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In the Matter of: ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE ON SAFETY PHILOSOPHY, TECHNOLOGY AND CRITERIA

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UNITED STATES NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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SUBCOMMITTEE ON SAFETY PHILOSOPHY, TECHNOLOGY AND CRITERIA

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Room 1046
Nuclear Regulatory Commission
1717 H Street, N.W.
Washington, D.C.

Wednesday, May 6, 1981

The Subcommittee met at 9:00 a.m., pursuant to notice, David Okrent presiding.

PRESENT:

Committee Members:

D. Okrent, Chairman
D.A. Ward
W. Kerr
C.P. Siess
M. Plesset
J.C. Ebersole

Consultants to ACRS:

W. Lipinski
E. Epler

NRC Staff:

J.M. Griesmeyer
B. Bernero
T. Murley

Designated Federal Employee:

R. Savio

P R O C E E D I N G S

9:00 a.m.

MR. OKRENT: This meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Safety Philosophy, Technology and Criteria. I am David Okrent, the Subcommittee Chairman. Other ACRS members present at the moment are Mr. Ebersole, Mr. Plesset, Mr. Siess, Mr. Kerr, Mr. Ward. We have two consultants, Mr. Lipinski and Mr. Epler.

The purpose of this meeting is to discuss matters relating to and methods of the development of requirements for new plants and methods for developing requirements for new plants.

This meeting is being conducted in accordance with provisions of the Federal Advisory Committee Act and the government in the Sunshine Act. Dr. Savio is the designated federal employee for the meeting. I welcome Dr. Griesmeyer here, a member of the staff in Washington now.

The rules for participation in today's meeting have been announced as part of the notice of this meeting, previously published in the Federal Register on April 21, 1981. A transcript of the meeting is being kept and will be made available by May 8, 1981.

It is requested that each speaker first identify himself and speak with sufficient clarity and volume so that

We can be readily heard. We have received no written comments or requests for time to make oral statements from members of the public.

Dr. Savio sent out a memorandum which shows the proposed agenda. Have there been any changes? Here is a revised one. Okay. Let me note at the opening of the executive session, if my memory serves me, this is the third meeting.

MR. SAVIO: The first was on the 28th. This would be the second.

MR. OKRENT: This is the third meeting of the Subcommittee on the subject. You will recall that we are trying to respond to a request from the Commission for recommendations with regard to what the Commission should do on the subject of requirements for new LWR's.

At the previous meetings, we have had some general discussion. We have focused on a couple of topics; for example, at one meeting we had the benefit of a memorandum prepared by Morton Lebarkin, Gary Quittschreiber of our staff, where they tried to look at a few general design criteria to see how they might be changed. This was an effort in response to our request to look at the question, if you are going to change the general design criteria, how much you go at it.

We had some discussion in closed session last time on the question of design for sabotage, and we had the benefit of the participation of the people who prepared the report under NRC auspices on nuclear power plant design concepts for sabotage protection.

We have some ideas that Mr. Epler has concerning ways in which one should go, at least in part, from the point of view of design of plants, and some of these are fairly fundamental, philosophic ideas.

Up until now, I do not think we have received from either the industry or the NRC staff any proposals for either general or specific approaches that would address the question before us. We have had presentations by several representatives of industry, but I do not think they really addressed the general question.

Westinghouse indicated that they are looking at their own product line in terms of specific design changes that they might make. I suppose that raises another kind of approach; namely, should the approach to this whole question be in terms of a look at specific design changes coming up and new requirements, by developing a new design and then seeing if it looks good. And they say, okay, this is a way to go; rather than the general design criteria and so forth.

In any event, as of right now I do not feel like if asked to, I could sit down and write a recommendation for just what the Commission should do. Maybe some of you do and I would like to hear it if you do. But I do not feel that way.

Nevertheless, we said we were going to try to do something by this summer which is rapidly approaching, so I would ask the Subcommittee members and consultants during the day, between pauses in sentences and so forth, to try to think about just what ACRS might propose or suggest or so forth.

I do not expect that we are going to say here are the answers, but maybe we can come up and say here are approaches which, if followed, can provide or have a chance to provide answers on a simple timescale, whatever that is. Anyway, those are my opening remarks. Would the Subcommittee members care to add, subtract or multiply?

MR. EBERSOLE: I would like to express my concept of what we are trying to do.

MR. OKRENT: Could you use the microphone?

MR. EBERSOLE: About preventing and mitigating. I see the new siting policy is a newly-recognized requirement. The site being the final aspect of safety in that it represents mitigation of what I will loosely call at the moment containment failure.

If we suspect that the containment will fail after an accident or it does fail, then, of course, siting evacuation is our last ditch.

Stepping forward into the containment as I see it, we are going to have to have modified containment designs which anticipate core melt. So in one context, the containment prevents the exodus from the community that we put the reactor in, or it should help to do so. It mitigates the consequences of a core melt accident, I presume. That's the way it appears to be going.

Stepping forward from that, I see now the reactor design itself and some of the features here described in Houston Power & Light's application for dedicated heat removal systems is in the preventing mode, from preventing core melt, and thereby preventing the need for having a containment.

At that point, I stop and life begins to get complex because now I'm into the bowels of the plant and I have a considerable degree of complexity in preventing core melt. And I expect to hear from the applicants their ideas about how this is going to be prevented with a higher degree of reliability than we had before. That is the way I put it together, and I will accept any criticism.

MR. OKRENT: Let me offer a comment. At the moment it is not complete clear to me where the staff is going to end up on the matter of siting. It is true that the report of the Siting Task Force suggested that they were trending toward less populated sites, but the recent comments made by Mr. Moeller have indicated that they are sort of back to where they were before they did the siting task force study, at least with regard to population density.

As I say, I for one am not sure just where they will come out. At least in their current go-around. And also, I do not know what the ACRS or others would have for input into that.

The only other comment I want to make is in case you have not all received a copy, there is a report that came out from EPRI recently entitled "Review of Proposed Improvements Including Filter/Vent of PWR Ice Containments" prepared by S. Levy, Incorporated, which is, in my opinion, an interesting review of the various things.

It is the first of this kind of thing EPRI has put out, so at least to me it represents an entry by them into an area that is thought-provoking.

Chet?

MR. SIESS: Back to the question of siting. I think we have to keep in mind there is some kind of a distinction on the staff siting policy between -- I do not know if I will pronounce the terms right -- de facto and de jure. In fact, except for certain possible areas in the Northeast U.S., the siting policy of the staff plus the industry, I guess, has been quite remote sites by any standards. And even more remote than their policy would call for.

So for the last 20 or 30 plants that were licensed, except for a couple of exceptions up in the New England area, you know, they were much better than the legal requirements. So the trend has been that way.

Whether they formalize it or not, I dc not know, but they are going to have a problem because there are certain areas where they cannot meet th same standards. Arizona, Massachusetts are a little different.

Dave, to what extent does this address standard designs, or do you feel that that enters into it?

MR. OKRENT: I think -- .

MR. SIESS: Do we know whether the standard designs are dead? Are they the wave of the future, or right now, nobody thinks there is a future. So -- .

MR. OKRENT: Well, we have not had any presentations by the industrial groups that came in at the last meeting. We will see what we hear today. Actually, my own feeling is very strongly that this is the way that the business should go, if there is business. That has a very considerable number of advantages.

In fact, I was wondering if one of the approaches we should seriously consider, assuming we make some recommendations and assuming that there is a way of doing this in a practical way, is that somehow several optimized designs be prepared. I do not know whether this is under irdustry auspices or DOE or NRC support or whatever. The reason I say several is because I think you might start with a certain set of boundary conditions, and arrive at one kind of a design; and with another set, arrive at a different kind of design.

So the guiding philosophy would lead you to one end point. Another one would lead you to another end point. But that one tried to have several such designs developed and that these then be reviewed, and an effort be made to see whether out of this, let's say, requirements for PWR's can evolve as well as some kind of agreement as to what constitutes a standard design that the NRC would accept. That might be an approach, as distinct from trying to develop new general design criteria but not designs.

Okay. Now, what do I mean when I say different philosophical points of view? Well, if you think of NUREG-0739 as an example, there have been some comments on this to the effect that what you should have are only primary criteria; namely, that the risk to the individual, maybe the risk to society fall below certain values. Somebody might try to design a plant with only those goals, and freehand beyond that.

I do not know what design they would come up with, but it would not necessarily be the same as if someone else were trying to design -- . It would also have to meet some of the conditions in 0739 on containment performance, for example. And somebody has to apply ALARA considerations. It might be still another design.

So this is one way in which boundary conditions could change it. There are other ways in which you could visualize that boundaries can -- you can say, well, do not use a single seismic design basis for all parts of the plant. Optimize the seismic design basis for different parts of the plant. That would give you possible changes so that in one case you might say you must have a dedicated shutdown heat removal system. I mean, that could be a ground rule.

Or you might have what Epler is proposing, if I can paraphrase it -- .

MR. SIESS: Some of the 0739 criteria are not site specific.

MR. OKRENT: That is right.

MR. SIESS: That would be difficult, if you have to put that -- .

MR. OKRENT: I agree. My point is, though, that if you could get some designs developed, because -- and another one might be look, we have a range of proposals for how you might improve resistance to sabotage. But we do not have a specific design or designs of plants with that in mind.

If people came in with two or three integrated proposals, let's say, from that point of view there is no single perfect answer in that regard. One might, out of this, develop new bases by which you arrive at a decision, and thereby perhaps develop what you might call design requirements of the future, and also, standard approaches.

So to answer your question, in brief after giving the long answer, I would be inclined myself to push the standard plant idea. Bill?

MR. KERR: The idea of a standard plant I think is appealing to us, to the people who review it and to the people who design it. But it seems to me, if it is to work it must have a good deal of flexibility.

Suppose, for example, one began to try to design a standard plant today. I do not know how long that design would take, but I would guess three or four years. And one would have to get licensing approval; that would take another two or three years. And then one would have to build it, which even if we were optimistic would take another seven to eight years. I would be surprised if changes in requirements did not occur over that period.

So what, then, is the standard plant? Is it what finally evolves out of this process of design, construction and changes in the licensing philosophy? It is hard for me to see how one talks about a standard plant when one is talking about billion dollar properties which take 15 years to design and build. I do not mean it is impossible; I am just not sure that I know what it means, and I think if we go that route we need to build in quite a lot of flexibility to make certain we are not inhibiting the very thing that we want to increase.

MR. EBERSOLE: I think it is literally asinine (inaudible) telescope these processes to evolve and approve, evolve and approve, as we go along, rather than work for four years and turn your product in and then have it altered, and then work another four and turn it in and have it altered. That is enormously costly, and I think the incentive to industry would just be a collapse of this 12-year interval down to something reasonable, which seems to me like five to eight at least.

And one way I can see of doing that is doing something that has been pretty much condemned. It is used in England, anyway, but not here. It is a telescoping of a process; it is progressive agreement on features that are critical to safety as you move along, and the plant evolves.

Now, the criticism of that is you become embroiled in the evolution of the process.

MR. KERR: I think you are probably saying it better than I said it. That one has to build in some flexibility, and the possibility of evolution for various reasons. And that if one standardizes too soon, one may remove what it is you are talking about.

MR. EBERSOLE: Another thing I think is conservatism on the part of the applicants should buy them precisely this: a reduction in licensing time and licensing perturbations of all sorts. Conservatism should be a carrot; it is not a free game, but they should get something for doing it. And I think production outages and lost generation in the beginning are the main ones, collapsing time. Time is of the essence.

I think our unit price, when we talk about cost to add a safety feature, is probably days of operation instead of dollars. Because people do not know how valuable these days are of lost generation. It is tremendous. If you cost a safety feature in terms of days of lost generation, you can deal in millions instead of billions.

I think it is a better perspective when we talk about conservatism to stay off the dollar value and talk about generation value in the context of lost days.

MR. OKRENT: Well, maybe we had better get to the agenda, since we have gotten a little late, but we have time at the end of the agenda, quite a bit, and I do urge you to try to develop some specific proposals if at all possible as we go along, so that we have something real to consider at that time.

All right. The first item on the agenda, then, is discussion with the NRC staff. We have Dr. Murley and Mr. Bernero here, who is going to lead off.

MR. MURLEY: Thank you, Mr. Chairman. We probably do not have the details that you might be looking for today, but we have done some thinking about where we should be heading, and some of the steps that we need to take to get there and what the licensing -- I call it a licensing framework -- for the next generation of nuclear plants, what it might look like once we are there.

MR. KERR: What do you mean by the next generation?

MR. MURLEY: I should say we do not have a staff dedicated to this type of planning. I hope to try to free up some people on my staff, the Division of Safety Technology, to do some of this. More of it, I should say.

Several of the topics that were discussed in your session just now I will touch on. I did not bring a number of experts with me, so if Bob and I cannot handle it we may have to defer some detailed technical questions.

So the approach I would like to talk about is first of all, the timing. The first item there is projections of the next plant orders; then second, what the steps we need to take and are taking to develop this licensing framework are; and then the bulk of the discussions will be on the elements of the licensing framework.

I might add that there are two I have added since this was put togethe that should be on there; that is, the think people and then what I call institutional changes.

Okay, the first real question is what are we aiming for. There has been a study by DOE, I am told, I have not seen it, but it is generally consistent, again I am told, with the projections by the electrical industry. I have taken some figures from the Electrical World Magazine, September 1980. Today, we have about 600,000 megawatts peak capacity. That represents a 32% margin nationwide.

Of course, that is not uniform around the country. They are projecting somewhere around 4% annual growth and peak demand over the next four years. In the pipeline, though, are about 22,000 megawatts per year average between 1981 and 86, coming online. That is both coal and nuclear. It is about half and half.

I think since they put their projection together, the nuclear online schedules have slipped, but that will probably -- the average will probably stay the same between 81 and 86, with them bunching up in the 83, 84, 85 time period.

The result is in 1986, Electric World projects a margin in the peak capacity of still some 27%. They note the problems facing the electrical industry today. I think they are well known; high interest rates, long-range inflation, the financial decline of the utilities, the slack in the growth rate of demand. It has been much less than 4%, as you know, in the last few years. Unclear administration nuclear policies and I would add to that I think what they mean is long-term stable administration policies, something that can be counted on for not just one administration but several. And, of course, unstable regulatory climate.

The results of this is that they project no nuclear plant orders before 1985 or 1986. This, I am told, is consistent with DOE's review where they actually polled most of the utilities in the industry. So that is the timeframe we are timing for to have something in place for the next generation of plants that are ordered in 1985 or 86.

So, Dr. Kerr, that is what I meant. It is the generation that is going to be ordered in that timeframe.

MR. PLESSET: You looked at what the industry has been talking about. I am curious, has the industry ever talked about the fact that they have the wrong kind of insurance? That what they need is insurance for their own property damage. They have insurance for damage to others perceived to be very ample, but they have nothing to take care of a financial disaster like Metropolitan Edison had.

They could easily do this. Have they ever raised this question, as far as you know?

MR. MURLEY: Not with us, but my understanding is they have formed an insurance pool. It is centered, I guess, in the Bahamas for some legal reasons, and that utilities are contributing to this. And there was some talk early on that they would give INPO a role in accrediting utilities to use this pool. I do not know whether they have done that, but if they did, that would give INPO tremendous clout.

MR. PLESSET: It is a little bit awkward thing to try to implement. I mean, if you pay premiums, you should get insurance regardless of how incompetent you are.

MR. KERR: There is a somewhat similar activity right now with insurance inspectors who visit an installation and they insist you make changes.

MR. PLESSET: If that is true -- .

MR. KERR: It is not an accreditation kind of thing, but it is an inspection kind of thing, which -- .

MR. PLESSET: Yes, in this case it would be a very tough decision to take it away from somebody.

MR. KERR: One might not take it away, but one might insist on changes.

MR. PLESSET: Yes.

MR. MURLEY: I think that is a useful idea. That really falls under what I call institutional changes that I think are needed as we move on.

MR. EBERSOLE: A question. To what extent could you maybe determine the effects of improvements in practices such as stabilization, rather than leave these horrible doubts that they will not satisfy the regulatory requirements, that they will still be an extrapolation of the same regulations they have today? That is very depressing to anybody who is going to build a plant.

If one could clean up that aspect of the whole problem a great deal, perhaps the picture would change. I am old product of TVA, you know, and I remember in 1934, although I was with them until 1939, they went and built to capacity in a region where there was no load. Why the hell are you building capacity where there is no load? The answer was, if I build sufficient capacity at sufficiently low cost, the load will come. It will come preferentially and it did. As a matter of fact, it ran outside of capacity.

MR. MURLEY: Yes.

MR. EBERSOLE: So you can invert this process of extrapolation if you work at it to a greater or less degree. I think, I am not sure, but maybe some degree of that philosophy is operative today.

MR. MURLEY: I would only point out, Jesse, of course it is a much different political climate today. One can look at Philadelphia Electric, who is being sued -- I do not know if that is the right word, but they are certainly being challenged on Limerick solely for the need for power question.

The arguments that are being made is that they have excess capacity and will have excess capacity far into the future, and that therefore, the Limerick units are not needed. And the Public Utility Commission of Pennsylvania, as I understand it, is having hearings on this very matter. So it is a lot more difficult these days.

I would only point out, as I am sure you know, it is a lot more difficult to build excess capacity in anticipation of need.

MR. EBERSOLE: Yes.

MR. MURLEY: So with that, and that sets the timeframe, I hope to be able to show you at the end that we are moving in a direction that I hope will lead to a stable regulatory climate. I am not sure, but some of the things -- the steps we go through and the elements will, if we can put them in place in the next five or six years, determine whether we have such a thing.

Okay, moving on to the second item then, which is the steps in developing the licensing framework, I see really three steps and we are right in the middle of the first one.

That is, we have to complete the rulemakings that have arisen out of Three Mile Island. The emergency planning rule is one, as you know, that was put into place just to upgrade the planning for the operating plants. We have an operating -- an OL rule so-called NUREG-0737 rule, which incorporates a lot of the action plan that is, I guess, going out for comment now.

We have also planned a near-term CP rule which is to deal with just those half dozen or so plants which were caught in the pipeline at the time of Three Mile Island, and that represents an upgrade in requirements. But again, it was more -- I would not regard those as long-term types of requirement. They are interim, not the final answer.

We also have the interim hydrogen rule that was sent out again for comment, I believe. The siting rule is planned, being worked on. I will talk a little bit more about that later.

I expect there will be an ATWS rule. I do not know the form it will take, but the staff certainly is strongly proposing that there be such an ATWS rule, and then perhaps the two most important are the minimum engineered safety features rule and the graded core cooling rule. And Bob Bernero will talk a little bit about those at the end, I believe, and what we are doing by way of studies in support of those two rules, and among those studies are a number of improved safety features.

Now, these rulemakings will take us throug 1984; at least 1983 and my guess is 1984 before they are all done. We will have to have a period, then, when we digest these rules. I note that we will have to develop regulatory guides and branch technical positions, that type of thing. It may be fruitful at that time to look at overhauling all of our safety regulations.

I say that with some trepidation because it would be quite a legal undertaking, but there are some regulations that go back, as you know, many years. I think there are some like the Appendix K to Part 50, which are generally acknowledged to be conservative, very conservative, and in fact, inhibiting to the staff. They take a tremendous amount of staff time to show compliance with regulations and the staff even agrees that it is frequently non-productive time. Nevertheless, those are law, regulations; they have the effect of law.

I am not proposing this overhauling, but it is something we may want to think about and it is something the committee may want to consider, when we have these rulemakings behind us.

And finally, then, is a document which governs the staff review of plans. We are, right today, updating the standard review plan and we hope to maintain that as a current control document.

By doing that, then the applicant can go to one location and find out what the staff regards as the current requirements. We hope to have a measure of control there, so if it is not in the standard review plan, the staff cannot just willy-nilly impose requirements.

So with these steps then, one can see how we might get to a licensing framework in, as I said, five years or so. If there are no questions on that, then I will move into -- .

MR. OKRENT: Excuse me. I would not expect myself to have requirements for new LWR's developed in five years, if I pursued the approach you have just outlined because it is taking you at least four years to finish the most important of the rulemakings you mentioned.

You indicated it takes some time to digest this. You are suggesting that after the rulemakings are done that one would develop these requirements. I do not think the rulemakings, in fact, address all of the topics that are relevant to the question of new requirements for LWR's by any means.

So I myself am not sort of attuned to the schedule you have given and prepared to say yes, following that we will have the requirements. That is the first point.

The second point is if, in fact, the industry, the utilities, wish to order new plants in 1985, somebody needs to know a couple of years earlier, I think, what the requirements are likely to be, or how to at least approach the general design because when you order you do not just say I want five pounds of oranges, or something like that. Where an orange is sort of well-defined. They come in different sizes; sometimes they are a little greener or whatever. You know, an orange is still an orange.

So at least at the moment, I am left unclear as to the path you are proposing and whether it would get us to an end point in time.

MR. EBERSOLE: I cannot help but say if we were in a military type discussion and we were talking in a military context, you would be talking about us having to use horses and our Navy having to use sailing ships to get from here to there. Those methods are too drawn out, too long. I cannot understand five years. I believe in moving conservatively. I cannot see this dead time, this apparent relaxation.

MR. MURLEY: I guess I could agree with you. I do not like it to take this long, either.

MR. EBERSOLE: The cost of that I think ought to be dragged out and displayed.

MR. MURLEY: There are two questions here. Dave raised the question, even following this path that we are on, are we even going to make it in 1985 or 86, and I cannot guarantee it. If there are substantive questions that are not being addressed by any of these rulemaking activities, and if that then leaves open substantive safety questions at the end of the period, then we probably will not make it. We may have to think about further rulemakings.

I do not know if you have something in mind, but that is how we get requirements into our regulations.

MR. EBERSOLE: Are there institutional changes that can do something about this?

MR. MURLEY: Yes. Legislation.

MR. EBERSOLE: Right.

MR. MURLEY: But I kind of have to deal with the world as we face it today, and this is how we do business. And all I can say is that this is the path we are on. It is awkward. I guess I am not quite as pessimistic as Dave is that we will not have a framework that is relatively stable by the end of 1985 and 86. That is about all I can say.

In my judgment, the most important rules in terms of plant design that are really going to have impact on the plant design are the minimum engineered safety features and the degraded core cooling rule. Those questions just have to be settled, in my judgment, before any vendor would offer a plant design or any utility would buy one. So we just simply have to get those questions settled.

And we are on a path, as I said, that is aiming at optimistically having a rule in 1983. My judgment is it will be a year later until we have one unless there is some policy change in the interim.

MR. OKRENT: We will come back to it.

MR. MURLEY: Okay, let's move on then to item 3, which is what might the elements of this future licensing framework include. I intended to go through these more or less in a general way and not get into details, primarily because I do not know a lot of the details.

The siting policy -- it by law will be a siting rule which says that the site must be independent -- siting policy must be independent of specific design features. This, as you know, has caused quite a bit of consternation amongst our foreign friends, primarily because they do not have the luxury that we do. I, quite frankly, see it as a positive thing.

That is, if we were to develop this siting policy, then it would no longer require a radiological calculation to go with it. And that, then, could perhaps encourage states to establish site banks with some knowledge that any plant that would be put there would be acceptable. And, of course, there are other regulations and we would have to require that such a plant met this minimum requirement.

I was talking with Harold Denton about this general policy yesterday and, of course, he goes back much longer than I do in this arena. And he said yes, we have talked for sometime about site certification, and in fact, have encouraged states and utilities to do this. It has always run into the snag of how long is a site certification valid. And I simply cannot answer that; no one can answer that.

If we had a regulation which established siting policy independent of design features, then clearly there would be some hope that the validity of a site certification might range into, say, a decade or two, which it has to if this site bank concept is going to be of any value.

Next, I will move on to the safety design guidelines. These are activities that are underway now primarily in the context of the degraded core cooling and the minimum engineered safety features rulemaking.

MR. OKRENT: If I could come back to the siting policy.

MR. MURLEY: Yes.

MR. OKRENT: Question -- .

MR. KERR: May I ask you a question to try and calibrate? Do you understand what is meant by a site that is independent of the design? This is not meant to be a critical question; I just wonder if you understand it, the statement.

MR. OKRENT: I will try to put an interpretation on it which may not be what the staff is saying. I assume that what they are saying is there will be some threshold level for acceptance of sites, and that you fall below the limit on population. In other words, we do not exceed some limit on populatio density; then the site is acceptable. And then you know, there are certain other things also which are somewhat -- .

MR. BERNERO: Dr. Okrent, may I volunteer an answer to that?

MR. OKRENT: I would appreciate it, go ahead.

MR. BERNERO: If you recall, in the present siting regulation, Part 100, there is radiological dose calculation at the site exclusion radius boundary and at the low population zone boundary, and there was a very ritual treatment of the spray effectiveness in a BWR and filters and things like that, containment leakage.

There is, at least in those respects, a very, very specific linkage between design and site, but it is of second order of importance because a spray is a spray. It becomes almost theological to debate spray effectiveness down to the last gnat's eyelash.

What the staff is doing with the siting policy is describing to the best of their ability the accident-risk characteristics of a state of the art light water reactor, without getting to the nicety of whether it is a one-tenth volume percent per day containment leakage or .15 volume percent per day leakage. Using generalized accident risk characteristics, then, looking at only site characteristic variations to determine acceptability or unacceptability with the expectation that one would then say that a state of the art, modern state of the art light water reactor of any licensable design would be acceptable on that site. And there is no need to do these ritual calculations that fine tune the containment features of the design.

MR. OKRENT: Now I will tell you again what my interpretation is, and I think it is complementary to what we have heard. Out of some such process they will arrive at upper limits on population; for example, in some way and some size perhaps for exclusion radius and so forth. And presumably then, if a site meets these characteristics in the population density area, it would be considered acceptable.

What is not completely clear to me at the moment is assuming that they have put certain limits on population because of the situation in the Northeast that was alluded to earlier, whether a utility in Arizona could say well, we have a site that falls within these limits that you prescribed for the Northeast. We also have a site a factor of 10 less, but this site meets these limits. We would like to put it in the site bank.

I do not know how they tended to approach that kind of a question, when someone in the Southwest proposes a site which is about as good as and easy to find as the Northeast. Should that also be okay? If so, why. If not, why not? I do not think this is the right subcommittee in which to address it, but it is not an unimportant or uncomplicated question.

The other thing that bothers me somewhat more about what we just heard, or what we heard from Mr. Bernero, is to try to envisage acceptable siting characteristics in terms of the current LWR. But we have also heard we do not think anybody is even going to start buying new LWR's for five years, which means construction would not begin for eight years. And presumably, those reactors may not be like the current LWR's.

And so, there is a little bit of -- oh, what is the word -- misorientation or whatever. Unless those plants are the same as these, whatever one is evaluating today may not be quite the proper basis. That is the only way I can put it.

MR. BERNERO: I would not want to take away the Subcommittee's opportunity to chide us for slow action, but if we tried to couple the siting policy to an improved LWR design, we would have to wait until we could define the accident risk characteristics of that design.

What the staff did was choose a state of the art design with the understanding and expectation that any changes in fundamental design characteristics would be improvements, not reductions in safety. So that it would increase the margin and would thereby enhance the defense indepth aspect of this uncoupling of design from siting.

MR. KERR: Mr. Chairman, stop me if we are going too far afield in this direction. Is it anticipated that the siting policy will provide an adequate safety margin so that one could indeed place today's plant on the site to be selected?

MR. MURLEY: Yes.

MR. KERR: So that the incentive for improvements in safety or decreases in risk come from some other quarter, if there are to be any or, indeed, perhaps one inaugurates a siting policy such that further improvements in safety are uncalled for.

MR. BERNERO: Just as in the design, one can obtain an ultimate level of safety by prevention of core melt accident. But rather than put all the eggs in one basket, a conscious philosophy is chosen to have a great deal of reliance on prevention and also a great reliance on containment or mitigation. And similarly, one can look at design and siting in that aspect, and that seems to be the heart of this divorce of design and siting.

MR. SIESS: I would like to point out that in the 0739, all of the criteria, proposed criteria, are site-related except the hazard state problems, and this to me is the same sort of thing you are talking about in the siting policy. I do not find it strange.

MR. KERR: I do not find it strange, either. I do not understand it, but until I understand it, I will not find it strane.

MR. SIESS: I think I understand it and I do not find it strange.

MR. EBERSOLE: What is the philosophy as regards to number of units and megawatt capacity?

MR. BERNERO: This is frequently considered. There is no clear philosophy there to my understanding. The problem of synergism, does an accident at one have a realistic potential for promoting an accident at another, is the most difficult aspect of that.

I think in the briefing you had -- we do no have a final rule, we are still in the throes. There is a body of thought that allows both a treatment of megawattage in a plant; that is the plant size provides for some change in site requirements, and that the number of units would be considered as well.

MR. EBERSOLE: Surely there would be some consideration in design to the synergism problem, and that would be an improvement, like leave some flexibility in the number of units or total megawatts for a given site. If we can improve them, then we can put more.

I presume they are going to be atmospheric dispersion plants, anyway. So the rivers do not get to be too important.

MR. BERNERO: Perhaps.

MR. MURLEY: Okay, anything further?

(No response.)

With regard to safety design guidelines, this is to give you a flavor of the kinds of improvements in design that are being looked at. Perhaps Bob can talk about those at the completion of my talk.

But they include improved containment, as Jesse Ebersole mentioned in the executive session; larger volume, greater pressure capability and so forth.

There are features for molten fuel retention and missile shields. They will also be considering diverse decay heat removal systems. Some may or may not be far out ideas of a PWR system depressurization, primary system depressurization and BWR containment spray.

We already have plans for more instrumentation as outlined in Reg Guide 1.97, and this generally comes from the Action Plan. So one might say that the requirements are on the books already for more instrumentation.

Better control rooms: that is an improvement, I think, that is already being worked on. It will take a while to develop better standards, I think, but action is under way on that.

More automation --

MR. KERR: Excuse me. When you say better control rooms, my impression is there now exists a rather large spectrum of control rooms, control systems. Is it better than anything that now exists, or is it conceivable that some of the proposed designs may be closed, or is that still an open question?

MR. MURLEY: I really cannot answer that. I can give you my views, though.

I went to the Black Fox simulator while it was still in the final stages of building at Singer here in Silver Spring. My impression is that that is pretty close to what is needed for future control room designs. It is compact. There is a lot of information on it. It makes quite substantial use of visual displays, CRT displays and so on.

MR. KERR: Thank you.

MR. EBERSOLE: Could you comment on the matter of the three kinds of containments that we have and their future, the dry or the suppressed, or which we have two types?

MR. MURLEY: Yes.

MR. EBERSOLE: How do you see these as being admitted or excluded?

MR. MURLEY: I think -- I do not see that the path we are on will lead to excluding those three types of containments.

MR. EBERSOLE: Not even the ice condenser?

MR. MURLEY: No. I do not want that to be a final statement, but I do not -- we are not on that path of excluding any types of containments of the three major types we have now.

MR. EBERSOLE: I was initially struck by the conservatisms in the German water suppression systems that they have. They are very intent on not bypassing the suppression process.

MR. SIESS: Tom, that is a strange-looking list.

MR. MURLEY: Yes, I agree.

MR. SIESS: The first item, I could characterize it in terms of a safety guideline; that is, for containment -- no matter what happens, the containment holds. Nothing gets out of containment. That is the direction I can see there. That is a criterion, if you wish. But I cannot classify those other things as to what the safety goal is.

MR. KERR: Excuse me. Which is the first one?

MR. SIESS: Improved containment. I mean, the ideal containment would be one such that no matter what happens to the plant, activity does not get out to the public. But the others, you know, sort of fall in the miscellaneous categories.

You could have a goal that says no matter what happens, the core does not melt. In other words, you have diverse, redundant, et cetera, et cetera, cooling systems to cool the core. And I cannot classify those more instrumentation.

MR. MURLEY: Okay. I get your point.

MR. SIESS: By god, yes, we always get more instrumentation, but I am not sure how that contributes to safety.

MR. MURLEY: Let me talk about the first four bullets, improved containment and so forth. They come from a list of some ten items which Sandia will be looking at.

Sandia is doing the study for Research as a backup for the degraded core cooling and minimum engineered safety features rulemaking.

I kind of would like to defer the details of that to Bob, but in a nutshell they are going to be looking at a number of plants, a number of accident sequences in those plants, and then they will selectively see what improvement -- reduction in risk these features in the first four bullets can lead to, so that is how they got on the list.

The other items are a little more speculative.

MR. KERR: Excuse me. Maybe this is not the time to interject a question, but to talk about a reduction in risk either says you are going toward zero, or you have a goal, or at least --

MR. MURLEY: Well, the first step is to find out what, if any, risk reduction these features give. We do not have a goal. We --

MR. KERR: Improved containment. Implicit in that statement is that there is some risk reduction, I assume.

MR. MURLEY: Yes.

MR. KERR: Is there some informal goal that says we want to try to use improved containment to reduce risk by a factor of 10 or 20?

MR. MURLEY: No.

MR. KERR: You just want it. So what you want is a formula that says if we spend X hours or dollars or something, we will get this much risk reduction.

MR. BERNERO: Yes, a sensitivity study. How sensitive is risk reduction to increased volume of containment or to increased pressure. Recently we had that very issue before us in one of the licensing cases. What is it really worth to jack up the design pressure of a Mark-III containment or an ice condenser containment from 20 psi to 40 psi? What is it really worth in risk reduction? It is a sensitivity study really.

MR. KERR: At some point then you will also be able to do a sensitivity study which says is it better to use a reliable decay heat removal system than to improve containment?

MR. EBERSOLE: Let me ask. I had ordered them this way. You have BWR containment spray, and then below that all of those steps you are taking are attempts to eliminate the need for containment.

MR. MURLEY: Yes.

MR. BERNERO: There is a list being xeroxed that will be distributed, and I had intended to go through these features in a slightly different context, and I think it would be helpful to do it that way.

MR. MURLEY: Okay, Chet. This list is not meant to be inclusive, and I have kind of mixed up, you are right, some apples and oranges and some other things. It was nevertheless my attempt at listing illustrations of features that we are looking at, some of which are right today under way, as I said, instrumentation and control rooms.

The improved shutdown systems, that is, the so-called ATWS fixes, we have a proposal before the Commission to develop a rule, and we, the staff, feel that there should be some improvement, and my own assumption is that there will be.

Two more speculative ones are the more automation. Harold Denton calls it a "more for giving" system. I do not know quite where that is going to lead. I know there has been a lot of talk about it in the past. I am not even familiar with all of what has gone on in the past.

But to give you an idea, Harold mentioned that the German designs make the claim that they do not have to take any operator action for 30 minutes on their plants. I do not know whether that is exactly the case, and if it is, for what sequences of whatever. But that is the direction that I guess we are kind of thinking we ought to be heading in these future plants.

MR. SIESS: In other words, more automation means protection systems rather than control systems.

MR. MURLEY: Yes.

MR. KERR: I do not understand what is meant by you do not have to take operator action for 30 minutes. For 30 minutes after what?

MR. MURLEY: After transient initiation, for example.

MR. KERR: The lesson of TMI is not whether you have to but whether somebody does or even whether somebody can.

MR. MURLEY: I agree. And whether he has the instrumentation to take action if he wants to, yes. And I do not have a lot more behind this thought other than in my judgment anyhow the direction of improved safety to me means the more use of automation in the plants.

MR. EBERSOLE: I certainly thought more instrumentation was in the context of control instrumentation.

MR. MURLEY: More instrumentation in the sense, as I used it here, is to let the operator know a little better about levels and flows and temperatures about his system.

Now, the final one, I think more attention quite frankly should have been given in the last 10 or 20 years even, is that we are finding -- it is probably no revelation -- that the PWR steam generators that have low thermal inertia lead to all kinds of complications; I might even say problems. They seem to require a fancy control system.

They seem to be more sensitive to relatively minor upsets in the balance of plant, and as we are finding in the thermal shock case that we have been looking at for sc e time, they generally lead to more severe demands on the pressure vessel.

It may be -- well, it is too late to do anything about the hundred and some plants that are in the mill. but one might consider, for example, setting a requirement of certain thermal inertia in the steam generator without specifying the design.

I realize that may rule out certain designs. I do not know.

MR. KERR: If you really are concerned about thermal shock, why not set standards on thermal shock rather than on standards on thermal inertia in the steam generator?

MR. MURLEY: I do not -- okay. The steam generator is more of a problem; that is, a low inertia steam generator leads to problems other than thermal shock.

MR. KERR: If there are problems, let's write specifications to eliminate those problems.

MR. MURLEY: I am not sure you can. I think it just simply leads to more challenges to the plant.

MR. KERR: Why don't you write specifications that limit the number of challenges to a plant? Say there shall not be more than a certain number of challenges.

MR. MURLEY: Well, I do not know. Maybe that is the right way to do it. To my mind it is easier to put specifications on the thermal inertia of the steam generator.

MR. KERR: But now, you see, you are designing a steam generator.

MR. MURLEY: No, not at all,

MR. KERR: It seems to me the problem, if I understand you correctly, the problem is not thermal inertia in the steam generator. The problem is things that result from that.

MR. MURLEY: Yes.

MR. KERR: Now, why not specify that those things cannot occur?

MR. PLESSET: He is trying to rule out one type of steam generator just because the water inventory is smaller than in other kinds, and you do not really want to do that, do you?

MR. MURLEY: No.

MR. PLESSET: That is what it boils down to. That is what would happen if you adopted this line.

MR. MURLEY: Maybe this is not the right approach to take. I am looking at the world as it is today.

MR. KERR: I wish I had thought of that expression, that that is what it boils down to.

(Laughter.)

MR. PLESSET: And how long it takes.

(Laughter.)

MR. BERNERO: If I could interject, if you go back, the problem is not thermal inertia; the problem is not challenges to the plant; the problem is not pressure vessel failure. The problem is public health and safety.

If you go to NUREG-0739, start at the fundamental threat to life, that is the core issue. That is what we are really after. But then we parse the problem and say not only are we concerned about the threat to human life offsite, but we want to put certain hazard state specifications on core melt, on containment performance. We start to subdivide the threat to human life, and really all you are talking about is the level to which you subdivide it.

MR. KERR: That is precisely what I am talking about, Bob, and I want to --

MR. BERNERO: It is equally legitimate to go down to the thermal inertia of the steam generator as it is --

MR. KERR: I want to give designers the possibility of being clever, and some of them can be. I do not know who to do it, but I was impressed recently in reading through a file that somebody got from Steve Hanauer in which he commented continually almost that regulators had to be careful that their regulations did not prevent people from making improvements. And I do not think you are trying to keep people from making improvements. Quite to the contrary.

I think we need to keep this in mind. We do not want to adopt regulations that make plants less safe by keeping people from making improvements.

MR. MURLEY: I think you are leading me astray from what my point was. If I had been around 10 or 15 years ago when the general design criteria were being discussed and if I knew what I know today, I would have argued strongly for a general design criteria on thermal inertia of steam generators and let the designers deal with that design criteria.

MR. KERR: I am not absolutely certain of this, but I thought our subcommittee looked at that problem and concluded that the behavior of that steam generator was not all that bad.

MR. EBERSOLE: You are right.

MR. KERR: There is not complete unanimity in the technical community that that thermal inertia -- isn't much of a problem, is it?

MR. MURLEY: We looked at it from the point of view of challenges to the vessel from thermal shock, overcooling transients, and it is clear that once through steam generators are, in our judgment at least, an order of magnitude greater more frequent challenge in terms of overcooling transients.

MR. EBERSOLE: Aren't there compensatory steps you can take to preclude that?

MR. MURLEY: Yes, but that buys you virtually nothing.

MR. EBERSOLE: Does it?

MR. MURLEY: Yes. There are steps to be taken, yes. And please, don't get me wrong. I do not intend to rule out anybody's design. That is not the direction we are heading.

MR. EBERSOLE: It seems you are doing this and throwing something out because it has one undesirable aspect. You may throw out half a dozen good aspects on the safety side, too. If I recall correctly, the B&W boiler was thought to be much better in the context of throwing gases off, not having gases in the U-tubes, lots of good things, perhaps more important than the thermal shock problem. I do not know.

Each one represents a basket of goodies and baddies. When you throw out one, you throw out something else.

MR. MURLEY: Yes. I did not mean to get the discussion focused on this particular design, although I realize it almost has to. But I still think that a steam generator with high thermal inertia is a good thing for safety, and I think the agency ought to have thought about this 10 or 15 years ago.

MR. EBERSOLE: It is a fly wheel.

MR. MURLEY: It is a fly wheel, yes. Okay.

Standardization.

MR. EBERSOLE: Pardon me? Just a minute before you leave that. There is another piece of logic which is containment. The secondary side has become a predominant problem rather than the primary side in containment overpressure. We now have a logic in design which precludes a discharge to keep from blowing up containment.

There is a case where a dry secondary looks better than a wet one. It is one of the goodies.

Do you follow me?

MR. MURLEY: Yes. And I agree, you have to balance these things.

Okay. With regard to standardization, I do not have much to say, quite frankly. I have had some discussions with members, I believe representing the AIF. Actually, it was a reactor vendor, but they are pushing, as you know, the idea of powerworthiness and certification. This will lead to standardization.

The problem with powerworthiness certification is it is a very broad approach to the problem, very complex. It requires legislation. Embedded in it is the notion of one-stop licensing, for example. So I would not say that

that is the way to go if we want something in the relatively short range.

I think the notion, though, of vendors developing product lines that are relatively stable is a good idea. I think the committee recognized it in their discussion earlier, and I think NRC ought to go some way toward providing incentives for standardization.

MR. SIESS: Excuse me. Does the concept of powerworthiness certification involve just the NSSS, or does it involve the entire design?

MR. MURLEY: It would have to be the -- certainly the entire design that is related to safety, that has safety implications. That generally is most of the designs.

MR. SIESS: Did you mean important to safety or safety-related?

(Laughter.)

Because I am beginning to wonder what parts of the design are not related to safety.

MR. MURLEY: I would suggest that -- again, I have --

MR. SIESS: GE's proposal on powerworthiness, did that extend beyond the NSSS?

MR. MURLEY: Yes.

MR. SIESS: Because they went to the nuclear island in their standard design, so they were talking essentially the whole plant, weren't they?

MR. MURLEY: Yes. They recognized, as they mentioned to me, that this really cannot be a GE proposal. It has to be an industrywide proposal. So they have gone to the Atomic Industrial Forum, and there is now a committee of some kind of the AIF that is doing a lot of thinking. They are talking -- they have a proposed concept. They are talking with Congress, committees of Congress on it; and I would suggest you may want to talk with them and get more details from them, because I really do not have a lot of details.

MR. EBERSOLE: There is about due now a report from OTA. I am sure you can get a copy of it. Have you read that yet?

MR. MURLEY: OTA?

MR. EBERSOLE: The only object was to expedite licensing. It was not particularly for improving plant safety, just expeditious in saving time.

MR. MURLEY: It runs into the problem that Bill Kerr mentioned. It takes years to have such a system, and there are changes that come about, and we are liable to have an accident or some kind or other in the next ten years, and god forbid that we should have to go through the same thing that we do now. But if we did, it would throw standardization way back.

MR. KERR: Is part of the standard plant idea that one will have one vendor, or at least a consortium of vendors rather than the present system of competitive --

MR. MURLEY: The system, as I understand it, would be more or less just a legal framework in which an applicant can come in with a standard design that has been precertified. It has a powerworthiness certificate, just like the Boeing 707, and then United can order one, and TVA can order one, and so forth.

MR. EBERSOLE: Bill, this report takes up that aspect about institutional barriers.

MR. KERR: It would be a standard design for each vendor?

MR. EBERSOLE: That is one concept. The other is an absolute standard design like the old Liberty engine in World War I.

MR. KERR: This sort of thing I think would require special legislation.

MR. EBERSOLE: Yes, it would, a great deal of it, and some extreme institutional shakeups.

MR. KERR: It would not be any more extreme than the last election.

(Laughter.)

MR. SIESS: But the aircraft concept, the airworthiness certificate does not freeze the design. There are allowances for modifications. They are made uniformly. And if we are going to rely very heavily on probabilistic risk assessment to evaluate designs, there are certain advantages in having standard designs. You can make much more thorough studies on them than you can with every conceivable variation you get between vendors and AEs.

MR. MURLEY: There is another aspect that presumably you have talked about and thought about, and that is, it is today, I think, quite difficult to feed back operating experience into plant design because they are all different, and every plant has a different valve located in a different place.

That is why I am quite impressed with the approach that France is taking, two designs, I believe. They have a system, I am told, for feeding back operating experience into the design. That makes it quite a bit easier than it does for us to evaluate the implications of it and feed things back in quickly.

MR. KERR: There are a lot of things about the French system that are desirable, for example, one utility and one vendor. I mean that --

MR. MURLEY: Maybe that is what it takes to get standardization.

MR. KERR: It certainly makes it a lot easier.

MR. MURLEY: That is right. Okay.

I omitted from the list -- it should be on here -- the notion of a safety goal. I am not really prepared to go into any detail, but clearly it is an element of a future licensing framework, and just how it would fit in I cannot say.

If the staff had a safety goal given to us today, we would not know what to do with it, quite frankly. We would not know how to apply it. And that is something that has to be addressed in any work or effort that the Commission puts out, and it has not been addressed to date.

MR. KERR: I can tell you that you would not be unique, because speaking from the university point of view, we have had a number of goals given us by federal agencies that we did not know what to do with.

(Laughter.)

MR. MURLEY: Okay. The next item, Item D, is licensee accreditation. Now I am getting into more nondesign aspects, but nevertheless I think are important. There is, as you know, no such requirement for accreditation of licensees.

The Nuclear Safety Oversight Committee is pushing in that direction. Their latest letter to the President has some remarks in it about upgrading the management of utilities, not from the point of view of how they distribute electricity or even generate electricity, but that the management has to become much more involved in the nuclear safety awareness, I guess.

Harold Denton tells me that he has in the past discussed -- and his view is that at least at the vice president level in the utility there ought to be someone with nuclear knowledge, and he should be the nuclear man, at least at the vice president level in the utility.

I think we ought to be doing much more along these lines in terms of requiring competent operations organizations, and perhaps more important, the design and safety support staffs for operating one of these complex plants.

MR. SIESS: Tom, I think most of us have some feeling that some utilities do a better job than others in terms of safety. I am not sure we all agree on which ones did the better job, but I am not sure it is related to size. In fact, I am sure it is not related to size.

But do we have any ideas of what characteristics of the utility organization-management structure leads to this difference? Has any study been made that tries to show whether having an engineer as the vice president is any better than having an accountant as vice president?

MR. SIESS: There are differences. How do we do anything about judging it or changing it?

MR. MURLEY: The answer to the question is there has been no such management study that I am aware of. We are looking at the management with regard to -- management of the utility. It is mainly an I&E effort with some support from NRR, and they are looking at the matter of, oh, I guess you would call it quality assurance and things like that.

I do not think that gets at what you are saying, and I could speculate on the features that make a good utility management with regard to nuclear safety. I do not know if this is the place to do it or not.

MR. SIESS: Are there any research programs -- are there people out there somewhere that are capable of finding out what makes some companies operate better than others?

MR. MURLEY: You mean with regard to safety?

MR. SIESS: With regard to safety.

MR. MURLEY: Not how to distribute electricity.

MR. KERR: It is not clear to me that the two are entirely separate.

MR. SIESS: A company may have equated safety with reliability and worked on that basis. I do not know. Some may have put safety well above reliability and accomplished the same thing.

MR. MURLEY: Some may have decided if the NRC gives them a license, then it must be safe and they do not have to worry about it.

MR. SIESS: There are differences. I do not know where it starts. My feeling is it is somewhere up at the top, and how it filters down or what the requirements are -- but how do we judge? I read the last oversight committee letter. They made some interesting points. But they do not know. I do not know.

Is it possible for somebody out there, management consultants, I don't know what kind of consultants, that could look at this and come up with some answers? Maybe just straight correlations would do something, but I doubt it.

MR. MURLEY: That is a good point. We will look at the notion of perhaps asking Research to undertake a program along these lines.

MR. SIESS: It may not be research. It may be a technical assistance thing. But there may be somebody who can evaluate this.

MR. KERR: I also think somebody ought to give some thought to whether one can accomplish safety by having a lot of separate safety organizations. I think safety has to be built into the structure and have an important place in everything that goes on in the system. I also have the same feeling about quality assurance, but I will not pursue that today.

MR. MARK: It troubles me a lot, the use of at the vice president level. That presumes you know what it means and it is always the same, and I doubt if either is the case. Real property is not whether he is vice president or manager or department head or whatever the heck you call him. He should have no real competing responsibilities. He should be capable and his only superior control should be to the corporation, the company, and not somebody who is separately worrying about rate structure.

MR. MURLEY: That is right. That was our point, not to be proscriptive.

MR. MARK: And then put that in a NUREG or a Reg Guide. Then you can always call somebody a vice president, for heaven's sake.

MR. MURLEY: And that is why I doubt you will ever see a proscription like this. It was meant merely for illustrative purposes, someone in the corporate structure who can command resources needed to run a complex thing like a nuclear plant.

MR. EBERSOLE: In the current Time Magazine there is an article on the influence of rate structure to the corporate management.

MR. SIESS: A number of years ago I was involved in a tunneling project that had half a dozen different contractors and we did see a tremendous difference in their performance in terms of safe operation, and the way it was characterized is the ones that ran scared were the ones that stayed out of trouble.

MR. MURLEY: They anticipated problems and had procedures.

MR. SIESS: Knew the problems were going to come up, expected them, anticipated them, learned from them, did not make the same mistake once if they could help it, as opposed to the optimist, you might say, or the oblivious.

(Laughter)

MR. MURLEY: There may be some benefit in undertaking a study along these lines.

MR. SIESS: I do not know how you are going to make decisions on licensee accreditation in terms of management without some answers to these questions

MR. MURLEY: The next item is guidelines for design process. Let me explain what I mean. One problem we continually run into, and I am sure you have run into it, is the interface between the NSSS supplier and the architect-engineer, and this runs, as you know, through many, many safety systems.

We just had a meeting the other day with a supplier and we asked about a certain design of a system out in the balance of plant that was important to safety, and the reply came back, well, that is not in our scope of supply. What this leads to is that you really do not get a true systems review during the design process, in my judgment, an overall systems review.

Take, for example, the decay heat removal system. In terms of the total number of systems that that draws into play at one time or another during a transient, I doubt that there exists a comprehensive review of that of the type that I am used to kind of coming out of the breeder program.

Now, to try to get some more information, or some thoughts, I guess, I asked the Clinch River people to come in, the design people to come in and tell us how they sat up their design process and how they do systems reviews and integrate reliability in the design process and so forth. They came in and talked to us a couple of times.

Of course, as you know they have had four years to really hone their design process down, but nevertheless it is an impressive method for reviewing designs important to safety. I would encourage you if you have the time to ask them to come down and explain it, but it goes into the balance of plant.

They have what they call key system reviews that involve the architect-engineer as well as the NSSS supplier. They have independent design reviews which, as you know, Harold Denton is pushing quite strongly for our own review process. It has met with what I guess you would all mixed success.

I think the idea is good and we are probably in a shakedown period, but this is going to lead toward integrated, true system reviews, I think.

MR. SIESS: I hope that is not limited to mechanical and electrical systems.

MR. MURLEY: No.

MR. SIESS: Structural systems.

MR. MURLEY: yes.

MR. SIESS: I had an example some while back. We got into arguments about compartment pressures. If you recall, it turned out that the plant was already designed and the pressure was higher than they figured it was going to be, and the concrete wall was going to be overpressured. So I asked what would happen to the wall if it saw that pressure.

Well, the guy that made the pressure calculations did not know what would happen to the walls so they found somebody else that could figure that the wall might deflect 3 inches. So then I said: What will happen if it deflects 3 inches? What is hanging on the wall? What is on the other side?

Well, nobody knew. They had to go find somebody who knew what was on the other side. Now, that is complete compartmentalization of the design. If everything works it is fine, but it does not look at what happens if it does not work.

MR. MURLEY: I agree. Back in the old AEC that is how we did reviews. We would get 20 people there asking all these different kinds of questions from different angles, and I do not see that in the way we design and even review plants. We do not review them from an integrated systems point of view today. I think we have to start moving in that direction.

MR. SIESS: It is incredibly complex.

MR. MURLEY: It is.

Any more questions on that?

(No response.)

The next to the last, then, is stabilize the NRC staff review process. We are upgrading the Standard Review Plan, the SRP, as I mentioned. It should be out in July. Well, it should be out in July. That is our commitment. We expect to maintain it as a type of requireme[illegible] control document, that is to say, to bring some discipline in our review process.

I do not know if we will be successful if it takes a management commitment to do that. Harold Denton is certainly committed to do it and I am, but it has to flow on down through the staff, too. We are developing a system and have a prototype on it working which I call a tracking system for operating reactor requirements.

There are several thousand requirements that we have laid on, individual actions that we have laid on operating reactors in the last year or two since Three Mile Island, and it, I would say, today is very, very difficult to find out what has been implemented and what has not on a given plant.

We need such a system for maintaining that, automating it and so forth. Really all it means is trying to bring NRC's management into the 20th Century with regard to information and control systems and so forth.

We have a plan to prioritize safety issues. This was discussed with the subcommittee, I believe, maybe the full committee, by Carl Kniel. We intend to start that up within the next few months, and by the end of the year we should have a first cut through all the generic safety issues ranking them in some priority scheme, and as new issues come up they will be prioritized.

Finally, the use of probabilistic risk assessment methods in decision-making. We will talk more to the committee on Friday, I understand, about that.

My last point is --

MR. SIESS: Will you use risk assessment in the prioritizing of safety issues?

MR. MURLEY: Yes.

MR. SIESS: Okay.

MR. MURLEY: The next point is a little more speculative. It has to do with institutional changes some of which have been described by the Rogovin group. Alvin Weinberg has discussed things like this at one time or another. They have to do with, for example, working with the public utility commissions to try and remove financial disincentives to safety, and that, I guess, I clearly am not the one to talk about. Harold Denton and Mr. Salzman did talk just a week or two ago with some PUC representatives along these lines, and it immediately gets very complicated and very difficult to enter into this murky area.

Nevertheless, if we are talking about improvements to safety, it is something I think we cannot ignore. We have to deal with it. And my understanding is if a utility wants to shut his plant down to make an improvement on his own to prevent something or other, those charges for downtime go into one pot. If he waits and lets it fail and has a forced outage, then that goes into another pot which goes into the rate base.

I am not totally sure that that is correct, but if there are things like this that can be changed, I think we ought to encourage them. So I just mention this really to stimulate thought, actually. Alvin Weinberg has mentioned, among others, I believe, the notion of a national reactor operating organization or groups of organizations. If a number of utilities wish to band together and have a subsidiary, let's say, which is an operating organization, it turns out that there has been such a group come in to talk with Harold Denton, and I do not know who they were, but there is interest out there to do such a thing, to pool resources so that one has proper backup staff that it takes to run a nuclear plant.

But then again, immediately you run into legal questions like who is liable if the operating organization were to make a mistake that caused damage to the plant. Nevertheless, these things, I think, ought not to be just left unattended just because they are difficult problems or whatever.

Now, that concludes my talk in this licensing framework. There is a lot of work under way and I think Bob Bernero can address the work that he has under way.

MR. BERNERO: In view of the time, I would like to do it in a somewhat summary fashion and just comment on three aspects --

MR. KERR: Mr. Subcommittee Chairman, in light of the agenda which calls for a break right now and I do not think we ought to br..k into his presentation, could I suggest a break before his presentation?

MR. OKRENT: Sure.

MR. MARK: I suggest you accept it.

MR. OKRENT: Oh, you wanted me to act on it.

(Laughter)'

We will take ten minutes.

(Recess.)

MR. OKRENT: Mr. Bernero.

MR. BERNERO: Gentlemen, the ground covered by Dr. Murley before the break is a matter I would like to cover again in a somewhat different form, summarizing this issue of how really we are talking about how shall we regulate new reactors, and threaded through it are implications on how we would revise or backfit existing reactors insofar as is appropriate.

Whenever one speaks of a new requirement there is an automatic issue raised of whether or not it is worth going back and backfitting. So much of the activity the staff is engaged in has a very strong flavor of backfit consideration as well as new reactor consideration.

Now, you can look at this issue from three aspects. The proscriptive design aspects, many times we will ourselves or people we discuss the matter with will raise the point: if only you had a dedicated shutdown heat removal system you would have a vastly safer plant or a filtered vented containment or something else or something else.

In the context of the Degraded Core Cooling Steering Committee, the group which should have been called the Reactor Regulations Steering Committee, we developed a list which appeared in the memorandum that terminated the life of that committee. There as an April 1 memorandum. I think most of you have received it by now.

MR. OKRENT: Has the committee received it?

MR. BERNERO: It was called the Action Plan on --

MR. OKRENT: What I saw was a memo that said the committee has not received it. Maybe since then the committee has received it, but would you check and see?

MR. BERNERO: I would happily undertake to do that.

Basically, there are a series of memoranda all about the same time, and Dircks disbanded the committee. There was the merger of the Office of Research and Standards coincident or virtually at the same time, and the committee had produced an Action Plan that does not purport to be the last word, but you know, it is a milestone and it sets forth major activities on an approximate schedule. There are holes in it and I would acknowledge those holes now.

One of the core items or central items -- let's leave out core -- it boils down to --

(Laughter)

One of the central items of this Action Plan is a design features study. It is a somewhat prescriptive thing but basically it is described in that memorandum and there was a key table that was circulated to you, a Xerox of a thing called Table 1, Features to be Considered.

Approaching the matter in a prescriptive manner, in a very design-specific and item-specific fashion, we identified a family of ten things, design features you can call them, or goodies. If you look at them they are almost all mitigation features, accident mitigation features, although threaded through there you will find accident prevention features such as add-on decay heat removal system.

The concept by which they were selected was are there identified design feature traits that can be pulled out as potentially prescriptive add-on requirements or the source of new design criteria that might be stated in some more general way, and they were set down in that order, which still does not follow a good solid, logical pattern.

But if you go down the list you have, you see containment heat removal whether active or passive system, containment mass removal, filtered or unfiltered different size vent systems, and then of course going to the containment itself, simply increasing either its volume or its pressure containment capability, and so on down the line.

Some of those features are very, very specific, like the combustible gas control, and others are much more fuzzy. The idea is to do a two-stage study, which we are just under way with now, which is really an extension of what you came to know as the improved reactor safety studies, and it actually builds on those.

In the improved reactor safety studies we were looking at things like filtered vented containment systems and add-on decay heat removal systems and trying to get very good information to compare what is the value of one system against another or one way of improving a reactor design against the other.

What we are trying to do here is set down in two cycles, a phase one and a phase two, just to iterate the thing, the risk reduction effectiveness and order of magnitude cost and complexity of these design features. A sensitivity study is basically what it is, and this would provide us with a much better sense of the relative merits of one system against another, and we hope the sensitivity point at which one system might be worthwhile and at another point where it might not be worthwhile.

To clarify, for instance we are looking at filtered vent containment systems, and one can easily look to a small filtered vent, say something on the order of a 3-foot diameter, and say that will cover quite a range of accident potential and provide a lot of help, but it will not cover the worst steam spike. The worst pressure spike would overwhelm it.

Well, one can compare them, the relatively modest difficulty and cost of a 3-foot vent to, say, a 20-foot vent and the risk reduction effectiveness of the two to some reasonable scale. By this means we hope to narrow the field. Some of these things we think may not be all that worthwhile, some may be very worthwhile.

We would set this information down in the rulemaking forum, and I would point out now a subject that we discussed a little while ago. The siting rulemaking is right now putting down information on the risk reduction effectiveness of siting tradeoffs.

If you change from Population Density A to Population Density B, what is the impact on site availability and what is the impact on risk reduction if you move the exclusion radius, you know, extend from one-half mile to a mile, something like that? In this same forum, then, we would see risk reduction for design features as well as siting features.

There is another rulemaking that that steering committee, now disbanded, was paying attention to, the rulemaking on emergency planning. The rule was passed, as you know, last -- I forget the date. You know, it is almost a year now, at least six months ago, almost a year.

The Commission issued an emergency planning rule, but the context of considering a new siting policy, new design features and both prevention and mitigation naturally entails reconsideration of emergency planning. So the entire rulemaking forum is open for consideration of risk reduction effectiveness of all of the features and how they relate one to the other and how the agency would choose to separate them.

There are holes in this and there are oddities. We have, for instance, the whole area of human factors. As most of you know, people generally estimate that half the risk with a nuclear power plant operation is tied up in operator error in one way or another, either predisposing the plant by not lining it up properly in advance or errors of commission and omission during response to an incident.

The context in which these design features are being considered --

MR. KERR: Excuse me. Is there some reference or set of references that you can give me later on which would lead me to that?

MR. BERNERO: The one that I usually steer people toward is one that was done back in the days of the Lewis Committee Report where that information was extracted from WASH-1400, and there is a memorandum of some, oh, four years age, three years age, something like that.

MR. KERR: If you could just drop me a note.

MR. BERNERO: I will get you a copy of the memorandum.

MR. OKRENT: Did the recent Brookhaven study suggest it was a factor of one-half?

MR. KERR: I do not think it is that quantitative, but there are some interesting conclusions in there.

MR. BERNERO: The Brookhaven study that was done for us was primarily to look at the sensitivity to the risk increase or decrease by improving operator action or worsened operator action in given systems or situations, but it is essentially built on the same information.

MR. KERR: It does lead one to look carefully to see how much improvement can be achieved by equipment changes without doing something about errors by people, not just operators, of course, unless operator is used in a generic sense.

MR. BERNERO: I wish I had had the foresight to bring one of the curves out of that Brookhaven report we are referring to. There is a truism in that that pertains here that is very important to say, that whether you are speaking of operator action or design, a mistake, an error can do a lot more to increase risk than an improvement can do to reduce risk because of the competing risk situation.

If you recall, there is one curve that really dramatizes that point, and the point we would make here is that when one is looking at design features such as filtered vents or whatever, one cannot ignore the human error, but it is very difficult to couple the two. There has to be a conscious consideration in those design features.

Are they in themselves highly vulnerable to operator error? And at the same time there has to be the more general consideration, is equal attention in general being paid to the reduction of prevention of operator error that is risk significant?

So the rulemaking forum, we had very, very much discussion of that in that steering committee, and at the present time we are in effect in a mode where we are saying the human error issue is being treated in the separate forum, in the Human Factors Safety Division of NRR and all fo their action plans. It is not directly threaded through this design features consideration work that I am just talking about, but it is strongly related and there must be a balanced look at it.

So in the rulemaking forum where we look at a new design requirement in particular, we must give equal weight to the human factors consideration.

Now, all of this information is coming over, let's say, the next two years. That may be optimistic. Maybe it will take a bit longer. But there is a great deal of information out there and the body of knowledge is growing rapidly. That information then comes to the table and offers one of two opportunities.

You can look at it prescriptively and say I will now require that every plant have a 3-foot diameter filtered vent, that every plant has a dedicated shutdown heat removal system or a bank of heat pipes that can remove 1 billion Btus per hour from the containment with no moving parts or whatever. You could generate design requirements that would be literally that, very, very specific design requirements.

One can look at it another way, look towards performance standards. One has been discussed and there is a great deal of working going on in the ACRS as well as the staff, the use of probabilistic goals, safety goals, first qualitative, and if possible, even quantitative, by which you can judge the performance of a plant, the effectiveness in protecting public health and safety.

By setting goals for protection of human life, protection of offsite property damage, prevention thereof and subdividing those goals down as far as one sees fit, either into hazard states concerned only, say, with core melt, containment performance, or going even further and getting into subsystem reliability, going into component reliability, diesel generator reliability, for example, or bulk AC power reliability as a different approach, that is one approach that is being worked on now.

A great deal is being one. There is research being done to explore what are the practical I will call them mathematical problems, but administration implementation problems in using a safety goal, trying to set down -- I think many of us are quick to cite a goal, to say, gee, there is a nice probability and I am going to use that as a goal, and if you ask the person, well, who estimated it, they will say that is an estimate I would make.

It is very difficult to put down methodology that can be consensus methodology that everyone can understand like we have in so many other disciplines of engineering. So we are doing research on what are the problems of implementing or using quantitative goals.

And then there is a distinct hole in the present activity that I hope to see filled soon, and that is what I will call a review of the general design criteria. Right now we have a body of design criteria that has been in existence for some years, and we have not sat down in an orderly, open way and reviewed them from beginning to end and said what are we really doing here.

One of my favorite examples is one of the general design criterion for containment leakage. If you go into the general design criteria you will find one -- I cannot remember the number off-hand, I think it is 42 -- that says there shall be an essentiall leak-tight containment.

Over years we developed Appendix J to Part 50, which is a very, very ornate and, by the view of some people, a very difficult way to demonstrate that you have leak-tight containment if one imposes leak-tightness in the realm of a tenth volume percent per day.

I know from personal experience of instances where plants have been unable to start up the first time or after a refueling because they were still fighting the problem of demonstrating their Appendix J leak-tightness, and if you have ever looked into that you see there is temperature measurement and, you know, a large volume of air and all sorts of administrative problems.

But we need to sit back and look at that and say is it really important whether it is one-tenth percent per day or three-tenths percent per day or one percent per day unit pressure.

MR. EBERSOLE: It may be a lot more important that you get the valves closed.

MR. BERNERO: Right. So that design criterion and that design requirement, Appendix J and all the ornate testing with 239 thermocouples spread all over the inside of the containment, is that really necessary? So we need to have a systematic evaluation of the currency of the risk reduction or risk effectiveness value of the general design criteria.

It may be that it is far more important to have a simple design criterion that says a pressure imbalance shall be maintained sufficient to betray an opening in the containment, and the hell with leakage. You know, I do not care if it is one percent per day or a tenth of a percent per day as long as the thing is basically shut, that the purge valves are not open, that somebody did not leave open some access hatch, you know, without an alarm or something like that.

So it is that sort of review of the general design criteria that is sorely needed. We believe that that sort of work can be done in parallel with the development of what I call the prescriptive work, you know, just how good is a filtered vent system, just how good is a core catcher or whatever.

And then we are in a position to make a choice of how design requirements are specified. Are they specified as design criteria which are general with performance standards related to them, or are they highly specific "thou shalt have a filter so big or a core catcher so and so quality"?

Now lastly, the aspect that I think is important and I think a very difficult one is what I call the regulatory structure.

MR. KERR: Bob, at some point, maybe after structure, one is doing a good many things to reduce risk, and you have said you would not know what to do with a risk goal if you had it, but have you thought about the point at which you stop, don't follow the goal or whatever? Does one keep on reducing risk on and on?

In some earlier presentations perhaps to a different subcommittee I think the statement was made by some staff representatives that the staff was going to at least do some sort of comparison between the risk of generating electricity by nuclear with the risk generated by other alternatives, and I did not hear necessarily whether it was going to be a lot safer if you did it by nuclear or what, by how are you going to determine that you have gotten there if you do not call it a goal or --

MR. BERNERO: That is an explicit issue in the safety goal arena and it is an important one, the idea of calling a halt, stopping at a level of acceptable risk below which one would suppress risk only on a cost-effectiveness criteria. Obviously if there is a further substantial or notable reduction of risk that can be bought cheaply, it may indeed be worthwhile, but there is a threshold of concern and that is one of the whole reasons for having a safety goal definition or at least an attempt at a definition.

As an example, I am wearing 200 millicuries of tritium on my left wrist and it is below my threshold of concern for radioactive exposure or radioactive hazard in the event that my little boy steps on it and smashes the ampules or something, but the safety goal would, I hope -- in fact, right now we even have a phantom safety goal that is really in use that this safety goal defines the level where there is a shift in the burden of proof. The plant is apparently safe enough now to go further in risk reduction in suppressing a risk sequence. It has got to be worth it.

It has to be something relatively reasonable in cost for the relative risk reduction obtained because you are down to the residues, the residual risks that are not that big, and I do not see a never-ending ratchet mechanism now. You know, in the future a never-ending further and further risk reduction. I see a much more disciplined one coming.

I think to the extent possible, quantitative estimates of risk are constantly being attempted. My biggest fear is improper, inaccurate or undisciplined use of them. A while back they were not being attempted. People were not -- the judgment call was being used without discipline to say I see a risk, I decide it needs to be reduced, therefore here is a new design requirement.

Now, I think there is much more discipline in the process.

MR. EBERSOLE: Bob, at this point I would like to mention something. A while ago we spoke of synergistic effects in multi-unit sites. Those are not all bad. I think there should be a discrete consideration as was done years ago at Browns Ferry as to whether one is building an integral multi-unit plant or three stalls. There are disadvantages, there are advantages.

For example, Browns Ferry has three batteries per unit, but that is only one battery per unit in layout. It has dispersed capabilities. The Germans build plants as integral plants, multi-unit designs. We have gotten into a box because of, I guess, regulating practicality and necessity to say that all of our plants are simply discrete units, therefore we have no capability to draw on the synergistic capabilities of a five-unit installation.

MR. BERNERO: Really we have a mixed bag in the U.S. I can think of examples in Zion, in Peach Bottom, like the fifth diesel in Peach Bottom is shared between units. There are the diesel generators --

MR. EBERSOLE: You can share investments.

MR. BERNERO: We have slide-along pairs, as some people call them, where there are stalls. That is very difficult. There is a lot of judgment involved in it. It is very difficult to come up with reproducible evaluations of the pros and cons of that.

MR. EBERSOLE: You might even share a containment. There are all sorts of things you can get in the form of goodies that cannot be financially justified on a one-unit basis but can be on a multi-unit basis.

MR. BERNERO: I will tell you, there is little going on in the staff in the thinking or the analysis going to that. The only concern that is extant in staff in all of this work is the negative side of that coin, which is need I discount the safety of a plant because it shares a site with another plant, or need I penalize the siting in some way?

What I was saying about regulatory structure I think is a very important one for the committee to consider and certainly the staff and the Commission to consider. You may recall in our long-range research plan we proposed, we used the term "reliability engineering" for a substantially enhanced approach to quality assurance.

Tom Murley earlier spoke of bringing in the people from Clinch River. This is a much stronger management system, much more akin to aerospace management systems, configuration management, the systematic use of reliability engineering, quantitative where you can be quantitative, and qualitative where necessary, far better than what we have now.

I think the original intent in Appendix B of Part

50 when the assurance regulations were put together was to go all the way, but there is an awful lot of what I call the quality control thinking in our quality assurance. I do not think the agency's quality assurance activity has ever gone as far as it should in that.

Now, in our regulatory structure if we choose to go for enhanced quality assurance, one of the probable aspects of that is a great shift in responsibility toward the licensee or toward the applicant and away from prescriptive regulation by the NRC of thou shalt have a core catcher of so and so character or a filter vent of such and so design.

So there is a strong tie there of going toward simpler regulation, more performance or goal-oriented regulation, and looking more toward the management of the project by the owner or the operator if we end up with that.

MR. OKRENT: I guess that trend is best illustrated by the recent regulation on fire control.

(Laughter)

MR. BERNERO: Appendix R was not of my doing. Yes, this is a difficulty. There was a very strong tendency in the staff to come up with things like Appendix R. Appendix J here is how to measure a leak rate, you know. That is highly prescriptive regulation. And if you really want to do proper quality assurance, you have got to get out of that mode.

MR. KERR: I learned just recently to my surprise that the NRC staff does not have its own QA organization, and it does seem to me that if the staff really believes in QA, it ought to set an example. Now, I happen to believe that QA can work, but I am beginning to wonder if the NRC staff believes in it since it does not use it. I have yet to resolve this anomaly but I mention it.

MR. BERNERO: You are preaching to the saved.

(Laughter)

The other aspect of the regulatory structure that was touched upon in some respect in Tom Murley's presentation I think is extremely important. Let's go back in history to the beginning of 1979. As you recall, we had at that time a very complex but recognizable and, to a great extent, understandable structure of regulations supplemented by regulatory guides which had a clear formal process for their preparation and consensus endorsement and use.

The regulatory guides were further supplemented by branch technical positions which had the character of growing or soon to become regulatory guides. There was the standard review plan in existence which complemented to a great extent and relied on the regulatory guides in interpreting the regulations, and I think it was fair to say that if somebody wanted to build a plant, he had some tough choices and decisions to make but he knew what he had to do, and the only question was the scale was increasing every year.

The regulatory requirements were escalating but they were indeed set down on paper, they were indeed in a structure that had formal procedures for managing the paper and getting approvals and agreements and the use thereof. Three Mile Island changed all that a great deal. The aftermath of Three Mile Island led to regulation by NUREG, by bulletin and by order.

We now have what borders on chaos. NUREG-0737 is a NUREG and it is full of Action Plan requirements. The Action Plan is itself a NUREG, an enormous one. NUREG-0660. Is that a regulation, is that a requirement, is that an act of Harold Denton in a formal letter? Just what is it? Will we translate that into a regulation? 10 CFR 50.0737 What are we going to do with that?

We do not have a structure, and out of lack of attention and resources, the old structure is a teetering one. Many regulatory guides are not being maintained. We are evolving to a situation where the staff is forced to say don't believe Reg Guide XYZ, that is superceded by Reg Guide 1.whatever.

The only glimmer of hope we have is that the regulations have to be kept up, you know, by law, and the

Admininistrative Procedures Act. At least those exist clearly and have to be changed to suit, and the standard review plan is being updated.

But there is a tremendous gulf or gap between those two, and one of the greatest problems we have in trimming down the requirements is not merely knowing what the requirement is or knowing how to state it, that is, whether a performance standard or a prescriptive standard, but knowing where we will put it, knowing whether we will be using NUREGs as some quasi-legal, quasi-regulatory structure.

If you look at the Emergency Planning Rule you have a very dramatic example of that. Where is the meat? Where is the meat of the emergency plannning regulation? Is it in the Emergency Planning Rule? No, it is in NUREG-0654, and the rule in effect endorses the NUREG or adopts it, and we have a very serious choice before us if that is the way we are going to have a regulatory framework, and that is one thing that I think is very important to clarify. If new requirements or stable requirements for new reactors are to be specified, we had better be very clear about the frame in which we will specify them.

I would be happy to answer any questions, but that is it for what I wanted to say.

MR. OKRENT: If I understand correctly, Dr. Savio can borrow your copy of this action plan.

MR. BERNERO: Yes. In fact, I will just give it to him.

MR. OKRENT: Okay. I am somewhat surprised it has not been sent to the ACRS, if indeed it has not been.

MR. MARK: I am not sure this bears directly on what you are telling us, Bob. It was mentioned by Tom and perhaps I missed it. To what extent is the understanding that this reduction has that might be estimate as a usable guiding quantity for setting priorities for making decisions?

MR. BERNERO: To what extent is it usable?

MR. MARK: Is it becoming more so, because previously it seemed to have very little weight at all.

MR. BERNERO: That is true, it is becoming more, I will say, popular or more sought after. It is, of course, fraught with peril because there are many instances in which it is difficult to distinguish the risk difference or the risk priority; it is difficult to analyze it.

There is a great deal of uncertainty in the comparison, but I would say it is a matter of attitude. There was a strong desire to use it wherever possible in setting priorities. I would say that is growing every day.

MR. KERR: There are two ways it can be used, as you know better than I. One is to make a decision and then do an analysis which justifies the decision, and the other is to try to use analysis as a basis for a decision, and I do not know -- .

MR. MURLEY: We are planning to talk with you Friday, I guess for about an hour, on this subject and we can give you some examples of how it has been used frequently or recently.

Just to answer this, I would say we tend to use it more to augment our judgment at this stage, as one input to our decision-making process.

MR. BERNERO: I would just add that in those instances I have seen, they are growing. It is in the latter use, you know, to use it -- does it tell me anything I can use to make a decision rather than a rationalization tool.

MR. OKRENT: In the matter of using PRA to either justify a decision or help make a decision, it is somewhat important to examine what are the absolute values that are being fed into the PRA.

Now, I guess I cannot tell what the staff thinks is the current level of safety, except from what I read. I do see various industry reports and so forth which give me a feeling for where they stand.

Now, one of the interesting things I have seen recently is the statement made by Mr. Dircks to the

Commission and it said something like this, and I will quote, "If a plant already satisfies our current design criteria with respect to redundancy and diversity and the TMI requirements, experience demonstrates that the estimated probability of severe core damage will likely be in a range of 10^{-4} to the 10^{-5} per reactor year. In which case, we believe that any action requiring modification should await the consideration of other reviews and studies. So any backfits would be appropriately coordinated with other possible requirements.

Any plants that are found to have a higher probability of severe core damage or which substantially exceed other currently accepted normal risks will be measured against our criteria and required to correct their deficiencies that would otherwise reduce the risk in a reasonably expeditious manner.

My question focuses on the statement that the estimated probability of severe core damage will likely be in the range of 10^{-4} to 10^{-5} per reactor year.

MR. MURLEY: He probably got that from Pernero.

MR. BERNERO: I was just about to wash my hands of it. No, I think I can explain the remarks and qualify the remarks. I do not know where he got it. He might have gotten it from our group with some qualifications that I do not hear there in the statement.

MR. KERR: Let me see if I understood. What he says is not that he think the probability is that, but rather that these are the estimates that are being made. That is what it says; experience indicates that the estimates are.

MR. OKRENT: It does not say whose estimates. The suggestion is, though, it is the staff's estimates. I know the industry's estimates will fall in that range.

MR. BERNERO: First of all, I will qualify, with the exclusion of the occasional outlier sequence which, in some instances, is debated on technical grounds is it a real sequence, and in other cases is addressed and fixed promptly because it is an outlier, both probabilistically and deterministically. That with the exclusion of that, the risk assessments that the staff has done, as a matter of research, Surry, Peach Bottom, the four RSMAP studies, the IREP on Crystal River, the staff finds that the high end of it is just creeping into the 10^{-4}'s. You can round it off as one times 10^{-4}.

To be more precise you might say a little bit higher than 10^{-4}. But in general, the pattern of dominant risks in number fall in that category of probability by most of the estimates we have in hand. That is, sets of things that are of that probability. The outliers, the peculiarities of design, that are discovered will occasionally come up at the 10^{-3} or 10^{-2} level.

There is a recent industry estimate that gives the overall probability of severe core damage or core melt as almost one times 10^{-3}. That is hand now.

MR. MURLEY: That is for one single plant, the Big Rock plant.

MR. BERNERO: I think that statement was originally intended to say, if it came from us, it would have been intended to say that with outliers suppressed, just with outliers suppressed, the probability of core melt would be in that range.

MR. OKRENT: I must confess I do not know what it means to say with outliers suppressed. Clearly, if you think you know what are all the things that lead to a higher probability, that is the first big if. And secondly, if you know how it got there, then you might say the residual is a smaller number.

MR. BERNERO: We have said before that if WASH-1400 was right, if WASH-1400 was accurate, further suppression of that risk might be warranted on some of the sequences like event V, where it is clearly possible to substantially reduce risk for very small cost. But the general level of risk appears to be acceptable.

And when we speak of an interim basis for judgment, that is really the heart of it. If it is not unlike that, then it is not an outlier.

MR. CKRENT: I think each study I have seen from the staff -- let's see. Or is it contractors. Crystal River, Sequoyah. I do not remember what the estimates were from Sequoyah. None of these support the statement unless you remove what you have just called the outliers. I do not understand what it means to remove them.

Even the recent study on auxiliary feedwater systems, for example, violates this number, so I must say I find that particular statement, which I think was passed along to the Commissioners -- .

MR. BERNERO: I would like to get it and trace it.

MR. OKRENT: It has reappeared in many forms. I think Denton has made similar statements. It is curious, and in a sense, I would say misleading. And if it is factored back into your risk evaluations, one needs to think about just what the impact of all that is.

MR. BERNERO: I would repeat, Dr. Okrent, in our current activity I think it is realistic to say that if the staff determines or discovers through some partial risk assessment, some partial analysis, that a sequence looks like it would fit into the herd of a WASH-1400 core melt probability level, it will be considered acceptable.

If it is substantially above that on a scale of urgency, the staff acts on it. We are really doing that.

MR. OKRENT: Let me pursue that a bit. Suppose you decided that the probability of failure due to cold over-pressurization -- over-pressurization after a thermal shock fell into the range of 10^{-4}, 10^{-5}. You would say that is okay? Isn't that what you just told me?

MR. BERNERO: You have me on the horns of the subject dilemma. Right now we are looking at that very issue. As you know, WASH-1400 set the probability of reactor vessel failure much lower than that. Reactor vessel failure, however, has the characteristic of being a very bad core melt immediately. It is a rapid one, and you know, a strong energy release. And the staff would very likely take a more jaundiced view of that particular accident sequence.

It is an unforgiving accident. It is all the eggs in one basket, practically.

MR. MURLEY: Could I add? I do not think we or anyone has looked in detail at a vessel rupture scenario, so I do not know -- we had some discussions in the staff, and some of them are quite raising because there may be missiles generated and so forth.

Others indicate it could fail in a relatively benign way; if you lose coolant, of course, you can make it up. But I would be a little cautious in saying what the consequences are.

MR. OKRENT: Let me say I am a little bit -- more than a little bit concerned about the statement that Bernero made that if a sequence falls into the range of 10^{-4}, 10^{-5}, I cannot remember what accident he used, but -- .

MR. BERNERO: Worthy of consideration for fixing but not obviously -- .

MR. OKRENT: Without in fact including the kinds of questions posed by the example I just gave you; the kind of question posed by whether this particular sequence in some other way leads to a bad release. Whether, in fact, it leads to a bad site or any other host of other questions. And if, in fact, the staff is doing what you say, I think it should put it to the Commission saying, this is what we are doing; put it to the Congress saying, this is what we are doing and this may be the consequence of what we are doing, because we have not looked at all these other things.

I don't know what the reception will be. I hope it is bad.

MR. BERNERO: You are accusing us of not being responsibly subjective, and I think -- I am asserting that the staff is being responsibly subjective in that there is no simple way to state how one would consider the severity of the sequence, the population density of the site, other factors such as you cite. We are aware of those.

MR. OKRENT: No, but they do not appear in the Bernero criteria of last July.

MR. BERNERO: No, there was a statement appended all the time that alludes to them.

MR. OKRENT: I will repeat; they do not appear in those criteria and they did not appear in some document that followed it, and it sounds from what you said like the drift is very strong toward just using those criteria in the form in which they are stated. And I think, as I just said, there are some strong problems with what is occurring.

Let's see. We are 50 minutes behind schedule, I think we ought to see if there are questions we have for Murley and Bernero that relate to the principal thing that we are trying to address; namely, can we develop any recommendations for the Commission with regard to design requirements for future LWR's.

What they told us is partly related to this, but partly related to other problems the NRC has to deal with.

MR. MURLEY: Could I ask a question? Is it limited to design requirements, or are you going to consider some of the broader things I mentioned, also?

MR. OKRENT: I guess I am not sure. It is hard to tell where it will come out. The original intent was to see whether there was a basis for developing guidance from the NRC in advance of the time it would be needed by the designers. Epler, did you have any questions?

MR. EPLER: No. I did have one. Since you stirred me up, maybe I can put it on the table. I think it is an interesting one. I have about a half dozen very difficult questions but I have one that is real easy.

I asked Mr. Murley this question. I think he is impressed with it; he did not have an answer. Why do we have to wait 35 years to find out the NRC has never instructed the designer that he must make provisions for safe testing of protection systems? That is an institutional question. Why do we have to wait 35 years to find out he has not been instructed to incorporate in the design provisions for safe testing.

When you answer that question, that answers the hardest one. Would anyone care to answer the question?

MR. MURLEY: Well, I agree to look into it a little further. There are cases, of course, where we do require testing in safety and shutdown systems.

MR. EPLER: How many cases do we have that do not require it?

MR. MURLEY: I agree.

MR. EPLER: When do we find out?

MR. MURLEY: I will look into it and see what we do require and why we don't.

MR. LIPINSKI: The closest you come to the requirements is the NRC endorsing IEEE 279, and within 279 there are specifications for testing as to how long a system can be out of service, because it does admit to testing one of two systems where you can disable one of the two systems provided the time is relatively short. Even though it is not in a reg guide anywhere explicitly, it appears in the endorsement of 279.

MR. BERNERO: I am willing to bet if you look through the general design criteria you can find some vague, general words that one might assert would cover the subject. The substance of what the staff has done for many, many years is to deal with the testing in the technical specifications and related documents such as IEEE 279, the reg guides and so on; it is, you know -- the general requirement could have been stated in the general design criteria.

But once again, one gets into the question of implementation; what does that mean, say, testing?

MR. LIPINSKI: I would like to comment on that because in reviewing the Westinghouse integrated protection system, their provisions for testing engineered safety features -- and they give a bypass switch in there that will take out one whole sequence of the ESF. And what it does is allow them to inject signals upstream to prevent those signals from getting to the fine elements, being a pump or motor. But by design, you can take both of those switches and put them in the test mode. They are not interlocked to prevent that.

There is no specific requirement on the NRC saying yor cannot do that; therefore, it is designed into the system. And by administrative controls, they say it will never happen.

Now, I have a further comment to ask pertaining to the list, in terms of risk assessment, the challenges that a plant sees are part of the risk. In going back to the Clinch River early days, there was a study called Transient Mitigation Studies. Its objective was to see what transient the plant was to endure and as to whether there were any plant design features that could be used to reduce the number of transients that would call on the plant protection system or engineered safety features to respond to.

Unfortunately, when the budget total was run up, it was too high, and those studies were deleted from the program so they were never completed. But equivalently, one could look at those same questions with respect to these plants; namely, turbine bypass capability. Should a turbine trip cause you to be able to bypass steam, if you lose offsite power should you be able to go to hotel load and keep your main pumps on. And so far, I have not heard you say anything along those lines.

MR. BERNERO: We have a separate activity, it is not part of this design feature thing. There is strong interest in the Office of Inspection & Enforcement in the causes and the reduction of forced outages, the challenges to the plant, the number of transients from the overall risk point of view. It is not a big factor to cut from six challenges to three challenges of the protective systems per year, but it is real. It is an improvement.

We have some related activity. It is not really going now, but we have a contract structure that is supposed to start shortly on that thing on forced outages, and whether that can lead us to a clear identification of a thing like 100% -- not 100%, but let's say 40% turbine bypass capability as a new requirement, that is possible. But I would be surprised if we got that far.

MR. MURLEY: That kind of study and that kind of thing is precisely what I had in mind in the area called Guidelines for Design Process. It seems to me that we ought to be requiring that there be studies like that done while the plant is in its very early design stages. So that is the time to require it.

And again, Bob's answer kind of -- we kind of drift toward a prescriptive approach; 40% bypass versus 50%, whatever. That should not be our job. We should lay out some general requirements about minimizing the challenges to this and that and let the designer figure out the best way to do it.

MR. EBERSOLE: A while ago, we were talking about the containment -- the dry versus the wet boilers, and I mentioned the fact that valves were critical in these big twin boilers, BWR type units. When you do one of your probabilistic studies and you have valves, many of which perform critical safety functions because they must stop flow from some hypothetical incident, what credit do you give or what do you give that by and large most of those valves have never been dynamically tested? And therefore, I do not know, for one, whether they are that good or not.

MR. BERNERO: Right now to my knowledge we do not take that into account.

MR. EBERSOLE: Well, you are accepting on faith a very ethereal sort of thing. And I think something should be done about it.

MR. OKRENT: We are at 12:00 o'clock, that puts us an hour behind the agenda. The next presentation was to be an hour. We can take it now and break for lunch at 1:00. Let's see, is there a preference our speaker would care to express? Well, why don't we do it right now then, okay. There is the podium.

MR. BERNSON: I am Sid Berensen, Manager, Nuclear Engineering for Bechtel Power Corporation and with me here today is Chris Jutter, Chief Nuclear Engineer in the Gaithersburg power installation. Chris has to leave about

12:30. His participation was primarily intended to help me react to some of your questions, so I hope you will ask questions as we go. I am sure you will, rather than wait until the end of this thing.

I enjoyed sitting here all morning long. I remember the last time I talked with Bob Bernero was a few weeks ago. I went in to talk to him and I spent 15 minutes listening to him. The same sort of situation occurred here. That seems to be typical, but he sure has a lot of information to impart, so I do not mind.

In my remarks today, I wanted to make some comments with regard to both the technical and the licensing process aspects relating to requirements for new plants.

MR. OKRENT: Excuse me, you might want to divide that into two parts, depending on -- .

MR. BERNSON: I will probably be dividing it up into three or more. This is intended to be informal. I do not have vugraphs, I do not have a shoft shoe act or anything of that sort.

MR. OKRENT: You may want to take those parts where you think your support man is most helpful.

MR. BERNSON: I wanted to remark, however, in the beginning and perhaps Chris has some comments as well, that when I listened to the presentation I am struck by the fact that the Commission has now determined that we have a moratorium on new plants. Since no one will know beyond the near-term construction plants what the requirements are going to be for some five years, and then, of course, we will have to figure out to design the plants to meet these requirements at the end of that time.

We will not even be participating, as I view this, in the process of developing these new requirements because there is an arm's length relationship between industry and the NRC and their consultants. Now we see the NRC acting in a way to help us figure out how to design the new plants because the existing generation of some 200 or more somehow are totally unsafe, and I wonder why they are operating.

It seems to me that the Commission's job is to have a regulatory process, a regulatory structure in place, that would allow somebody to come in and apply for a license any time. One of the reasons why people are not interested in taking some creative actions in the next few years I think, aside from the financial things which are being worked on, and the public attitudes which I think are being worked on, and we do have a new administration which says we need nuclear, and all of the statistics on excess capacity around the country are very misleading when you look at regions.

One of the problems is that people have no certainty whatsoever that they could come in with a perfectly licensable design, a replicate if you will, of something recent and expect to have it considered. The staff would not know what to do with it. The Commission would not know what to do with it.

And I believe that nothing has really happened that forces us to stop for the next five years or ten years to figure out what the next generation of nuclear plants should look like. Because it seems to me that we perhaps we ought to be forgetting the light water reactor project entirely, if that is the way we feel about it. So I am a little disturbed.

Also, the discussions on system reviews and so on seem to imply that nobody is going to use existing designs as a base for future designs, and these are mature, extablished, detailed things that we and the other people in the industry already have developed. And the kind of systems review process that they are talking about may be very fine for developmental technology where you really do not have any previous history. But it is not really the kind of thing that I view should be applied to mature technology, and in fact, we do have a mature technology in nuclear power plants, light water reactor nuclear power plants. Most of the technology is known by the industry.

I am constantly disturbed to find out how little the staff knows about the extensive engineering process that goes on in the development of the designs of these plants. The systems engineering, the reviews, the interactions that occur between the NSS supplier, the licensee, in developing these things.

It seems to me we need much closer communication, and before we start conjuring up new ways to tell us how to do our business, maybe it is partly our fault for not spending enough time explaining these things to you, but we've put a lot more engineering hours into the design of systems than the NRC staff does in reviewing systems; an infinitely larger number of hours, and that is not spent by people with very little knowledge of systems.

And over the years I think the track record in design is not bad. The communication to operation has been bad. So let's see. I think I would like to give Chris a chance, if he wanted to make some introductory remarks on any of these subjects before we go on to some other things.

MR. JUTTER: Thank you, Sid, those comments reflect my own feeling. One additional point that Mr. Murley was trying to bring out in terms of his concern about the lack of systems review in terms of the structural components where an over-pressure situation occurs that was not anticipated. No one was aware of what was on the other side of the wall. That, in his opinion, reflected a very compartmentalized approach to design.

I think that is a little simplistic in that the design of one compartment and the systems, the components on one side of the wall, certainly are designed as a system and where they traverse into other compartments there is an integration. But if one is looking at the strength of a wall and its impact on the other side, the design presumes a certain design pressure for certain transient and accidents; pipe breaks and what have you.

And if the design parameters change so that a larger pipe break or more energy is released or whatever it is that causes an over-pressurization, then the design is looked at. And we do look at the other side of the wall, we do look at the systems and the effects and modifications are made if necessary.

But the fact that up until that point no one had asked the question what if we get a greater pressure in that room. Well, that is not really the designer's point. The design is set around the parameters against the regulations and the guidance and the design principles and standards, and within those criteria we work.

But to ask at every juncture what if we exceed all these design criteria, we are in a never-ending design loop that never translates into a complete design. But where changes in design criteria or parameters are identified, then we certainly do have a systemized approach to it. It is an integrated approach, as Sid explained.

There is an immense interface amongst disciplines and between organizations such as the NSS and the architect engineer, and this goes on endlessly. And although anyone can point to examples where he has talked to individuals representing one organization or another, he might say, well, that is not in my scope, that does not represent the design process.

MR. BERNSON: Do you have any specific order you would like to cover these things in? Do you want me to just go on?

Well, the assumption that I am making as a preamble to this discussion is we are talking about features and processes that might be applied to new plants, to new designs. We are not talking about backfitting, we are not talking about near-term construction permits. I guess that is all there is in the pipeline.

MR. OKRENT: That is the correct assumption.

MR. BERNSON: Okay. So that backfit considerations and issues of that nature are separate and distinct from this, and the things I talk about I do not necessarily believe should be bandaids to add to existing plants. That can be discussed some other time.

We also have the belief and a basis for our position is that the current designs are mature, as I mentioned; they are basically safe, and the design of the new generation, hopefully which will come out of the end evolutionary process. We should recognize that the existing plant crop, if you will, includes a number of light water reactors overseas that have been sold by U.S. industry. They are being built and several more of these are likely to be committed in the next few years.

So there is an ongoing process of design and construction of the current generation of light water nuclear plants going on in the world. It is just not happening here.

The overseas customers are expecting a high degree of stability and consistency from us, and they require that the design should be licenseable in the U.S. So we have a problem -- we being the industry -- in trying to communicate to the people overseas as to what current U.S. regulatory requirements are if you guys go into hibernation for the next five or ten years.

This factor, plus the wealth of experience that we are going to be getting from the plants and the reliability analyses, the PRA's and all the wonderful things we are going to be doing, strongly suggest that even future design should not depart very much from the current designs, and the changes should be logical, controlled and represent obvious improvements. I do not know how you measure obvious but it ought to be significant.

As most people in the industry have told you over the years, we favor changes are toward accident prevention or changes that are obvious simplifications in safety systems. Many of these features have become rather complex over the years as we have laid out more and more requirements. So they really do not reflect all of the let's say the design bases they were originally conceived to handle, and so they become a little bit cumbersome.

And I think, over on our side of the fence, on the reactor side of the fence, they would welcome an opportunity to take another look at their systems and see what fine tuning might be required in some of these areas, based upon new requirements.

But this type of fine tuning I think would occur more effectively in an environment that allowed some tradeoffs, and not necessarily requiring that every change had to be added and that every change had to be backfitted to meet existing designs. But rather, they are allowed to make the tradeoffs for simplicity, complexity in the future generation.

I also have a personal feeling that our excessive preoccupation with accident mitigation could be a real problem for us because if we, in fact, as a community believe we cannot make the plant safe enough so that the mitigation features we already have, the containment essentially and all these other existing characteristics, are inadequate and we need another round of extensive and complex mitigating features, then in fact we believe we are goi g to lose reactors at a fairly high rate. And if we are going to lose these plants, why would anyone want to invest in them? Is it a prudent investment for the country, for the utilities, for the industry?

Shouldn't we come up with a design that does not require a tremendous emphasis on mitigating features?

MR. KERR: What is the conclusion of that logic? I am not sure. I follow you to the point where you say if these plants are going to require a lot of mitigation we should not build them. But what does one then conclude?

MR. BERNSON: I think the conclusion is -- let's say a hard conclusion, simplistic conclusion, would be that if existing plants are so likely to have core melt accidents that you need to design in and engineer in significantly for -- in the way of accident mitigating features, then we ought to attack the other side and do what we can to reduce the probability of core melt to the point where you do not have to provide the mitigation features.

And somehow it seems to me that safety goals and risk assessments or whatever standard you use for judging what is acceptably safe would demonstrate what you need to do to get the probability of core melt down to the point where one does not need the mitigating features. And I point out I am talking about significant additional mitigating features.

I think all of us feel that the current designs and containments and so on are a desirable, necessary part of the design basis for plants. I doubt anyone is suggesting we back away from these. But my point is when we begin talking about core catchers and filtered vents and things of this sort, and major accident recovery features, we are saying ourselves and we are admitting to society that we really think these things are going to happen.

And then I think some studies ought to be made on what -- is it really pursuing the technology if you really believe that that is the way to make it safe.

MR. KERR: I am reluctant to try to give you a lecture on statistics because I could not if I wanted to. But we all recognize the probability of a core melt is not zero. And I think we all agree that we want it to be small.

The problem, it seems to me, is one of deciding how small and having decided on that, how one demonstrates that one can make it that small. I think you have this problem and we have it to consider.

And if one decides that the goal is one which says it must be this small before we can forget about mitigation, and if the statistics that we have do not permit us to demonstrate that indeed it is that small, then we are faced with a dilemma. What do we do?

If you cannot demonstrate statistically that it is that small, you say, well, my judgment tells me it is that small, and so I am going to build on those mitigating features. Or does one say that since I cannot demonstrate on the basis of experience that it is that small, then a conservative approach is to build the mitigating features. To me, that is the essence of the problem. I do not propose that I have the answer immediately available.

MR. BERNSON: Okay. But I think we also can demonstrate that there is a certain capability inherent in existing designs to handle core melt situations that also exist. And I think we can also demonstrate we have been using relatively conservative assumptions in terms of what happens to fission products when you have a core melt. You combine all these things and the risk to the public, even in the event of a core melt, is low.

And the way that I look at it is that a core melt that would jeopardize the integrity of an existing containment and release large quantities of fission products is not likely to happen more than once in the life of a light water reactor. That is a personal feeling. It is a philosophical one, but I do believe if you begin to study the post-accident period -- and I think we should be looking at these things -- how many of these accidents that we would like to mitigate with a vent are likely to happen in the life of the whole population of reactors. And how many people are we really protecting? What level of improvement would occur after the first one?

MR. KERR: Let's suppose that the answer to the number is one, and to the number of people that we are trying to protect is 20,000; then what would you do?

MR. BERNSON: Well, I would reduce the probability of it happening, of the core melt occurring, because I think -- .

MR. KERR: You are convinced that you could do something which would make it possible to demonstrate to an objective group of people that you have indeed reduced the core melt probability to an appropriate level?

MR. BERNSON: I think that has got to be the key to this. Yes, that is my personal feeling. Okay. But we hope that the future design-related regulatory requirements will emphasis criteria and not design prescriptions; encourage simplification of safety features. And I doubt this will ever happen, but except simplified analysis or even engineering judgment rather than some of the state or the art techniques we are using and extent of qualification testing.

We seem to be unable to accept history, experience and judgment in a lot of areas, and find that we are getting more and more involved in very complicated analytical prescriptions, and no one is convinced that anything will work unless it is qualified and tested to the exact environmental conditions.

In most cases, when one is followed up by environmental qualification, we found that the problems are either obvious or there are no problems. I think to some extent, judgment has to be factored into these things.

MR. OKRENT: I guess I am not quite sure what the basis of your suggestion here is. You feel that the record, even Bechtel's record, is such that it is so free of errors in design, construction and so forth; in fact, even in judgment as to what would work and what would not work, that the regulatory staff could just leave it to Bechtel to do a good job and say, you know, the general design criteria now are as general as you could deduce. You say, you meet these, which is what people would say back in 1964. And then the NRC should walk away from it?

MR. BERNSON: No, no.

MR. OKRENT: Then what is it you think they need to do and why?

MR. BERNSON: I think the requirements should be in the form of criteria, but I do think that the engineer, the licensee, has the responsibility to demonstrate that the requirements have been met to the NRC -- to the staff. And through analysis and -- .

MR. KERR: I thought I almost heard you saying that one of the criteria should be -- one should use good engineering judgment.

MR. BERNSON: What I am really describing here, in another phase of our activities frequently engineering judgment is not given a great deal of credibility, even though there is a reasonable demonstration that something is safe enough or reliable enough based upon experience, or the design is adequate. One is forced to go through an extensive analysis and qualification testing. There is an awful lot of emphasis on getting perfect documentation.

MR. KERR: One of our former members for whom I have a great deal of respect once said that the difficulty with specifying engineering judgment is that it implies that one has both engineering and judgment. And that is a fairly strong qualification; much stronger perhaps than saying that one does an analysis or one does testing. I do not think any of us are opposed to engineering judgment provided it exists.

MR. JUTTER: Our discussion of judgment is not a one-sided affair. We are not talking about Bechtel's judgment or the industry judgment; we are talking about the freedom to apply a judgment from the regulator as well, which prescriptive regulation obviates.

If the technical staff does not have the freedom to interact with the designers and come to reasonable decisions that include judgmental calls, but merely have to go down the SRP acceptance criteria or the checklists that are so prescriptive and say, thou shalt do this, or you shall demonstrate with so much paper or so much testing; that does not allow for the freedom of applied experience and judgment calls to come up with a mutual decision. That is what we are calling for.

MR. EBERSOLE: Aren't a lot of the delays that have been exprienced really due to poor interpretation of generalized criteria; non-conservative interpretation? It gives you a freedom to make a judgment. You come in with a judgment because you did not have a prescription and the staff stops you in your tracks and tells you to go home and make a new judgment.

MR. BERNSON: There is some of that. There are also a lot of cases where people on both sides of the fence would agree that the judgment is fairly reasonable, but the prescription says you have to have this, this and this in place, and demonstrated.

MR. EBERSOLE: One of my favorite criteria is GDC-19, control room criteria. It says you will be able to shut down a plant from outside the control room. A loose and non-liberal interpretation of that is you can run from the control room with wires out of the control room to an extension point, like an extension switch, and therefore fulfill in the narrowest sense the fact that you can shut down from outside the control room.

That does not, in any way whatsoever, eliminate the control room from being the focal point of inability to shut down.

MR. BERNSON: Well, yes, but you will recall, I think, there is an awful lot of detailed NRC guidance on that subject that says this is acceptable. We are not dealing with something that was just left at the GDC level.

MR. SIESS: Coming back to judgment, you are not talking about unreviewed judgment; you are talking about the staff exercising judgment. Do you feel that the staff is not permitted to exercise judgment under the present regulatory system?

MR. BERNSON: I think there are a number of areas where this is true. I think it is certainly true in areas where the decision gets away from NRR and into I&E. I do not see the same degree of exercising or permission to exercise judgment over in that area.

MR. SIESS: Do you think that in some cases the inability to settle matters on the basis of judgment is because of the hearing process? That hearing boards will not accept judgmental statements, or do hearing boards accept judgments?

MR. BERNSON: I think that is part of it. But again, there is variation in the case of the hearing process. There are some examples where the regulations themselves are so proscriptive that one is not allowed to exercise judgment.

MR. EBERSOLE: What about making judgments and getting agreement along the way; that is, parallel effort to obtain judgment agreements?

MR. BERNSON: What I am really referring to is I find our state of the art analytical tools keep growing by leaps and bounds, computers get bigger, the analytical models we have to use get bigger, and all of the engineers are eager as heck to use them on every problem. And sometimes they find things that are even analytical artifacts from the analysis. They are not real, but they are problems that you cannot put to bed very easily even though you know that they cannot cause any difficulty.

Some of the high frequency stuff that comes out of these analyses we know the equipment can survive it, but it is a heck of a job to prove and, in fact, they have not been tested at these high frequencies. And yet people are afraid to exercise judgment and say all right, it comes out of the analysis; we see it there, but it is not a significant factor, it is not a significant threat to the integrity of the component or the performance of the component.

These are the areas that I am concerned with and it is going to get worse because our analytical models are sophisticated but they are not perfect representations of the real physical world. And that is really where I am concerned; the dynamic analysis of structures, of piping systems, the things that we are doing in that area, and the problems that we are discovering in the process.

MR. SIESS: Do you find the compounding of conservatisms a bar to judgment?

MR. BERNSON: Yes, and in some cases I think the excessive conservatism in one area which I was going to touch on later -- .

MR. SIESS: I really was not saying excessive. I amnot talking ECCS when I use the term; I am really talking, say, evaluation model versus best estimate analyses in the general sense. If you put in too many conservatisms, compound them, and you end up with something that is so far from reality you cannot exercise judgment on it.

MR. BERNSON: I guess the ECCS is one. I think that there are some pipe break areas where we have gone overboard in the assumptions of pipe breaks and the consequences of pipe breaks that have led to rather complex and cumbersome design solutions which may, in fact, adversely affect safety. But you can't really prove it.

MR. LIPINSKI: Mr. Chairman, are you familiar with the ATWS discussions? I think we are in our 13th calendar year. GE was the first one to come forward. Are you familiar with the Browns Ferry event?

MR. BERNSON: Yes, I follow these things.

MR. LIPINSKI: We thought these fixes were in until the Browns Ferry event, and it looks like we have a design error that had been sitting there. NRC did not review every design detail as submitted by the nuclear steam supplier. And after the fact, if you take a closer look at it you find out there could have been a core melt, had it happened in two places at the same time. So that when you say that a core melt is very improbable and you look at Browns Ferry and you thought you had the fix and then you find out somebody did not design it properly, it makes you feel uncomfortable.

MR. BERNSON: I do not claim to be an expert on that one, but I suspect that the margin was a lot greater than you represent it to be.

MR. LIPINSKI: Not with design errors creeping in.

MR. OKRENT: It is a good example of probing into your question of is it enough for the NRC to prescribe performance criteria. If it is enough, what is the rest of the system that makes it enough. I think we ought to look at it in that sense. I am not in any sense myself wedded to any single approach. I personally would like to see us use performance criteria if it would, but then I see this kind of example and see then how the pressure immediately arises for it. A detailed review of every nut and bolt, in effect.

MR. BERNSON: I think, first of all, I agree, the performance criteria must then be supported by a good process of design review, both on the part of the designer and the plant owner, and at least on an audit basis to the extent until they are satisfied by the NRC. I would much rather see the staff spend their time reviewing, personally, reviewing final designs when they are finalized on a spot basis or to whatever extent they think is necessary to gain confidence, than I would the level that we have addressed now.

We've spent a lot of time reviewing in detail things that are not really final, and it is not reviewed to the level of detail that it probably should be. I am not suggesting that there be less review on the part of the designer. In fact, I am suggesting there be more. I think reliability analysis and things of this nature are required and should be part of meeting the criteria.

But what I am saying is you ought to give the designer the flexibility to meet the criteria in a variety of ways and let him demonstrate to you, to the NRC that it has been done through the process as well as through at least spot reviewing the detailed results. And I also expect that over the years we are going to stumble into a number of problems like the Browns Ferry problem. No process will be perfect, and when we do then that calls for special action. It calls for a special examination and investigation of that event and what its consequences might be and what fixes people would propose to make in order to preclude it.

MR. LIPINSKI: That would be a core melt, though.

MR. BERNSON: Some people claim that TMI was a core melt, too.

MR. LIPINSKI: When you say we are going to encounter the next event and then fix it, why, that next event might be a core melt.

MR. BERNSON: I do not know; I doubt it, I doubt it. But that is an opinion.

To emphasize or amplify on some of the things I said before, it seems to me we should be looking for simplifications of systems and substitutions. One of the problems is that a lot of the systems are somewhat difficult to understand the operation of some of those safety systems.

MR. OKRENT: Can you give us an example of what you mean when you use the term simplifications, or two examples?

MR. BERNSON: One of them I guess you had presented to you last month in the Westinghouse presentations where they discussed this possible evaporative condenser that they might consider substituting for the auxiliary feedwater system. Which seems, at least at first without analysis, to be simpler, accomplishes the same purpose maybe better, and eliminates some of the requirements that have grown and become a part of the design of the auxiliary feedwater system. So this may be an area where one would pursue simplification.

I think that -- well, I personally think that we ought to, as an industry, be looking at systems that perform single instead of multiple functions. Safety systems that perform -- I am one that believes safety systems ought to be single purpose and dedicated for the purpose of -- .

MR. EBERSOLE: Like dedicated heat removal systems?

MR. BERNSON: Dedicated in the sense that its primary purpose is heat removal and not three or four other functions as well. But that is -- I would say that is a point of view, it is a personal point of view and I could be persuaded that there are better ways to accomplish the same objective.

But in principle, I like to think simple, so I think a system that has a single function, the operators understand it, it works this way and it can operate without causing any problem for a long period time, is a desirable feature; one that does not need a lot of attention and control. And I think some of these would be forthcoming if they were not treated as (a) to be backfit on existing plants; (b) to the added to all the existing paraphernalia we already have in the plants.

There has to be some tradeoff.

MR. EBERSOLE: What do you think of the characteristics of testing these systems? Should they be able to be tested online without significant disturbance?

MR. BERNSON: Some of the -- most of the systems are required to be tested as far as they can be during operation, and to the extent they cannot be, during shutdown.

MR. EBERSOLE: Many of them are not really tests; they are just mild exercises to see if the things are going to move. I, for one, have little faith in large valves performing their terminal function, which is intercepting tremendous flows.

MR. BERNSON: Okay, if you are talking about an isolation valve that has to interrupt a large flow, if that is its function, it seems to me you have to find some way to show a high level of confidence that it is going to do that. I am not sure that it is possible in all cases to do it by testing.

But it seems to me that by a combination of testing and conservative analysis you ought to be able to accomplish that.

MR. EBERSOLE: At the moment, our shortfall is testing.

MR. BERNSON: I agree. Otherwise, I feel a little comfortable. I think most people would.

MR. OKRENT: How would you propose that the NRC proceed with regard to new plants, in order to develop the regulations or requirements in whatever form that would lead to what you consider to be the improvements that could come from simplification? Whatever phrase you wish to use.

MR. BERNSON: I think you have to handle it on a piece-by-piece basis. I really do not have much confidence that one could take a look at the whole structure of regulation and reg guides and so on in a single step and remodel, remake the whole thing.

My feeling is that perhaps if an effort like this was considered desirable, the way to do it would be to interact with the industry first to identify the principal areas, the trouble spots, and work on them, and to some extent, based upon what reactor suppliers and engineers would like to have considered as optional ways of doing things.

So in other words, I think an interaction early on would be the proper first step to identify those areas where we thing regulatory change or reg guide changes or the SRP process or the branch requirements are inhibiting things we are doing. It may be that there are not too many.

I have a feeling -- you know, we are familiar with the process. We know how to work with the process. But I think that there may be some areas where the requirements have become inhibiting, and I think that if the Commission was prepared to entertain this kind of an activity, the industry would be willing to come in and talk about it.

MR. SIESS: If you eliminated the standard review plan and reg guides, you would have performance criteria, pretty much. But performance criteria are no good to you unless you know how you can demonstrate performance, right? I mean, you have to demonstrate performance to somebody, and you could probably save on the amount of paper it took to write the regulations, but you would increase tremendously the amount of time required to convince somebody that you had met the criteria. The standard review plan and industry standards and reg guides that constitute a deed to satisfy a document for those performance criteria.

MR. BERNSON: I am not suggesting you throw any of this away. What I am saying is let's look at those and see if we cannot collectively identify the ones that may be inhibiting improvement, simplification and address those only. You cannot throw out this whole process. You cannot throw out the body of standards, the SRP's and reg guides that are here. We understand them, they are -- .

MR. SIESS: A reg guide should not be inhibiting because you can almost offer alternatives.

MR. BERNSON: Theoretically.

MR. JUTTER: I agree with Sid's statement that we understand the process. That is about as much as I can agree with. I agree with Bob, we have a framework -- we are used to dealing with it I think is what he said. But the framework is getting very, very cumbersome and it is very complex, and we may be a little deluded because we work with the NUREG's and the SRP's and the reg guides and the branches, and the branch technical positions and so that is our jargon.

But, if I were coming into it and trying to make some sense out of it anew, I would be flustered, to say the least. I think there is some merit in looking at the GDC criteria afresh with today's insights, and prioritizing them and taking a look at infusing reliability priorities.

But I also would agree we should not throw out all our experience that resides in the various documents, whether they be SRP's, branch positions or whatever. But they do need an overall and a housecleaning.

MR. SIESS: Is it possible that you could come up, say, with a design on the basis of the standard review plan or the regulatory guides that would then be completely satisfying to the criteria, in the minds of the staff?

MR. JUTTER: I am sure that could be done.

MR. SIESS: Are they complete enough?

MR. BERNSON: At what point in time? We have been trying to do that for the last five or ten years, but we start here and by the time we get to there, the documents have changed and we are no longer -- .

MR. SIESS: Are they changing laterally or are they simply increasing in amount of detail?

MR. BERNSON: Both, both.

MR. SIESS: There are actual changes in position as well as covering new positions?

MR. BERNSON: I would think so, yes.

MR. JUTTER: I would like to remember that this conversation is aimed at looking ahead to new plants, and maybe new institutional systems and new design criteria or whatever will evolve. In that respect, we are talking about modifying the existing licensing information and preserving our experience gained to date; but applying into a more streamlined fashion.

But we are also going to be dealing with a much more limited number of designs in any future when we bring standardization back into the picture. How do we get from here to there? Mr. Murley talked about the number of years it would take to get through the rulemaking and this, that and the other thing. And Dr. Okrent quite properly figured that we could not get there from here. And what we need to bring this judgment is we need to take a look at the regulatory documentation, the framework we have, and there needs to be a close interaction between the regulatory function and the industry to apply these judgments.

Take a look at these design requirements. Are they integrated, are they reasonable? Has the new look at criteria been applied and come up with a logical set of groundrules and criteria, and the supplemental reg guides and whatnot that allow for experience, allow for the interaction of judgment between the regulator and the designer. And hopefully, we will have a cogent set of design groundrules that we can all live with and we can call standardized at some point in the near future.

MR. BENDER: Would anything like this happen if the regulatory organization did not take any initiative?

MR. JUTTER: I refuse to answer that question; I really do not know. I would have to say on the surface I do not think it would in the amount of time that has gone by. But there are probably arguments that would say it would happen faster.

MR. BENDER: You would not presume that someone would independently do it unless the regulatory organization said to take a look at the other criteria and see whether we are interpreting it right, and whether it is addressing the right questions? That's the way I would -- .

MR. BERNSON: You might modify it and say we would like to, we would want to. I think the point is, first of all, there has to be a willingness expressed on the part of the Commission to do this. And then I think the response is forthcoming. If there is no expression of willingness on the part of the Commission to do it, I doubt that industry would be prepared.

There are other examples, I think, to answer your question. There is a whole raft of designs developed where they maintain strict separation between safety-related and non-safety related components. They would not even a tie a useful pump into the onsite power system because they understood that there was a proscription that said thou shalt not mix safety and non-safety related systems; you should not tie non-safety related systems into the emergency bus. It might be elevated to the status of a safety system.

This might be a misinterpretation of an SRP or branch interpretation. But in any event, this is one of the things that happened over a period of time. I think we are moving back away from it now.

MR. OKRENT: I do not see how this relates to your point of simplication. You had made a statement, I thought, earlier that you would like to see safety systems single purpose.

MR. BERNSON: That is right, but I think also they could be and ought to be backed up by the availability of the existing plant systems.

MR. OKRENT: Well again, I am still trying to press you firmly but gently to give me examples. People use buzzwords, I find, and I am not always sure I know quite how to put them into real examples that I can judge.

MR. BERNSON: Well, I think, for example, it would be worthwhile looking at these additives that we put in containment spray systems to expedite the absorption of iodine. Is it really buying us anything? I look at some of the added features that are put on some plants in the way of leak chases and enclosure buildings to trap leakage from welded steel containments or containment liners that do not leak and things of this sort.

We ought to ask ourselves, and I think Bob alluded to this too, whether we are getting much by specifying such tight leakage or by collecting things that we really do not think will exist if the containment integrity is maintained.

MR. KERR: I think your spray additive is a good example because we have discussed that at some length, who should be doing that, who should take the initiative of convincing whoever needs to be convinced that either no spray additives or better spray additives should be considered.

MR. BERNSON: I do not know. I think it requires some kind of interaction. I think one of our problems is the relationship we have in most interactions with the staff it is not really possible to come up with many of these.

MR. KERR: It may be my perception -- I am sure my perception is limited, but it is my perception that there has been some reluctance on the part of industry, whatever that means, to take the initiative in areas of this kind just to assemble the information that is needed to make a convincing argument to the staff that says here is something that really is safer than what you are now requiring, let's use it.

What I have seen is an effort to say to the staff we do not need that, but I do not see much that has said, look, this is what you are now requiring, here is something which we want to do which is simpler and which will be better. Maybe I just missed these situations.

But I think the spray additive one is a very good example because I agree, I think something needs to be done about that, but I do not know who should do it.

MR. LIPINSKI: Mr. Chairman, the balance of plant includes aux feedwater systems, does it not? And as an example, do you design flowmeters in the outlets of the pumps or do you have pressure gauges that indicate pressure is up when the valve is open and you assume you have flow?

Now, you are given a general specification to put in an auxiliary feedwater system in your single-failure criterion, but it does not say you have to meter that flow directly. Then you get into the testing requirements. If the testing requirements are not spelled out in detail such that you test one train of the feedwater system, that you shall not defeat the other train of the feedwater system, such that if you accidentally walk away after a test mode and you have left both trains defeated, how would you propose you get all that information by a general design criteria?

MR. BERNSON: I think there are several points here. First of all, we have done and are recommending a reliability analysis on the auxiliary feedwater system.

MR. JUTTER: I am going to let you handle this one. I am leaving.

MR. BERNSON: We have done this on some plants prior to TMI. As far as testing is concerned, I have had certain problems with that because, as I understand it, if the objective is to do monthly testing at full flow, one has to in effect reduce the capacity or capability of the auxiliary feedwater system to respond to the demand unless you reconfigure the valves, whereas if you test it at reduced flow, you would not have to reconfigure the valves at all.

We have some designs which in effect can be tested but they are always available. We have other designs where you have to reconfigure the valve lineup in order to put the system in the test mode and in fact reduce its capability at that time.

I personally believe and we have made some recommendations for future plants that the safety status of all systems be known, monitored and reported and available in the control room at all times so that operators would know if they had safety systems available for operation, and this would include monitoring the critical valve lineups; and I think there is a reg guide that requires it.

Reg Guide 1.47 requires that all these valve positions be monitored if they are changed in position more than once a year. So I think there are a number of existing requirements as well as prudent engineering practice that causes these things to happen.

I think to some extent we are looking at plants where designs were frozen a long time ago before some of the new requirements and criteria had been developed.

MR. LIPINSKI: You only had a general criteria.

The only way you have gotten your new orders is through some bulletins and orders telling you how to modify the system.

MR. BERNSON: What I am saying is I do believe that the orderly process of developing reg guides, the orderly process of developing designs, of doing more systems analysis over the last four or five years has led to these discoveries and has improved the systems, quite apart from regulation alone.

MR. LIPINSKI: Okay. But if the general design criteria are not changed, you have no requirement on how to design those feedwater systems any differently than you had in the past if you disregard the bulletins and orders.

MR. BERNSON: If you are saying that the only guidance we have on how to design the plant comes from NRC, then I guess I would agree with you.

MR. LIPINSKI: We are looking at the results of designs to general criteria that have deficiencies.

MR. BERNSON: Then what you should be concerned with is the process of design and not telling people what the product ought to be.

MR. EBERSOLE: Suppose these were more prescriptive? Then we would have avoided this, wouldn't we?

MR. BERNSON: You may have avoided this and at the same time accomplished or overlooked something else. I think you have got to be concerned with the process and demonstration that the process does all these things for you.

MR. EBERSOLE: Since Walt brought up the topic, why shouldn't I have auxiliary feedwater systems where I can walk up, punch a button and say go, and merely observe that it went and the main feedwater system did not have to provide that fraction of flow that it did, and I could do that any time I wanted.

I just punch a button that says aux feedwater system on, and I observe then that the main feedwater system pulled down so many pounds per hour.

MR. BERNSON: I do not have the answer to that. I think it is not possible in existing designs.

MR. EBERSOLE: If I had my druthers I would put it in there as a prescriptive feature.

MR. BENDER: Let me go back to the other point that you made, we ought to be working on the design process. Suppose I accepted that? There is something called reliability analysis around here that people are making a big fuss about. Is there a process?

MR. BERNSON: Do you mean is there one that you could --

MR. BENDER: That you could point to and say do this kind of procedural action in order to be sure that we get the kind of reliability and performance characteristics that we need for public safety purposes.

MR. BERNSON: I cannot identify one reference and point to it, but I am sure it could be defined in -- the process could be defined in a reg guide or something of that sort.

MR. BENDER: It has not been yet. Would you support the idea of a reg guide?

MR. BERNSON: I would much rather see us go back to what we did a few years ago, that is, let's get some industry standards written that the Commission could endorse. This is really the proper process for developing these things.

MR. BENDER: The common denominator was so low that there was not anything left. Will it change now?

MR. BERNSON: We have not tested the industry since TMI. The standards program since TMI I think has been a little better.

MR. BENDER: I think the industry might be willing but the people are unwilling. That is my impression.

MR. BERNSON: One of the problems, of course, is that a lot of the people in the standards community are losing their enthusiasm because they are finding that the Commission is not adopting the things they are developing without major changes.

MR. BENDER: Standards are like everything else. Unless you have a good example to work from --

MR. EBERSOLE: The standard is what everybody is doing. There is no effort to make it any better.

MR. BERNSON: They have changed a bit in the last few years.

One of the things we ought to be looking at in terms of regulatory requirements that ought to be applied is in the area of extensive use of multiplexing and fiber optics systems in safety program systems. Our engineers think this is a real winner for the future in terms of system security, fire security, plant layout, simplification, but it seems to me that we need to look at what the safety requirements would be, what the regulatory requirements would be for use of such systems.

And here is an area where I think interaction with the industry and the technical community staff and so on would be very useful in advance because I am not sure that anybody would be hero enough to plunge into this without having some understanding of what the requirements should be.

MR. KERR: Again, who should take the initiative in this? What is to prevent the industry from saying here is a much better system than we are now using and here is the way we would propose to construct a reliable, testable, workable, simple system.

MR. BERNSON: Where would be go in the Commission today to have that thing reviewed?

MR. KERR: Is the alternative to simply wait until the Commission tells you what they would accept?

MR. SIESS: An example is the passive containment system. Somebody thought they had a simple system.

MR. KERR: I am sorry. I am open to a suggestion which was made that greater use of fiber optics and certain kinds of information collection and dissemination systems would make things better and simpler. I am saying given that, who should take the initiative?

MR. LIPINSKI: Mr. Chairman, optical isolators have been used and they have been accepted.

MR. BERNSON: We are talking about fiber optics transmission loops. You can extend that. The principles are extended.

MR. LIPINSKI: It is up to you to propose your designs.

MR. BERNSON: I understand.

MR. KERR: It may be so difficult it is completely self-defeating. I do not know. It may be virtually impossible to get a new idea accepted. If that is the case, it is very unfortunate. It may be the case.

MR. BERNSON: I do not think so.

What I am suggesting here is that an expression of willingness on the part of the Commission to listen to proposals in this area may be all that is required or an expression that we recognize this as a new technology that ought to be factored into or considered and evaluated for future plants. That might be enough to stimulate action in the standards community or somewhere to bring this about.

I just have a feeling that at the present time the standards, the processes, the rules do not exist, and I am not sure to what extent someone would be hero enough to propose a complete system using this technique for future plants.

So it is a synergistic thing. We have to find a way -- there is a willingness on the part of the Commission to consider it, a willingness on the part of the industry to develop it.

MR. SIESS: What is your thinking in terms of a physical separation? What is your thinking in terms of separation, physical separation of redundant systems?

MR. BERNSON: I personally think with the present designs that there ought to be separation of, you know, two trains. If you have two-train systems, there ought to be two separate areas, physical separation. All of our new plants have maintained that degree of separation.

Our newest designs attempt to accomplish the physical separation throughout the plant, of course except in the control room, which is a central point.

MR. SIESS: The German designs where the diesel generators are on opposite sides of the building --

MR. BERNSON: I think a fire wall between them is adequate. I am not suggesting that we need greater physical separation for some unknown threats beyond fires and tornadoes and things of this sort which can be protected against.

MR. SIESS: It seems to me sabotage was one objective for separation, common environment, other than fire, flooding.

MR. BERNSON: Each of these things can be designed against to some extent, and I really wonder whether one can achieve the degree of security you think you are achieving by greater physical separation. When you consider all of the spurious functions that you have to prevent in each train in order to keep the plant safe and some of the conflicting problems that we have, I am not sure that some of these things aren't really cosmetic.

When you begin to analyze the system in detail you find that some of these ideas are cosmetic solutions. They deal with part of the problem but not all of the problem.

MR. LIPINSKI: How about the cable tunnel between the cable building and the aux building, single tunnel, two tunnels?

MR. BERNSON: Two. Appendix R requires it.

I think that we are running kind of late. There are a n"mber --

MR. OKRENT: Why don't we let Sid run through the points he wants to make.

MR. BERNSON: Okay.

I think that we need to take a look at areas, and I believe maybe that is part of what Tom Murley's job is, to see if we have not gone too far in one area at the expense and as a result increased the difficulties in some other area. Fire protection is a favorite here.

We have heard some individual expressions of concern with regard to how much of the control room might be engulfed in a major fire. The measures that one might have to take to mitigate that I believe would severely degrade the reliability of the control system.

So these things have to be looked at together. Are you gaining enough by pushing the definition of fire beyond all reasonable criteria and thereby incorporating features in the control systems which are transfers, things of this nature that actually reduce the reliability of the system and its controls and its safety?

We talked to him and we will be doing some more in the way of talking to the staff about that.

I think you look at tornado and missile criteria and it leads us to put heavy structural walls and roofs on safety-related buildings up high, increasing the seismic response, perhaps even creating the first missile in the event of an extreme seismic event. Are we designing for realistic missiles? Are we designing for tornado and missiles that are so severe that they are beyond credibility and at the same time reducing somewhat the seismic safety of the plant?

The same thing would be true in the case of defining excessively conservative radiation sources that you have to shield the control room from or auxiliary building spaces from. Again, this leads to a lot of concrete, concrete up high in the structure. So these things need to be looked at because we may be in fact reducing the seismic safety in going beyond reality for tornado and missile effects.

Pipe break is one of my favorites. I think that the design criteria we have for selection of pipe breaks is terribly conservative. In particular we feel that the selection of two arbitrary breaks in every run of piping regardless of stress is excessively conservative and leads to pipe restraints and provisions for jet impingement that really accomplish very little in the way of safety, add to the cost of the plant, make access more difficult, could possibly reduce the reliability of the piping system.

We have been attempting in many ways to expedite the Commission's work to try to come up with more realistic pipe break criteria for years. As I say, this is an example. I think you need to have some response from the other side.

Now, the Commission's program is a very elaborate one. Many studies are being done. I do not know how much money is being spent on the question of pipe break. Almost everybody taking advantage of the work that has been done would conclude today we are way too conservative in our definition of pipe breaks for large high-quality piping systems, and yet I see no action to eliminate these things except where on specific plants and specific areas we find a problem and then there is analysis to show that maybe we do not have to deal with the break at that particular location.

But generically we need to address the question of pipe break and we need to eliminate some of this undue conservatism.

I have some observations on the licensing process. I think there needs to be more communication among the branches of NRR. We should be getting the same story from all sources. We do not always do that, and I encourage all efforts to stabilize the process and make sure that NRC requirements are firmly stated and licensees are not obligated to respond to individual opinions of the reviewers but they are only obligated to respond to literally stated regulatory requirements.

We have had a lot of design by, I guess, review or ratchet, if you will. I do not want to give you any examples, but I think we are all probably aware of a number of those. I wanted to talk about standardization a bit, but there really does not appear to be time.

MR. OKRENT: Why don't you take five minutes and talk about it?

MR. BERNSON: Okay. I can hand out something here which is a section of a document we gave to the Nuclear Safety Oversight Committee discussing our standardization program, and we have been involved in standardization for nuclear plants just about from the day we started designing nuclear plants.

Our first step, of course, was to try to use the proven standards from conventional technology to the extent we could in the design and procurement of our nuclear plant equipment and construction of the facilities. Then soon after that we embarked on an effort to update our own standards and guides to accommodate -- to reflect the unique requirements of nuclear.

We had over the years a lot of standards. During the past 15 years we developed a large number of engineering standards, guides, covered most aspects of our nuclear power work. We have a comprehensive set of standard specification for procurement of materials and equipment, services. We have internal guides which include a generic design material for our BWRs and PWRs, which set forth a reference design, and they are used as reference in a lot of our current projects.

We also have an internal reference safety analysis report which contains a lot of reference material addressing all the requirements of the reg guide, and it contains our current recommended positions on all the regulatory guides and so on. We have used these for reference on many of our projects overseas as well as in the U.S. since the early to mid-seventies.

We have prepared and submitted I think 13 topical reports all of which have been approved, and the only one that has not is our containment pressure analysis topical where there has been some residual disagreement for the last four years, but it is a minor issue, and the analysis we do has been accepted on every one of our applications anyway, and we have been involved in the duplicate replicate plant licensing options.

We have now submitted a standard reference design for PBA, and we are currently participating in the AIF effort to develop the proposal for one-step licensing and for a standardization program that would be compatible with the one-step licensing program.

We believe that to be useful for balance of plant applications, the future standardization program should be based upon the submittal of a safety analysis report that has the following attributes. It would describe a fixed -- it would contain fixed plant and equipment arrangements.

It would contain well-developed and I would say rather fully-developed safety system designs, PNIDs, flow diagrams, functional descriptions, things of this sort, well-defined and complete design criteria for safety-related features, the description of the methods that are going to be used to complete the final design and the acceptance criteria that would be used to measure the design criteria, and it would have sufficient flexibility to accommodate all potentially suitable sites in the U.S. without imposing significant cost penalties for sites with favorable environmental factors.

It should have flexibility to permit competitive procurement of equipment from qualified suppliers, and it should not have to incorporate unnecessary or redundant information such as detailed numerical design information where criteria govern and details of nonsafety significant features.

I recognize that we all have a different opinion as to what is safety related and what is not, but there are obviously a number of things in a current SER that go beyond things that anybody would agree have much bearing on safety. So this is our general feeling. We think that all of the options for standardization should be left open, and that includes, as I mentioned before, reaffirming support for the national standards program.

And again, to summarize, it is important, I think, that we recognize that the industry should still retain the responsibility for designing plants, demonstrating they are safe. I do not think it is healthy for the NRC to assume the responsibility for developing new designs for safety systems for nuclear power plants.

Thanks.

MR. EBERSOLE: (Inaudible.) Is there a way that that can be determined?

MR. BERNSON: It is an internal document. Each section will indicate whether this is an owner-supplied part or whether it is an NSS-supplied part. If it is a part that Bechtel normally supplies, there would be recommended draft text.

MR. EBERSOLE: I see.

MR. BERNSON: Yes. You can follow this thing and understand who contributes the various sections.

MR. OKRENT: I guess I do not have a sense of having heard how one might arrive at a relatively few standard plants by the procedure you have discussed. I mean a relatively few nationally, not a relatively few that

Bechtel itself was doing. It sounded to me like what you are proposing could still lead to a considerable number of differences even among the Bechtel-designed plants.

MR. BERNSON: Well, we do not intend to have significant differences among Bechtel-designed plants, I guess I would say, you know, unless there are rational reasons for it. Obviously there are plants overseas --

MR. OKRENT: Let's stay within the U.S.

MR. BERNSON: We are at the mercy of the reactor supplier. If the reactor supplier changes his design, then of course we have to have a design that matches up to it. But our intent would be to use what we call our generic design as a basis for any new design, and if we see that the opportunity exists for new projects and for viable standardization for a standardization program that allows us to present what is really essential in a license document, then we would certainly cons.der firming this thing up even more.

But the previous requirements for standardization we felt were really restrictive for balance of plant applications and therefore could not be applied consistently for all the applications we had at the time.

MR. EBERSOLE: In your standard designs do you maintain a regular practice of seeing why your standard looks different from, for instance, Stone and Webster's standard or some other AE's? Do you keep up with the other fellow's practice?

MR. BERNSON: Yes.

MR. EBERSOLE: There are discrete differences, I suppose, if you want to make a study of it, differences in philosophy, whatever.

MR. BERNSON: I do not really think there are significant differences. There are some fundamental philosophical differences in layout. We feel that ours is based upon a lot of experience in construction of the plants, and for our containment design, our approach reflects our experience, and we think it has the flexibility that is sufficient. It is constructable.

MR. EBERSOLE: Does that mean larger spaces?

MR. BERNSON: Larger spaces where they are needed. Some of the criteria that have gone into designs, like the SNUPPS, of course, there has been a lot of consideration for constructability, skid-mounted equipment, access for maintenance, dose reduction, all the things we have been talking about, ALARA, security and so on.

MR. SIESS: What is your standard containment for a PWR?

MR. BERNSON: Stress concrete.

MR. OKRENT: Well, we are running a hour and 20 minutes behind the agenda. It is not due to Mr. Berenson.

But I suspect we had better break for lunch.

Let me ask, if we were to slip roughly 45 minutes with GE, KMC and Stone and Webster, would you all be able to survive that revised agenda? I did not hear anybody say no.

Let me suggest, then, that we try to be back at 2:05. That will give you 45 minutes instead of an hour for lunch. Is that okay? And we will hear from General Electric and we will welcome further comments from Bechtel during the afternoon if you want to chime in.

MR. BERNSON: Thank you for the chance to be here.

MR. CKRENT: Thank you.

(Whereupon, at 1:20 p.m. meeting was recessed, to reconvene at 2:05 p.m. the same day.)

AFTERNOON SESSION

MR. OKRENT: The representative from General Electric is here. We are ready to begin.

MR. SHERWOOD: I was brought up in an old country school in upstate New York, and all my T-shirts I thought were 85. They were probably only 55. That happens to all of us.

One of the things which they always taught us is we always had to stand up to talk. I have never been able to defeat that, so I always stand up.

The other thing I wanted to make as a preamble, I had one of the best goddamn jokes to tell you today that I have had in a long time, and the recorder tells me it is going to be recorded and I should not tell it.

MR. OKRENT: We will go into brief executive session.

(Laughter.)

(Discussion off the record.)

MR. OKRENT: The meeting will recommence.

MR. SHERWOOD: I am Glenn Sherwood, Manager of Licensing for General Electric. I have been here many times so most of you know me. I have with me today two colleagues.

Mr. Joseph Quirk is one of the licensing managers from my organization, and Joe is responsible for the design basis of the BWR-6. Joe has been in licensing for quite a while. Most of you know Joe. And he was involved in the early days with the TVA design with the TVA GSAR and also the TVA FSAR. So he has had a lot of experience with the BWR-6 design. He is responsible for the BWR-6 design in GE from the point of view of its licensing basis.

My other colleague today is Jack Duncan. Jack Duncan is from Engineering. Jack is manager of all TMI programs. He formerly was in charge of our ECCS programs for many years at San Jose, so he has a wide background of experience.

After my overview, I will be introducing Joe and then Jack. We plan to cover several general areas.

I am going to spend about 10 to 15 minutes talking about our design philosophy at General Electric on the BWR and what we are trying to do at General Electric to both confirm and affirm the existing product line.

We have done a number of things which some of you are familiar with, and I want to explain those and then those will be given to you in detail later. I want to go over some of the things that we are looking at in the event we feel the design needs to be broadened.

We are looking at a number of things with customers. You have heard about most all of those so I will essentially be summarizing those today. And then I want to talk about the nuclear island concept of GE, which all of you know is somewhat unique if not totally unique in the industry, where General Electric is responsible for the total design of the plant, both the nuclear steam supply and the balance of plant.

So I would like to chat a little bit about that concept and licensing and then even make a proposal to you for the PWR-6 standard plant and the one-stage licensing through the FDA concept.

So that is sort of a summary of my overview.

Now, in terms of the BWR-6 Mark III, I would like to open it with a statement and then make five observations with the BWR-6 Mark III.

The BWR-6 Mark III we feel will be the flag carrier for General Electric for the next decade. If we sell 100 or 50 or 1000 plants, we would intend to sell the BWR-6 Mark III. There might be some modifications. If they were, they would be in the few percent, and I will discuss some of those today.

However, we feel that the BWR-6 Mark III is now at the end of roughly a 20-year evolution in design. This is a conscious design evolution. Joe will discuss some of the details. The origin of our design looks much like a PWR, and through the years this design has been changed again with conscious decisions by General Electric through the jet pump era to the current design.

We feel that the current design offers many very interesting opportunities for the utility, some of which have not been agreed to by the ACRS and the NRC. In other words, we feel the BWR tends to get licensed with the same set of -- let me try to select the right word -- with the same set of criteria as the PWR.

And so therefore the simplicity of design of many ECCS pumps and the fact that we have a suppression pool generally had not been given the formalistic licensing credit which we would hope that the ACRS would appreciate.

Now let me talk about -- by the way, I neglected to mention that any of the three of us would be pleased to entertain questions as we go along.

Now, where do we at GE think the BWR-6 Mark III is? We think it is at the 80 percentile in design. We have one plant loading fuel, that is, Coshane (phonetic). We have another plant within three months of an SER. All of the BWR-6 Mark IIIs have been designed and largely shipped. I say it is 98 percent because we still have a 2 percent ripple -- maybe it is 3 percent, because of things such as environmental qualifications in going from a relay control room to a solid state control room.

Also we learned things such as the Browns Ferry scram event of a year and a half ago, so that we feel it is important that the things that we learn from the operating plan are cranked back into the design. We are also learning other things about how you start the RC-IC if you want it to start every time as opposed to starting 50 percent of the time, and we are learning how to crank that information back into the design.

So our design, which we believe is a package of paper, a package of hardware, and it is also a package of operator instructions -- and we will elaborate on our operator instructions later because we have added what we feel is a major step forward in simplified operator instructions to prevent any possible TMI-type action.

So we feel that the fine tuning which is taking place with our plant covers the whole spectrum from the point of view of design and operation, and we are out beating the bushes now for areas where we need to improve that las 2 percent. As I say, I gave you three or four examples.

We do not see the need right now for any major changes in the design, with some exceptions. We have, and I think you have all heard about this because Joe has been here before, General Electric has had a major design review group in process since TMI. It was headed by Jack Duncan. Even now we have roughly 20 to 30 people working full-time at GE cost looking at our design and looking at probabilistic assessment, fault trees and event trees and looking at FEMAs.

That level of effort of 25 to 30 has been going on for a number of years. It is a large effort from some of our key engineers at General Electric, and again we are looking at the fundamental design. We have a $2 million effort going on FEMAs in the balance of plant. Some of that is in the NSSS, but we are anxious that the balance of plant have essentially the same design review scrubdown and write-off by our engineers as the NSSS.

Joe will give you a more detailed example of the FMEAs and the balance of plant, and he will also give you some examples of problems that we found in our FEMAs and the balance of plant. We do not want to have a situation with a BWR where somebody drops a light bulb in the control room that you lose the reactor, and we are guarding against that by doing FEMAs and fault trees.

Again, we feel at General Electric, and I would like to have your input, that that is a fairly substantial amount of effort re-looking at the BWR after it has been designed on almost an orthagonal basis. Namely, we have already looked at it on a deterministic basis using all the single failure criteria and the other trappings of Washington approval at the same time we are re-looking at it through probabilistic assessment, the fault trees and FEMAs.

Joe will explain when that program is to be completed. We feel that our effort is unprecedented in terms of size and scope in the industry. We should have that done in about a year. I guess I am not cutting into your details. We should have that done in about a year and we feel that that will be a major confirmation of the design of our entire plant even though the design used deterministic, used single failure, used various criteria.

We are attempting to bring all that together with the fault trees and event trees. I am sure I am leaving out a lot, so I hope you remember, Joe and Jack, how we want to close these. I am only trying to set of a picture of the thinking of GE in the direction that we are going.

Now in addition, the view in General Electric is that we have some excellent design features. Every time you talk to us at GE, you know, when I talk to Jesse in the hall, when I see Bill Kerr on a trip, they always say that whenever they see GE, they press the GE button and they get the GE story. You probably want to hear it again today so why should I rob you of that opportunity.

This was given to you sometime ago by Joe when we heard the presentation for the Allens Creek construction permit, so I do not intend to review that again. Some of the details you will be given by Joe and Jack.

But we do have some unique features which we really entreat the ACRS to think about and to discriminate between our product and other products because, as I said, in the 23 years of getting CPs and OLs, we have not gotten the credit that we think is appropriate because of the fact we have a single cycle, single vessel, direct level measurement, something like anywhere from 13 to 15 pumps for an inventory, a reactor protection system which is now in its third generation with the solid state nuclear net system, a redundant RHR and decay heat removal system.

I know that some of you are concerned about failure problems with our RHR. We want to remind you today that we have three modes of shutdown with the RHR system, two modes which are licensed, and even a backup mode; so therefore we feel that our RHR system does provide -- and again, this has been codified in our fault trees and risk assessment. It is a proper design and it does not expose the people to any level of risk other than any of our other integrated systems such as the reactor protection system.

We feel the same way about the control rod drive system. Yes, there have been things which we have learned about the control rod drive system over the last year. Yes, we realize that that problem could have been avoided if we had tighter specifications on all the plants in the last 20 years.

However, the specifications which we have on current plants would have avoided that Browns Ferry flap of a year ago, and so we learn by those things, and as we make changes in our plant, as we do with the RCIC, the HPCI and other systems. So all of those systems we have programs at General Electric to bring them up to capability.

So t' ɇ advertised function of the RCIC at 90 to 95 percent actually happens. It is not 70 to 75 percent.

Now, we have also been looking at parametric designs. This is part of Jack Duncan's effort, which, as I said, has now been over the span of a year, and as large as 20 people on some occasions doing the PRA work as well as some of the generic engineering work.

What John and his work attempted to do is after the fault trees and event trees were completed and we did a fairly extensive and exhaustive complete of these on Limerick, you may recall that GE with the help of NUS and SAI did the Limerick risk assessment, about $1.5 million. So the fault trees and event trees are -- what is the word you use -- are necessary and sufficient to assure that one has adequacy in the fault trees covering the major potential failure sequences.

We have also done a similar effort on BWR-6 in terms of the fault trees and event trees leading to core melt. Having done that, we look at all of the fault trees to core melt and obviously they all have initiators such as turbine trip, mainstream isolation valve closing, loss of offsite power, ATWS and what have you.

What GE has attempted to do is to level all of those historgrams so that the risk to the public is roughly the same. Let's say roughly 10^{-5}, 10^{-5} per reactor year that you would reach a core melt condition, not that you would have offsite consequences but you would have a core melt condition or a couple times -- did I say 10^{-5}? It is a few times 10^{-6}.

So what we have done is we have assumed that we have added the ATWS ultimate 3A that brought that probability for core melt down. For loss of offsite power we have assumed that we have an atmospheric containment vent that brought that probability for core melt down.

We also did a number of control fixes on things such as RCIC, HPCI and so forth so we would improve the reliability. In general we improved the reliability of inventory during the many events by minor fixes on the control hardware. You will see some results of that. And those show that those fixes bring the probability of core melt to something like a few times 10^{-6}.

Now, this is a fairly substantial study and we would like to offer that sometime.

MR. OKRENT: Are you referring to the Limerick study now?

MR. SHERWOOD: No, we are talking to the GE study and we spun off -- this is a BWR-6 presentation, and so we spun off a lot of the information from the BWR-4 work we did on Limerick. The rest of it we did ourselves on BWR-6. Now, I should say and must say that the BWR-6 work is not done, but we feel that with the work we picked out of Limerick plus the work we have done, it is not going to change more than a few percent over the next year.

What I am trying to say is if you believe systems engineers that do fault trees -- and we are not talking about the analysts who do funny things with numbers. We have used the GE systems engineers who have designed this equipment. They have participated in making the fault trees and event trees. They have provided the numbers that we have. There has been no system analyst that stood over their shoulders and gave them direction as to how to come up with numbers.

So we have done this as hard as we could being looked over the shoulder by EPRI, by NUS and by SAI, a bulletproof PRE number for the probability for core melt because we recognize that whenever one puts a number, $10^{-5,6,7}$, then the question is a doubt of the basis for that number. So therefore we are prepared in the future to work with your people, your staff or the NRC staff, and I am sure that will happen to show you the efficacy of that work.

MR. OKRENT: Again, I am trying to understand, when you just made that offer were you talking about your results on BWR-6 Mark III or about Limerick?

MR. SHERWOOD: The presentation is on BWR-6 Mark III, and what I did, Dave, is I said some of the Limerick work was so substantial, it was $1.5 million worth of work, that we lifted many of the fault trees and event trees from Limerick since they were so like BWR-6.

MR. OKRENT: Is there a report available on the BWR-6 Mark III?

MR. SHERWOOD: Yes, sir. It was submitted to the NRC roughly a month ago.

MR. OKRENT: A written report.

MR. SHERWOOD: A written report. I am sorry. I am answering --

MR. OKRENT: I have seen the Limerick report. I am just trying to understand whether there exists a separate report on the BWR-6 Mark III.

MR. SHERWOOD: No, this is all GE internal work.

MR. OKRENT: All right.

MR. SHERWOOD: Which has not been documented.

MR. OKRENT: When you said you would like to discuss something with the ACRS, were you referring to your work on Limerick or on BWR-6 Mark III?

MR. SHERWOOD: BWR-6 Mark III.

MR. OKRENT: When do you think you will have something documented that one could look at prior to such a discussion?

MR. DUNCAN: On the order of a year.

MR. SHERWOOD: That is when we would have it complete. I wonder if there is any reason why we could not sit down with anyone right now and discuss our work today?

MR. OKRENT: Let me say our experience is it took me approximately eight hours to read the Limerick report, and then in order to see what comments I might have on it, I had to reread it. So it was in effect, you know, 16 hours, and you cannot get that from sitting and listening to a presentation for the same amount of time, in fact, because you really need to spend more time where you do not understand something and so forth.

So having something in writing prior to the presentation would be helpful.

MR. LIPINSKI: Mr. Chairman.

MR. SHERWOOD: We have used a year as a number wherein we would have the total work done and published, including the site work, and that, of course, is an extension beyond the probability of degraded core.

MR. BENDER: I agree with Dave. Having the opportunity to read the report would be easier to discuss it with you. I would not be opposed to hearing the report prior to that. We might want to hear your report twice, as a matter of fact, because sometimes the story changes from time to time.

MR. SHERWOOD: We would be pleased to review it with you.

MR. LIPINSKI: You referred to your bulletproof number on core melt. You said a few times 10^{-6}. I assume that is 3×10^{-6}. What are the error bounds, times 10, times 1? If your analysts did a good job, they have error bounds on that number.

MR. SHERWOOD: Do you know what that is, John?

MR. DUNCAN: No, we have not placed error bounds on it yet but it will be when it is a more complete activity.

MR. LIPINSKI: Thank you.

MR. SHERWOOD: Now, again let me point out that as part of the risk assessment study some changes were made to the BWR over Grand Gulf, let's say. ATWS alternate 3 was added, containment atmospheric venting was added before core melt. Namely, if you use decay heat removal, then an alternate way for decay heat removal is to vent the wet well. That has been suggested on Limerick, and I think it is their full intention to license i on Limerick.

It also has been offered on Houston Lighting and Power. I do not know what their intent is right now.

MR. LIPINSKI: Please refresh my memory on alternate 3 for ATWS. Alternate 3 for ATWS included what? Recirculation pump coast down?

MR. SHERWOOD: It included recirc pump trip. It included the alaternate rod injection system, which is really a prevention system. It includes replumbing the pumps. The pumps are now designed to operate singly. There are two 43 gpm pumps, so the standby liquid system now pumps 43 gpm into the reactor.

That would be repiped, piping double that into the reactor. Both pipes would be used and the location would be different. It would go into the jet pump instrumetation lines rather than the stand pipe, which used to be the location for better mixing. And the fourth would be automatic upon failure to scram.

MR. LIPINSKI: With what time limit?

MR. SHERWOOD: It depends upon whether it is MARK I, II or III, but it is more or less two minutes.

MR. LIPINSKI: What about the cleanup? Did you do anything to the cleanup systems after injection?

MR. SHERWOOD: We looked at that with the customer and I think the view is if one can truncate the boron injection quickly, the cleanup can be done easily. To answer the question another way, we have not done an exhaustive, detailed study on it. The hope woud be you could clean it up, the boron injection, and I believe

Dresden ten years ago, I think it was done over a short period of time and was taken out by the demineralizer beds.

MR. LIPINSKI: But your initial opposition to automatic injection was the cleanup time and the cost per day.

MR. SHERWOOD: That is correct. That is correct.

MR. OKRENT: On ATWS I think I recently read something submitted by some BWR owner's group in which they were looking at ADS inhibit and so forth, and if I remember correctly, there is a question of should you allow ADS under some less stringent conditions.

And at the end of the summary and also at the end of the document, there was a sort of a cryptic remark that said when we bring some transients involving ATWS into consideration, this made need further review or something like that.

Could you elaborate on that for me a little bit?

MR. SHERWOOD: I could, but Jack knows that area, if you would not mind. When Jack stands up he can cover that.

MR. OKRENT: All right. I appreciate understanding what the concerns are as you view them as they may arise from ATWS and do they relate to different alternatives in different ways in different versions, 3A, 4A and so forth.

MR. SHERWOOD: So I wanted to make a point. Now, in the program that Jack had for six months he made the recommended -- he recommended roughly 25 changes. Some of these, many of them were for maintaining inventory control. Others were on ADS, what have you. He will discuss these briefly.

And included in this group were the ones that brought the risk down, that is, the alternate 3 scram, that is, the fixed liquid boron, the containment venting, and I guess those are the only two big ones and the rest of them, again, are inventory controls such as RCIC.

So with that capability we are down to something like 10^{-6} per reactor year. Let's assume you believe that. Let's assume you had your presentations now with GE and over whatever period of time, and you said yes, they did a good job, I could not find any real faults with them, I have to admit that is their number.

So I guess if that is really the case, what else would you do for the next 100 or 200 or 500 BWRs if the probability for core melt is a little bit more than something, a few times 10^{-6} per reactor year. And this, of course, does not take credit for the scrubbing capability of the pool, which those of you who have to listen to us from GE, you know we argue that we ultimately feel that the work that was done by the Oak Ridge group and Milt Levenson will show that the decontamination by the pool will be something like anywhere from 10 to 10,000 as opposed to the fact -- the numbers that are currently used are something like 1 to 10.

And of course there is te secondary containment on the Mark I and II which then provides a further defense against hazard to the public. So I guess I put it to you, if you are satisfied -- if you could be convinced about the GE logic and getting to the 10^{-6}, and if you become convinced then about the GE logic and the other logic on the decontamination factor of the wet well and the fact that you have a containment, what more would you want?

MR. OKRENT: Well, by the way, Limerick does not include design errors, does not include sabotage.

MR. SHERWOOD: Flooding.

MR. OKRENT: Flooding. Certain other things are really not included which could be contributors which come in well before you get to 3×10^{-6}. So I do not know whether these are included in this. They do not get 3×10^{-6}. They get a pretty small number.

MR. LIPINSKI: How about common mode, Dave? I have not seen the report.

MR. SHERWOOD: Yes, there is an effort made. They include things such as operator errors but they do not include intentional operator --

MR. OKRENT: Errors of omission.

MR. LIPINSKI: Errors of omission but no

commission.

MR. OKRENT: And of course Limerick does not give OA detailed estimate of the uncertainties.

MR. SHERWOOD: That is true. You have listed all of them precisely.

MR. OKRENT: There are a few others I can name, but nevertheless, you see you earlier said suppose you came in, and the word you used was suppose you agree that this is what GE said, you have to agree that that is what GE said if that is what GE said. But whether or not we said that yes, we think that the number expected value is 3×10^{-6} is a different question and you have to raise it in two contexts.

The first, after we exclude things like this and other things that are not included, is it a good number; and then how is it impacted by the things that in fact are not included. I do not want to pretend that this is a complete list. It is not clear. There are things like certain kinds of systems interactions that you would not pick up in this type of a study or even in the Limerick study.

MR. EBERSOLE: Does it include anything having to do with -- (inaudible) --?

MR. SHERWOOD: Yes. It includes the fixes, yes. Dave is precisely correct. He listed the two major categories, one of error bars and confidence, and the second one is the external events. We hope that the Limerick risk assessment will do that second phase. That is to be decided. Probably will.

I think the feeling of the experts is that it probably will not make a whole lot of difference in the outcome, but I do not want to -- I am not making a statement today that it wouldn't, but again, I have talked to Erdman and others and that is their feeling. We hope to do it, as well as we hope to do that same thing for the BWR-6, and that is the reason why Jack is talking about a year from now.

So I think we are sensitive to the things that you feel need to be done for completeness, and we intend to do these as soon as we get the customer direction.

Now, I also might mention that again let's assume you were to believe the GE numbers and you were to be satisfied with the fact that we looked at the outside sources and so forth, and then you all went away and Dave said to his colleague: Sherwood is right, they did it right, I could not find a goddamn thing wrong.

If that were the case, then you would see where we would be a General Electric. We would have number like a little larger than 10^{-6} per reactor year for the probability of core melt, and then if you agreed on decontaminaton, a number like another factor of 1000, maybe even 10,000 for the possibility of offset consequences.

So I think we are at an interesting number in terms of what should be said about nuclear power and how many fixes need be considered.

MR. OKRENT: You really should not act like those are things you can multiply. It is not a valid proces' Even if the decontamination works for certain sequences, there are some sequences in which it is bypassed. So I just wanted to note that. Don't suggest -- some things stretch beyond what I am willing to even let GE say. It is not to anybody's advantage.

MR. LIPINSKI: Excuse me. Other than what happened at Browns Ferry with the header filling, Carl Michaelson in looking at that system identified the drain valve as an Achilles heel that could lead to a flooding out of the ECCS systems. Is that included in your fix?

MR. SHERWOOD: Yes. Well, no, I am sorry, it is not included in the fix because our conclusion is that the Michaelson scenario is trivial.

MR. LIPINSKI: Trivial? The loss of air on that valve causes you to partially fill you header, call for the rods to scram, you get an increased leakage rate so long as that path is open, and eventually you dump more water into that sump than the sump pump can handle, and eventually you flood. And the only way you can get in there to close those valves is by handwheel operations.

MR. SHERWOOD: There is another view of that, and that view is in ten to twenty minutes the operators would depressurize the flow, it would go down to about 40 gpm, and in no time you could close those wheels.

MR. LIPINSKI: The entire primary would be depressurzed?

MR. SHERWOOD: Yes.

MR. EPLER: Blowdown.

MR. LIPINSKI: Blowdown.

MR. SHERWOOD: It takes 20 minutes to ADS. If you would go to full blowdown it would take four hours. In the four hours he would go in, the flow would be 40 gpm, he would isolate those valves.

MR. EBERSOLE: He does not have any procedures for those now, does he?

MR. SHERWOOD: Yes. We have caucused the customers, and obviously, as you know, Jesse, they were all different. So they waffled their words, but they say essentially the operator would be required to depressurize the new procedures. The emergency procedures are much, much more precise, and when those are put into play over the rest of the year, they will direct that he should depressurize.

MR. LIPINSKI: You have an assumption that you had a full scram, that it was not a partial scram, and you are at part power.

MR. SHERWOOD: Any time he has more than a few valves that he can depressurize, then --

MR. LIPINSKI: You must shut down. If you are going to depressurize at part power, you have another problem you have not addressed, namely, fuel integrity.

If you are postulating depressurization under those conditions, it becomes even worse.

MR. SHERWOOD: Well, I do not know if we're talking about stability. The fuel duty is so small there is probably some instability, but the fuel duty is insignificant.

MR. LIPINSKI: It is a question of clad surface temperatures. We are talking about stability conditions where those channels are blowing cold, wet and dry and the fuel temperatures go up in an isolated manner.

MR. KERR: Do you understand that? Dr. Lipinski is talking about a failure to scram along with this.

MR. LIPINSKI: His assumption when he blows down is that he has scrammed. If he is not scramming when he blows down he has a problem.

MR. OKRENT: I thought you did not want to blowdown if you had a failure to scram. Isn't that what we were referring to earlier?

MR. SHERWOOD: Yes. The reason you don't want to is if you have a failure to scram, you are filling your system with boron. That is right, that is right.

MR. DUNCAN: I do not think in the recent Michaelson issue in addition to the leakage that there was a failure to scram also.

MR. EBERSOLE: I did not think there was, either.

MR. LIPINSKI: If that air line causes a slow bleed onto the main valves you would get a partial filling of that scram header, resulting in a partial failure to scram as well as the leakage path being open and through the valve.

MR. SHERWOOD: The scenario is subsequent to a full scram, you have all 185 valves leaking. Why don't we discuss that after the meeting?

MR. LIPINSKI: Okay.

MR. SHERWOOD: Now, notwithstanding these numbers which I think we will obviously be talking about in the future, we have looked at other things, and the ACRS is familiar with some of these.

For example, should there be a need in a licensing basis to accommodate full loss of AC power. As you know, with the RCIC we can now accommodate AC power for something like four to 20 hours, depending upon what you believe operator actions will provide. But at the minimum, it would be four hours when the batteries are in operation, and then later on you have to invoke operator action by the installation of an isolation condenser which most of you are familiar with. I know you are, Jesse. By the addition of an isolation condenser -- I think you have seen the cartoons of this from Joe Quirk -- then we would provide a passive decay heat removal system ad infinitum for the BWR-6.

We have done nothing more than look at that and put it back on the shelf. We have been through the isolation condenser before. It is a simple system; it is on the primary side and there is only one that would use the upper fuel dump as the location for the isolation condenser.

MR. EBERSOLE: Full pressure system?

MR. SHERWOOD: Yes. In addition, as some of you know, we have a program going with our licensees in Japan. The lead on this is a joint effort between TEPCO and General Electric, and the performance by TEPCO, Toshiba, Hitachi, Haseaton and General Electric. And there are some "what ifs" going on in a large number of areas about how you reduce radiation and so forth. But the two subsequent areas that are being looked at in terms of engineering are fine motion drive and internal recirc pumps.

That program, up until about a year ago, is in the evaluation stage in terms of the benefits to the BWR product, and it is now moving into a second phase which is still in the process of discussion and negotiation with the Japanese in terms of how much testing and hardware engineering will be done, and over what period of time. So that is currently not established.

MR. BENDER: Are you planning to tell us what those terms mean?

MR. SHERWOOD: What terms?

MR. BENDER: Fine motion drive, what does that mean?

MR. SHERWOOD: A fine motion drive is a screw drive and I did not come prepared to do -- .

MR. BENDER: I was less concerned with what its mechanical detail was and more with what its intent is.

MR. SHERWOOD: Our intent is to provide a drive with a linear insertion rate into the reactor. Right now, as you know, we have a step function insertion rate for the reactor, and the step function insertion rate causes certain problems with our fuel if the operators do not follow procedures in terms of driving those rods into the core, as you well know. You know, we have leakers.

So the fine motion drive would be linear insertion of the reactor would once and for all put that to bed.

MR. BENDER: And the intent of the internal recirc pump is what?

MR. SHERWOOD: One is to reduce complexity. I am not the one to give you -- .

MR. BENDER: If we are going to hear more about this, I do not want to pre-empt someone else's story.

MR. SHERWOOD: Can you cover the internal drives, the internal pumps? Are you familiar with that? They make a horrendous vessel. They cut down, obviously, external problems such as ECCS analysis and so forth. You have four loops that you do not have to deal with. I understand that -- I did not go to the briefings but I understand the Swedes have a very excellent experience in terms of mean time between failure with those pumps. There are more projects going on line, as you probably know now, with internal pumps. You get rid of some piping systems, you have less ECCS exposure.

MR. EBERSOLE: Do you get rid of the large LOCA?

MR. SHERWOOD: You get rid of some LOCA's, yes.

MR. BENDER: That is a little cryptic.

MR. EBERSOLE: (Inaudible).

MR. SHERWOOD: I invented that; why would I want to get rid of it?

(Laughter.)

I would like to go on to a couple more points because I think we are probably done with philosophy. Now, you all know that General Electric has the nuclear island design. I mentioned the FMEA's that we are doing, and the fault trees. We intend to understand the sneak circuits as the electrical engineers -- is that what you call them, Bill, sneak circuits?

We intend to understand those for the BWR-6. Joe Quirk will give you an example of some which we found in the work which we have done so far. Obviously, we are all engineers and we know we are not going to find them all.

The question is do we have the necessary and sufficient number after our work so that we can be satisfied with the capability of the design.

The design of the BWR-6 as reflected in the current plans has now been submitted to the NRC on an FDA, a final design book. This book of some 10,000 pages then represents the TVA nuclear island design. We feel that with the fixes that we talked about that this BWR-6 design will provide us with a competitive and effective and a risk-free design for the next number, whatever that number is to be.

MR. EBERSOLE: (Inaudible).

MR. SHERWOOD: The answer is no, we have not absorbed them; we used many of them because they are the lead engineers for the balance of plant.

MR. EBERSOLE: Are they out of business?

MR. SHERWOOD: Not for a few years. They have a few contracts left, but we have a group that manages them and we have a group of engineers that reviews every drawing that they produce. So we have -- as a matter of fact, the man who was going to be here today runs an engineering group in GE who is responsible for this balance of plant work. So we do not have 1800 people, but we have 20 people who are responsible and understand that balance of plant.

MR. EBERSOLE: If they walk out of the business will you pick up their AE function?

MR. SHERWOOD: No, we would most likely use another AE. Now, it seems to us that a proposal would be appropriate. I think you would agree with us that while we have a well-designed offering for the next decade, as well as our other vendors, that the business as a whole looks like it is going nowhere; certainly, in the United States.

I do not think any of you feel that there would be another nuclear power plant order within the next several years, possibly three to five years.

It might be appropriate to have the ACRS recommend a program to help turn around this malaise in the United States. And one notion might be something like this: there is a Skagit plant which is a BWR-6 which references the nuclear island GESSAR design. It is looking for a new site in Richland, and from what I understand from the Puget people, they expect to wind up there. It is an eminently well-established site for this type of thing, a military reservation, and what have you.

It seems to me that initiative with a utility such as Black Fox to get a combined CP-OL using the GESSAR-FDA documentation would be the kind of thing which the ACRS could recommend and could be helpful to the Commission and to the Reagan Administration.

Yes, you may well recommend that we do all kinds of things to keep saboteurs out of our plants and so forth, and maybe that might be interesting to someone. I think, on the other hand, if you are convinced that the major vendors -- I will speak for us all for a moment, certainly General Electric -- if you are satisfied that we are going in the right direction and we have done the right type of homework on our plant, you might think about offering such a proposal to Joe Hendrie and to the DOE.

It seems to us like an eminently desirable kind of thing right now which would do several things. It would put in place a licensing process which is fundamentally agreed to right now; namely, the write-off of the BWR-6. Grand Gulf is just about written off, and they are going to write off GESSAR as well. This should be done by September if not the end of the year.

Skagit wants a site and they expect to get one on the military reservation. It seems to me this would be a great opportunity to put a one-step licensing scheme into place with a standard plant and attempt to build this in something like six years.

So this is something which we in GE would like you to think about as not a substitute for what you are doing, but at least an alternative. And I am sure you know that the DOE is thinking about something like this except it is more oriented toward the paperwork effort. We think it would be better suited towards the design of an actual plant, consummated in an actual plant under a control situation.

This, then, would be the prototype for other BWR's built along the same design and with the same licensing profile. That is the end of my introduction.

MR. BENDER: That is a 98% complete design?

MR. SHERWOOD: Yes. Yes.

MR. BENDER: I have strong recollections of definitions of 98% designs. The last two percent takes as long as the first 98.

MR. SHERWOOD: No. If you look at an S-shaped curve, the airplane or whatever should be able to take off around two or three sigma, and at the 98% design, you are changing small things. That is our view. We made some changes from the Browns Ferry scram event. We made some changes because of RCIC not starting. We have gone from 1971 to 1974 on environmental qualification. All of those things -- none of them keep the airplane from flying; these are just modifications.

So we look at those as a ripple on the DC.

MR. OKRENT: Implicit in your suggestion was that if the NRC were to do this, they would be saying for these plants, not the Skagit one, which I guess is still an NTC plant, as I recall, but the smaller plants; they would not have to consider something that came out of the degraded core rulemaking, for example.

MR. SHERWOOD: But they would have to -- I am just posing to you a situation where a snapshot of a risk today on this plant shows that it's very small. Whether you can accept it today, I am not asking you to do that. I think much more work needs to be done.

If one were to come to believe these numbers over a period of time, you might argue that there is no need for any modifications out of the degraded core rulemaking. That is just a "what if."

MR. OKRENT: Well, okay. Again, you know, we have a small problem like there does exist some kind of a draft abbreviated risk study of Grand Gulf done by an NRC contractor that does not give numbers as small as you.

MR. SHERWOOD: That is an error. We have been to Sandia to give them the correct numbers. Essentially, their calculations were off by a factor of 100.

MR. OKRENT: I have not seen -- .

MR. SHERWOOD: Talk to Bill Snyder, he knows about it.

MR. OKRENT: Their revision -- well.

MR. KERR: I think we could all encourage GWE to produce a BWR-6 with the kinds of risk they stated. I would encourage them very much.

MR. OKRENT: I have to agree with that.

MR. BENDER: And it is not unreasonable to assume that if you can do it, some of us would urge the licensing of it.

MR. SHERWOOD: I think a sensible kind of thing would come out of it which would help the industry tremendously now, and I think it might help more, you know, than possibly concerns about should the next 1000 have a sabotage prevention system.

MR. OKRENT: Now that you talk about sabotage, even though this is an open session so we cannot get into details, there are certain avenues that people have suggested are of particular interest for BWR's, just as there are certain ones for PWR's. Some are of interest for all.

You did not mention, in what you have been saying, whether you had taken any special steps in the design of this plant to try to guard against sabotage by the insider, or whether you thought that was so unimportant it was not necessary, or whether it was so hard to do you didn't know how to change it from what it currently was in a meaningful way, or what. Can you comment?

MR. SHERWOOD: We are developing some thoughts along those lines. We have only recently gotten involved in this in the last meeting you had with Sandia. So we would like to be prepared to talk to you at some future date.

I think our initial feeling now is that it is -- is that there is a modicum or more of protection in the plants. Obviously, we all visit them, we know this. Some of them are sloppy, but that can be fixed. Major doors already are bolted closed. These could be monitored and so forth. So we feel -- again, I am giving you sort of our preliminary thoughts -- we feel that there is already a modicum of protection if one were to take advantage of it.

Now, the next level of protecting against the expert dedicated operator who plans for a month before he takes action is a different story, as is the onslaught. So we are not really prepared to discuss those latter two. Except that our people feel there is a lot available now that we could take advantage of if we wanted to to improve the security.

I had better stop or they will not let me summarize anymore.

(Slide.)

MR. QUIRK: My name is Joe Quirk, I am Manager of BWR standardization for the General Electric Company. The items I propose to discuss I have listed here. They include a very top level General Electric nuclear plant protection goal and heaven knows, with this morning's discussion, we have lots of comments on philosophy. So it is not my intent to persist with that or even repeat some of it, but there are some points that I would like to make before I move on.

I would briefly like to review the evolution history of the BWR, keeping in mind that the question at hand today is really desirable features for new designs.

Must we do something to our present designs to go forth into the eighties, and believe me, this part of the presentation is intended to focus on that very same question. But I think a part of that is where have we been and where are we going, and Glen touched on it a little bit.

I would like to kind of step back and develop it just a little bit more. Along with the evolution of the product there is also an escalation of design requirements and I would like to briefly mention those. GE has been active in standardization; I would like to summarize our involvement in that.

At GE we have ongoing activities to assess how our design meets our nuclear plant protection goals. I would like to briefly touch on that. Jack Duncan will then expand in more technical detail on some of the results of our investigation.

The top level criteria that relate to nuclear plant protection are basically two very simple and very fundamental -- protect the investment and protect the health and safety of the public. And those are so obvious that one hardly needs to even talk about it, but I think it is very important.

We, as NSSS vendors and manufacturers, must ensure that for plant operations there can be equipment failures, there can be operator mishaps, and that these result in a rather non-significant event. One that may result in a shutdown so that you can go in and repair the equipment, fix the plant and then start back up.

As good businessmen, it is our charge to insure that we have such a design. There are plant events in here that will happen that are precursor events. If we, as a company, do not analyze those events, apply those to other designs of a similar nature and look to see how they could be fixed, then we are not keeping our finger on the pulse of what is going on. And as a result, this thing will happen again and the consequences may be more severe.

So at General Electric we have an organization that assesses the plant events and evaluates them and makes recommendations. I show roughly two examples here. One is an event that does not break through the protective investment threshold but does approach it. An example might be the Browns Ferry fire. That was a very serious fire resulting in an extended outage but one which was recoverable and for which plant operation resumed.

This other example can be likened to the Three Mile Island where the protecting investment barrier was passed but stopped short of endangering the public. The only thing I would like to leave with you here is that as an NSSS supplier, we must evaluate these events, we must learn from them and factor them into existing designs and future designs so that we can insure that this lower threshold is maintained.

(Slide.)

This chart is intended to just quickly summarize the evoluticnary nature of our BWR product line. And briefly, as you can anticipate in any industry, there is an introduction of a product, there is rapidly changing demands on that product, there is evolution of products and then there is fine tuning, and in our BWR we have such a history.

In 1955 we introduced BWR-1, a Dresden-type plant. The features included an isolation condenser. This was followed by BWR-2, an Oyster Creek type plant, and likewise, BWR-3 and 4. Significant changes in the BWR-3 and 4 was first jet pump application and the improved ECCS. It included spray and flood.

In 1969 the BWR evolved into the BWR-5 product line which included HPCS and RCIC and on to BWR-6 which included improvements such as 8 x 8 fuel bundle, improved ECCS, improved jet pump performance and introduction of a solid state nuclear power system, nuclear system protection system, and a compact control room design.

So what I am trying to show is that as in other industries, with introduction of a product there is an evolutionary history that learns from previous designs and then factors those into the next generation of plant. And at General Electric we have such a history and we have ended up with a BWR-6 design which we are comfortable with proceeding into the future.

This bottom line here is an offshoot of our BWR-6. It is the nuclear island. So we go beyond the NSSS and into the BOP, and talk about integrating the radiologically significant systems and structures with the NSSS, and couple that design as an offshoot, and this was offered in 1972 and we have a customer, Hartsville/Phipps Bend. This is about 36% constructed in the field. That is Hartsville Unit-1.

(Slide.)

As the boiler has evolved, so also has our pressure suppression technology. And this shows briefly the three types of pressure suppression containments. The Mark-I containment which is referred to as the torus, and the light bulb which has a dry wall in containment and suppression chamber; the Mark-II which is referred to as the over/under also has a dry wall containment with a suppression cool; and our BWR-6 Mark-III which separates the dry wall and the containment function. The dry wall function has a pressure barrier, and for postulated breaks in the primary system, funnels the steam through horizontal vents into the suppression pool. reducing the pressure demands on the containment fission product barrier.

So, if you were to go look at design pressures for these three types of containments, this would be on the order of 65 psig. This would be on the order of about 45, and the containment here is on the order of 15. So, as the technology evolves, we are lessening the duty or the pressure response of the fission product barrier. And in that way, ass[illegible]ing that it would more reasonably perform its function.

Now maybe I could address just very briefly NTCP; near term construction permit.

MR. BENDER: So I understand the nature of that evolution, I think if I interpret what you said properly, essentially what has happened is you have been lowering the pressure requirements on the system external to the suppression pool by improving the suppression capability. Is there anything more to it than that?

MR. QUIRK: I would say economic as well. Perhaps the problems we encountered here would be a factor.

MR. BENDER: Basically, it is the same pressure suppression system; it is a different configuration, and is there more to it than that?

MR. QUIRK: No. Some of the improvements of the Mark-III are, for example, the lower building profile which has improved seismic capability; and also, we are locating a lot of the equipment inside the containment, and the containment can be occupied during normal plant operation and maintained and inspected and improved. And we think, you know, there are desirable features along with reducing the pressure requirements.

MR. BENDER: So access is better.

MR. QUIRK: Access is better, yes.

MR. BENDER: Thank you.

MR. EBERSOLE: You mean you loaded that containment with instrumentation?

MR. QUIRK: Yes, instrumentation.

MR. EBERSOLE: Now you have to have access to it routinely.

MR. QUIRK: That is right.

MR. EBERSOLE: So you have to have purge valves, et cetera, and they have to close, et cetera.

MR. QUIRK: That is right.

MR. EBERSOLE: All right, that is all.

MR. QUIRK: This did come up on the preliminary design review GSAR, and we have minimized the size of those penetrations during normal plant operations, so they have gone from 42-inch penetration to an equivalent of about 18 inches. So the size of the penetrations has been reduced.

MR. EBERSOLE: All right.

(Slide.)

MR. QUIRK: But as the designs evolved, so also have the design requirements evolved. And this is just a comparison of three different vintage plants, the first being the turnkey Oyster Creek in 1960; then there is the Fukushima plant, and our TVA Strike. So we are comparing the same numbers. We have only included the nuclear island portion of the Oyster Creek plant, and have left out the turbine building and the switch yard and the intake structure. The same with Fukushima 6.

So these numbers are comparable and it shows from the early sixties to today that there has been an escalation of roughly a factor of 14.

MR. KERR: They just do not make engineers like they used to, do they?

MR. QUIRK: I think they do. It is not indicative of the engineers; it is indicative of the escalation of requirements engineers have to contend with today.

It is also the design schedule as shown; a significant slippage as well, so our observations are custom designs are, indeed, costly and the standard designs may be a way of leveling out this escalation or inflation.

(Slide.)

I would like next to address our integrated plant protection concept. With the seventies came standardization and in 1973 the staff -- in 1972 the staff introduced their standardization program. The question at GE was, what should we standardize on and what should we utilize to take maximum benefit of standardization?

Initially, we considered just the NSSS, but because the regulatory requirements are very detailed and the interfaces are so complex, we felt to just minimize -- just to standardize the NSSS left a major part of the rest ofthe plant to be re-reviewed over and over and over again. And so, you would not be gaining ground really on whittling down the licensing process.

So we evolved into let's talk about a total plant safety approach. Let's identify the criteria and the systems that we would implement to meet those criteria so that we can talk about total plant safety. And that is the way to get at the licensing process and, in one docket with one designer, talk about total plant safety.

This simplifies the interfaces; it maximizes the standardization and savings gained from the licensing standardization; it allows an indepth view of systems interactions, if you will, not limiting your view just to the NSSS, but going also out into the BOP and requires strong engineering support.

One organization is technically responsible for that design and integrates the BOP with the NSSS. It results in a complete design record of the basis, and the documents to show that the bases have been met, and detailed plant design specification. So this was a concept that we introduced, referring to the nuclear island, and for which it is currently being built at Hartsville.

(Slide.)

Along with design standardization is licensing standardization and for our BWR-6 product line we, in essence, have three phases. The first phase goes back to January through September 1972 when we submitted to the NRC and to the ACRS topical reports that described the BWR-6 design and the Mark-III design. And in September of 72 we received endorsement from the ACRS on those concepts.

We then submitted the nuclear island to the NRC for a preliminary design approval. This was in April of 1973, and it received that approval in December of 1975. So the BWR-6/Mark-III consideration has been reviewed and approved at the CP stage by the NRC.

We have since submitted that same design in final form to the NRC in March 1980, and that is currently being reviewed or has not been accepted yet for docketing. From 1978 to the present, GE has gotten up a subject which I'm sure you have heard about; it is called power-worthiness certificate. It is aimed to streamline the licensing process from a two-step process to a one-step process. And this is then coupling design standardization with standardization of the license.

Because all vendors and most of the AE's have their own standard plant design, a lot of the detailed information is available at project initiation. So to go into a two-step process no longer makes sense. And what we are proposing to do when that detail is present is that the application can submit for a one-step licensing processing; the staff would do one review and issue a combined construction permit and operating license to that applicant. Then the applicant would begin construction and before he operates, he would submit a verification report to prove that the equipment he purchased and located in a plant met the design requirements in his licensing document. And in that way, there is one safety review with a confirmatory audit check at the end.

(Slide.)

Now, I do not want to leave the impression that we have evolved in the BWR-6 marketry and that is it. We are continually checking and assessing our plant in light of experiences in the field that could be applied to this plant, and in light of review questions and answers. The first bullet on this chart talks about an evaluation of BWR product in light of the TMI experience. We have done that and we have talked to you before about the qualitative results of that. Jack Duncan will address some of those improvements.

Further, we have assessed our integrated plant design, the nuclear island design, against the standard review plan. This is an internal effort at GE that has been completed, but we have evaluated our BWR-6/Mark-III against the SRP.

In addition to that, we are in the midst now of conducting failure modes and effects analysis of the NSSS and the portion of the BOP and the nuclear island. There are some 70 systems that are being evaluated. We are roughly 50% complete with that effort. And as you can expect when engineers go through their design with such an analysis, there are improvements that have been identified and we are making some of those.

As a follow-on to this effort, we will conduct a BWR-6 standard plant probabilistic risk assessment. We think that this will be directly applicable to the risk assessment effort. And on standardization I think we have pretty much talked about that. Our efforts, although I have just talked about the NSSS -- I mean the nuclear island -- we also have NSSS standard plant documents of two sizes, and both of those have received PDA's.

(Slide.)

So this chart shows that we have come a long way with the Dresden-1 type design. It looks very much like a PWR. We have four main recirc loops, four steam generators, external steam drum. We have evolved from that into our BWR-6. Glenn was talking about removing of these loops maybe sometime in the future, and that would leave just a vessel standing by itself and there would be no design basis LOCA. There would still be steam line breaks, for example, but there would not be the large recirc line break.

Now the question we are addressing today is, what should this design look like in the 1980's, and through the 1980's. And our answer, based on evaluations that we have done, failure modes and effects analysis to date is that that design is the BWR-6. And we will continue to optimize and improve that design, but we think that this is the design we should continue with and go forward with.

(Slide.)

But as you might anticipate, one question that comes up is what about keeping up with changes in the state of technology? Well, an example of keeping abreast with that is the solid state nuclear system protection system. It is a four-channel solid state reliability; it has provisions for pulse testing and has an analog transmitter trip unit system. We believe this is a step forward and an advance, and as such, we have incorporated it into our design.

(Slide.)

Another major change that reflects changes in the state of technology is our nuclenet, which is also the power generation control complex. This shows the divisional separation maintained in the control room; the nuclenet console from which the total operation of the plant can be run from one station. It shows the three-hour fire walls in the plant; the fire tested four-channel switches are separated divisionally by conduit, and we think goes a long way toward addressing man-machine interface problems that have been addressed.

(Slide.)

In summary, I would like to say that this evolution has continued from 1960 through 1980 and has resulted in design improvements. The standardized integrated plant design maximizes achievement of the goals and our capability is being reassessed in light of TMI, which will be addressed by Jack Duncan, and our current activities are sufficient, we believe, to meet the nuclear plant protection goals established by General Electric Company.

MR. BENDER: We heard earlier some discussion by Sid Bernson about the architect engineer systems approach, and I think I heard today some comment from GE along the lines that it feels it has systems design. Maybe that is not the right term for it. It should take more responsibility for the external system; the system outside the nuclear steam supply.

I do not have a personal opinion about it, but it seems to me it is a place where the lines of responsibility could be drawn in several ways, and I think it would be helpful to hear more clearly how GE views that aspect of things.

MR. QUIRK: We do not believe it is a requirement that vendors enter into the BOP and establish the safety design requirements for the BOP. We believe the industry can continue along the NSSS and BOP lines and probably will, and that safe plants will result from that.

But as a supplier, the impact -- the BOP has a profound impact, as you well know, and we feel that by understanding the BOP more and by establishing what an acceptable design could be -- and there can be more -- that we would learn more about our total plant capability and some day maybe, the BOP's for the BWR will all look alike.

That is not the case now and it may be in the future; that could be. But, you know, it is our intent to have a BOP which is a working example of implementation of our BOP criteria, in hopes of coming to -- .

MR. BENDER: When Glenn was making his pitch a little while ago he used Grand Gulf and Hartsville almost in the same breath. Grand Gulf I think represents the way in which the Bechtel approach is used. Hartsville, I guess, and Strike -- are there significant differences in those two concepts?

MR. QUIRK: The principal one would be the containment. We have a dual-barrier, freestanding steel containment. Grand Gulf is a concrete lined containment. But for the NSSS systems now, they are identical except for size.

MR. BENDER: They both have a containment, and it is just executed in a different way?

MR. QUIRK: That is right.

MR. BENDER: I would not have thought that to be a significant difference. How about a difference in the systems since? How are they different?

MR. QUIRK: No, I believe -- I am running through up here the horizontal incline transfer is the same type of design. I think they are the same philosophically.

MR. BENDER: So the answer comes out the same way, whether the NSSS vendor gets involved in the balance of plants or not.

MR. QUIRK: It should, that is right.

MR. BENDER: Okay, that is all I wanted to know.

MR. EBERSOLE: Would you put the slide of the nuclenet up there please?

(Slide.)

I thought you had one.

MR. QUIRK: I do, here it is.

MR. EBERSOLE: I noticed there seemed to be a prodigious effort there to put in embedded divisions, three-hour fire wall and so forth. Just for the sake of argument, if I am a saboteur and I have a five-gallon Molotov cocktail, can I go in there and do you in?

MR. QUIRK: It is hard for me to see how you could do it with a Molotov cocktail.

MR. EBERSOLE: Is the thesis that everything within that room is fireproofed; that there is no potential for ever disabling all of the guts of that room?j

MR. QUIRK: The cabinets themselves are fire-rated and tested. The floor sections are fire-tested to sustain fires.

MR. EBERSOLE: It is your argument that they will only have channel-by-channel failure in there under any circumstances whatever?

MR. QUIRK: That has been the objective of this design.

MR. EBERSOLE: There is no distant place from which we can bring it down? There is no distant place from which we can shut down the plant?

MR. QUIRK: I did not say that; no distant place from which you could shut down the plant. You could go into the motor control center and pull a wire that would close -- .

MR. EBERSOLE: Do you have any organized pre-set of arrangements for taking the plant to Home Safe if that room becomes embroiled in some sort of catastrophic event?

MR. QUIRK: We have a remote shutdown panel.

MR. EBERSOLE: You do?

MR. QUIRK: We do.

MR. EBERSOLE: It is independent of the liability of that room?

MR. QUIRK: Yes, it is.

MR. EBERSOLE: It can be sacrificial in the final analysis.

MR. QUIRK: Well, we can safely shut down the plant outside of the control room.

MR. EBERSOLE: Thank you.

MR. QUIRK: I would like to address something related to the near-term construction permit. Now, I would like to address it from the staff point of view. If I was the staff, I think I may respond the same way they did, given Three Mile Island. That is, ask utilities and vendors about their containment design capability and see if they can boost it up because there were some significant amounts of hydrogen concentration as a result of Three Mile Island.

I think I would also ask them to look at minimizing or dealing with large amounts of hydrogen, because on the chart I showed earlier, their mission is to prevent that threshold, to protect the health and safety of the public. But I think that is the wrong focus, and if we have learned one thing, we've learned that we should not spend too much time looking at large, rather unlikely double-ended breaks. And I feel that in response to TMI, once again we are mitigating the plant response, and I think more emphasis should be put on prevention.

And perhaps my perception would be different if I was a regulator but my mission is, above all, to protect the health and safety of the public. But we believe in the industry that the way to do that is through prevention; to put into verse ECCS cooling systems and to make the probability or the likelihood of such scenarios so low that they do not happen. This industry cannot stand another Three Mile Island.

And that is our charge, so I just wanted to touch on that they are doing their job and sometimes it looks like we are opposing them, but we think there are the ways to get there; mutually beneficial ways.

MR. OKRENT: I would like to make a couple of comments. If I think about what the staff has asked both in BWR's and large dry containment PWR's, at the moment leaving the ice condenser aside, almost everything of significance that came out of Three Mile Island is aimed at preventing the core from getting into a severely damaged state. I do not know whether you call that mitigation or prevention, but I would call it prevention of core damage in any severe way.

Some people use mitigation to mean well, you have begun an incident and you mitigate the incident like an ECCS mitigates a LOCA. It keeps you from getting significant damage, that sort of thing.

I do not understand what you mean when you say the staff emphasis has been on mitigation. I do not think it has, in fact, up to now. They say they are going to have a rulemaking for those reactors I just identified -- . In fact, on the ice condenser, as I understand the situation, they would probably be in the same position, but Commissioner Gilinsky in particular, and the ACRS in a little more subdued fashion, urged that someone look at the ice condensers since they were low pressure, smaller volume containments. But I am not complete sure that that statement is accurate.

And now I find something interesting arises out of a point mentioned in one of the earlier presentations by Dr. Sherwood. He mentioned that in looking at Limerick it was found, in fact, for certain scenarios if you put a containment pressure relief in, which was to be used prior to the presence of significant radioactivity in containment, it seemed that it could reduce the likelihood of that scenario or that group of scenarios going on to severe core damage or core melt by a considerable factor. I think the Limerick report is better than 50; a big factor.

All right. I have a couple of observations to make with regard to that. In the first place, if you were unwilling to look at events that go beyond the single failure criterion, if you are unwilling to concede you can lose a redundant system and you never even consider this containment venting device so the act of being forced to look at events that had the potential for getting to severe core damage led whoever did that particular study and arrived at that particular addon to what the authors of that report conclude. It is an important cost-effective feature.

MR. SHERWOOD: We are not going to do that.

MR. OKRENT: You are not going to do what?

MR. SHERWOOD: Our new operator procedures assume that the containment venting that is possible is available, and he monitors his inventory and he monitors a derivative of inventory and he takes appropriate action, including containment venting.

MR. OKRENT: Again, my point is -- .

MR. SHERWOOD: Did I miss the point? That is new; this is all within the last six months.

MR. OKRENT: GE would have refused to look at a situation, a scenario where you need to think about venting the containment because in order to get there you had to violate the single failure criterion.

MR. DUNCANT: Dr. Okrent, I do not quite understand that. I think you said if we had not been forced to look we would not have identified it. Nobody forced us to look at that; we identified it without any external pressure.

MR. OKRENT: All right. I will let you re-interpret that word.

MR. DUNCAN: If you will, TMI forced us to.

MR. OKRENT: WASH-1400 was the first step and other people exerting pressure to look at accidents beyond the single failure. And certainly, TMI, although only indirectly.

MR. SHERWOOD: Some of us young people at GE even thought that the isolation condenser was -- .

MR. OKRENT: Well -- .

MR. SHERWOOD: We were not forced to do that from the staff.

MR. KERR: It seems to me a discussion of who should get credit for this is maybe beside the point.

MR. OKRENT: I was giving them credit, I thought, because they, in fact, arrived at -- .

MR. KERR: You were giving them credit for being forced to do it, and they do not want credit for being forced to do it.

MR. EBERSOLE: (Inaudible.)

MR. KERR: GE is not a monolithic organization. In 1969 some of the people here were not with GE. So, -- .

MR. OKRENT: I somehow have been careless and have worded the point so it came out not the way I wanted to make it. My point is, when you consider events that went beyond the single failure criterion, for some of these scenarios in fact you found features which were not on the current plant, which in fact could be a significant help.

MR. SHERWOOD: Correct.

MR. OKRENT: If one did not look at such scenarios, one did not consider those features at all. Okay.

MR. BENDER: I would not want to say more than to state -- .

MR. SHERWOOD: I think it would be appropriate to say that our evaluation of Limerick and the BWR-6 which is only partially done, while having been done by our people at San Jose, could not have been by a group of our aerospace people who came in from Valley Forge, Maryland and knew nothing about the single failure criteria, and essentially

-- .

MR. OKRENT: I agree, I absolutely agree.

MR. BENDER: Somehow I get the feeling that people feel vented containment is something that just showed up after TMI. Vented containment was the only containment for a long time, and it was only when people decided that they did not want to vent when we found up with any kind of pressurized system at all. And now we have re-invented what was probably a good idea in the first place.

MR. EBERSOLE: They were going to burp the EGCR --.

MR. KERR: If all of you old duffers want to sit around and reminisce about history it is fine with me, but let's go forward.

MR. BENDER: It is as though we discovered something, and what we have done is go back and look at what the basic principles were.

MR. KERR: If these young whippersnappers will just learn to listen to us old duffers they would not have to rediscover all these things.

MR. BENDER: If we would just learn to listen ourselves, it would help some.

MR. EBERSOLE: Are you going to sell venting in the regulatory process? Venting has been a horrible thing to contemplate. It is against the law, as a matter of fact.

MR. SHERWOOD: Philadelphia Electric is going to sell it on the Philadelphia Electric OL for that unit. We expect that HL&P, although I do not know the details -- they will also -- .

MR. EBERSOLE: In another department of your outfit you are very anxious to avoid any effluents containing slight radioactivity. It is direct contradictory logic to what you have here. You should sink the rods and then close up.

MR. SHERWOOD: It is going to take some work in developing a logic for that vent system. We are working on it now.

MR. EBERSOLE: Okay.

MR. OKRENT: Well somehow, in my way of wording the previous remark I may not have made it clear that there is, in fact, merit in looking at scenarios which go beyond criteria which exist, and there is merit in the fact of postulating a range of conditions. After you have postulated them, one looks back and sees well, what is the likelihood of this scenario. You don't just say these are all a priori, equally probable and so forth, and need the same way of mitigation or prevention or so forth.

But the act of looking, in fact, can lead to worthwhile or potentially worthwhile changes.

MR. SHERWOOD: Yes. That in particular is why

General Electric is in the process of doing these and will continue, because we learn so much about our own product as opposed to having some small company do it on the side.

(Laughter.)

The selection of words was not -- .

MR. EBERSOLE: Do you consider it profitable to put a lot of garbage inside the containment when it is the potential scene of a lot of, you know, undesirable circumstances?

MR. SHERWOOD: I do not think the amount of equipment at Mark-III -- Mark-III, first of all, there is a million and a half cubic feet, so it is large. And when you walk around the Mark-III, it is not really that restricted.

MR. EBERSOLE: I will tell you why you asked that.

MR. SHERWOOD: I do not think it is clutter.

MR. EBERSOLE: I have seen these vast R&D programs on equipment qualification and you could avoid a lot of that just by putting things on the c ar side of the wall.

MR. SHERWOOD: That is what we have in the auxiliary room.

MR. EBERSOLE: Here you have them in containment.

MR. SHERWOOD: That is right. Here they are in a mild environment.

MR. EBERSOLE: It is a mild environment.

MR. SHERWOOD: It is a mild environment.

MR. EBERSOLE: Okay. It is a suppression process, isn't it?

MR. SHERWOOD: Yes.

MR. EBERSOLE: Is that mild?

MR. SHERWOOD: Yes.

MR. EBERSOLE: I cannot find any way to breach the pressure, can I?

MR. EBERSOLE: On the back side? Breach through it. I cannot find a way -- can I breach through suppression by any conceivable method?

MR. SHERWOOD: Sure. If you call froth, add froth after a safety relief valve is vented. We have no pool cover on the MARK III pool, so the froth in a combination of earthquake plus a seismic event goes up about 20 feet, and so it is designed so there is nothing to impact on that distance.

MR. EBERSOLE: What do the temperatures get to be in there, how hot?

MR. SHERWOOD: If you take the worst case, it would be the hottest service water temperature in the life of the plant, and you allow the plant to get fairly high initial temperature, like 100 degrees, and then you have other -- you lose one RHR and so forth, and then it can go up to 185, 195.

MR. EBERSOLE: Do you spray the dry well here?

MR. QUIRK: No.

MR. EBERSOLE: You eventually end up with 100 percent steam atmosphere in there and all the air is up above.

MR. DUNCAN: All the air gets purged out through the horizontal --

MR. EBERSOLE: It is on the back side, the void space, so to speak. Do you have to let it back to a void differential? Are there any oscillations or chokes that will flap them around and choke them up, make them not work?

MR. SHERWOOD: We do not have them in operation yet? We had some on MARK I and we fixed them. We had some problems with isolation breaks.

MR. QUIRK: It depends on where you are going with the bypass --

MR. EBERSOLE: Yes -

MR. DUNCAN: The concern --

MR. EBERSOLE: I saw the Germans had guard pipes on their downcomers, which I thought was rather conservative. This was in the MARK II version.

MR. DUNCAN: As a result of that being raised, on the GESSAR plant the NRC required we put in containment sprays, so that given some sort of bypass leakage, that we could condense the steam with the sprays.

MR. EBERSOLE: You have a spray capability but not quite as large as suppression, I guess, but pretty good.

MR. QUIRK: That is right.

MR. KERR: Mr. Chairman, break.

MR. OKRENT: Break? Is that what you suggested?

I have a request for a break. Ten minutes

(Recess.)

MR. OKRENT: Why don't we continue.

MR. DUNCAN: Should I start?

MR. OKRENT: Yes, please do.

MR. DUNCAN: I am Jack Duncan, as introduced before. My responsibility is to program manage a number of Three Mile Island related activities that we have going on in Engineering.

This afternoon I will review some potential improvements to BWRs that we have identified as a result of our own studies after the TMI accident and consideration of a number of the NRC's requirements.

We have eliminated a number of charts that might be helpful in presenting some of these points because many of them have been presented to you before. For example, we discussed several key BWR features in the context of hydrogen control when we discussed that with you a few months back, where we indicated that we are working with our customers on both igniter schemes and post-accident diverting schemes.

(Slide)

This is an outline of what I will review this afternoon. We will go over the post-TMI review, note the major conclusions. We will show you some risk assessment charts, some of which you have seen before, but we need to show this in order to quantify what we see as the change in the level of plant protection before and after these improvements are applied to a standard plant.

We will provide a number of charts on emergency operation to provide some background information that I do not believe you have seen before and give you a general idea of our emergency response information system, which I believe can improve the quality of BWR operation.

It is rather difficult to quantify in the risk assessment world but we feel it will be of great value in addressing such things as operator errors of omission or commission, and then we will conclude and indicate that we think we have a safe, easily controlled design which can be improved further if the need is there.

(Slide)

Just to take a look at our product after TMI, even though it did not happen on a BWR, we felt even before NRC told us to do somethings, we started doing them ourselves. The general purpose of our review was to examine the BWR design and operation in light of the accident at TMI and identify changes which in our judgment should be made to the product: no rules, no single failure rules, no other kinds of rules, take a look at the product and see if you can find some weak spots and see if you can identify some ways to improve on those weak spots.

We were also asked to identify changes which might further improve the level of plant protection, not required, but it would help if you will. In doing this we considered several key areas of BWR design and operation. For example, water level instruments, means of controlling reactor vessel water level during accidents and transients, the water delivery systems themselves, both isolation and normal means of providing water, reactor core isolation cooling and feedwater, as well as the emergency core cooling systems, both the feed and turbine systems.

Heat pressurization is a key feature in BWRs and we examined that area. We concluded that the BWR is relatively immune to TMI complications, primarily because of the many diverse water sources. Decay heat removal is passive for a long period of time. The system is relatively simple and, we think, relatively easily controlled compared to the TMI plant.

We did not identify any changes which we felt had to be made. We came out relatively pleased with the way the product is put together. We did not find it so perfect, however, that we could not identify some improvements, and I will review several of the more significant of those changes with you today, those changes which can further improve the level of plant and therefore public protection.

MR. LIPINSKI: On your line there, relatively immune to TMI complications, TMI had loss of level with fuel uncovery and core damage. There was an incident on a BWR on the East Coast where an operator error ended up in reduction of level, but the fuel was not damaged. Do you consider this comparable to TMI?

MR. DUNCAN: You mean Oyster Creek about two years back?

MR. LIPINSKI: Yes. There was a loss of level, but fortunately they turned around before the fuel was uncovered and damaged.

MR. DUNCAN: Comparable to TMI. That plant was down I think for a month or so as we and the utility analyzed it, and another vendor which also supported the utility, so we are not comparable in the amount of damage or downtime. It was a thing which is somewhat similar to level indication difficulties at TMI.

MR. LIPINSKI: The loss of level and possibly clad damage.

MR. DUNCAN: In that case, as I remember, they had indication of water level outside the shroud, but that volume was isolated from inside the shroud. As a result, they had level indication but the level was lower inside. Their instrument told them that. They had an instrument in there which told them that but they did not believe it.

MR. LIPINSKI: Is that unique to that plant?

MR. DUNCAN: It is unique to that class of plant. That is before we went to the recirculation loops and the jet pump design. But now inside the shroud and outside the shroud, there is an open pathway which cannot be valved off.

MR. LIPINSKI: Your statement applies to your current product line. That is immune to TMI complications, namely, loss of level and --

MR. DUNCAN: It applies in general to the entire product line. I do not mean to say that we did not find some places that improvements could not be made, and water level indication is one of them. Okay. But I am saying in a relative sense the difficulties of the operator and the design experience at TMI, we are in substantially better shape than that design was.

MR. SHERWOOD: I think we believe, as we all state, that the BWR is a very simple, simple and forgiving design. For example, we have a large number of pumps and we feel that the fact that we have a large number of pumps precluded a major accident at Browns Ferry several years ago because the CRD pumps, even though we lost 13 or 14 pumps, we still had the CRD pumps.

And at Oyster Creek there were a number of sequential operator errors where all of the recirc lines were valve closed, yet we never had water uncovery. Again it was all because of essentially the simple and forgiving design of the boiler and the low power level and the isolation condenser in that case.

MR. OKRENT: Excuse me, but at Oyster Creek the isolation condenser did not help. You had a situation that was somewhat specific to Oyster Creek, which maybe does not apply.

MR. SHERWOOD: From the point of view of the fact that the operator valved off all the recirc lines, presumably you would have had a situation for loss of coolant, and because of the normal coolant, natural circulation capability of BWRs, this is very difficult to do. If you can get some water into the vessel.

MR. LIPINSKI: On your Limerick fault tree event trees, since you do not have commission then you would not look at what the operator could do to tell about the drop of level in the core.

MR. SHERWOOD: We do have operator errors which are introduced in the fault trees, whether or not they are by commission or omission -- they are not by commission. They are essentially operator errors.

MR. LIPINSKI: In the case of level reduction, that would be something that he might do to you deliberately, given that the operating sequence allows him to do this.

MR. DUNCAN: The operator error of shutting the last loop off was the transient initiator, as I recall. Generally these risk assessments, at least at the start, do not consider operator errors of commission because it is so difficult to imagine what a man might dream up to do.

MR. LIPINSKI: I have all kinds of imagination in tha [illegible] ect.

MR. DUNCAN: However, I think --

MR. KERR: I want to make sure I understand. When you say commission, do you mean a deliberate attempt on the part of the operator to injure the plant?

MR. LIPINSKI: Omission means he forgets. Commission means he goes ahead and he does it.

MR. DUNCAN: Does what you do not want him to do.

MR. OKRENT: I think in Limerick, for example, if the scenario has begun and at some point, in order for residual heat removal to continue to be removed, it is necessary for an operator to change a valve position, that human error would be included. That would be an error of omission. He omitted something he should have done.

MR. KERR: Suppose he set the valve in the wrong position. Is it included that he could set valves wrongly?

MR. LIPINSKI: If it was open they would not have considered he went and closed it. They would have assumed it was in the correct position and remains there.

MR. KERR: That is the reason I asked. I mean an operator can do something but do it wrongly. It is an error. It is not deliberate on his part. Is that commission, in your view?

MR. LIPINSKI: Yes.

MR. SHERWOOD: No.

MR. LIPINSKI: The fact that he -

MR. SHERWOOD: An error of commission is when he makes an error and he intends to do it. In other words, he knows about it. An error of omission is a normal error of what we understand.

MR. KERR: I do not think Walt is using the word in the same way you are.

MR. LIPINSKI: I am using it differently, and I will take TMI, where in this case they turned off the high pressure injection, they knew what they were doing, they went ahead and did it anywy.

MR. KERR: They did not do it, Walt, to try and deliberately harm the plant.

MR. LIPINSKI: No, no. I am not saying they are going to deliberately harm the plant. They are making a mistake. That is all I am saying.

MR. KERR: I am trying to understand whether you are talking about sabotage or not. You aren't.

MR. LIPINSKI: No, I am talking about the system setup, it is functioning, he goes ahead and closes the valve.

MR. SHERWOOD: We call those operator errors.

MR. LIPINSKI: That is in your fault tree event tree?

MR. SHERWOOD: Yes.

MR. EBERSOLE: In that particular plant design, is there a specific instruction for him not to close these loops if he has a LOCA?

MR. DUNCAN: Oyster Creek?

MR. EBERSOLE: The old design.

MR. DUNCAN: I think there are interlocks now installed on those designs to prevent the closure of all the loops at once.

MR. EBERSOLE: That causes a blowdown which then closes it.

MR. DUNCAN: I did not get the sense of the question.

MR. EBERSOLE: You are rigged for a blowdown which is persistent. Your subsequent refilling process is not conditioned to receive a large blowdown which is then subsequently closed. It is not in your design.

MR. DUNCAN: In the case of Oyster Creek there was not any LOCA.

MR. EBERSOLE: If there were, would the operator be specifically forbidden to close the place where the LOCA was?

MR. DUNCAN: No.

MR. EBERSOLE: He would not. Then he could close it after virtually instantaneous loss of a lot of coolant and you could not refill fast enough.

MR. DUNCAN: We have considered that. I do not recall that consideration specif to Oyster Creek, but we had considered should the operator be directed to attempt to isolate the break. I think that is --

MR. EBERSOLE: If you have analyzed it, you have done whatever you have to do.

MR. DUNCAN: We decided it is not critical that he try to do that. It is better he not fool with it.

MR. LIPINSKI: In the Limerick report did they include operator errors when he does something, say after an automatic system has been set up he goes in there and does the wrong thing. Was that factored into the analysis?

MR. OKRENT: I have to guess now. I do not remember. I do remember seeing the errors of omission. I do not remember specifically seeing areas of commission, and I know it did not include errors of commission in the general sense.

MR. SHERWOOD: That is correct, it did not.

MR. LIPINSKI: Okay. If the residual heat removal system had been set up, your analysis does not include what happens if he goes ahead and closes valves that should remain open; is that correct? If you did, your analysis is unique.

MR. SHERWOOD: That is correct.

MR. DUNCAN: Although we believe there are ways to sense that that has happened and to correct the situation. There is no strict treatment of that sort of difficulty.

MR. LIPINSKI: You set an automatic system, he leaves it that way. He does not go in there and defeat it.

MR. DUNCAN: That is right. I think there are mechanisms for increasing your confidence so he will not do that. That will be the tail end of presentation. Not that he won't do that, but if he does, the situation is more likely to be recognized and therefore corrected.

This next chart outlines the discussion of improvements that we have identified.

(Slide)

I will start out with a picture, we call it a chimney chart, to illustrate the relative significance of transients that threaten to uncover the core and possibly lead to core damage. I will briefly show you those. I think you have seen them before. Then I will spend about one chart per improvement and then we will take another look at the chimney charts again to try to make a judgment as to just how valuable these improvements are.

(Slide)

Now, I toyed with the idea of showing just straight before and after, but I guess I ended up getting lazy, and before and after are on this chart and the last one. We are estimating the core damage probability per year, and here are the causes of the transients running from a loss of feedwater all the way to a loss of heat removal.

This is for BWR-6 although many of the general statements I make are also applicable to other product lines. I think I personally find it easier to think in this world rather than in the offsite consequences world because it is something one person can almost get their arms around and understand the whole thing.

I think it is the most direct and understandable assessment of the level of plant protection. Fundamentally, then, this analysis showed us that there are three key contributors to risk for core damage. This one over here, which is loss of heat removal, at 6×10^{-6}, and then two others, loss of offsite power and loss of feedwater at about 1 or 2×10^{-6}.

So those are the ones that we view to be the most direct threat to damage in a BWR core.

Other events, stuck open relief valve and the different size breaks, are a decade to two decades below.

(Slide)

MR. LIPINSKI: The numbers we see here have common mode factors included in them?

MR. DUNCAN: To a large extent. I do not think we have completely addressed that point yet. To a large extent they do. I should preface my point with a point that Glenn made earlier. These are estimates that are based on our experience or knowledge of the difference between BWR-4 and BWR-6. We expect them not to change too much as we complete this effort throughout the year.

MR. SHERWOOD: That last chart includes the ATWS alternate 3 fix.

(Slide)

MR. DUNCAN: These are the improvements that we think are relatively significant in the core damage world, if you will. We have talked about the first two off and on throughout the discussion, containment overpressure relief, and Dr. Okrent, you mentioned this one, automatic depressurization system logic improvements. That is where you had the question relative to the effect on ATWS.

In addition to that we have identified some improvements in our reactor core isolation cooling system.

(Slide)

I will spend about a chart apiece on each one of those.

Containment overpressure relief, another way to remove decay heat, addresses the highest of the chimneys that we saw a couple of charts back. Here I have outlined the sequence which can lead to core damage. Main condenser is not available for one reason or another to accept decay heat. Neither of the two residual heat removal systems are available to remove decay heat as the reactor discharges steam to the suppression pool. That discharge heats up the suppression pool and eventually the pool boils.

As a consequence the containment pressure increases because of that steam being vaporized off the pool surface. That can lead to containment overpressure, which can -- we do not think it is tremendously likely but it can lead to loss of the suppression pool and perhaps loss of emergency core cooling system suction.

The design concept that we are considering to address this particular sequence is before any core damage, as was mentioned before, we will vent the containment to prevent that overpressure from happening.

Now, possible signals that we are considering are vent on containment pressure sometimes before you hit perhaps the design setpoint or perhaps vent with suppression pool temperature as the initiating signal. It would then be necessary to replenish that suppression pool water, and we have identified a number of water sources.

We have not picked our favorite yet, but one possibility is to dump the water from the upper pool which sits above the reactor vessel into the suppression pool by a continuing suction through the several pumps which c[illegible] ump water into the core.

MR. EBERSOLE: You can go back to your customers and tell them they can save a hell of a lot of money by using that flood control equipment now, the flood protection. Now they are locked up like a boat, and they could have done this.

(Slide)

MR. LIPINSKI: How does the containment figure result in loss of suppression pool?

MR. DUNCAN: We do not think it is likely, as we discussed a couple of months back in the hydrogen control arena. We think it is more likely that a containment will fail high up, and if it does, then we would not lose the suppression pool, but in the probabilistic world everything is possible and there is a possibility it would fail down below and drain the water out of the pool. It is best to avoid that. It is best not to worry about what is the probability here or there when there is a relatively simple concept we think can address the issue straight on.

MR. LIPINSKI: What happens with the design concept if you have core damage? The assumption is before core damage I send you down another path and say you have core damage.

MR. DUNCAN: This sequence is where containment failure causes the loss of the water sources and that leads to core damage. The other sequences go the other way where you lose the water in the core first. And then we have some system concepts and ideas to address those points, too.

MR. LIPINSKI: Okay.

MR. EBERSOLE: May I elaborate a little bit on the design concept at the bottom? For the case of the flood that I know, this means horrendous doors have to be erected. You have to entertain the rather doubtless process of maintaining virtually leak-tight seal to keep the auxiliary equipment rooms dry and do a whole lot of things, keep diesel running, when all you really need is a little pump to pump a little water. That is what is in the field now.

So if you can sell this to the new and backfit to the old --

MR. SHERWOOD: What is it, now?

MR. EBERSOLE: Keeping everything dry so it will run under 40 feet of water.

MR. KERR: Or better still, avoid 40 feet of water.

(Slide)

MR. OKRENT: I am not sure you can equate this one for one with the other for all scenarios, Jesse, so --

MR. EBERSOLE: No.

MR. OKRENT: Well, yes. Okay.

MR. DUNCAN: The next improvement is an improvement in the automatic depressurization system logic. This improvement addresses or improves upon the next two highest chimneys that I showed a couple of charts back, loss of offsite power and loss of feedwater. The existing system design for the automatic depressurization system is summarized at the top of the chart. A low reactor water level signal and a high dry well pressure. The dry well is the volume right outside the reactor vessel.

That second signal is the signal to the logic that there is a LOCA, a loss of fluid to the dry well. It signals several safety relief valves to open and they depressurize the reactor on the order of five minutes by dumping steam to the suppression pool, and this reactor depressurization is accomplished so that the low pressure emergency core cooling system can deliver water back to the reactor vessel.

So basically it was designed to handle a loss of coolant accident and did not anticipate another threat which wse believe is more likely. The second bullet outlines the sequence which could lead to core damage.

There is a loss of feedwater or a loss of offsite power, which leads to loss of the normal high pressure water delivery system feedwater. If you postulate that the reactor core isolation cooling system and the high pressure core spray which are supposed to start on low reactor level do not start, and if the control rod dry cooling flow is not sufficient, then you will have a steady decrease in water level but there will be no automatic depressurization because there is no break to cause the pressure to increase in the dry well.

If this happens and the operator does not follow his emergency procedures that are developed from the guidelines that have been worked out by GE and the BWR owners group, if he does not follow those procedures and open those relief valves manually, then the core uncovers, and if it goes substantially farther than that you can get into a core damage sequence.

MR. LIPINSKI: Where is the steam blowing to that is being manufactured in the core?

MR. DUNCAN: It is going out through the safety relief valves into the suppression pool.

MR. LIPINSKI: But you said --

MR. DUNCAN: For a time with the reactor at pressure, those valves will cycle on the order of 1100 psi in the reactor, and that will continue on virtually forever. At some point in time it would be appropriate for the operator to open those valves, I think it is on the order of 8 for BWR-6, and have a steady blowdown to depressurize the system.

MR. LIPINSKI: The automatic cycling will not raise the high dry well pressure.

MR. DUNCAN: That is right. The heat passes the dry well and goes directly to the suppression pool. The concept is pretty simple. It is make the system not worry about whether there is a LOCA or not, so the concept that we have in mind is modify the initiating logic to make the depressurization automatic if required because the water is low, not because the water level is low and there is an indicaton of a LOCA.

One of the options we are considering is simply to eliminate the need for that dry well pressure signal, possibly with time delay in it. So this would make the action automatic within several minutes, certainly within plenty of time for depressurization to happen and let the low pressure pumps come on.

So this is a case where we are addressing the sensitivity to an operator error to fail to follow his procedures. Perhaps he did not recognize the situation he was in.

MR. OKRENT: What is the ATWS complication?

MR. DUNCAN: We have developed -- it seems like you never completely close all the issues. This design modification was developed independently of ATWS considerations, and that statement there at the end that you say, I think that that owners group report was just an admission of that, that the ATWS issue has to be resolved before this is applied.

I do not know what the end result will be. We just have not got there yet.

MR. OKRENT: I think there is an ATWS complication, is there not?

MR. DUNCAN: Rather not blowdown if you have an ATWS because then you have a tendency to inject cold, unborated water, and we have to come to grips with that and decide what is the appropriate thing to do.

MR. OKRENT: So in other words, for this transient if it occurs, in order to handle the chance that the operator does not follow the procedure, you say it might be good to have automatic depressurization. But you could have somewhat similar, not identical but somewhat similar symptoms for the ATWS and not want to automatically depressurize.

MR. DUNCAN: That is right.

MR. EBERSOLE: These valves are in a hostile environment. The ADS valves are in a hostile environment. Have you done anything to improve the rather doubtful state of affairs whereby you use the solenoids to -- for instance, have you carried the solenoids outside the dry well and put only air lines in?

MR. DUNCAN: Well, let me first say, do you mean hostile --

MR. EBERSOLE: High pressure and temperature.

MR. DUNCAN: If you have a LOCA you would tend to have a hostile environment. This is a transient situation so it is less hostile than --

MR. EBERSOLE: But if you have --

MR. DUNCAN: There are cases (-GL-)

MR. EBERSOLE: You have these rather delicate solenoids stuck in there inside. They could be outside and you could carry the air supply to the piston valves.

MR. DUNCAN: One of the improvements that we identified which did not make the list of the top which had the most substantial benefit is an alternate supply or those valves, alternate air bottles, for example, outside the containment, and in this case there is no electrical whatsoever, and then comes up, it is a hand valve, it sends air to open those valves.

(Slide)

MR. LIPINSKI: Has an operating reactor ever gone through automatic depressurization?

MR. DUNCAN: I do not think so. There have been spurious blowdowns and intentional blowdowns. Not very many intentional blowdowns. Spurious blowdowns with one valve.

MR. LIPINSKI: How long does it take to do a blowdown?

MR. DUNCAN: About five minutes.

MR. LIPINSKI: An operating reactor has gone through a five-minute blowdown?

MR. DUNCAN: I do not believe so.

MR. LIPINSKI: Your analysis shows no core damage?

MR. SHERWOOD: We should be able to maintain covery.

MR. LIPINSKI: How much cooling are you getting on your fuel?

MR. DUNCAN: No significant core damage anyway. When you ask that question it becomes sensitive a little bit to how accurate is your calculation of water level. There was a water level swell, for example, as you form voids because of depressurization. Our calculations say that especially if there has been no break, that you depressurize the system, and those low pressure systems can reflood that vessel very, very rapidly.

For example, I am told -- I have not done this calculation, but there was initial test of the emergency core cooling system before startup, and you virtually fill the vessel on the order of a minute. There would possibly be a very short duration for uncovery.

The alternate is to just let the plant sit there and boil dry, the core sit there and boil dry. You need to depressurize to get down within the capability of the low pressure systems, given that the high pressure systems were not sufficient.

MR. EBERSOLE: This would also cover a LOCA in the main steam lines.

MR. DUNCAN: Yes, that is essentially identical.

MR. EBERSOLE: Yes.

MR. DUNCAN: The third improvement, which also addresses those second and third highest chimneys, is summarized here, improvements in the reactor control isolation cooling system. Here are the key features of RCIC system. They are here. Reactor steam supplies turbine drive pump. That takes the suction from the condensate storage tank first, and then if that runs dry or to a low level, it takes the suction from the suppression pool and it maintains reactor vessel water level with the vessel isolated.

There are a number of features in this design which can contribute to that system not starting, or not being available when it is needed. Containment pressure increase during a LOCA can increase the turbine back pressure and the setting as such that will cause the turbine to trip, and then the reactor core isolation cooling system is not available for a LOCA.

The system starts very rapidly, and on occasion that leads to tripping the turbine on overspeed, and sometimes it causes the system to be isolated because the system thinks there is a break. It sees all the steam flowing through the steam inlet to the turbine.

The third point is even if the pump comes on on low water level, it turns off when the water level increases to a higher setting. Then there is nothing delivering water to the core. The water level comes back down again. It is then necessary for the operator to manually restart the system, and there is some potential for him forgetting to do that.

Having identified those, I guess it follows pretty obviously that the improvements we have in mind address those points. We think it is probably practical to increase the turbine exhaust pressure settings so that that relatively valuable pump will be available if you have a loss of coolant accident.

We think that the system starting speed can be modulated a bit and make it less likely to trip off on overspeed. Time delays are considered -- we are considering adding them in the circuit so that the break detection logic waits several seconds before worrying about whether there is a break or not, and only if there is a longer duration high steam flow would be isolated.

And then we are considering automatic restart on low water level for that system.

MR. EBERSOLE: Are you going to reflect these changes back on the old steam turbine HPCI pumps?

MR. DUNCAN: The first problem does not apply to high pressure core injection pump that works during a LOCA. That is the purpose of the system. I am not exactly sure of the differences between those two systems.

They are steam driven in a rather similar way but it is less susceptible to these problems, the turnoff on overspeed and break detection, although on the earlier designs we have identified a modification to the break detection logic for the HPCI system too. So I guess where it applies, yes. Here HPCI starts on low water level -- restarts on low water level automatically.

(Slide)

MR. EBERSOLE: How close are you to the turbine casing failure on the exhaust side? Are you already pushing it? Do you have a lot of margin?

MR. DUNCAN: That will be the limiting issue that tells us perhaps we cannot do it. I believe we can do it. I am not very close to that particular design effort. I think that we will find a way to --

MR. EBERSOLE: The relief guide, that is the weakness, that is the main killer because it discharges into the room.

MR. DUNCAN: You might be right.

MR. BENDER: Some of these schemes where you put time delays in always raise questions of if the time delay is there, what is there to say that the time delay will not be one which is never signalled to start the action? Are you looking at those kinds of events or just relying on the fact that you have it?

MR. DUNCAN: You mean like introducing an extra piece of logic, a timer, the timer fails?

MR. BENDER: Yes. It is such a common event that I would say it is likely to happen. You call upon a timer to delay something. In some fraction of the time the delay will be forever.

MR. DUNCAN: We will take --

MR. BENDER: Is that what is inferred by all this?

MR. DUNCAN: We will take a look at that design from the raliability standpoint. I would not be surprised to find two or three timers in the circuit to try to anticipate that kind of a problem.

The other action that would be taken is I think the operator would isolate the system after a while if the automatic circuit failed to do it.

MR. BENDER: Well, some of that may be helpful, but I guess by view is it is just like the timers on the diesel generators starting and sequentially loading of the system. They do not come out right every time.

MR. DUNCAN: That I think, although I am not familiar with either of the details, I think the timing on diesel loading is substantially more complicated than this thing, which just says wait ten seconds or so and then do the system isolation.

MR. BENDER: I think there is more in the sequencing of the diesel, I agree, but in principle they are the same thing.

MR. EBERSOLE: Can you define the purpose of the time delay?

MR. DUNCAN: The purpose of the time delay is to not sense or not act on the relatively high steam flow that is taken to start the turbine.

MR. EBERSOLE: There is no invitation for operators to intervene, is there?

MR. DUNCAN: Not likely there. This happens relatiavely fast.

MR. EBERSOLE: You tie his hands for that. It is not like the old -- you see, right now there is a 30 second delay on blowdown. The operator is invited to do something which evidently the automatic instrumentation cannot do, but I do not know what it is.

MR. DUNCAN: Are you talking about the time delay on the automatic depressurization system? That is on the order of two minutes.

MR. EBERSOLE: That is a period of invitation for the operator to step in and take action when his instruments are telling him something that they cannot tell his equipment automatically. I have not been able to figure it out.

MR. DUNCAN: It is an invitation to him to fix the problem before the blowdown is necessary.

MR. EBERSOLE: If the problem can be fixed, then it can be automatically sensed that it is fixed and it will inhibit itself. Why it is an operator interdiction I have never been able to figure out. Why does the operator have to interdict? Why can't it be automated?

MR. DUNCAN: We are shifting over to the automatic depressurization, but if he does not interdict, the system will blow down.

MR. EBERSOLE: Why should he interdict with any better information than the equipment has? He doesn't have it, does he?

MR. DUNCAN: The real intent there is to allow him some time to get some water sources back such that the blowdown is not required. To some degree -- I should strike that. To some degree. There is an opportunity for him to defeat the blowdown.

MR. EBERSOLE: There is.

MR. DUNCAN: Yes, by pushing a reset feature to extend that time delay.

MR. BENDER: Has an operator ever defeated a blowdown?

MR. DUNCAN: Not that I know of. Well, you don't get that many opportunities.

MR. BENDER: You get a couple a year in most plants.

MR. DUNCAN: Those kinds of blowdowns are spurious openings of single valves. I do not know if an operator has ever defeated one of those.

MR. SHERWOOD: There is still a difference. The ADS is a number of valves. It is a few minutes, where as a blowdown is one or two valves. It could be 20 minutes.

MR. DUNCAN: The opportunity for the operator to interrupt that blowdown to some degree I guess is a mission that the designer cannot think of everything and give him opportunity to turn off that safety function. It may be because a blowdown is relatiavely severe. You are taking fluid out of the vessel. You really do not want to do that unless you are sure.

MR. EBERSOLE: On the other hand, if you do not do it in time, then you will never get the water back.

MR. OKRENT: Jesse and GE, I am afraid I am going to have to act like a chairman. We are getting much too late now and I do want to make sure the last two speakers have a chance, and I also want to have a chance for the subcommittee to talk. So let's if we can let GE finish the presentation, and only ask questions that relate to the charter of this meeting.

I know this is all interesting and important and more interesting than what we were originally trying to do at athe meeting, but nevertheless, we will meet again with GE sometime.

Go ahead.

MR. DUNCAN: Take a look now at the same chart and focus on the after-improvement chimneys. These arrows indicate how much we think those sources of core damage have changed as a result of the design feature that we are considering.

Containment overpressure release has its effect here, and the automatic depressurization system logic and the reactor core isolation cooling system have their effects here, and the net result is about a one decade improvement in the sum, and the sum we have at about 7.5×10^{-7} -- I am sorry, that is not the sum, that is the dominant sequence. And that is the major contributor to the base case that Glenn was mentioning earlier.

MR. LIPINSKI: Why is loss of offsite power important? Don't diesels take over for you?

MR. DUNCAN: Yes, but they might not start either. If you lose loss of offsite power, the diesels have to start. So in some other sequence the diesels do not have to start. On a LOCA, for example, the diesels do not have to start if you have offsite power.

(Slide)

Now, just to try to paint the whole picture, this is a shortened version of the chart you saw earlier when we talked about hydrogen control. It summarizes these core damage probability estimates for WASH-1400 and BWR-6 as is -- or before application of these improvements, if you will, and then with the potential improvements.

You saw these numbers before. Basically we are estimating about a factor of 4 improvement in the core damage arena for BWR-6 relative to WASH-1400 and a factor of 20 for a further factor of 5 as a result of these improvements that we have discussed.

In the risk area similar comparisons are shown with a factor of 30 improvement in risk, BWR-6 relative to WASH-1300, and a factor of 200 or so with the potential improvements that we have discussed.

(Slide)

Now I would like to shift focus a little bit and talk a little bit more about operator response than system design. Previously we discussed the system design. The key element, we think, in plant production is the ease that the operator has in controlling events. These factors that I have listed on these two charts we think make the operator response relatively simple.

There is one vessel and one loop on the BWR compared to the several at TMI. There is direct water level instrumentation on the reactor vessel versus the more -- or the less direct sensing used at TMI. Emergency operation on the BWR is similar to normal boiling. It occurs in emergency and non-emergency conditions.

The normal pumping systems are the first line of defense for loss of inventory events. That is, the feedwater is available first. The emergency core cooling systems provide a backup to that. That is available in the direct cycle, whereas the feedwater is not available to keep the core covered in the indirect TMI type.

(Slide)

As we mentioned a couple of times and showed on charts earlier, decay heat removal, passive decay heat removal is a key point that is provided by the relatively massive suppression pool that can accept energy from the core for quite a long time before the operator really has to take action to remove decay heat.

Natural circulation is nowhere near as complicated in a BWR as it was at TMI. The suppression pool, as I indicated here, has a several hour capability before the operator action is really required. There is a common response to inventory threatening events. Keep the core covered is the response.

I have tried to show that graphically on the next picture.

(Slide)

We worked quite extensively with the BWR owners over the past year and a half or so to develop the emergency procedure guidelines for the operators. This one chart is an attempt to summarize that. Basically the operator has two functions, and that is to maintain core water level and to provide for decay heat removal.

His first action -- here I am indicating the functions down this way and time across the chart. His first action is to maintain water level with his high pressure sources if they are sufficient, or depressurization, as I mentioned earlier, and bring the low pressure system in.

In the meantime while he is doing that decay heat is being removed from the reactor vessel and stored in the suppression pool passively. No operator action is required for quite a long time.

After some substantial period of time, then the operator needs to take action to bring on his residual heat removal system to establish a long-term heat sink, or he might, if the main condenser is available, use that.

We started out in the emergency procedure guidelines developing separate guidelines: do the following if you have a loss of feedwater, do the following if you have a loss of coolant accident. There is another guideline for if you have a stuck open relief valve.

Well, after a little bit of work on that it occurred to us that the following is almost identical: that is, watch water level; if it gets too low and you cannot bring your systems on, then depressurize and bring some more systems on.

So as a result of that rather unidirectional feature of the plant, we are able to develop rather simple guidelines based on symptoms, and the key symptom is reactor vessel water level.

(Slide)

Guidelines are only a part of the assistance that we think can be provided to the operator. On this chart I try to show the integration of those guidelines with some control room features which I think will make it substantially easier for the operator to control the plant.

Basically these top couple of rectangles are a summary of the actions that were taken to develop the emergency procedure guidelines. Decide what safety functions you need to do, do some analyses, confirm that yes, indeed, it is unidirectional, develop emergency procedure guidelines or the operator actions. From that the utilities will develop plant-specific emergency procedures and they will train their operators based on those.

There are checks of these procedures with the control room as part of the development process.

On the right-hand side we are showing the additional data or data summary that can be provided to the operator. As a result of having identified these emergency procedure guidelines, the information that the operator needs comes into much clearer focus and you can indeed make a list of the parameters that he needs to look at in order to control the plant.

So we identify those data needs, provide emergency response information system to display that information to him in a convenient fashion. That particular system can be checked out in control rooms and on simulators, and the net effect is as the guidelines and the emergency response information system come together, the operators are traine to use the two together, the procedures and the emergency --

MR. BENDER: The first two blocks --

MR. DUNCAN: Excuse me.

MR. BENDER: The analyses and the emergency procedure guidelines. Where did that guidance come from?

MR. DUNCAN: Who does it?

MR. BENDER: He will do that?

MR. DUNCAN: The work is done. That was a cooperative effort between GE and the BWR utility onwners.

MR. BENDER: It is universally applicable to all BWRs?

MR. DUNCAN: It is applicable -- it is written generically such that it covers the entire span. I think the first version only went to BWR-5, our next to the last product line. The version which is about to be developed also includes BWR-6.

(Slide)

Here is a picture of the overall emergency response information system. Basically there are sensing units located throughout the plant, control room and the environment feeding information to a computer called the emegency response information system computer, which does some processing of the information and displays that to the operator in the control room.

It also displays information to technical support people in other buildings, but mainly I will focus on the control room operator here today.

(Slide)

The function of the emergency response system in the control room is to assist the plant operator by displaying such things as real time plant parameter status continuously on line to aid in the early indication to the operator that it is appropriate to enter the guidelines, provide data to assist the operator in following the emergency procedure if one needs to, provide when needed two variable plots such as a heat capacity limit curve, which tells the operator when he is approaching certain limits relative to the containment heat capacity so he can respond faster and void the need to look at two or three different instruments and do a mind comparison of where he is relative to a particular curve and then he can take actions more quickly.

In addition it is to provide validation of some of the more important parameters. That would be some sort of cross-checking between one water level instrument and another, for example, and perhaps throwing out the highest and the lowest or doing some analysis to detect what the more likely core level is.

In addition, trend variable plots are available so the operator can call up and see what a variable has been doing for the past several minutes. Displays that are availabl in the control room are things we call the normal display, and I will show you a picture of that and a set of displays which are called up by the operator or perhaps automatically, depending on what part of the emergency procedure activities he is in.

In addition to that, there are two-dimensional plots like I said and trènd plots. Now, let's take a look at a normal display, and these are a bit more effective with colors but unfortunately I only have colors on the last chart.

(Slide)

This is a display which would be -- the operator could look at any time while the plant is in operation. And over on the left we show a reactor vessel, a scaled reactor vessel with a composite water level indication. That is this part here (indicating). That is a composite of several instruments, several water level instruments over several ranges, temperature compensated to adjust for some sources of indication error, and two instrument zeroes.

There is a digital readout showing reactor vessel water level relative to, if you will, the original instrument zero, and also a reading relative to the top of the fuel, indication of the main steam isolation valve position, is it in the right position. You can tell that at a glance by looking at the color of that bar -- of that valve symbol there.

Indication of reactor pressure, both analog with a bar here, and a digital readout. Similar readings on suppression pool temperature water level and dry well temperature and pressure. You would use colors on thse displays to indicate if the parameters are in the normal range, perhaps green; if they are approaching a caution, approaching an action level, perhaps yellow would be used there; probably red for abnormal.

If the abnormal condition calls for emergency procedure entry, for example, low water level, there would be an automatic or a manual shift to the appropriate display. Let's just imagine here that we did get that sort of a signal, low water level or one of the other entry conditions for the level control part of the guidelines. Then the operator would see this sort of a display.

(Slide)

Over on the left the vessel and core mimic, you see, is fundamentally the same thing except now this water level indication has changed color because the level is decreasing. He has some additional information presented to him now, water level direction arrows which tell him what direction the water level is going, and make some judgment about whether that is good or bad.

If water level is low and is going down, that is bad, so the arrow would point down and be red, probably. If the water level is high and going down, for example, perhaps the high level trip, the upper part of the control band for water level had been reached, systems had been turned off and water level is decreasing, that is just exactly what you want to happen.

So the water level would be down and the arrow would indicate down in green. Now that, if you will, is what we call the baseline, the absolute minimum of the system that we have designed. There is also the potential for adding many enhanced features. The next sketch shows an illustration of that. This is the one that I have colored.

(Slide)

This is the display or display similar to what the operator would see with the enhanced system with more information presented to him. The others, as I mentioned, would also be colored.

Similar kind of information here with the water level and the core mimic. This little thing down here at the bottom reminds me what the situation is so I do not have to assess it like maybe the operator would. We have had, for example, a loss of feedwater, and as a consequence the water level is low. So we have a red bar here indicating low.

The water level is decreasing and that is bad, so here is the red bar indicating that or the red arrow indicating that. The relief valve is cycling so we have this light indicating relief valve, going red to green to red to green as the valve cycles.

The vessel is isolated and it is supposed to be isolated, so we see a green indication on MS, the main steam isolation valve. That tells the operator that that valve is in the proper condition, not necessarily opened or closed but proper. In this case it means closed.

In this particular case we have imagined that the high pressure coolant injection or the analog for BWR-6, the high pressure core spray failed to start. The operator can tell that at a glance by looking at these displays which give him some guidance about whether key water delivery systems are on this chart, on this side available or ready to do their duty, if you will.

We look down here. We see that feedwater is not. That was the cause of the problem in the first place.

Reactor core isolation cooling system is ready, and ready means valve lineup is proper. For example, valve lineup is proper. There is steam to the turbine. For a motor driven system it might be voltage on a bus.

High pressure coolant injection system is not ready, so it is red, et cetera. These other supplies are ready.

But ready sometimes is enough, sometimes is not. Those lights, by looking at such things as flow indication, is the valve lineup proper, and you do not have an indication of flow and you are sending it to a test return line or something like that.

So feedwater is not injecting, RCIC is, et cetera. These low pressure systems, although they are ready they are not pumping in, and they are not pumping because they do not pump against this pressure of 1000 pounds.

Other displays over here are an indication of water level sources for these pumps. Basically we are showing condensate storage tank level here. This is reactor pressure and that is high, so it is red. Condensate storage tank and suppression pool and hot well levels tell the operator that he has an adequate source of water for those pumps.

The time to empty the condensate storage tank is printed out here by extrapolating a water level reading for the past several minutes.

MR. OKRENT: I think we are going to have to finish up now.

MR. DUNCAN: That is my last chart except for conclusions.

MR. OKRENT: Right, I realize that.

MR. DUNCAN: When we talk about different kinds of operator errors throughout our discussion, and admittedly, I guess to some degree it is hard to anticipate what they are. Here with this sort of information available not only to the operator but to technical supervisory personnel and assistance personnel, it is much more likely that you know the operator has made a mistake.

If he turns off this system and this system, now you have a string of red bars to flag it, to tell you that that has happened and make it more likely that you can call up the operator and say why the devil did you turn it off, maybe you better turn it back on again.

To conclude, then, we took what I believe to be a very critical look at our product after the accident at TMI. We confirmed that we have highly effective plant protection that is effective for both TMI types of challenges and other degraded transients and accidents.

We made an assessment of the probability of core damage and I think it is small, though we have to continue our calculations and provide more complete study on the order of a year. We think basically that the system design is sound, it is safe. We can make the risks smaller yet if there is a need to as a result of different safety goals or what have you.

That is it.

MR. SHERWOOD: If I could make on statement, Professor.

MR. OKRENT: Not more than a minute.

MR. SHERWOOD: One minute.

What we tried to show you is the results of our internal efforts within GE to review our plant design, you know, on an orthogonal basis from the normal single failure criteria, normal licensing basis criteria which we generally talk to you about.

We have made a number of improvements and we are looking at a number of other interesting things such as containment venting. We think we have a hell of a design with the plant we are talking to you about, and we are investigating it throughout the entire plant, including the balance of plant, with our nuclear island concept.

Again in summary we would like to ask you to contemplate an opportunity to use such a design. I think the other vendors have the same, similar types of capabilities. Such a design with a current CP plant and pushed towards a one-stage licensing effort, say long the line of the Skagit project, I think it could be very helpful for the country.

Okay.

MR. OKRENT: I want to thank you and go on because we have two speakers yet. We are running 2-1/2 hours late according to the clock.

So, the speaker from KMC. I think I recognize the face from somewhere in my distant past. You changed your hat from a white hat to a gray hat or a black hat? What is it?

MR. BOYD: I do some work for the Department of Energy occasionally. I would like to apologize for Don not being here. My name is Roger Boyd and I work for KMC, Incorporated. Don Knuth was supposed to make the presentation today. He unfortunately cannot be here. He is out in the cultural -- the cultural center of the midwest was Bill Kerr's comment.

You have his three-page statement. The topic is essentially limited to the question of design features to add further sabotage protection. He makes a number of points in there. One is that there appears to be general consensus that the outsider threat is pretty well already covered by such things as guard forces, intrusion devices and so forth, and that design feature improvements are generally considered for the insider.

And for that matter, in many discussions when people start talking about design features they start to focus on bunkering, and I would not want anything in this discussion to have to do with the bunker mentality.

But the conclusion of looking at this is there in fact may be some benefit to providing yet another barrier, but frankly, it would be outweighed by the cost, the cost to safety.

Don's points are that there are already many, many other safety requirements piled up in the plant, the plants are becoming quite cluttered and they make it difficult for the operators to do their jobs, along, for that matter, with the present security requirements that one would worry that adding more elaborate features that you could produce a negatiave attitude about security on the operators. This would make it more difficult for them to do their jobs and, for that matter, could discourage plant walkthroughs because, again, of the same difficulty.

Our argument that we have been pursuing with the NRC goes along the lines of a personnel screening program. It seems to us, I guess, that if in fact you have reliable personnel and have gone to some length to assure yourself that you have such people, that that negates the need considerably for worrying about the insider threat.

Of course, you can always make the argument that there will always be some amount, I suppose, of insider threat. A general thought I had, though, that I wanted to leave you with which seemed to pop up today.

I listened to some of the discussion this morning of the highly specialized things that everyday somebody is looking at in this business. It reminded me of a drawing that I saw 25 years ago and cut out of I believe it was

Aviation Week. I am sure some of you have seen it. It shows various airplane designs but from the point of view of the individual specialty groups.

As a matter of fact, I saved it. It was thrown away in my drawer somewhere and I made a Xerox copy of it, and when you are contemplating things tonight, just take look at some of these dream airplanes and imagine -- I always wanted to do one for reactors but I do not have the talent for it.

But even so, it is, I think, a word to live by. Pass this around at your leisure.

Any questions?

MR. OKRENT: I would just like to note something with regard to the written statement. On page 2 it says, and I quote, "No one from industry was permitted to attend these sessions." He is referring to the session we had last month which was closed and which dealt with sabotage matters.

In fact the ACRS tried to get attendance from industry. I believe there was only one last-minute request by someone from industry, meaning someone from Don Knuth's organization.

MR. BOYD: I believe it was Don who tried to come.

MR. OKRENT: One last-minute request, as I understand it, and they were unable to transmit the necessary clearances in time. So I think the record should make it clear that in fact we did want such participation and in fact I, for one, was very unhappy it was not there.

MR. BOYD: I recall the situation. I cannot comment on the last-minuteness of it, but Don did try to be able to come to the meeting.

MR. EBERSOLE: In view of the fact that all I need to carry into a plant to sabotage it is a roll of Scotch tape, I think you would do well to do the X-ray machine on them -- do other things other than look for pistols and hardware.

MR. OKRENT: He is suggesting screening personnel.

MR. EBERSOLE: I am talking about screening as you go through the gate, blood pressure, pulse rate, et cetera, et cetera.

MR. KERR: In fact I think there has been some recent work that indicates that gerbils can sense people under stress.

MR. EBERSOLE: Of course --

MR. KERR: You could put a gerbil in a box --

MR. EBERSOLE: They have telephones now that can tell whether a man is lying or not.

MR. BENDER: Jesse, the practicality of controlling every individual that goes in and out of the gate by that method just defies credibility.

But I wanted to ask a different question, Roger.

The inference of Don Knuth's statement would be that the so-called bunkered systems are further complications on things that are already complicated. Some people have made the point that by putting in the bunker system, you can simplify a lot of other thing and put the reliability in a place where it was well protected.

It seems to me the discussion misses that point entirely, and it would be helpful if you would come back and respond to that question. Have I made my point clear?

MR. BOYD: You have. Obviously from a design point of view it would be something you would look at.

MR. KERR: Are you saying this could be done on a backfit basis?

MR. BENDER: No.

MR. KERR: Aren't you speaking to a backfit in this paper, or are you speaking to new plants?

MR. BOYD: Fundamentally to new plants. But you know, it has been our experience that when one talks about new plants, everybody smiles and says, yes, that would apply to a new plant. The next day they ask about the requirements for the existing plants. That seems to be --

MR. KERR: My question is what are you really worried about because as I read this paper I thought you were worried about making existing systems more complicated by putting on new features. If you are not talking about that but you are talking about alternates to existing decay heat removal, the paper does not make that very clear to me.

MR. BOYD: I think the worry is as you create new ideas they will be in fact backfitted.

MR. BENDER: The subject of this meeting was philosophy for new plants.

MR. BOYD: I understand that.

MR. BENDER: And that is one of the difficulties in trying to deal with new plant design and construction permits, is that people are still worried about what will happen to the old plants. And if you are going to continue to do that, you will never get a new plant licensed.

MR. BOYD: There has to be a distinction between a construction permit plant and an honest new plant that has not been conceivet yet.

MR. BENDER: Some of us think maybe if you start from scratch, you might find a better way to deal with the sabotage question. Starting from the old designs, you do not get very far, and I think it would be constructive if some of these "small companies" who are not already biased in a given direction could have some positive views.

MR. KERR: Mr. Chairman, may I change the subject?

MR. OKRENT: Sure.

MR. KERR: It seems to me that in order to follow the recommendation of this paper, one has to have a good bit of confidence in one's ability to screen. Does KMC have confidence that there exists a system which has a high reliability of picking out those people who will and who will not likely contribute to sabotage?

MR. BOYD: I think you could come up with a system that would certainly compete with the ones that the government uses.

MR. KERR: That is not the question. I ask because, in the first place, I do not know how effective is the one that the government uses, although I do not think it is very effective. And in the second place, I do not know how effectively one needs such a system to be, and I assume that you guys have looked at that.

MR. BOYD: I think so and the answer is it does not have to be 100 percent effective.

MR. KERR: How effective does it have to be?

MR. BOYD: I do not know you can quantify it all that well. I suppose someone could do an analysis and come up with ten-to-the-minus type of numbers, but I do not think you want that.

MR. KERR: But you want something that says the system has to be this good and we are convinced it can be, if you are going to rely on it, it seems to me. Maybe not in quantitative terms but in some terms that gives one some confidence that indeed the system you are using is workable and will accomplish the objectives that you set forth.

MR. OKRENT: I for one wonder how well you can do this on the following basis. I continue to read in the paper or sometimes see in movies about how members of a very select group, namely, the secret service of some country has ended up on the other side. There must have been a very good screening process originally in getting such people, and yet it breaks done reasonably frequently.

Certainly there cannot be a 1 in 10^4 event or you would not read about it that often.

MR. BOYD: My view on that, by the way, is that there is still the probability, or possibility, rather, of that happening, and if you had bunkering instead, for example, it might not be much better. That same person can get through that.

MR. KERR: It seems to me in order to decide which is better, you have to have some measure of the effectiveness of your screening system or else how can you compare it to the bunker? It is not good enough to say, well, the bunker has flaws, too. Of course it does. But if you are going to suggest this as an alternative and if you are going to have to decide between one or the other on any basis other than engineering judgment, then it seems to me you need at least some measure of the effectiveness of some system that can do screening.

MR. OKRENT: And two countries have chosen to take the bunker route, at least I think. At this stage you sort of have more than a proposal to say it is not as good as something you are proposing or not necessary in view of something you are proposing or so forth.

MR. KERR: By the way, I am waiting with an open mind to be convinced. I would much rather have a system that did not have to have a bunkered system, so I am not prejudiced in that direction.

MR. LIPINSKI: There is one other consideration on the screening of people going back to the SL-1 situation. If the person involved had been screened six months earlier, he probably would have passed your screening process. But given the events within the preceding 24 hours and his state of mind at the time, that is an entirely different consideration, and you would have to have a continuous screening process to see how individuals are responding to events outside the N-plant affecting them in their daily lives.

MR. BOYD: But there again, once this individual feels this way, is the plant really protected by bunkering any more so than it is protected now with all the secure areas and everything else?

MR. LIPINSKI: The object is to make it more difficult for him such that he cannot use two hands to complete an act where he has to be really ingenious and move about and work a little hard, but not to make it convenient for him.

MR. EBERSOLE: You can bunker, let's say, a scram system; you can bunker it, secure it, seal it, line it up and walk out of it, energizing a variety of devices that will cause it to fail safely in the direction that you're going toward.

MR. KERR: Common mode failure will get you in the end.

MR. EBERSOLE: I will reduce it because I cannot even get into it without causing it to go in the proper direction.

MR. BOYD: The people will never get into maintain it.

MR. EBERSOLE: They will not have the opportunity -- they cannot just say I am not going to go in frequently; they are going to go in on a pre-described schedule. They do not have a choice to make. They will go in under force fields. They will have to go in, like you have to take orders. There is no prerogative.

MR. BOYD: I see that as somewhat self-defeating. I think you find that operators' maintenance people in plants do far more than what they have down as orders.

MR. EBERSOLE: I am for imposing military type discipline.

MR. KERR: If you want to go with military type discipline, talk to some of the -- not the officers, but the operators that have been on nuclear submarines before you do it. Some of them worked for me.

I am just saying I'm a little skeptical of military type discipline after some of the stories I have heard.

MR. EBERSOLE: Okay.

MR. BENDER: I can cer ainly see that a bunkered system could reduce the number of opportunities for damage by just restricting the number of people that could get to them. And I think even that point is not addressed in this discussion.

MR. OKRENT: Mr. Bernson?

MR. BERNSON: I am a little concerned with the nature of the discussion. It seems to me that we, in this case, and some other things I heard today, one, invents a concept that supposedly leals with a problem without defining what the concept is in detail and whether it works or not and to what extent it works. We assume you have solved the problem and now the issue is -- tell me why I should not put it in because that takes care of the threat. And now if you define the nature of the security threat and you identify what you have to do to protect your plant against it, I think you have to go a darned sight further than any bunkering concept that I have seen.

I think that frankly, it is an example of a bandaid. The types of bunker safe shutdown systems I have seen, because they really do not deal with the protection of all the valves and pumps and systems that could get you into trouble. They assume the plant is well behaved except you want to provide decay heat to it and maintain reactor coolant inventory and a little bit of boration.

But if somebody really intended to sabotage the plant they probably could arrange some way to open up low pressure systems connected to the primary system, do things of this nature. And I am not sure that these bunkered systems are designed at present to supervise and independently isolate all these things.

So it seems to me you have to define what your threat is and then you have to do a very careful system analysis in a real plant and figure out whethere you have accomplished your objective or not before you assume somehow that you improved the risk, or reduced the risk and improved the level of safety of the plant.

The same thing is true with the venting we heard about before, and some of the other things. We reach a certain point and then we do not want to think any further. And that is kind of the problem. That is the reason we get into problems with small break LOCA's.

So let's recognize that we have to think these problems through, and we have got to do very careful engendering on real physical systems and not just think about it conceptually.

MR. OKRENT: I will turn it right back if I may. There has been a variety of proposals for specific design features that might improve the chance of a system resisting some kind of insider sabotage. No one has been, to my knowledge -- purports to be perfect, but people said this might help in this area, and another one helps in another area.

I have not seen, although it may exist, a study from industry which systematically looked at the question of how to design against sabotage, and are there measures that one can do in design that are, in fact, improvements. Not why there are not measures that represent significant improvements.

In fact, as I indicated earlier, the only attendance proposed at the last minute was one last-minute intervention as it were. Don Knuth asked, I think, to attend but it was too late, apparently, to work out the clearances. In my opinion, industry has shown a lack of interest in it. This is only one instance of a somewhat continuing lack of interest.

I am interested in knowing how one, in fact, gets the necessary studies done. If, in fact, what Germany and Switzerland have adopted is a bandaid, I'm sure they would like to hear what it is and also what you think is better. And I would also.

MR. SHERWOOD: The question I have is the degree of importance of sabotage relative to the other kinds of things that we are investigating for nuclear power plants, contemporary or future plants. I do not want to downgrade this area, but I wonder if anyone has shown, you know, the degree to which it should be addressed relative to the other concerns for nuclear power.

I wonder -- again, I am not trying to downgrade it, could this be the kind of situation where having a gun in your bedroom is for the one in a million where the statistics show that one in 100, someone will kill themselves with a gun.

MR. OKRENT: I think that is an unfortunate example.

MR. SHERWOOD: I am not trying to do that.

MR. OKRENT: Unless you have a case to make that the proposal or some fix, let's say, with regard to sabotage is, in fact, negative to safety, and I can think of proposals which would be of that nature, one way or another. Not all positive and not strongly positive, to use a number like one in a million and one in 100.

This, I think, leads to the wrong connotation. You know, I would put it this way. If you are unable to assess the possible contribution of sabotage to risk from a nuclear power plant if, in fact, it could be dominant over all other things that we saw on the board or in your vugraph a moment ago, not by a factor of two but by a factor of 100, I do not know of any way at the moment for you or me to show that it is not dominant by a factor of 100. This is the difficulty as I see it.

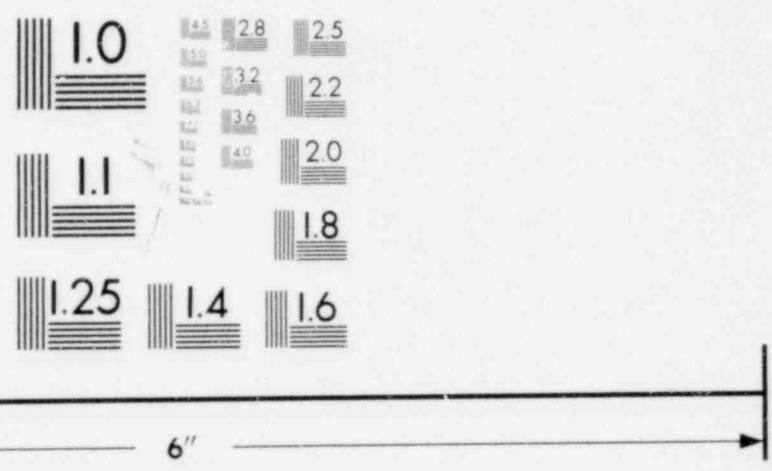
MR. EBERSOLE: Your early remark about the incapacity of a bunkered system, no bunkered system would be adequate unless it had a capacity to isolate within itself in the primary containment the effects of any influence external to those perimeters. So it would close up like a turtle with a bump on it, and then you would not care if somebody blew up the intake building or whatever.

MR. BERNSON: I think you have to define what the threat is, what the system is, and make sure the operators do not get a false sense of security by having it. The worst thing I think that could happen is if they had a minor threat in the control room and they all ran out to the bunker. This might not be the right response.

MR. EBERSOLE: True.

MR. KERR: Also, Jesse, with your skepticism about the ability of things to close off, it seems to me that this bunkered system would have to look at that closing up possibility pretty carefully.

IMAGE EVALUATION
TEST TARGET (MT-3)



MR. EBERSOLE: It would, I agree.

MR. OKRENT: Well, in any event, you stimulated a lot of discussion, Roger. I guess we probably should go on to our next speaker in order to make sure that at least we can get that on the agenda. Sorry we are so late.

MR. KERR: Mr. Chairman, while he is getting up, I meant to pose a question to GE and I want to pose it. They may not have a chance to answer it after this. But I did not see any reference in their risk assessment to the specific contribution of human error in the sense, for example, of maintenance errors. It may have been built into those chimneys that you showed, but wait until after this presentation is over with if you do not mind, and if you do not get a chance to maybe you can tell me later.

I just wanted to know specfically where the human error came into your assessment or if it did.

MR. WALKER: I meant to say good afternoon. Good evening, my name is Lloyd Walker and I am here from Stone and Webster Engineering Corporation. We appreciate the opportunity to address you.

First of all, let me state that Stone and Webster believes that its reference plant, as described in SWESAR, is a safe design. Stone & Webster also believes that standardization is the most effective way to ensure safe designs. Let me briefly state some of the reasons why we believe.

The use of standardized designs as opposed to a series of tailor-made designs permits both designer and regulator to concentrate their resources on determining whether there are ways to meaningfully improve the safety of nuclear power plants, as opposed to the busy re-designing and re-reviewing new plants.

The standard plant design details are available earlier; thus, operators can be trained earlier and more thoroughly. In fact, operators training for a new plant can familiarize themselves with plant operations in an operating plant of the standard design, because standardizing hardware results in standardizing software; namely, operating, maintenance and administrative procedures.

The ability to implement corrective action is improved in standard design. Upon identification of a deficiency in the design it can be corrected and the correction can be readily disseminated to all plants using that standard design.

I would like now to discuss a concept for improving the current standardization program. The concept would provide the NRC with a sound basis for its conclusions regarding the safety of nuclear designs at an earlier stage in the licensing process. Both the Kemeny and Rogovin reports expressed strong support for this goal. The standard design approval and the single stage licensing concepts which I am now going to discuss accomplish this goal.

It is primarily a modification of the current final design approval concept. One of the problems with the final design approval concept as it now exists, particularly for AE's, is that we would be unable to provide information related to specific equipment which is going to be used in the plant. The reason being, it would be anti-competitive in nature if we named all the manufacturers of relays, pumps, et cetera. The concept would work as follows.

The developer of a standard design for a nuclear plant or a major portion of a plant would submit a safety analysis report with an application for a standard design approval. The applicant could be either a reactor manufacturer, an architect engineer, a utility or any combination of these.

The application could describe an NSSS alone; it could describe a nuclear island, a balance of plant, a turbine island or othe major portions of a plant, as is now done under the reference system option. Or it could describe an entire plant, as is now done under the manufacturing license duplication and replication option.

The safety analysis report for a standard design approval would contain a considerably greater level of detail of information than a current PSAR, but somewhat less than an FSAR.

As I mentioned earlier, to avoid implications of anti-competitiveness, the equipment and components would not be identified by manufacturer as is currently required in FSAR's or in final design approval applications. Instead, detailed functional requirements for equipment and components would be specified wherever detailed design was dependent on the identification of a manufacturer.

For example, current FSAR's require final electrical control diagrams which cannot be provided until the equipment manufacturers have been selected. Another example of what cannot be provided is certification of equipment qualification.

However, even without naming manufacturers, the standard design approval safety analysis report would include detailed PNID's and basic electrical and control diagrams with manufacturer-related items treated as black boxes.

Those black boxes would be described with detailed functional specifications. This level of design detail will permit such things as failure modes and effects analysis to be included in the safety analysis report. This level of detail also means that the design is essentially frozen.

The end product of the NRC review would be an essentially final staff safety evaluation report supporting the issuance of a standard design approval which would not be subject to NRC re-review in individual utility applications. In fact, the level of detail provided in the safety analysis report would provide the NRC staff with a sound basis for its safety conclusions and enable them to give confident hearing testimony regarding any safety-related aspect of the design.

The standard design approval concept that I just discussed provides a ready progression to single-stage licensing. Single-stage licensing would combine construction permit and operating license proceedings into a single NRC action called a conditional operating license.

After the issuance of a conditional operating license, an audit function would then be conducted by the NRC to confirm that the as-built plant met the previously approved detailed design and the equipment functional specifications stated in the safety analysis report.

Once the audit function is satisfactorily completed, the plant would then be permitted to operate with no requirement for further NRC action.

My final comments are directed towards the various degrees of standardization which have been proposed. One proposal is Congressman Udall's idea of a single standard design by DOE. Another proposal would have established four design teams consisting of a nuclear steam supplier and an architect engineer for each of the four water-cooled reactor systems.

And, of course, another proposal, the one which I discussed with you today. Stone and Webster favors making more extensive and efficient use of the present standardization program including the implementation of standard design approvals and single-stage licensing because of the serious disadvantages which would result from the single DOE design and the four NSSS-AE design concepts.

The current standardization program and the improvements are discussed today. They are consistent with well-tested and longstanding practices in the nuclear industry. They can be implemented with minimal perturbation on the industry and on the regulator.

The single DOE design and the four NSSS-AE design team concepts would be a significant disruption of current industry and regulatory practices. These concepts also have a significant drawback of giving commercial advantage to those AE's who were selected to be part of the single DOE or the four NSSS-AE design teams. This could cause other AE's to withdraw from the nuclear business.

Loss of a significant portion of expertise would be damaging to public safety, not only because of limited participation by AE's in the development of the standard designs, but because of a loss of continuity in keeping track of those designs already in use.

Another disadvantage is the potential for common design deficiency to disable a significant fraction of operating power plants. This could create a sudden and serious shortage of power with its attendant effects on the health and safety of the public.

Stone and Webster believes that to ensure a safe design, the best standardization to proceed upon is to make more extensive and efficient use of the present standardization program, including implementing the standard design approval and single stage licensing.

I have one additional comment. Dr. Okrent raised the question earlier regarding the number of standard designs that might exist. In this regard I would like to point out that the SWESAR safety analysis report, 90% of that report is common to all four reactor designs covered in the SWESAR document. Only 10% is specific nuclear steam supplier related.

Thank you, gentlemen. Questions?

MR. KERR: When you talk about a standard plan, I gather you are not talking in any sense about plants that are identical; you are talking about the present standardization policy does not produce plants that are identical, does it.

MR. WALKER: The SDA concept would provide for a mere final design at the application stage or the standard design approval. The plants would be system-wise identical. There will be naturally some site variations: cooling water, et cetera.

MR. KERR: Now, if you discuss this in the context we are discussing it, which is for new plants, you said that Stone and Webster is convinced that SWESAR is a safe plant. I am paraphrasing, perhaps, but does that mean the existing SWESAR, the one where you have a PDA -- .

MR. WALKER: PDA's? Yes.

MR. KERR: You wouldn't modify that, or would you take another round of improvements and then come up with a SWESAR which you would consider appropriate for new plants? At what level are we -- .

MR. WALKER: Since our PDA's were issued, we have had some significant events such as TMI. And, of course, that would have to be incorporated.

The NRC has many action plans -- .

MR. KERR: You are telling me it would not be the SWESAR for which you have the PDA, but another one?

MR. WALKER: It would be the SWESAR's we now know and love with the improvements that have been mandated by the NRC since that time.

MR. KERR: Given that you have that, how long would you feel comfortable about building plants to that design without making significant changes?

MR. WALKER: We would feel comfortable with an eight-year approval period, with the proviso, of course, that if a significant CP issue came up, that that would be considered by both NRC and Stone and Webster for incorporation in the standard design.

MR. KERR: That would be an eight-year period. You would be willing, at the end of the eight-year period to contract with somebody to build a plant using that design, and that assumes that the plant is going into operation X years after that, where X is about how much?

MR. WALKER: After we are chosen as the architect engineer?

MR. KERR: After you and your contractee, if that is the right word, decide you want to build with that SWESAR.

MR. WALKER: We are talking about another five to eight years.

MR. KERR: So you are building a plant that goes into operation 16 years after the approval of the SWESAR, and you would not feel, of the impossible safety changes that any changes in design would be appropriate for that period?

MR. WALKER: I think it would be on both sides. There would be changes that would be made because of significant safety increases that would result from those changes, and if it turned out that the marketplace was such that it was unsaleable, then one would come to the NRC and request a change.

MR. KERR: I am trying to get a feel for your experience, whether you think the market and technology will stand still, in effect, for 16 years. That is sort of what you were telling me. I am trying to get an idea of how standard standard plans can be and for how long, and I do not have a preconception. Except I think standard plants are impossible. But other than that, I do not have any preconceptions.

(Laughter.)

I think you are telling me you do not feel uncomfortable in talking about a 16-year period.

MR. WALKER: Correct.

MR. OKRENT: Any other -- ? I guess the late hour is inhibiting discussion. Mr. Bernson?

MR. BERNSON: Just sort of a footnote to this. I think to some extent it depends upon the level of detail that you are dealing with. As I said before, I think all of us feel that the basic systems of these plants are quite mature, and once set for a given NSSS would not require change unless you were faced with a given safety issue. As long as you are not frozen to specific equipment because you are going to buy it commercially at the time, that gives you some flexibility.

Now, you may want to come in and buy -- and try to license a new control room in four years if the state of the art changed fast enough for a new computer system. I think all that is covered by this concept of standardization.

Our point is that we should make sure that the level of detail necessary for licensing is well understood, and I do not want to use the word limited because that is not fair. There may be some commercial reasons to go further. But we ought to reach a good understanding as to what it is that the staff reviewer needs to reach a finding that if you complete the design that way you will, in fact, have met the requirements.

MR. OKRENT: Let me ask Epler and Lipinski if they think the proposal as described by Stone and Webster, where one sets performance specifications for various control elements for example, would be sufficient, and so that you would not have to worry that one manufacturer's control element had some anomalous failure mode. I am not sure how big a component is going to put in a box. If he is going to put in -- .

MR. WALKER: We will not go as far as the reactor.

MR. OKRENT: How about the core protection system? Is that a box?

MR. WALKER: A system, no. Now, we are talking about for Stone and Webster's portion of the design -- we have flow diagrams, we have PNID's, how we are going to intrument it and what the actual choice of the flow control element -- the naming of the manufacturer, which affects the very little ends of detailed control drawings, that would not be there.

What would be there would be the functional requirement for that, including its postulated failure modes. And then when we purchase -- when NRC is performing an audit function, they could then look and see whether or not, indeed, A, B, C flow element company, Model C, met those functional requirements.

MR. EPLER: I would like to respond to that. We do have some experience. We designed the first light water reactor control system in 1946, and we designed one once a year after that for the next ten years and we made some changes. But we did not go into the second generation until we went to the HFR in 1965. That was 20 years. We did make some small changes but no radical change for 20 years.

I would observe that the commercial reactors made some decisions in the early fifties that they are still using. The regulatory process does not encourage radical change, and some would like to see change but there has been no change because of the inertia of the regulatory process.

So I think it is quite all right to embark on a program that would commit you to a given design for ten years, and that you would spend X more years marketing it.

And I am also sure that if the regulatory process would permit it and the vendor found it to his advantage to break into this standard design with some small changes, that he would do it, because all he would risk is some regulatory -- I do not see anything wrong with this.

MR. OKRENT: You answered a different question, though. My question was can, at least from the portion of the plant that the AE specifies, if you take certain components and instead of saying I am going to get something Honeywell makes or whatever it is, or valves made by so-and-so, you put in performance specifications for that component. And I guess you have now said also something about failure modes.

MR. WALKER: Yes, and this would -- and this would enable you to do a failure modes and effects analysis.

MR. OKRENT: This would be an acceptable procedure, and then you could go out, presumably, and buy it from whomever met those requirements and you, as the guy who is always worried about common modes, would not worry about it in the process of doing this. Whoever changes this might be vulnerable to something else. He might buy 12 relays according to this mode of purchase and then they all had -- .

MR. EPLER: I guess I do not identify the concern.

MR. OKRENT: Good. If, in fact, you think you can deal with the problem in that fashion that is fine, because that would make this proposal somewhat, you know, more tenable.

MR. KERR: I was just going to comment, irrelevantly or irreverently, I am not sure which, this discussion of standardization reminds me of the little boy whose aunt gave him a pincushion for Christmas. And after repeated nudging from his mother he finally wrote her a letter and he said, Dear Aunt Bessie, thank you very much for the pincushion, it was just what I was always wanted. But not much.

(Laughter.)

It sounds like to me we want standardization, but not quite.

(Laughter.)

MR. LIPINSKI: Let me comment. You have the same problem now in terms of whatever components they select on the balance of plant and the staff review plan. And balance of plant, they do not look at each and every item. They are focusing their attention on the aux feedwater systems now.

But the rest of the equipment that is in balance of plant they are just giving a glossed scan to that because it does not have safety connotations in the same sense that the nuclear -- .

MR. KERR: On the one hand I hear that one of the advantages of the standard plan is if you build them like that and an operator can go into one plant and he goes into the next plant, then he just feels right at home because he cannot tell the difference. To me, that says they are almost identical.

MR. LIPINSKI: That is the Stone and Webster balance of plant. He is not the only AE.

MR. KERR: On the other hand, maybe a standard plant does not mean that at all, and I guess part of what I am doing is educating myself as to what is meant by a standard plant. And it may just mean a plant that does not have to be relicensed every time it is built.

If that is what it means, that's okay.

MR. WALKER: It means more than a plant that does not have to be relicensed or re-reviewed.

MR. EPLER: Could we put it like this; we change models of automobiles once a year; couldn't we do it with nuclear plants once every eight years.

MR. WALKER: Why not?

MR. EPLER: You still have four wheels on the ground, one steering wheel; comes in different colors but they don't change much. Sometime before 1920 they put on self starters so the ladies could drive them. They put glass windows on them, but they haven't changed much since then.

MR. EBERSOLE: Maybe you picked a good example. Automobiles can be beautiful things or they can be lemons. They come in immensely differing quality levels.

MR. EPLER: That is because they change them too often. Depends on whose production line; American or Japanese.

MR. EBERSOLE: When you buy a lemon you had better have a changeable parts list.

MR. EPLER: On the other hand, I think some of the changes we have seen in the plants are frivolous.

MR. EBERSOLE: I am all for changing it right the first time and using it for 50 years.

MR. KERR: Mr. Chairman, do you suppose without ending the discussion, I could get a response to the question I asked GE?

MR. OKRENT: I think it is the right time to get the response, thank you.

MR. KERR: Did you understand the question I was raising?

MR. DUNCAN: I think your question, just to repeat it to get it clear, was to what extent were maintenance errors considered in those risk assessments that we were discussing earlier.

MR. KERR: Maintenance errors and any other human errors that one might have singled out as being significant. But talk about maintenance errors first if you like.

MR. DUNCAN: Okay. I hate to have you wait so long for such a short answer, but I am not familiar with the details. I do not know if maintenance errors were considered specifically, although the unreliability associated with particular equipment is largely based on historical records. That is, this particular design feature has been in plants for so many years, and there is some historical record as to how often it fails.

Those analyses are often compared to more specific analysis by looking at individual components, the failure rates on those and then there is some compari ,n made of what you might analytically calculate for an unavailability.

MR. KERR: I would say this is entirely reasonable if yorr reliability data have come from operating GE plants. Is that where you get your -- .

MR. DUNCAN: Yes, basically. And as new systems are introduced, you often do not have that, and usually in that case, then, some similar system is selected to make that judgment on.

MR. KERR: Okay.

MR. DUNCAN: Pumps and valves, for example. The steam turbine on which those kinds of adjustments are made. So I cannot answer your question specifically, but there is some degree of historical checking on what kind of experience on that particular design or valve.

MR. KERR: I would think particularly if you are looking for improvements, you would at least have scanned through to make certain that there is not some particularly vulnerable system which might provide significant improvement because of maintenance errors or something. Or that there might not be something in which the experience in a nuclear plant is different.

MR. DUNCAN: To some degree, I think that was included. For example, I mentioned that although I did not highlight them in our presentation, I did mention some ideas we came up with for improving water level indication. There have been maintenance errors whereby pass valves have been left open or partially open which equalizes the pressure in the system. The system thinks the water level is different than what it really is. And some of the ideas we have developed addressed that sort of problem.

MR. KERR: Thank you.

MR. OKRENT: All right. At the beginning of the day I wistfully assumed we were going to have spent two hours by now having discussed how the subcommittee makes possible recommendations to be developed for the full

Committee to be considered. I do not know what you all feel; I guess I will raise a couple of alternatives.

One is that we discuss this matter at this time, and see what surfaces. The second is that each one here try to write down one or more suggestions for consideration or a general approach or maybe a suggestion that it is impossible to recommend anything. I do not know what you all feel.

MR. KERR: I do not function very effectively after about this time of day, and I could write some things down. I would personally prefer to do some writing. One certainly gains something by discussion. If there is a consensus we should do that, I will not object.

MR. EBERSOLE: I guess I feel about the same way.

MR. OKRENT: I see. Well, let me then do the following. Let me ask that each of you -- and I will ask Dick to contact the other members who are not here -- write me a memo indicating what you think either of the general approach or a specific kind of recommendation that we should consider suggesting to the full committee their possibly sending out to the Commission. To the extent possible, if you have things you think you would like to see recommended for inclusion in any draft letter, I would like to have them worded. It is not as helpful to receive 100 pages with a note -- .

(Laughter.)

-- that here is an issue I am concerned about, as to give me the 100 pages but give me about a page which is written in the form, you know, draft ACRS letter form.

I think Ed knows what I am referring to.

MR. EPLER: Yes.

MR. OKRENT: Is that okay? And I think I ought to have this by the end of May I would like it if I can. By the way, I am reminded by Dick, assuming that the full committee stays on a better schedule than we did, we are going to discuss this matter with the full committee, and at that time, you will have a chance with everybody to make some suggestions. But whether that occurs or not, I would like to have your specific suggestions, whatever they are, by the end of May.

Okay. Fair enough. Any other comments?

(No response.)

Let me thank all the speakers for giving us a rather wide range of topics. I think they give us some feeling for the way some of the approaches we have in mind might go, and so, it has been helpful.

With that, I will adjourn the meeting.

(Whereupon, at 6:05 p.m., the Subcommittee adjourned.)

NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

____

in the matter of: ACRS/Subcommittee on Safety Philosophy, Technology and Criteria

Date of Proceeding: May 6, 1981

Docket Number: ______________________________

Place of Proceeding: Washington, D. C.

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

David S. Parker

Official Reporter (Typed)

[signature]

(SIGNATURE OF REPORTER)

POOR ORIGINAL

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I. Introduction and Summary

Domestic nuclear power business has been in the doldrums for the past half decade. That is unfortunate because our industry has a proven record and a socially beneficial way to provide power to meet America's energy needs. Industry is not attempting to foist an unstable technology on an unsuspecting public; it is offering a soundly engineered, thoroughly evaluated approach to providing energy for public consumption.

During the past decade, the licensing process for a nuclear power plant has been lengthened considerably by many factors, with a large portion attributable to duplicative and redundant reviews by the NRC staff and the unnecessarily repetitive and time-consuming two-stage licensing process. This two-stage licensing review, in conjunction with mandatory construction permit stage hearings as well as possible further hearings during the operating license stage, has created uncertainty and associated delays that are unwarranted from the standpoints of enhancing public health and safety and of improving our energy supply.

Improvements in this licensing process are required to alleviate the delays that have been experienced, to eliminate the duplication of effort and wasteful use of our country's human resources, to infuse new life into our industry and to permit use of a key energy option. It is believed that further emphasis on standardization and single-stage licensing will go a long way to achieving these objectives.

It is in this context that the following presentation surveys the significant history of the nuclear power plant standardization effort and provides specific recommendations concerning the direction the industry and its regulators should take. It proposes retaining the best features of current NRC standardization policy, integrating the best features of a number of additional approaches that have been conceived and proposed by industry and others, and implementing a single, simplified policy that can be supported by the public, the industry, and the NRC. This new unified approach would combine the benefits of nuclear plant standardization with the benefits of a single-stage licensing process.

II. Background

The Atomic Energy Act of 1954 introduced the two-stage licensing process and procedure. The two stages were identified as the construction permit (CP) stage and the operating license (OL) stage. The two-stage licensing process envisioned a first stage describing preliminary or conceptual designs which were clearly understood to lack detail and which were expected to be further developed, thus requiring a second review. This was often the case for plants proposed through the mid-60's.

As the nuclear industry and nuclear power plant technology matured, the AEC (and later the NRC) staff requested more and more information at the CP stage. This trend shifted more and more of the detailed safety review from the later OL stage to the earlier CP stage. In essence, it resulted in some areas receiving a final (operating license) type safety review at the CP stage. As this trend continued, the OL-stage became less and less necessary, although it was still conducted because AEC/NRC has traditionally interpreted the mandate of the Atomic Energy Act as requiring two reviews.

The maturing nuclear industry had already begun efforts toward developing standardized approaches to nuclear power plant design when the AEC issued its initial policy statement on standardization in 1972. For example, the Stone & Webster standardization effort began in the 1960s with the best features of one plant design being utilized as the "current standard" for later plants. In similar fashion, the reactor manufacturers were standardizing their nuclear steam supply systems (NSSSs).

The 1972 AEC policy statement on standardization held forth that its goal was:

> "...to encourage, support and give priority consideration to activities leading to greater standardization of nuclear power plants in terms of their design, fabrication, construction, testing, and operation."

In 1973, the AEC announced its readiness to implement its standardization policy through the use of the Manufacturing License and the Duplicate Plant and Reference System Concepts. A fourth option, the Replicate Plant Concept, was added in 1974. These four standardization approaches were to be implemented within the framework of the existing two-stage licensing process, but major benefits were expected through the elimination of the need for the staff to rereview a design that had previously been reviewed and approved as part of an earlier application.

Under the Reference System Concept, the outcome of a successful NRC staff review of a reference plant design was the issuance of either a Preliminary Design Approval (PDA) or a Final Design Approval (FDA), depending on the level of design detail contained in the Safety Analysis Report (SAR). The Duplicate Plant Concept, which was applied to a specified number of units, has its Preliminary and Final Duplicate Design Approvals (PDDA/FDDA). A utility-applicant's CP or OL applicaton would incorporate by reference the appropriate design approval(s) from either of these two approaches. The Replicate Plant Concept had its CP or OL issuance dependent on the results of a qualification review that would verify the acceptability of the base plant for replication. A Manufacturing License (ML) would specify the number of units that could be manufactured under the license, and a CP or OL application would reference the ML.

In 1973, 16 nuclear facility applications (many for multiple units) were submitted to NRC and docketed. Two of these applications (for four units) were based on duplication and one application (for eight units) was for an ML. In 1974, 19 new docketed applications included six (for 11 units) based on duplication, one (for two units) on replication, and seven (for 19 units) on the reference plant approach. In 1975, six new docketed applications included one (for two units) based on replication and two (for four units) based on the reference plant approach.

Within a few years, nuclear power plant licensing activities had declined significantly. Only two facility applications (for four units) were filed in 1976, and the same number again in 1977. One of the 1976 applications (for two units) was based on replication and the other (also for two units) on the reference plant approach. Only one application (for two units) of the two filed in 1977 was based on standardization - another reference plant.

At the present time, of the 23 reference plant designs that have been submitted to NRC for PDA review and were docketed, 13 have been awarded PDAs, three have been withdrawn by the applicants, and seven have had their reviews suspended by the NRC. Of 13 CP applications utilizing a reference plant design (for a total of 31 units), only nine applications (23 units) have been issued or have pending CPs; the rest have been withdrawn. The eight applications utilizing the duplication option (15 units) have been reduced to six applications (13 units) with CPs either issued or pending. Of five applications utilizing the replication option (nine units), only one application (two units) remains extant. The single application (eight units) for a Manufacturing License remains pending, although the potential users have cancelled their orders. At least two PDA holders have upgraded their applications and resubmitted them to the NRC for Final Design Approval (FDA) review. Those applications are also currently pending.

In 1977, the NRC reviewed its experience with standardization since the program's inception in 1972. As a result, in 1978, the NRC issued its latest policy statement, which, in addition to lengthening referenceability periods, recognized the need for an additional approach called the Standard Design Approval (SDA).

The Standard Design Approval (SDA) concept provides a ready progression to a single-stage licensing approach. The SDA had been proposed to the NRC by Stone & Webster in 1977, for a number of reasons, including anti-competitive implications relative to the level of design detail required for an FDA that would not normally be available until procurement of equipment. It envisioned a single-stage near-final design approval oriented toward combining construction permit and operating license into a single NRC action called Conditioned Operating License (COL). A supplementary audit function by the NRC staff would be conducted during construction and would confirm that the final detail design and "as-built" configuration of the plant met the previously approved detailed functional specifications. The SDA/COL philosophy will be further discussed later.

As referred to previously, the 1978 NRC policy permits a PDA to be referenced for five years from its date of issuance. To prevent their expiration and allow a longer referenceable period, the NRC recently administratively extended certain of the issued PDAs. The AIF Committee on Reactor Licensing and Safety sent a letter commending the Commission for this positive step taken to preserve the standardization options available to the nuclear industry and stressing the need for additional positive steps. The industry is concerned that NRC's intent to rereview an approved design against "current licensing requirements" would be misconstrued as being inconsistent with the intent of maintaining the standardization concept and would effectively negate the benefits of an approved PDA. The letter further stated that only the significant TMI-2 related safety issues should be addressed in the new application and that the most effective use of staff and industry resources would result from not rereviewing previously approved material.

With major accomplishments achieved over the last decade and the maturing of the nuclear industry,the necessity of a two-stage process has been increasingly questioned. The two-stage process is inherently duplicative with the repeated review of design aspects that had been reviewed and approved during earlier licensing proceedings. In addition, the two-stage process offers little incentive for future design standardization in spite of high inherent reliability, availability and safety benefits, as well as significant cost and time savings.

The Kemeny and Rogovin reports both indicate strong support for the concept of submitting more complete designs to the NRC to provide NRC with a sounder basis for its conclusions regarding the safety of nuclear designs. This would be accomplished with single-stage licensing. The Rogovin report also directly supported the single-stage licensing procedure.

In 1980, General Electric Company proposed again the one-step licensing concept, originally presented to DOE, NRC and other interested parties in 1978. In essence, this nuclear plant licensing reform combines standardization and single-stage licensing. Through rulemaking, the GE proposal would allow issuance of a "power worthiness certificate" (PWC) for a nuclear island - a portion of a plant that includes all buildings which are dedicated exclusively or primarily to housing systems and equipment related to the nuclear system. The power worthiness certificate would be referenced by a utility applying for a combined CP/OL.

A draft of the soon-to-be-issued report of the Congressional Office of Technology Assessment (OTA) on its workshop on nuclear power plant standardization held September 9 and 10, 1980, expresses a favorable attitude toward standardized plant designs. However, the OTA report's definitions differed as to what standardization should be - one standard national design, four basic plant designs, or separate standardized systems. One approach advocated a single national design embodying the best features of the current reactor designs. Another approach advocated was called "the safety block," which was defined as that portion of a nuclear power plant that monitors and executes all safety functions protecting the core and containment - a scope definition somewhat less inclusive than a nuclear island but more inclusive than an NSSS.

Finally, two important sources of past licensing reform legislation originated from DOE in 1978 (H.R.11704) and EEI in 1979 (H.R. 3302). Both bills had sought to introduce forms of single-stage licensing as well as preapproved siting. The two bills included an assortment of measures, some of which would impede licensing, and others which effectively prevented achieving any Congressional agreement. Any new bill brought before the Congress should be limited to key issues, to focus on accomplishing basic reform. That is the essence of what is needed.

III. Current Developments

The AIF Subcommittee on Standardization, formerly the Subcommittee on Standard Design Approval Guidelines, has broadened its objectives to include assessment of standardization techniques, development of the basics of licensing reform legislation, and preparation of suggested implementing rulemaking policy and requirements and associated regulations. AIF will work with other groups, such as the Edison Electric Institute (EEI) and the American Nuclear Energy Council (ANEC), to accomplish the desired legislative objectives.

The standardization subcommittee's basic goal is to set the stage for NRC to grant Conditioned Operating Licenses (COLs). To achieve this, the subcommittee has assigned itself three tasks - two near term and one longer term. The near term tasks are (1) to prepare the basics of proposed licensing reform legislation, for introduction to the Congress, that addresses standardization, early site approval, and single-stage licensing, and (2) to prepare a suggested revision to Regulatory Guide 1.70, to include single-stage licensing format and content information requirements. The longer term task involves providing guidance and assistance to NRC in the development of the necessary revised regulations and guidelines that will promulgate and implement standardization and single-stage licensing.

Some members of the legal community believe the NRC could proceed with a single-stage licensing procedure without legislation because the Atomic Energy Act of 1954 may already allow it. However, the risk of delay, caused by the questioning of legality, to the first single-stage applicant is high enough that single-stage licensing legislation is needed to accomplish two aims: first, it would clarify congressional intent to permit single-stage licensing and second, it would define the way the NRC should implement that intent.

To ensure the involvement of industry in the development of this vitally needed licensing reform, the AIF Subcommittee on Standardization has started to prepare material describing the basic aspects of legislation that would implement both its unified, simplified standardization approach and the single-stage licensing process that is directly needed to revitalize our industry and our country. The legislation would authorize a nuclear power plant standardization program and introduce, as an alternative to the present two-stage (CP&OL) process, a single-stage licensing process involving a Conditioned Operating License (COL).

The basic concepts behind the subcommittee's efforts are relatively simple. They do, however, serve to reduce the total number of formal standardization options presently existing, while simultaneously increasing the overall flexibility in the standardization program.

The developer of a standard design would submit an SAR describing its design with an application for a Standard Design Approval (SDA). The applicant could be either a reactor manufacturer, an architect-engineer, a utility or a combination thereof. The application would describe an NSSS, a nuclear island, a balance of plant (BOP), a turbine island, or other major portions of the plant that under the existing guidelines are encompassed by the reference plant option; or an entire plant, addressed presently under the manufacturing license, duplication, and replication options. The SDA would be essentially equivalent to the design approvals presently conferred by the NRC to attest that the plant design is such that the plant can be constructed and operated without endangering the health and safety of the public. The SDA would be awarded solely on the basis of the NRC (including ACRS) review, as was the case with the PDAs and FDAs and the PDDAs and FDDAs (Preliminary and Final Duplicate Design Approvals) permitted under the current program.

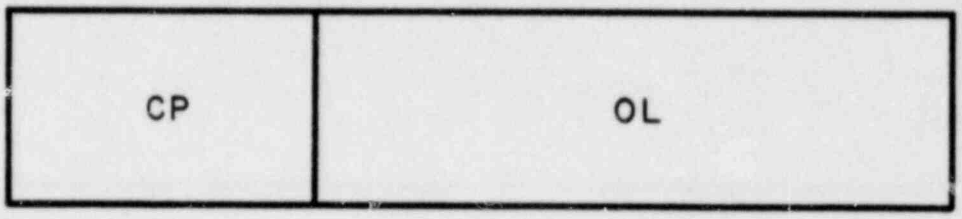
Following receipt of an SDA, an applicant could, if desired, apply for certification of the approved standard design via rulemaking proceedings that allow for public participation. The certification process would then result in issuance of a certified design approval (CDA) or a nuclear acceptability certification (NAC). A certified design, having once gone through the public hearing process, would not be subject to further review in the COL process. The issuance of an SDA, CDA or NAC would effectively fix the plant design, except for significant safety related changes, for a definite period of time, thus minimizing design changes during construction of the plants using the standard design.

A prospective plant applicant could proceed with a COL (Conditioned Operating License) application by preparing an SAR that incorporates SDAs, CDAs (Certified Design Approvals) and/or NACs (Nuclear Acceptability Certifications) for an NSSS and a BOP, or for an entire plant, and by providing the necessary site/utility specific information. Or the applicant could submit an SAR describing a custom plant design (given a sufficient level of design detail) and request a COL, thus taking advantage of single-stage licensing without utilizing the standardization approach. In either case, a preapproved or banked site could also be used, providing additional benefits to the applicant (as well as to the regulators). The only portions of a COL application that would be subject to the public hearing process would be those portions of the plant for which a CDA or NAC had not already been issued and those site-related aspects not already approved in an early site review (ESR) certification. Thus, the proposed licensing process would accommodate all of the existing standardization options - the reference plant, manufacturing license, replication and duplication options.

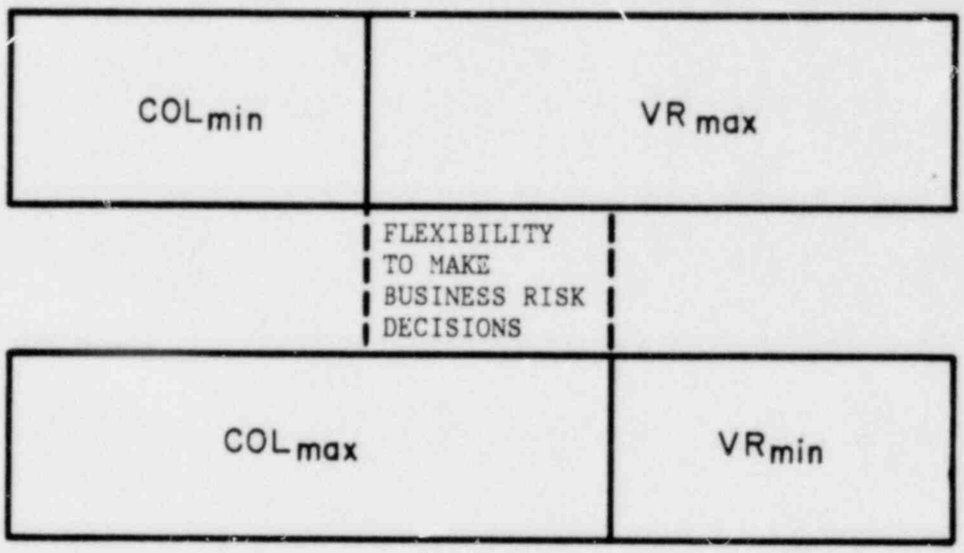
As was stated previously, the Subcommittee on Standardization is currently also developing a suggested revision to Regulatory Guide 1.70. The objective of this effort is to include single-stage licensing format and content information. The current RG 1.70 (Revision 3) defines the level of design detail required at both the construction permit (PSAR) stage and the operating licensing (FSAR) stage. The single-stage SAR for an SDA would incorporate a considerably greater level of design detail in many areas than a current PSAR, but less detail than a current FSAR. Detailed functional requirements for systems and equipment would be specified wherever detailed design was dependent on equipment supplier; individual equipment and components would not be identified by manufacturer. As an example, the current FDA approach requires an application to specify equipment and plant failure modes and to provide resultant failure modes and effects analyses (FMEAs). In addition, the current approach requires seismic certifications for equipment and provision of final electrical elementary diagrams. Much of these types of information is not available until procurement of equipment and the resultant finalization of design, and hence would not be available for inclusion in an SDA SAR.

To avoid implications of anti-competitiveness, the SDA SAR would provide detailed equipment and component performance requirements, including potential failure mode(s) and basic FMEAs. Specific equipment manufacturers would not be identified. The SDA SAR would include detailed P&IDs and basic electrical elementary diagrams, with manufacturer related items treated as "black boxes." Thus, system designs would be basically frozen. Detailed descriptions of methodology (such as testing and computer modeling) explaining how equipment would be qualified, possibly even including sample results, would be included. Thus, the approach will provide sufficient information at the SDA and COL stages for the NRC to determine that the proposed plant meets applicable safety requirements and will not adversely affect the health and safety of the public. Inherently, the single-stage licensing document would provide adequate detail to enable the NRC to give competent testimony regarding any safety related aspect of plant design.

The information currently required at the OL/FSAR stage that could not be provided at COL time under the single-stage licensing approach, would be identified and later provided to the NRC in verification report(s) following award of the COL, i.e., during construction. The specific equipment and construction-dependent information would be provided as the information became available. The verification report(s) would include such items as the seismic certifications of equipment, final elementary diagrams and final FMEAs as well as any other previously omitted information that was dependent on component selection and purchase. Insofar as possible and practical, nothing would be left for post-COL verification that would require NRC review of analyses or design methodology, since that could lead to reopening the safety review and, hence, introduce the potential for additional hearings. The level of detail contained in a single-stage licensing application and verification report is shown in the attached illustration.



CURRENT 2-STAGE APPROACH



PROPOSED SINGLE STAGE APPROACH

COL_{min} = MINIMUM LOD FOR APPLICATION TO GET COL

COL_{max} = MAXIMUM LOD FEASIBLE AT COL STAGE

$VR_{min\ or\ max}$ = INFORMATION FOR (POST - COL) VERIFICATION REPORT

LEVEL OF DETAIL REQUIRED TO OBTAIN OPERATING LICENSE

STONE & WEBSTER

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Construction would be monitored for compliance with the COL by the NRC. It is expected that an unencumbered Operating License would result administratively upon completion of construction, testing, and submittal and acceptance of the verification report(s).

IV. Conclusions

Standardization, coupled with a single-stage licensing process (and preapproved siting) should create an atmosphere characterized by stability and predictability. This will support current commercial and industrial activities and will encourage and enable meaningful planning for the future.

In a reasonably positive financial environment, investors will be attracted when they have some relative assurance of an equitable return on investment. A standardization/single-stage licensing program will significantly shorten nuclear plant lead times, thus tending to reduce present day long-term tie-up of capital that could profitably be used elsewhere; a more timely return of principal provides for future investment.

With the predictability that comes with standardization and single-stage licensing, a utility can practice rational forecasting and planning with reasonable success. Again, instability and uncertainty regarding national nuclear technology policy can be removed by combined industry and government action. It is in the utility industry's and the nation's own economic well-being and interest that standardization and single-stage licensing be implemented.

The public must be made aware of the urgency to revitalize the nuclear power industry without delay. They must be intelligently informed of the consequences of failing to provide this necessary source of energy. The most viable energy source readily available today is nuclear power.

With the new Administration's positive shift in regard to nuclear power plant development, industry must act expeditiously. The attitude in Congress in support of nuclear power is more conducive now than it has been in recent years. The Reagan Administration has significantly reduced the government's emphasis on alternative sources of energy while increasing emphasis on nuclear energy.

Current NRC policy recognizes four standardization options available to the nuclear power industry. A distinct need exists, however, for adoption of a new, simplified standardization approach coupled with a single-stage licensing process.

The AIF approach summarized here is an attempt to consolidate the numerous options available and proposed into a single unified policy that can be supported by the public, the nuclear industry, and the NRC. It is an attempt to optimize safety, availability, and reliability of future nuclear plants, while at the same time minimizing the wasteful use of resources in misdirected, unconsolidated, and time-consuming efforts. The interminable delays and the lengthy time period in getting a nuclear plant operating and on-line in the United States are common knowledge.

Comparatively, it averages somewhere between 2 to 3 times longer in this country than in many overseas countries.

The nuclear industry must demonstrate to both the Congress and the American public that it is aware of the nature of the problems and is attempting to find solutions to those problems. Having confronted the myriad of problems in designing and constructing nuclear power plants, the nuclear power industry is the best-qualified group to establish the criteria for standardization and single-stage licensing.

Should the nuclear industry apathetically stand by, Congress and the NRC will establish the criteria and set the pace for future nuclear development. The inevitable inconsistencies and complicated results of the past would certainly be duplicated in the future. It is essential that the nuclear industry's voice be heard and heard clearly in formulating the criteria.

Section 2

NUCLEAR POWER PLANT STANDARDIZATION

2.1 KEY ELEMENTS

The experience acquired from design and construction or construction management responsibilities for more than 70 nuclear units has been used to develop the Bechtel standardization program. The program is designed not only to avoid the wasteful practice of unnecessary redesign, but also to allow more time for innovation, refinement, and improvements. In 1973, the Generic Pressurized Water Reactor Manual was published for use on future PWR power plant projects. In 1975, the Generic Boiling Water Reactor Manual was issued as its companion to be used as the basic design document for all BWR power plant projects.

The advantages of standardization include:

- Facilitating maximum use of proven experience with resultant improvement in plant safety, quality, reliability, and availability
- Improving overall plant design and construction schedule -- particularly licensing and front-end engineering periods
- Optimizing plant cost
- Improving maintenance and operability
- Allowing more effective use of technical personnel.

The Bechtel standardization program is comprised of six key elements as follows (see Figure 2-1):

- <u>Criteria</u> - Participation by senior technical personnel in the formulation of national and international codes and standards (see Figure 2-2).
- <u>Criteria Application</u> - Generic topical reports covering specific designs, analytical methods, or procedures. These reports provide a mechanism for obtaining Nuclear Regulatory Commission (NRC) approval of critical areas of design and analysis independent of, and prior to, a specific license application (see Figure 2-3 for a listing of Bechtel topical reports).
- <u>Basic System Design</u> (Figure 2-4) - Key design documents consisting of system descriptions, system flow diagrams, system piping and instrumentation diagrams, system control logic diagrams, electrical single-line

diagrams, and discipline design criteria. These design documents form the basis for detailed plant design, and facilitate early review and approval.

- Plant Arrangement (Figure 2-5) - The plant arrangement concept reflects our experience. Major plant elements are divided into functional modules which results in efficient utilization of space and increased constructibility. This functional layout is undimensioned, and provided with sufficient flexibility to accommodate various site parameters, final equipment selection, and new regulatory requirements. This flexibility also permits incorporation of present and future licensing requirements in plant layout. Construction access and schedule flexibility are maximized in the arrangement concept, because we believe that if the plant is constructible, its maintainability is enhanced and the overall plant reliability and safety will be increased.

- Licensing (Figure 2-6) - The Bechtel Standard Safety Analysis Report (BESSAR) assists the projects by reducing efforts in preparing specific safety analysis reports (SARs). It provides guidance and standards in designing nuclear plant systems. Because BESSAR is presented in a uniform manner and follows the U.S. Nuclear Regulatory Commission (NRC) format as well as SAR reviews by licensing authorities, project personnel and the client are greatly facilitated. BESSAR is also periodically updated to respond to the new Regulatory Guides and Standard Review Plans issued by the NRC.

- Procurement - Standard specifications cover major items of equipment, fabrication, and materials required for the construction of the power plant and are prepared, controlled, and maintained by the appropriate discipline chief engineer (see Figure 2-7). These specifications are provided to the project engineering design team, which makes only those changes necessary to satisfy their unique project requirements. These changes or deviations are subject to the approval of the appropriate chief engineer. In this manner, the standard specifications provide management control and a uniform approach to the suppliers which results in greater consistency and desired quality.

2.2 APPLICATION

A summary of the accomplishments of Bechtel's standardization program is as follows:

Of eight BWR units undertaken by Bechtel since 1972, four units have made partial use of the generic manual and two units have followed it directly. Of 23 PWR units, three have made partial use of the generic manual, and 12 have followed it directly. In power generation capability terms, about 25,000 out of 35,000 MW of capacity have been based on partial or full application of the generic designs since 1972 (see Figure 2-8).

2.3 FUTURE DIRECTION (Figure 2-9)

We intend to continue the Bechtel program for standardization at a level consistent with the needs of current projects and our projections of the future. Significant efforts on updating or expanding the scope and detail of our current generic designs do not appear worthwhile unless there is greater stability in the licensing process and a favorable prognosis on future plants.

We do not believe that the current NRC policy on the reference design option for the balance-of-plant provides an entirely satisfactory framework for future standardization for the following reasons.

First, it does not appear to provide enough flexibility to accommodate all potentially suitable sites in the U.S. without imposing significant cost penalties on sites with favorable environmental factors. For example, we understand that the design would have to be executed for the approved seismic design level regardless of the specific site characteristics.

Second, unnecessarily detailed numerical design information is required, thereby restricting the optimum selection of equipment for a specific plant. Standardization should allow sufficient design flexibility to permit competitive equipment procurement and not preclude qualified suppliers.

We believe that a viable standardization program for the balance-of-plant, should be based on fixed plant and equipment arrangement and well-developed safety systems designs, combined with approved design criteria and methods for completing the final design.

We also favor the proposed one-step licensing approach that would result in a conditioned operating license granted at the time plant construction is authorized, provided the level of detail required is not unnecessarily restrictive. It should be possible to grant the conditioned operating license based on information that is not much more detailed than currently accepted for construction permits if provisions are made for NRC staff to audit the final design execution.

BECHTEL STANDARDIZATION PROGRAM

KEY ELEMENTS

CRITERIA	—	CODES & STANDARDS
CRITERIA APPLICATION	—	TOPICAL REPORTS
BASIC SYSTEMS DESIGN	—	GENERIC KEY DESIGN DOCUMENTS
PLANT ARRANGEMENT	—	GENERIC - MODULAR PLANT ARRANGEMENT
LICENSING		STANDARD PSAR (BESSAR)
PROCUREMENT	—	STANDARD SPECIFICATIONS

FIGURE 2-1

G1003249-09

BECHTEL GROUP
1980 CODES AND STANDARDS PARTICIPATION

ACTIVITY	NO. OF CHAIRMEN	NO. OF MEMBERS	TOTAL
ACI	2	13	15
ANS	8	26	34
ANSI	4	17	21
ASME	8	60	68
ASTM	2	15	17
IEEE	7	40	47
ISA	5	18	23
OTHER	4	38	42
	40	227	267

FIGURE 2-2

BECHTEL TOPICAL REPORTS

BC-TOP-1,* REV. 1 (12-72)	CONTAINMENT BUILDING LINER PLATE DESIGN
BC-TOP-3-A,* REV. 3, (8-74)	TORNADO AND EXTREME WIND DESIGN CRITERIA FOR NUCLEAR POWER PLANTS
BC-TOP-4-A,* REV. 3 (11-74)	SEISMIC ANALYSIS OF STRUCTURES AND EQUIPMENT FOR NUCLEAR POWER PLANTS
BC-TOP-5-A,* REV. 3 (2-75)	PRESTRESSED CONCRETE NUCLEAR REACTOR CONTAINMENT STRUCTURES
BC-TOP-7* (9-72)	FULL-SCALE BUTTRESS TEST FOR PRESTRESSED NUCLEAR CONTAINMENT STRUCTURES
BC-TOP-8* (9-72)	TENDON END ANCHOR REINFORCEMENT TEST
BC-TOP-9-A,* REV. 2 (9-74)	DESIGN OF STRUCTURES FOR MISSILE IMPACT

*APPROVED BY NRC

FIGURE 2-3 (Sheet 1 of 2)

BECHTEL TOPICAL REPORTS
(Cont)

BN-TOP-1,* REV. 1 (11-72)	TESTING CRITERIA FOR INTEGRATED LEAK RATE TESTING OF PRIMARY CONTAINMENT STRUCTURES FOR NUCLEAR POWER PLANTS
BN-TOP-2,* REV. 2 (5-74)	DESIGN FOR PIPE BREAK EFFECTS
BN-TOP-3, REV. 3 (8-75)	PERFORMANCE AND SIZING OF DRY PRESSURE CONTAINMENTS
BN-TOP-4,* REV. 0 (7-76)	SUBCOMPARTMENT PRESSURE ANALYSES
BP-TOP-1,* REV. 3 (1-76)	SEISMIC ANALYSIS OF PIPING SYSTEMS
BQ-TOP-1,* REV. 2A (1977)	BECHTEL QUALITY ASSURANCE PROGRAM FOR NUCLEAR POWER PLANTS

*APPROVED BY NRC

FIGURE 2-3 (Sheet 2 of 2)

BASIC SYSTEMS DESIGN
GENERIC KEY DESIGN DOCUMENTS

- SYSTEM DESCRIPTIONS
- SYSTEM FLOW DIAGRAMS
- SYSTEM P&IDs
- SYSTEM CONTROL LOGIC DIAGRAMS
- ELECTRICAL SINGLE-LINE DIAGRAMS

FIGURE 2-4

GENERIC MODULAR PLANT ARRANGEMENT OBJECTIVES

- REFLECT BECHTEL LEARNING CURVE FOR FUTURE PROJECTS
- FUNCTIONAL LAYOUT WITH NECESSARY FLEXIBILITY TO ACCOMMODATE
  - VARIABLE SITE CONDITIONS
  - ALL QUALIFIED MFRs EQUIPMENT
  - NEW REGULATORY REQUIREMENTS
- INSURE IMPLEMENTATION OF PRESENT AND FUTURE LICENSING CRITERIA & REQUIREMENTS IN PHYSICAL PLANT LAYOUT
- MAXIMIZE CONSTRUCTION ACCESS AND SCHEDULE FLEXIBILITY
- MAXIMIZE PLANT RELIABILITY, EASE OF PLANT OPERATIONS, & MAINTENANCE

FIGURE 2-5

BECHTEL POWER CORPORATION
BESSAR

INCLUDES

- TEXT COMMON TO ALL NSSS
- ALTERNATIVE TEXT FOR UNIQUE BOP FEATURES
- TYPICAL EQUIPMENT PARAMETERS
- CRITERIA FOR DESIGN

EXCLUDES

- TEXT UNIQUE TO NSSS SYSTEMS
- TEXT UNIQUE TO PLANT OWNER
- UNIQUE SITE CHARACTERISTICS
- INFORMATION DEPENDENT ON DETAILED DESIGN

FIGURE 2-8

BECHTEL POWER CORPORATION ENGINEERING STANDARDS

- STANDARD SPECIFICATIONS
- STANDARD DRAWINGS
- DESIGN GUIDES
- INSTRUCTIONS/PROCEDURES
- DATA LETTERS
- NEWSLETTERS
- PROBLEM ALERTS

FIGURE 2-7

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RECENT* APPLICATIONS OF BECHTEL GENERIC DESIGN

	YES	PARTIAL	NO	TOTAL
BWR UNITS	2	4	2	8
PWR UNITS	14	3	8	25
	16	7	10	33
MWe	18,150	8,343	9,872	36,365

*STARTED SINCE 1972

FIGURE 2-8

FUTURE DIRECTION

- GENERIC APPROACH
- SITE FLEXIBILITY
- EQUIPMENT PROCUREMENT
- MINIMUM DETAIL
- NRC AUDIT VERIFICATION OF DESIGN
- ONE STEP LICENSING

FIGURE 2-9

G1003249-17

Table 1 - Features to be Considered

1. Containment heat removal

   - active or passive

2. Containment mass removal

   - filtered or unfiltered
   - different sizes

3. Increased containment volume

4. Increased containment pressure capability

5. Combustible gas control

   - controlled burning
   - inerting, prior to and post accident
   - halon injection
   - fogging

6. Core retention devices

   - dry or wet
   - active or passive cooling

7. Vapor explosion control

   - missile shields

8. Add-on decay heat removal system

9. PWR primary system depressurization

   - automatic or manual
   - size

10. BWR containment spray system

A Licensing Framework for the Next Generation of Nuclear Plants

I. Electrical Industry Projections of Next Nuclear Plant Orders

II. Steps in Developing the Licensing Framework

- Complete the Post - TMI Rulemakings
- Digest all the Lessons
- Update the SRP

III. Elements in the Licensing Framework

- Siting Policy
- Safety Design Guidelines
- Standardization
- Licensee Accreditation
- Guidelines for the Design Process
- Stabilize NRC Staff Review Process

I. ELECTRICAL INDUSTRY PROJECTS OF NUCLEAR PLANT ORDERS

(ELECTRICAL WORLD SEPT. 1980)

- IN 1981 - 600,000 MWE PEAK CAPACITY
- IN 1981, 32% MARGIN IN PEAK CAPACITY NATIONWIDE
- PROJECTING 4.4% ANNUAL GROWTH IN PEAK DEMAND OVER THE NEXT 4 YEARS
- ADDING 22,000 MWE/YEAR AVERAGE 1981-86 (11,000 MWE/YEAR NUCLEAR AVERAGE)
- IN 1986, PROJECTED MARGIN IN PEAK CAPACITY IS 27%
- PROBLEMS FACING THE ELECTRICAL INDUSTRY
  - HIGH INTEREST RATES
  - LONG-RANGE INFLATION
  - FINANCIAL DECLINE OF UTILITIES
  - SLACKENED GROWTH RATE OF DEMAND
  - UNCLEAR ADMINISTRATION NUCLEAR POLICIES
  - UNSTABLE REGULATORY CLIMATE
- NO NEW NUCLEAR PLANT ORDERS BEFORE 1985-86

II. STEPS IN DEVELOPING THE LICENSING FRAMEWORK

A. Complete the Rulemakings
   - Emergency Planning
   - OL Rule
   - CP Rule
   - Interim Hydrogen Rule
   - Siting
   - Minimum Engineered Safety Features
   - Degraded Core Cooling

B. Digest All the Lessons
   - Reg Guides
   - Branch Technical Positions

C. Update the Standard Review Plan

III. ELEMENTS OF A FUTURE LICENSING FRAMEWORK

A. SITING POLICY

- SITING INDEPENDENT OF SPECIFIC DESIGN FEATURES
- ENCOURAGE STATES TO ESTABLISH SITE BANKS

B. SAFETY DESIGN GUIDELINES

- IMPROVED CONTAINMENT (LARGER VOLUME, GREATER PRESSURE, HEAT REMOVAL, PRESSURE RELIEF, HYDROGEN CONTROL, MOLTEN FUEL RETENTION, MISSILE SHIELDS)
- DIVERSE DECAY HEAT REMOVAL SYSTEM
- PWR PRIMARY SYSTEM DEPRESSURIZATION
- BWR CONTAINMENT SPRAY
- MORE INSTRUMENTATION
- BETTER CONTROL ROOMS
- MORE AUTOMATION
- IMPROVED SHUTDOWN SYSTEMS (ATWS FIXES)
- PWR STEAM GENERATORS OF HIGH THERMAL INERTIA

C. STANDARDIZATION

- INITIATIVE MUST COME FROM INDUSTRY
- NRC CAN IMPROVE INCENTIVES

III. ELEMENTS OF A FUTURE LICENSING FRAMEWORK (CONTINUED)

D. LICENSEE ACCREDITATION
- MANAGEMENT ORGANIZATION
- OPERATIONS ORGANIZATION
- DESIGN AND SAFETY SUPPORT STAFFS

E. GUIDELINES FOR THE DESIGN PROCESS
- CONFIGURATION MANAGEMENT
- INTEGRATE RELIABILITY INTO DESIGN PROCESS
- INDEPENDENT DESIGN REVIEWS

F. STABILIZE NRC STAFF REVIEW PROCESS
- MAINTAIN SRP AS A REQUIREMENT CONTROL DOCUMENT
- TRACKING SYSTEM FOR OPERATING REACTOR REQUIREMENTS
- PRIORITIZE SAFETY ISSUES
- MAKE USE OF PRA METHODS IN DECISION-MAKING

G. INSTITUTIONAL CHANGES (SPECULATIVE)
- WORK WITH PUCs TO REMOVE FINANCIAL DISINCENTIVES TO SAFETY
- NATIONAL REACTOR OPERATING ORGANIZATION

PROTECTION FROM RADIOLOGICAL SABOTAGE

AT

NUCLEAR POWER PLANTS

BY

DONALD F. KNUTH

OF

KMC, INC.

AT

ACRS SUBCOMMITTEE MEETING, MAY 6, 1981

We appreciate the opportunity to provide our views on the protection of nuclear power plants from acts of sabotage Our views are mainly focused on the generation of plants already in operation; however, the comments are also applicable to plants which may be ordered for future construction.

The nuclear utility industry has been required to provide ever increasing protection for its nuclear power plants to meet the NRC perceived threats of radiological sabatoge. Although all known previous studies have not identified any groups (within the U.S.) who are motiviated to sabotage nuclear power plants, and it has been recognized that many non-nuclear industrial facilities have the potential for creating more severe consequences, extraordinary security provisions are required at nuclear power plants.

To protect against the external threat, extensive intrusion, detection and surveillance equipment is required and at many facilities there are more security personnel assigned to each shift than there are operators. In a similar way to protect against the insider, design features to control access and other administrative features have been required.

This subcommittee has considered, in a previous meeting, the views of the NRC and its contractors on measures that are being studied for new power plants (and perhaps potentially for backfit). Although no one from industry was permitted to attend these sessions, we are generally aware from publicly available reports that resistance to the external threat is generally regarded as adequate and Sandia has studied design features such as additional subcompartmentaliziation and feasibility of so-called "bunker" designs in proving increased sabotage resistance to an insider.

KMC has been actively involved in evaluation of security matters for a group of 24 utilities. Although we recognize there may be an incremental improvement in the design of this security system by adding additional compartmentalization or addition of more systems, those expected gains need to be weighed by the off-setting degradation of security attitude and of safety. The incremental design improvements could provide additional impediments to operator access to vital equipment. In nearly all sabotage scenarios access is already required to multiple pieces of vital equipment; therefore, design "improvements" would require access to one more area. Adding impediments for an operator to operate, maintain, and test the plant equipment in the name of security can foster a negative attitude toward security for promoting those impediments. It also can impede operator response into a vital area to respond to a safety need. More insidiously, because of the additional effort involved, it can discourage maintenance and operations personnel from conducting tours of equipment which often reveal incipient problems before they can affect plant safety.

We have concluded that in lieu of any plant design changes, it would be productive to conduct a meaningful personnel reliability program and to relax some of the existing overly restrictive vital access controls and personnel search requirements. The utility group has been working with the NRC staff to this end. We fully expect the NRC staff will propose a regulation requiring a personnel screening program and continued reliability program for all employees granted unescorted access to nuclear power plants.

We would urge the subcommittee to seriously weigh the suggestions before it, since we do not agree with the regulators' view that "better" immediately translates into "more design features." We are convinced that implementation of an operator reliability program should in fact be cause to reduce some existing requirements to attain better security and safety.