire, including those spread-out circuits all over the place?

DR. ERICSON: We looked at the plant with Appendix R in place. We used Appendix R submittals.

MR. EBERSOLE: I understand that, but did you look at increment in risk presented by those old circuits that are still there?

DR. ERICSON: Specifically, I don't know. I can't

answer that question.

MR. EBERSOLE: They are still there.

CHAIRMAN WARD: Any other questions for Mr. Ericson? Okay. I think as a Subcommittee, we need to discuss what we think about what we have heard, where we want to go particularly. We haven't heard directly on the issue which we can spend some time on this, that the Point Beach analysis, we haven't heard directly from the EPRI group or whomever it is now that is responsible for that and we might want to do that in the future, but I think we need to put that in the context of what we are trying to do.

So before we go into that discussion, though, and I am going to suggest that we have that after lunch, I would like to hear from Mr. Minners a little bit more specifically, you know, what is your schedule? When are you going to do what, toward, you know, final resolution of this? What do you need to do, and what would you like to have from the Committee, from the ACRS? What do you see that you need, if anything, from the Committee. Isn't necessarily what you are going to get, but just like to know what you think you would like to get. Could you tell us that?

DR. MAZETIS: Let me start and just--Jerry Mazetis--as far as schedule in the near future, I may have indicated in recent conversation with NUMARC, Jerry Nyles yesterday, led to our tentative initial dialogue with, the

interface with them perhaps around the first or second week in March, and before then, of course, we would continue amongst ourselves in-house interfacing with completion of the review, and preparing ourselves for that meeting.

I would anticipate concurrent with that would be the availability as I indicated earlier of the draft or the updated regulatory analysis distribution, at the moment unknown, but it would be my guess available for the ACRS within that timeframe, the next month or two.

CHAIRMAN WARD: Okay.

DR. MAZETIS: Let's see. You had another question? Your other question was?

MR. MINNERS: What do we want out of the Committee? I think the usual word is that you know, we have brought this down to you. We value any comments that you had. I don't know whether you want to give it your blessing, but we are going to present a proposed resolution and traditionally the ACRS has commented on it, and sometimes said yea or nay, so I guess it is more up to the Committee exactly what you want to provide.

CHAIRMAN WARD: I realize that, but I just wanted to know what your perspective was.when you say the draft analysis, regulatory analysis, that's going to present your proposed resolution, and right now you think that is going to be item number whatever it was.

MR. MINNERS: Two.

CHAIRMAN WARD: And then present the arguments for that; that's what you mean by the regulatory analysis?

MR. MINNERS: Well, the purpose of the regulatory analysis is not to present the arguments just for alternative 2. The purpose is to discuss all six of the alternatives, okay, so that people can see what basis the decision was made on.

CHAIRMAN WARD: Okay.

MR. MINNERS: I think--

CHAIRMAN WARD: Okay. That's all?

MR. MICHELSON: Warren?

DR. SIESS: Warren, they have got to do some kind of PRA, right?

MR. MINNERS: To do what?

DR. SIESS: The individual plants.

MR. MINNERS: Yes.

DR. SIESS: How is the staff going to handle this? I don't think there has ever been an instance of a licensee making a PRA that the staff didn't think the probability was one to two orders of magnitude higher.

Is the staff going to makeup, do a PRA to go along with every one the license does, accept the licensee's value, or are you going to apply a factor of say of ten on it.. Conservatism or at empirically ten to 15 seems, ten to 50

seems about right.

MR. MINNERS: I don't know the answer to your question. It is perfectly possible that the staff might not even review the PRAs done by the licensees. That's a possibility.

DR. SIESS: You really think that's a possibility?

MR. MINNERS: Anything is possible. Now what is probable is something else again, and I don't think we know the answer to your question because it takes a lot of staff resources. And I guess that's going to be, I mean this is something that is being worked out basically in the IPE process. If we look on to those guys, we come out and it is their worry, but we are, you know, it is something that has been being discussed as we say.

One of the purposes of reviewing this EPRI-Westinghouse owners group analysis was because we think it is kind of--I don't know how to say it--one of the precursors to an IPE submittal, okay, and maybe some precedent will be set or at least indicated by our evaluation of their analysis, but I would point out to you is that yes, you do, you get a factor of ten lower, but here is a particular incident that if, a reason you have got some of the difference is because they installed some new equipment, and that's fine by me.

DR. SIESS: I saw the Susquehanna IPE evaluation

with their ten to the minus 6, ten to the minus 7, and they say it is, all comes not from installing any new equipment but from taking advantage of accident management procedures in site training, based on their PRA.

MR. MINNERS: Okay.

DR. SIESS: I remember when you had the six choices, one of the objections to No. 2 was opens everything to argument, and No. 3 or 4, whichever it was, prescribed fixes, at least was clear cut, somewhat reminiscent of ATWS. ATWS ended up being prescribed figures, right? Were negotiated or developed let's say in cooperation with the venders.

MR. MINNERS: We are going the opposite way here. ATWS, that's right. We said we weren't going to have individual evaluation models. We will paint everybody with one brush. And we are going, seemingly going the other way.

I don't know what to do, Dr. Seiss. I think it is recognized that when you get into PRA, you have got this problem. You have got many knobs and switches that you can turn on these analyses, and people have different views of them. And you can--and take different views. I guess that's a problem.

The, I guess what you have to look at is your alternatives. Your alternative is a very expensive prescriptive system, or a less expensive prescriptive system which I'm not sure that no matter how you train the operator,

he will ever turn it on.

DR. SIESS: Well, even on that ATWS you had to have different systems for different plants.

MR. MINNERS: For feed and bleed you are talking about?

DR. SIESS: Hardware fixes for ATWS, for each vender, the hardware fixes for DHR are likely to be different for every darned plant.

MR. MINNERS: That is correct.

DR. SIESS: Going to be more variations that affect the SCRAM system.

MR. MINNERS: Well, you know, we work with, for the Commission, and I think the Commission set out a severe accident policy, and I think we should be guided by that, and their decision was to do it in a PRA way, and I guess we are going to work out the details of how that gets reviewed, and I think that A-45 is more of a severe accident issue than anything else. I mean kind of falls into that category naturally, so I think, you know, I think there is, to my view, some Commission guidance that's the way they would like to go.

Now whether policy statements and that kind of stuff is the proper thing to use for severe accidents is, that was their decision. I think that's what your question is. I think you are more questioning the IPE process than you are our A-45 because that's going to cover more accidents than we

have covered. If we went out with a prescriptive solution and fixed decay heat removal, there could still be ATWS, or interfacing LOCAs, or any other, or other sequences that could dominate and all our fixes would be for naught because it would be overridden by these other possible more dominant vulnerabilities at particular plants.

MR. DAVIS: Mr. Chairman, I had a question. I think I agree with the alternative you have chosen. It seems to me that your studies have shown that there are significant plant differences, and therefore, we need to look at each one individually.

But I guess I am still troubled by how we decide if we have got a problem or not. Both your study and the EPRI study indicated that there were no fixes justified on a cost/benefit basis I thought for Point Beach, and yet you seem to, you seem to have a high core melt frequency that you now think should demand some sort of effect. Am I missing something here?

MR. MINNERS: Depends what method. I don't agree with you that there is, that on the cost/benefit method they are not justified. I mean I don't know what you, I mean we presented three and there is probably any number of combination you want to use. My view is that the, you should include on-site costs, and that's in my view, a kind of a negative impact. You subtract that off of the limitation cost

and then do your ratio bit, and in most cases that comes out it is worthwhile.

Now I don't think you should be regulating on the basis that you are going to reduce on-site costs. That should not be the impetus for the regulation. The impetus should be you are going to have off-site safety improvement, but when you consider the balance and what you put on each side of the billion as you have to put on to the cost, and the affected on-site costs are real costs, somebody is going to pay those costs. Okay. And they have happened and somebody is now paying for them. Okay. So I think they ought to be put in the balance.

MR. EBERSOLE: Don't you think it is important who pays those costs?

MR. MINNERS: No, I don't care who pays those costs.

MR. EBERSOLE: Let me tell you why I bring this up. It is, if it is a corporate cost, there are forces that will come in the direction of saving corporate costs. If they are public costs, that's different. I am putting incentives to fix the incentive, the pocketbook as ever, and the public has no way of reaching in and influencing that incentive, as you know, except the intervening process.

MR. MINNERS: I don't agree with that. I think PUCs have very strong influence on--

MR. EBERSOLE: Get down into this?

MR. MINNERS: They sure have.

DR. SIESS: If we assume that the off-site costs are an industry concern, a business-type concern, is it fair to make the industry consider the on-site costs with your PRA results, which is two orders of magnitude higher than their PRA? They look and say it is on ten to the minus 6 probability that it is going to cost me a billion dollars, and you say that is a ten to the minus 4 probability that it is something happened to the public. Make them use the ten to the minus 4, with their billion dollars.

MR. MINNERS: I don't think there is any such thing as industry cost, Dr. Seiss. The industry has no way of paying for anything. Only way they get their money is out of people. I mean we are the source of all of their funds, and so eventually, the country pays for those costs.

MR. EBERSOLE: There is a--

DR. SEISS: That is not NRC s concern.

MR. MINNERS: I think it is NRC's concern in making the balance.

MR. EBERSOLE: The corporate stockholders can fire the president, chairman of the Board, everybody else, if they don't have a good design. The public can't do that. And I think there is a difference in the incentive. If the cost is seen as corporate costs, management will rise up and pay attention to whatever the plant is designed.

MR. MINNERS: I don't think I have any regulatory authority to say who will pay the cost. the Public Utility Commissions will decide in their prudence hearings, prudence hearings who pays what costs. I have no influence on that.

MR. EBERSOLE: You believe that can be shunted off to the PUCs?

MR. MINNERS: Believe it can be? It is. I don't read anything in the Atomic Energy Act that let's me regulate their costs.

MR. EBERSOLE: I am not impressed by PUCs as I dig down this far for details.

DR. SIESS: If you were advising the PUC to look at this sort of thing on a cost/benefit basis, what PRA would you advise them to use, the licensee's, or the NRC's or the quote, correct one?

MR. MINNERS: I would advise them to use the best PRA they can get.

DR. SIESS: But in other words, should they--let's face it. The NRC PRA or Sandia or whoever is always a higher probability than the one that comes from the licensee. I don't think I have ever seen a case where they weren't in that usually by a factor of one to two orders of magnitude. There are conservatisms in the regulatory PRAs. Should the PUC be using a conservative--

MR. MINNERS: No.

DR. SIESS: Value even by one order of magnitude or be using the most realistic thing they can get?

MR. EBERSOLE: Generating their own.

MR. MINNERS: For economic calculations, it is clear you should be using the mean value for making any of your economic calculations, so they should try to give a PRA that gives them the mean core melt frequency.

DR. SIESS: You wouldn't offer opinion as to which of the two we have looked at is the closest to that?

MR. MINNERS: No. I think that this is an honest effort, and I appreciate it, and industry has their new and they tend to take a more optimistic view. Fine. I think that's good because I think we need some balance in lookiing at that. I think some elements of ours are conservative, but then again, there is always the question that we have missed things in PRAs. It is a very--I tried in the beginning to get people to sit down and write all the assumptions that went into these things, and then from that, make a qualitative assessment on the conservatism or non-conservatism of the PRAs, and we were unable to do that. It is too difficult a task to do I think. It is sounds good ideally, but I think it, as a practical matter, it is not good. But nevertheless, I think decision-makers are going to have to do that. It is going to have to come to some judgment of who has got the appropriate PRA. Some of the stuff can be resolved on

technical bases I am sure, go out, get a consensus this is the right number, but I think, on human error rates, what do you pick? That's anybody's guess.

DR. SIESS: You think they are both biased?

MR. MINNERS: Yes. I do think both, do agree with that, and don't imply from that that I think there is a gross bias, okay? I think that when Sandia came to a point of decision they would tend to go to the conservative. Okay. When they had to make a decision I think when--and disagree with me. I expressed my opinion. I think when industry came to that same decision, they go more the optimistic route.

DR. ERICSON: I agree with you, Warren. The answer is that every study that is done is biased, without putting bias in a derogatory or negative fashion. We all are biased by our own experience base, and by our own perception of the problem. That doesn't mean that it is bad or negative or wrong, but we are biased.

MR. MINNERS: Well, see I think maybe the point that ought to be made here, I guess it is said all the time with PRAs, don't bottom line it. This is a very interesting set of numbers, okay, but don't get mesmerized by the bottom line numbers, okay. Look more into what the PRA tells you and then start to use your engineering experience and say hey, is that a reasonable thing?

CHAIRMAN WARD: I think the bias that we are

concerned about is not the bias resulting from your personal experience, but the bias which comes from being interested in the result, having some particular interest in the result. That's the bias you are concerned about, we have to deal with.

DR. SIESS: It is conceivable--

MR. MINNERS: They both produce bias.

DR. SIESS: It is conceivable that the normal regulatory bias, you know, we know it is there. I think we always think a little bit on the conservative side, that the regulatory bias itself could account for a 54 difference. Maybe it only accounts for about 30 and the other 20 is some optimistic bias on the other side.

MR. MINNERS: Factor of 50 is well within 1150s feather diagram.

DR. SIESS: Everything is within that

MR. WARD: Everything is, yes.

DR. SEISS: Zero and one, you know, we have about covered that 1150.

CHAIRMAN WARD: Okay. Well, thank you very much, gentlemen. Before we--let's see. We will take a break for lunch, but I would like the Subcommittee to come back and we will be in Executive Session, which means we don't need a record, at 1:45. I want to spend about an hour or so in a more general discussion.

(Whereupon, at 12:40, the recorded portion of the

meeting was adjourned.)

REPORTER'S CERTIFICATE

DOCKET NUMBER:

CASE TITLE: ACRS--Subcommittee on Decay Heat Removal

HEARING DATE: January 28, 1988

LOCATION: Washington, D.C.

I hereby certify that the proceedings and evidence are contained fully and accurately on the tapes and notes reported by me at the hearing in the above case before the Nuclear Regulatory Commission.

Date: January 28, 1988

Catherine S. Boyd

Official Reporter

HERITAGE REPORTING CORPORATION
1220 L Street, N.W.
Washington, D.C. 20005

STATUS REPORT ON USI A-45
"SHUTDOWN DECAY HEAT REMOVAL REQUIREMENTS"

PRESENTED TO THE
ACRS SUBCOMMITTEE FOR DECAY HEAT REMOVAL
JANUARY 28, 1987

ROY WOODS, SENIOR TASK MANAGER
DIVISION OF REACTOR AND PLANT SYSTEMS
OFFICE OF NUCLEAR REGULATORY RESEARCH

BACKGROUND

- CONCERNS ON RELIABILITY OF DHR FUNCTION:
  - RAISED BY TMI
  - EXTENDED TO SPECIAL EMERGENCIES (E.G., FIRE, FLOOD, SEISMIC, SABOTAGE)
- ACRS, TASK FORCES, AND SPECIAL COMMISSIONS RECOMMENDED THAT HIGH PRIORITY BE GIVEN TO STUDIES OF IMPROVING SHUTDOWN DHR FUNCTION (POST-TMI EFFORTS)
- UNRESOLVED SAFETY ISSUE (USI A-45) APPROVED DEC. 24, 1980 (SECY-80-325)
- KEY QUESTIONS:
  - DO CURRENT DESIGNS PROVIDE THE RELIABILITY NEEDED TO MEET CDF GOAL?
  - ARE THERE IMPROVEMENTS TO DHR FUNCTION IN OPERATING PLANTS WHICH ARE COST-BENEFICIAL?

USI A-45

SPECIFIC OBJECTIVES

- DETERMINE THE SAFETY ADEQUACY OF DECAY HEAT REMOVAL IN EXISTING POWER PLANTS FOR ACHIEVING BOTH HOT SHUTDOWN AND COLD SHUTDOWN CONDITIONS

- DEVELOP AND EVALUATE ALTERNATIVE METHODS FOR IMPROVING RELIABILITY OF DECAY HEAT REMOVAL FUNCTION,

- ASSESS THE VALUE AND IMPACT OF ALTERNATIVE METHODS

- ESTABLISH NEW REQUIREMENTS, IF NECESSARY, TO REACH DHR RELIABILITY COMPATIBLE WITH CDF GOAL

USI A-45 SCOPE

- EVALUATED DHR SYSTEMS NEEDED TO RESPOND TO TRANSIENTS AND SMALL-BREAK LOCAs (DID NOT INCLUDE LARGE BREAK LOCAs OR ATWS)

- ALSO EVALUATED SUCH SYSTEMS' VULNERABILITY TO FIRE, FLOOD, SEISMIC, INSIDER SABOTAGE

- SABOTAGE CONSIDERATIONS:

  - CONSIDERED VULNERABILITY OF DHR SYSTEMS TO "INSIDER" SABOTAGE

  - DID NOT CONSIDER "PHYSICAL SECURITY" METHODS ("OUTSIDER")

A-45 STUDIES

- DHR SPECIFIC STUDIES OF SEVERAL PLANTS

- PLANTS SELECTION CRITERIA:

  - REPRESENT EACH NSSS VENDOR
  - COVER "RANGE" OF DHR CONFIGURATIONS, AEs
  - UTILITY INTEREST IN STUDIES

- PRA CASE STUDIES FOR DECAY HEAT REMOVAL (ALL COMPLETED)

PLANT	TYPE	REPORT NO. (NUREG/CR-)	DATE
POINT BEACH	W2LP	4458	3/87
TURKEY POINT	W3LP	4762	3/87
ST. LUCIE	CE	4710	8/87
ANO-1	B&W	4713	3/87
QUAD CITIES	BWR3	4448	3/87
COOPER	BWR4	4767	7/87
(SUMMARY)	(ALL)	-	(EARLY '88)

SUMMARY OF
FINDINGS FROM SIX CASE STUDIES

- PROBABILITY OF CORE MELT DUE TO DHR FUNCTION FAILURE [$P(CM)_{DHR}$] AVERAGES 2 TO 3 x 10^{-4} PER R-YR (INCLUDES INTERNAL AND EXTERNAL CAUSES)

- SUPPORT SYSTEM FAILURES (E.G., EMERGENCY POWER, SERVICE WATER, COMPONENT COOLING) CONTRIBUTE SIGNIFICANTLY TO $P(CM)_{DHR}$

- LACK OF REDUNDANCY AND SHARING OF SYSTEMS, PARTICULARLY AT SUPPORT SYSTEM LEVEL, CONTRIBUTE SIGNIFICANT RISK FOR SOME PLANTS

- LACK OF INDEPENDENCE, SEPARATION AND PHYSICAL PROTECTION OF REDUNDANT SAFEGUARD TRAINS CONTRIBUTE SIGNIFICANT RISK

- RISK FROM FIRE, FLOOD, SEISMIC, SABOTAGE IS SIGNIFICANT

- BOTTOM LINE IS THAT RELATIVE IMPORTANCE OF VULNERABILITIES IS PLANT-SPECIFIC

° REGULATORY ANALYSIS

- SEPTEMBER 26, 1986 PRE-DECISIONAL DRAFT PRESENTED TO CLOSED SESSION OF ACRS SUBCOMMITTEE DESCRIBING SIX ALTERNATIVES

- DRAFT REVISION BEING PREPARED. WILL DESCRIBE SAME SIX ALTERNATIVES. WE WILL PROPOSE RESOLUTION WITH ALT. # 2 (PLANT-SPECIFIC ANALYSIS)

ALTERNATIVE 1 - NO ACTION

WOULD BE ACCEPTABLE IF NRC ANALYSIS RESULTS ARE OVERLY CONSERVATIVE (EPRI/WOG: POINT BEACH)

ALTERNATIVE 2 - LIMITED SCOPE PRAs

SEVERE ACCIDENT PROGRAM IPEs

ALTERNATIVE 3 - SPECIFIED SYSTEMS MODIFICATIONS

USIs AND GIs

ALTERNATIVE 4 - DEPRESSURIZATION AND COOLING

PWR - FEED AND BLEED

BWR - CONTAINMENT VENTING

ALTERNATIVE 5 - DEDICATED HOT SHUTDOWN CAPABILITY

ALTERNATIVE 6 - DEDICATED COLD SHUTDOWN CAPABILITY

REG. ANALYSIS (CONT'D)

DIFFERENT APPROACHES TO VALUE-IMPACT ANALYSIS

- VALUE-IMPACT ANALYSIS PERFORMED 3 WAYS:

  A. AVERTED OFFSITE COSTS ONLY

  B. AVERTED OFFSITE PLUS ONSITE COSTS

  C. ABOVE PLUS EFFECTS OF SPECIAL CONSIDERATIONS (E.G., SABOTAGE, MORATORIUM, RESOLUTION OF OTHER GENERIC ISSUES, UNQUANTIFIABLES)

- RESULTS:

  - METHOD A - ALTERNATIVES 2, 3 & 4 MAY BE COST-EFFECTIVE
  - METHOD B - ALTERNATIVES 2, 3 & 4 MAY BE MORE COST-EFFECTIVE
  - METHOD C - ALTERNATIVES 5 & 6 MAY BE COST-EFFECTIVE

REG. ANALYSIS (CONT'D)

- RES ENDORSES ALTERNATIVE 2, PLANT-SPECIFIC ANALYSES AND IMPROVEMENT OF DECAY HEAT REMOVAL SYSTEMS.

- BASIS:

  - A-45 CASE STUDIES SHOWED MOST RISK CONTRIBUTORS TO BE PLANT-SPECIFIC.

  - USE OF "METHOD C" (CREDIT FOR "MORATORIUM AVOIDANCE") GOES BEYOND VALUE/IMPACT METHODS PREVIOUSLY USED FOR USIs/GSIs AND THEREFORE ALTERNATIVES FIVE AND SIX CAN NOT BE JUSTIFIED ON THE BASIS OF CONVENTIONAL VALUE/IMPACT

  - INSIGHTS GAINED FROM SIX CASE STUDIES AND EPRI-WOG ANALYSIS (PLUS NRC/SANDIA REVIEW) WILL BECOME GUIDANCE TO LICENSEES.

IMPLEMENTATION DETAILS

(ALTERNATIVE 2)

° RES PROPOSES TO REQUIRE PLANT SPECIFIC PRAs TO IDENTIFY PLANT-SPECIFIC VULNERABILITIES

° SHOULD BE PART OF THE IPE?

- GREATER EFFICIENCY, BUT
- WOULD REQUIRE MORE THOROUGH PRA
- WOULD OBLIGATE LARGER NRR REVIEW EFFORT FOR IPE ANALYSES

° SHOULD BE SEPARATELY REQUIRED?

- SIGNIFICANT REDUNDANCY WITH IPE, WOULD REQUIRE EACH LICENSEE TO PERFORM TWO SEPARATE ANALYSES

- COULD PERFORM MORE THOROUGH PRA FOCUSED ON DHR ONLY

° COMMITMENT TO REVIEW ANALYSES

- LARGE EFFORT NEEDED, NOT NECESSARILY AVAILABLE
- SAFETY IMPROVEMENT DEPENDENT UPON REVIEW COMMITMENT

EPRI/WOG POINT BEACH PRA

° NRC REVIEWING FOR 2 REASONS:

1) GUIDANCE FOR UTILITIES PERFORMING A-45 PRAs

- WHAT METHODS ACCEPTABLE
- WHAT NUMERICAL ASSUMPTIONS ACCEPTABLE

2) IS ALTERNATIVE 1 JUSTIFIABLE?

- IF THEIR PRA CORRECT, AND

- IF PB IS A "BOUNDING" PLANT
  (THEN ALT. 1 WOULD BE ACCEPTABLE)

- WE ARE NOT CONVINCED THAT EITHER OF THE ABOVE ARE CORRECT

° THUS THE REVIEW RESULTS URGENTLY NEEDED

° WILL BE DISCUSSED BY NRC AND SANDIA

COMPARISON OF NRC/SNL AND
EPRI/WOG RESULTS

SOURCE OF RISK	CORE MELT FREQUENCY PER YEAR NRC/SNL	EPRI/WOG	REDUCTION FACTOR
INTERNAL	1.4E-4	2.6E-6	54
SEISMIC	6.1E-5	7.4E-6	8
FIRE	3.2E-5	6.3E-8	500
INTERNAL FLOOD	7.7E-5	1.0E-8	7700
EXTERNAL FLOOD	1.9E-8	1.0E-8	(2)
WIND	4.0E-6	1.0E-8	(400)
LIGHTNING	5.8E-8	1.0E-8	(6)
TOTAL	3.1E-4	1.0E-5	31

TAP A-45 SHUTDOWN DECAY HEAT REMOVAL ANALYSIS

COMPARISON OF SNL/NRC AND EPRI/WOG RESULTS FOR POINT BEACH

ERULAPPA S. CHELLIAH
NRC/RES/DRAA/PRAB

ACRS SUBCOMMITTEE ON
DECAY HEAT REMOVAL
JANUARY 28, 1988

POINT BEACH DHR/PRA

SEQUENCE	FREQUENCY [/RY]	SUMMARY DIFFERENCE
S2MH1'H2'	4.7E-5 [SNL]	• REVISED SMALL LOCA FREQUENCY
	5.8E-7 [EPRI]	• MODIFIED CCW SUCESS CRITERIA
		• CREDIT FOR SW BALANCING
T1MLE	6.7E-6 [SNL]	• UPDATED INITIATOR FREQUENCY
	7.7E-7 [EPRI]	• ADDED CLASS IE DC SYSTEM
T3QH1'H2'	2.5E-5 [SNL]	• NO NEED FOR RECIRCULATION
	NA [EPRI]	
T3QD1D2	4.6E-6 [SNL]	• NO NEED FOR RECIRCULATION
	NA [EPRI]	
T2MQH1'H2'	3.5E-6 [SNL]	• REVISED PORV PROBABILITY
	1.9E-7 [EPRI]	
S2MD1D2	8.7E-6 [SNL]	• REVISED SMALL LOCA FREQUENCY
	9.5E-8 [EPRI]	• MODIFIED CCW SUCESS CRITERIA

POINT BEACH DHR/PRA

SEQUENCE	FREQUENCY [/RY]
SW FLOOD	7.7E-5 [SNL]
	1.0E-8 [EPRI]
SEISMIC	6.1E-5 [SNL]
EVENTS	7.4E-6 [EPRI]
FIRE	3.2E-5 [SNL]
EVENTS	6.3E-8 [EPRI]

SUMMARY DIFFERENCE

- NEW METHOD FOR FLOOD FREQUENCY
- UPDATED HPIS PERFORMANCE
- CREDIT FOR REFILLING RWST AND CST
- ADDED CLASS 1E DC SYSTEM
- USED MODIFIED HAZARD CURVES
- CREDIT FOR SECOND TRAIN HALON SYSTEM
- REVISED HALON SYSTEM FAILURE PROBABILITY
- CREDIT FOR RECOVERY OF AFWS FOR SWITCHGEAR ROOM FIRES

POINT BEACH DHR/PRA

SEQUENCE	DESCRIPTION
S2MH1'H2'	– SMALL LOCA FOLLOWED BY THE FAILURE OF LOW AND HIGH PRESSURE RECIRCULATION SYSTEMS
T1MLE	– A LOSS OF OFFSITE POWER EVENT FOLLOWED BY THE COMMON MODE FAILURE OF THE DIESELS, RESULTING IN EARLY CORE MELT
T3QH1'H2'	– A TRANSIENT INVOLVING A STUCK OPEN PORV AND FAILURE OF RECIRCULATION SYSTEMS. THE MFW SYSTEM IS ASSUMED TO BE INITIALLY AVAILABLE.
T3QD1D2	– A TRANSIENT INVOLVING A STUCK OPEN PORV AND FAILURE OF BOTH HIGH AND LOW PRESSURE INJECTION SYSTEMS. THE MFW IS ASSUMED TO BE INITIALLY AVAILABLE.
T2MQH1'H2'	– A LOSS OF FEEDWATER EVENT FOLLOWED BY A STUCK OPEN PORV AND FAILURE OF RECIRCULATION SYSTEM.
S2MD1D2	– A SMALL LOCA EVENT FOLLOWED BY THE FAILURE OF BOTH HIGH AND LOW PRESSURE INJECTION SYSTEMS.

POINT BEACH DHR/PRA

SW FLOOD – A FLOODING EVENT IN SERVICE WATER PUMP ROOM CAUSING INOPERABILITY OF ALL SW PUMPS, RESULTING IN LOSS OF CORE COOLING SYSTEMS. THE FLOOD IS ASSUMED TO RESULT IN A TRANSIENT.

SEISMIC EVENTS – SEISMIC EVENTS OF LOW TO MODERATE INTENSITY RESULTING IN:

(A) LOSS OF FEEDWATER SEQUENCES INVOLVING INJECTION FAILURES,

(B) SMALL LOCA SEQUENCES INVOLVING INJECTION FAILURES, AND

(C) TRANSIENTS INVOLVING THE FAILURE OF BOTH PRIMARY AND SECONDARY COOLING SYSTEMS.

FIRES – TRANSIENT COMBUSTIBLE FIRES WERE CONSIDERED.

(A) A FIRE IN AFW PUMP ROOM FOLLOWED BY PRIMARY COOLING SYSTEM FAILURES.

(B) A FIRE IN 4.16 KV SWITCHGEAR ROOM FOLLOWED BY PRIMARY AND SECONDARY COOLING SYSTEM FAILURES.

TAP A-45 Shutdown Decay Heat Removal Analysis

Comparison of SNL/NRC and EPRI/WOG Results for Point Beach

David M. Ericson, Jr
ERCI Incorporated

Kenneth G. Adams
Sandia National Laboratories

ACRS Subcommittee on Decay Heat Removal
January 28, 1988

USI A-45 (TAP A-45) Program Objectives

Determine adequacy of DHR in existing NPP

Evaluate feasibility of methods for improving DHR, including diverse dedicated systems

Assess the value and impact of potential alternatives

Limits on Scope of PRA

Initiating events considered did not include Large LOCA, reactor vessel ruptures, Interfacing system LOCAs, ATWS

Only plant systems contributing to DHR were analyzed

Although specific plants were identified for analysis, the analysis was to provide representative results for similar plants

EPRI/WOG Analysis

Best estimate of Point Beach risk from industry perspective

Same analysis scope as USI A-45

Primarily used RMQS

Risk Management Query System (RMQS)

Store principle components of a PRA
- Initiators, Accident sequences, System cut sets, Basic event (component) probabilities, Risk management factors

Ask questions of the PRA

Investigate effect of parameter changes
- Initiator frequencies, recovery events, failure probabilities, new loops

Internal

Core Melt Frequency

NRC 1.4E-4 WOG 2.6E-6

Reduction Factor 54

New Batteries

Small LOCA frequency

CCW success criteria

Operator action

Refill of CST

Diesel generator failure rates

Handling of relief valve LOCA

External

Core Melt Frequency

	NRC	WOG	R/F
Seismic	6.1E-5	7.4E-6	8

Recovery, new batteries, seismic hazard curve

Fire	3.2E-5	6.3E-8	500

Recovery, new batteries, initiator frequencies

Internal Flood	7.7E-5	<1.0E-8	>7700

Flood frequency, success criteria for cooling of HPI

Wind	4.0E-6	<1.0E-8	>>400

Diesel generator exhaust supports strengthened

Results of Reanalysis

Factor of 30 reduction in core melt frequency

Additional factor of 7 in offsite consequences

50% to 400% increase in cost estimates

General Form of Accident Sequences

Transient with failure of secondary heat removal and feed-and-bleed

Transient with failure of secondary heat removal and successful feed--and-bleed in injection mode, but failure of ECCS recirculation (HPR mode)

Small LOCA with failure of ECCS recirculation

Small LOCA with failure of ECCS injection and failure of either secondary heat removal or LPI

Transient-induced LOCA and failure of ECCS recirculation

Transient-induced LOCA and failure of ECCS injection (and failure of either secondary heat removal or LPI)

Reasons for Differences

HPI does not require CCW

SBLOCA and transient-induced LOCA frequency

Low Point Beach-specific transient frequencies

AC and DC bus cross-connects

Miscellaneous operator recovery actions or human error in performing normal actions

Areas for Discussion

Timeliness of data (snapshot)

Plant characteristics (interties/interconnects)
EPRI/WOG included new batteries

Human effectiveness (recovery)

Times available for recovery

Initiator frequencies

Modification costs

General Comments

Different plant based on new batteries and success criteria

Current methodology does not provide a "correct" answer

Difficult to establish effectiveness of human performance (particularly under new ERG)

Difficult to ascertain exactly what data, models and assumption were used

Success Criteria for Support Systems

CCW provides seal rather than bearing cooling and is therefore not required for HPI operation in injection mode

SW not required for cooling of CCW and recovery possible by operator when less than three of six pumps available (balance load)

Changes in HRA Quantification

Reduced failure to initiate feed and bleed
9.E-3 to 1.E-3

Reduced failure to initiate sump recirculation
3.E-3 to 1.E-4

Reduced failure to depressurize
1.5E-2 to 3.E-3

Change the human recovery time reliability correlation, reduction by up to a factor of 50

Additional Recovery actions

Criteria for Recovery

USI A-45

- Two actions before two hours (RA-1 or RA-2 + another)
- Three after two hours (two + RA-1 or RA-2)

WOG

- Number of options available
- Time required to perform each action
- Presence in procedures and training (Emergency Response Guidelines or plant specific procedures)

USI A-45 Recovery

RA-1	Loss of offsite power
RA-2	Loss of main feedwater
RA-8	Battery common cause
RA-9	Battery fault
RA-10	Diesel common cause
RA-11	Diesel fault
RA-6	Other failures from control room
RA-7	Other failures locally

EPRI/WOG Recovery

RWST refill using spent fuel pool or chemical and volume control system

Cross-connect AC or DC buses

Manual control of turbine-driven AFW pump

Provision of backup supply of feedwater

Use of charging system for loss of feedwater

Balancing loads on the service water system

Recovery from common mode failures

Small LOCA Frequency and Modeling

2.0E-2 to 3.0E-3 eliminate seal leaks

Small small break LOCA 0.5 to 1.5 inches

Significantly less injection for makeup

AFW can delay core uncovery, more time for recovery actions

Small enough for recovery by the alternate sources of water for the RWST

Relief Valve/PORV LOCA

1.4E-3 to 1.1E-4 RCMF 2.9E-5

Survey of operational Westinghouse plants conducted in 1981 showed no failures in PORVs. Included 163 operational openings

Common-Cause Failure Rates

Reasons for Changes

Design review for determining beta factors

The design review process has yielded a factor of two lower in EPRI's application than the beta factors calculated using all industry experience. (i.e., Factor of 3 on pump failure)

Recovery from common-cause failures

A review (AEOD report C504) indicates that roughly 60% of both human and hardware failures were recovered within one hour

Used data from Millstone-3 PRA

Common-Cause Failure Rates

	USI A-45	WOG
Batteries	9.6E-4	4.0E-4
MDPs & TDP	2.0E-4	3.0E-5
2 running SWPs & 1 standby	2.0E-5	4.0E-6
Running & standby CCWPs	8.0E-5	3.0E-5
Other pumps	1.0E-4	3.0E-5
MOVs	4.0E-4	8.0E-5
Diesel generators	1.5E-3	5.0E-4

Seismic

New Seismic Category I batteries

RWST tank failure recovery

Seismic hazard curve conservative by factor of two for low accelerations, and by a factor of five for high accelerations

Frequency of small break LOCAs

AFW recoveries implemented from control room

Failure of one CST will cause loss of inventory

Internal Flood

(Service Water Pump Room)

USI A-45 study used generic room flood frequency of auxiliary building moderate flood

2.2E-2

WOG used frequency based on relationship of break to pipe characteristics

- length of pipe
- pipe diameter
- pipe thickness
- weld quality
- dynamic loading factor

3.73E-5

Pipe Break Frequency Correlation

(EPRI/WOG)

$$P_o = (P_o/P_l) * (Q_p + A * S * Q_w) * BF * P$$

P_o = probability of break over the pipe length

P_c/P_l = percentage of breaks out of leaks (.06)

Q_p = ratio of product of pipe diameter with length of pipe to square of thickness

A, S = factors related to weld quality (50, 1)

Q_w = same as Q_p but for the welds

BF = dynamic loading factor (2)

P = Global pipe failure rate per Q (1.E-8/yr/Q)

Length=3 ft. diameter=10 in. thickness=.5 in.

Issues Related to EPRI/WOG Approach
(Internal Flood)

Correlation modified without explanation

Restricted pipe length considered

Definition of terms

Containment Success Criteria

EPRI/WOG

- RCS leakage and small LOCAs do not place a significant load on containment
- Recovery considered

USI A-45

- Used criteria for a large LOCA design based accident

Source Term Comparisons

Using EPRI/WOG Core Melt Frequencies

	expected dose person-rem/reactor yr
EPRI/WOG 1 BMI-2104 and draft NUREG-0956	0.08
EPRI/WOG 2 IDCOR program	0.16
EPRI/WOG 3 Engineering judgement	0.7
USI A-45 .3 time WASH-1400	1.2

Cost Estimate Differences

Failure to consider all design requirements (seismic) for specific aspects of modification

Failure to account for existing structures and/or buried piping or cabling

Failure to account for iteration between initial design and final installation

Cost experienced in installing new batteries

Upgraded Emergency Operating Procedures

There is evidence NUREG/CR-4617, March 1987 that EOPs markedly improve operator performance (CMF coservatively estimated to be reduced by a factor of 1/8)

Synergisms amoung transient analysis, upgraded training, and management overview