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NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

IN THE MATTER OF:

235th GENERAL MEETING

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Place - Washington, D. C.

Date - Friday, 9 November 1979

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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Friday, 9 November 1979

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

235 GENERAL MEETING

Room 1046
1717 H Street, N.W.
\.ashington, D. C.

Friday, November 9, 1979

The 235th General Meeting of the Advisory Committee on Reactor Safeguards was reconvened, pursuant to adjournment, at 8:30 a.m.

PRESENT:

DR. MAX W. CARBON, Chairman
DR. MILTON S. PLESSET, Vice Chairman
MR. MYER BENDER, Member
MR. JESSE EBERSOLE, Member
MR. HAROLD ETHERINGTON, Member
PROF. WILLIAM KERR, Member
DR. STEPHEN LAWROSKI, Member
MR. HAROLD LEWIS, Member
DR. J. CARSON MARK, Member
MR. WILLIAM M. MATHIS, Member
DR. DADE W. MOELLER, Member
DR. DAVID OKRENT, Member
MR. JEREMIAH J. RAY, Member
DR. PAUL G. SHEWMON, Member
DR. CHESTER P. SIESS, Member

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P R O C E E D I N G S

DR. CARBON: This is the second day of the 235th meeting. Speak up. Let's start the meeting without further ado.

DR. OKRENT: Mr. Chairman, may I raise a question on schedule before we get further into the agenda?

DR. CARBON: Yes.

DR. OKRENT: If I recall correctly, the current plan is we meet until Saturday, noon?

DR. CARBON: Until Saturday, noon, yes.

DR. OKRENT: Much as I look forward to getting an early plane back, it is not clear to me that we shouldn't take advantage of the available time, for example, either to see whether we have any recommendations that we want to complete this meeting, or to take a first hard look at what the Kemeny report means from our point of view, or something. It strikes me that during these rather fast-moving days and weeks, we perhaps should give thought to whether we want to use that time.

DR. CARBON: Your point is well taken. Ray told me later yesterday that there is a request on its way to us asking for our views on how the Kemeny report affects us. Those recommendations that it makes with respect to ACRS, at least. So, we definitely will have procedures subcommittee the day before the December meeting to consider that. That does not cover everything that you speak of. I want to try to maximize the time today that we can devote to Mike's report and put just as much time as possible on it and defer other things until tomorrow and maybe cancel something this afternoon, although I am not sure anything can be done there or not.

Would you have specific thoughts on things we might well work on tomorrow afternoon? For example, discussion of the Kemeny report?

DR. OKRENT: Well, that could be a topic. It wouldn't even, I suppose, be improper to start thinking in a preliminary way about how one would best organize what the NRC expects to be trying to do during the coming months and what seemed to be important to be done for operating reactors on a short or a long basis.

Again, Lewis yesterday indicated that if we have any I guess what you would call administrative kinds of recommendations as distinct from what I will call nuts-and-bolts recommendations, this is an important month for such recommendations. I don't know if we have any, but if we don't talk about them, then I am sure we won't have any.

DR. CARBON: Anyone else have comments to make on the subject at the moment?

DR. SIESS: I have a comment: that I have already

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changed my reservations, and other people may have also. I may be able to change them back, but somebody has got to decide real quick.

DR. CARBON: Okay. Let's go on with the agenda for the morning.

DR. SIESS: If we're going to decide about tomorrow, I would like to know whether to change from 1:00 o'clock to 5:00 o'clock.

DR. CARBON: I had in mind trying to do something later this morning, but maybe we might as well do it right now.

DR. SIESS: I don't care. I have got a reservation now --

DR. CARBON: Let's just stay on it and do it right now.

DR. SIESS: You might ask how many people can now stay beyond.

DR. CARBON: I changed mine, but I can change them right back again. How many people could stay until, say, 4:30 or 4:00 o'clock?

DR. MARK: Only if reservations are available.

(Show of hands.)

DR. CARBON: Two, three — possibly seven.

PROF. KERR: We could start with 2:00 o'clock, but I am not sure that two hours would be enough.

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DR. CARBON: Well, let me ask. 2:00?

(Show of hands.)

DR. CARBON: Well, with your approval, I propose rignt now, then, that we just stay until 4:00 o'clock tomorrow afternoon, as many people as can. If somebody has to drop out at 2:00 o'clock, so be it, and we'll work on until 4:00, those of us who can stay. So be it. Let's do it.

Let's go on, then, with our agenda. Mr. Check.

MR. CHECK: I am Paul Check, of the reactor safety branch, division of operating reactors.

The committee has invited us to discuss systems interactions resulting from steam line breaks outside containment. Actually, the subject is broader than that. I believe you are referring to the events preceding and surrounding a letter from Harold Denton to the industry, dated approximately the 17th of December, in which he asks for the opinion of each licensee regarding certain concerns expressed in the licensee event report submitted to us by Public Service Electric & Gas Company, New Jersey.

Let me begin, then, by saying that what I hope to do today is describe something of the history of this issue, to discuss where we are today, and make a few comments about the future

(Slide.)

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I guess, first of all, I should describe the issue itself. Prior to the first entry here in this chronology, actually, I guess, in late August of this year, Westinghouse sent letters to its customers alerting them to potential spurious control system operations which might result from adverse envi-onmemtn which attends postulated high-energy line break. These could be steam line breaks, it could be feedwater line breaks, it could be primary system breaks.

Westinghouse informed its customers that such spurious operation might impact protection functions in such a way that the consequences of the high-energy line break could be more limiting than those presented in the plant SAR. In that letter to its customers, it invited customers to a meeting, an owners group meeting, in Pittsburgh, on the sixth of September. That meeting was held. I wasn't there. I don't know the tenor of the meeting. But as I said earlier, Public Service Electric & Gas Company of New Jersey, the owner-operator of Salem Unit 1, felt as a result of what it had learned that it should notify the Nuclear Regulatory Commission, which it did on September 9.

Shortly thereafter, the office of inspection and enforcement issued an information notice to all licensees. And about the same time, Harold Denton wrote a letter to all licensees asking them to respond to this issue. Briefly, the NRC was concerned -- I am quoting now from Denton's

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letter -- "was concerned that similar potential may exist at other operating light water reactor facilities, including yours, for an unreviewed safety matter relating to the effects of the environment on control systems resulting from high-energy line breaks inside or outside containment and the result of these effects on the required safety systems."

In his letter he requested that all licensees respond within 20 days, presenting evidence which would enable the staff to determine whether or not licensees should be modified, suspended, or revoked.

In the week following that letter there was a series of meetings, one with each of the owners groups that had been established since Three Mile Island to discuss the matter. The following week, the assignment was given to me to prepare for the receipt of the licensee submittals that would be coming in another two or three weeks. As part of this we began to explore whether in fact there was a basis for continued operation of plants.

So, although the chronology suggests that we didn't come to such a determination until after licensee submittals were in, in fact in a very short time we did make a determination regarding the basis for continued operations. And that is contained in a document that Eisenhut sent to Denton on the 15th of October.

(Slide.)

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Briefly, what we said was the basis of what we knew at the time, while we had a safety concern we could not find a particular safety problem. What I mean is: no event had been identified which led to an unacceptable consequence. We observed also that there were considerable margins in the safety analyses for most high-energy line breaks and that these margins were probably sufficient to absorb our present uncertainties about the effects of what we were calling "consequential control system failures."

We observed that there were unresolved safety issues of a similar kind in existence, and that plants continued to operate in the face of these. And we contrasted this concern with some issues which had led recently to shutdown orders. And fourthly, we observed that the ability of the operator to cope with the high-energy line break we did not feel would be substantially degraded by the addition of this so-called "consequential control system failure."

MR. EBERSOLE: Is your topic pertinent to boilers as well as PWRs?

MR. CHECK: Yes. All licensees received this letter.

DR. SHEWMON: And all line breaks are instantaneous and complete. Right?

MR. CHECK: Yes.

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MR. EBERSOLE: I want to ask you a question concerning a generation of boiling water reactors that has a break in a 10-inch HPSI line immediate adjacent to the outboard isolation valve. This break, should it occur at that point, will strip that valve of any functional capability to close. The valves, I believe, at least designs, are nominally standing open up to the stop valve at the turbine. The inboard isolation, which is an AC-driven valve, can be a fresh random failure.

The end result of this particular incident is that continuous discharge of 10-inch, initially 1100 psi steam into the environment which contains the shutdown equipment as well as the operators. How does the operator cope with that?

MR. CHECK: Mr. Ebersole, I should have said at the outset that we are not prepared to discuss in technical detail particular event scenarios. I do not know whether that one was identified in the GE responses. They have a rather extensive matrix. We will show you something of what they have provided to us.

MR. EBERSOLE: I would like that one to stay on top of the list.

MR. CHECK: This issue is not closed.

MR. EBERSOLE: This issue is 10 years old.

MR. CHECK: Obviously, this issue isn't closed.

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DR. RAY: A point, please. If that's characteristic of BWRs in service, Jesse, I would think it should be given priority of consideration on the part of this task force.

MR. EBERSOLE: I agree with you.

MR. CHECK: If you will bear with me, gentlemen, we will describe for you something of the plan that we have for dealing with this.

(Slide.)

I don't mean to mislead you regarding the detail into which the NRC has gone up to this point in dealing with this specific issue. There is a presumption of innocence until guilt is shown. If we find a problem, then we deal directly with it. But we have been notified by the industry of potential unreviewed safety questions, and we are going as quickly and as systematically as time permits through a large body of information in order to make some assessments, general and specific, on continued operation.

You may, in fact, have a very interesting scenario and one that ought to be recommended for study. But I think if you will bear with me, we will talk a little bit more about pulling together a lot of disparate elements of a large task.

MR. CHECK: Okay, then, the licensee submittals came in. And perhaps not too surprisingly, they generally speak confidently about the issue. We have screened these. We are preparing a status report presenting our interim findings on our evaluation, and I will touch on those in just a moment.

But I wanted to mention that, in connection with this, the industry had begun for the first time -- I think for the first time -- to act in concert to try to bring as many people, as many interests, together in a common effort -- something that we, of course, have encouraged. And as a result, an NSAC report memorandum was written and sponsored by the Atomic Industrial Forum. It was sent in. That report was referenced by a number of utilities. That report, for those of you who haven't seen it, deals principally with a probabilistic analysis of the Westinghouse scenarios and also discusses the likelihood of high-energy line breaks.

(Slide.)

As I said, we are preparing a status report which we hope to comlete shortly. We have screened all the licensee submittals. I should note that there is a general acknowledgement in the responses from the industry that the issue deserves longer-term considerations; this deserves further study. Our initial findings are -- continue to be that we have not identified any safety problem.

We distinguish safety problems from safety concerns. Safety concerns involve mostly uncertainty, in our minds, which derives from a lack of information. There are assertions made in the responses with very little supporting hard information, not enough information which would allow us to conclude independently as they have. That's what I mean by "concern" as opposed to safety problem where something would be identified as deficient.

We say our concerns reside in the question of the breadth and the depth of the systems interactions reviews that they've performed. In the question of the environmental qualification of the equipment and in this matter that you bring up, Mr. Ebersole, the ability of the operator to actually function as he is presumed to.

DR. RAY: Your concern with the adequacy of the breadth and depth of the systems reviews, is that in response to this request or in a general routine reviews and in the course of evolution of the plant?

MR. CHECK: No. My comments are directed to the response that came from Harold Denton's letter, yes.

DR. OKRENT: I have a question. First, could you repeat the scenario, just so we have it in front of us again?

MR. EBERSOLE: Yes. Some of the designs — these are boilers -- contain the concept of having full pressure steam against the intake stop valve of the HPSI turbine right up to the stop valve. This necessitates that the two oscillation valves which feed this turbine are wide open. Typically, the inboard valve is an AC valve, so it can better resist the environment of the containment. It stands open. The outboard is a DC-driven valve for diversity. They both stand open.

If I postulate a main steam line failure, which is a 10-inch steam line in this case, in the region adjacent to the outboard valve, I no longer have the privilege of saying I have two random failures available to me before the function fails, because the outboard valve becomes involved as a direct result of the initial event. It is stripped of its functional capability.

The first random failure could be the inboard valve, which is protected because it's inside containment. If that failure occurs, the end result is the BWR feeds the steam not into the outer environment as it would in the case of the main steam lines, but to the inner environment wherein are located all of the shutdown heat removal equipment and the operators. It may feed into an environment of three units.

The situation is: you have a long-term continuous discharge of 10-inch steam into that building which houses

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all of the mitigating systems. Besides the roof coming off, I suspect that the equipment will indeed not run very well or very long at all. From temperature, humidity, water, a variety of reasons.

That is a standing condition. It was deplored in 1968 by TVA, to GE and to the regulatory commission. Nothing was ever done about it except that TVA provided a straight piece of pipe inboard in this main steam line for someday when better judgment would put a valve in that place. I think that time is due.

DR. OKRENT: How would you examine such a question and arrive at a decision whether or not it was important enough to backfit? It's not a straightforward situation. It involves a break and then a single failure. I am curious to know how you would proceed.

MR. CHECK: I suspect, Dr. Okrent, I would do what you are trying to do now. You would want to find out what the staff had been doing on this issue. There have got to be countervailing arguments. We have heard something here. I suspect Dr. Ebersole — Mr. Ebersole knows something of the response to the concern that TVA expressed.

MR. EBERSOLE: As I recall, the decision was the probability of the break in the pipe at that particular distance from the outboard oscillation valve was sufficiently low to claim purely random failure of the outboard valve.

MR. CHECK: It sounds like a policy decision.

MR. EBERSOLE: Indeed, it is.

DR. SHEWMON: It was not a pipe break; it's a failure of the valve casing.

MR. EBERSOLE: No, it's a pipe break. Anywhere within, say, 10 to 15 feet of the valve, including the casing.

DR. SHEWMON: But you strip the valve of its --

MR. EBERSOLE: Of its delicate trim, that's called, that makes it go. You know, all valves have a relatively delicate accessory system which tells the valve what to do -- the motors or whatever they may be.

DR. SHEWMON: You have had two simultaneous failures --

MR. EBERSOLE: I have not. I have had one failure followed by causally occurred failure, then a random failure.

DR. PLESSET: Jesse, what was this thing that TVA did? Was that considered a fix?

MR. EBERSOLE: No, that was a waiting game.

DR. PLESSET: Oh.

MR. ETHERINGTON: These pipe lines are carbon seal; aren't they? So we have a reliable material.

MR. EBERSOLE: Yes, you do, indeed. That's true.

Some possible fixes -- and I am not sure; you may introduce these, if you wish -- would be to change the whole logic and have these valv s normally closed. That was never developed. Another one would be to have the valves cracked. The main reason they were kept open was to keep the line hot and available for instant start of HPSI. And there are several solutions, but the most solid one, of course, is the third valve inboard of the containment.

PROF. KERR: Mr. Chairman, clearly, Mr. Ebersole has identified a problem which he considers important. Can we agree that we can send some sort of note to staff asking that this be examined? I doubt if Mr. Check and we can solve the problem.

DR. CARBON: No, that's right. Fine.

MR. EBERSOLE: It's just an example of an old issue which maybe had a new light on it.

MR. CHECK: It may very well. And again, I ask you to reserve until I get down to the premises. Okay?

DR. CARBON: Fine.

MR. CHECK: We'll be talking something about the future. I think a more systematic study than has been done in the past is in the offing, and issues such as those should be addressed.

DR. CARBON: Are you near winding up?

MR. CHECK: Yes, I hope so.

(Slide.)

That brings us just about to the present.

We have drafted a status report with our initial findings and told you about those, and we expect that within the next couple of weeks that we will be writing back to all licensees stating our finding, perhaps encouraging some to follow up in a way that they have in fact suggested -- minor plant modifications or procedural modifications -- and urging active participation in an NRC-industry plan to deal with this issue.

And that brings me to where we go from here. I have the impression that some of you had heard from Roger Mattson about his final report in Lessons Learned. I want to read from it, recommendation No. 9:

"The owners of operating plants and all plants under construction should be required to evaluate the interaction of nonsafety and safety-grade systems during interaction of nonsafety and safety-grade systems during normal operation, transients, and design basis accidents, to assure that any interaction will not result in exceeding the acceptance criteria for any design basis event.

"The event should be system tic, include all nonsafety components, equipment, systems, and structures. Under all conditions of normal operation, anticipated operational occurrences and design basis accidents initiated both within the plant, such as pipe breaks, and from outside

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the plant, such as earthquakes and other natural phenomena, and off-site hazards.

"The interactions and effects should consider various failure modes, including spurious operation, failure to operate upon demand, and any unusual or erratic operation that might result from exposure to the abnormal process or environmental conditions accompanying the event under study. As a necessary part of this evaluation, proper qualification of safety systems, including mechanical components, should be verified."

I think that is an excellent charter for the kind of study that would address issues as you bring up, Mr. Ebersole.

(Slide.)

This slide shows a number of existing review efforts or programs that could be considered elements of the kind of omnibus task that is being recommended by the Lessons Learned Task Force. It remains for the NRC to implement such a task.

PROF. KERR: Mr. Check, what is meant by consequential system?

MR. CHECK: That's what we are calling this. High enery line break creating an environment which in consequence results in a spurious control system.

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PROF. KERR: Thank you.

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MR. CHECK: I'm sure that we could come up with a better title.

PROF. KERR: I didn't mean to criticize the title. I just wanted to understand it.

MR. CHECK: I'm not nuts about it.

The last item on the chronology was the industry meeting. We met with the industry yesterday, representatives of the industry yesterday to explore a new way to accomplish a task such as this.

(Slide.)

This is all so new, it hasn't even been typed. We proposed for consideration a scheme for involving the industry early in the planning and design and the resolution of this issue.

The central feature of this scheme is a steering committee of mid to senior level NRC and industry representatives which develops the task action plan and establishes the schedule and thereafter, overseas performance.

Other responsibilities would include developing review or problem-solving methodology and developing acceptance criteria.

The NRC hopes to gain by this an equivalent or superior safety product at less cost to the taxpayer. Industry, I think, should profit by helping to confine regulatory

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requests and requirements to true safety matters.

That's all I have to say, Mr. Chairman.

DR. CARBON: Fine.

MR. EBERSOLE: One quick question. I notice in this flood of literature we get, there's occasional reference to the potential in this aspect of overpressurizing the PWR containments as a result, for instance, of continual run on the main feedwater after a main feedline break.

I really would like to suggest that you look at these large potential result-type accidents as a first-stage look due to the gross consequence of this.

My impression is that there may be a growing concern about containment inadequacy against some of the system failures.

DR. CARBON: Any other questions? Harold?

MR. ETHERINGTON: Is there any concern about jet action, or is it just the atmosphere?

MR. CHECK: It's all environmental effects, including jet impingement on wires or other components.

MR. ETHERINGTON: And do you expect the controlled instrumentation to retain its integrity until it's performed its function and then you don't care beyond that?

Is that right?

MR. CHECK: Well, if it must perform in a good

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way --

MR. ETHERINGTON: A good way, of course.

MR. CHECK: Then, of course, there would have to be appropriate environmental qualification of the equipment. Some of the assumption, in our judgment thus far, has been that things don't fail catastrophically. We have been looking at this perhaps more mechanistically than we would if we were doing an FSAR design review.

We're dealing with the world as we find it and we are trying to give it the benefit of reality.

MR. RAY: Is it possible that you might schedule some tests of those components of control and see what it takes to destroy them, make them inoperative?

MR. CHECK: Yes, that's certainly the kind of thing that may happen.

DR. CARBON: Fine. Thank you, Mr. Check.

Let's then move on to Mike's report.

MR. BENDER: Let's pick up on 6. This first section deals with design basis accidents. At one time, I thought it should have been -- we might talk about societal risks, too, but I think I am going to read what it says about design basis accidents and suggest that that be what the subject matter ought to be in this particular section.

The NRC adopted the regulatory safety requirements of the AEC as a starting point for its administration. Design basis accidents are the foundation for these regulatory requirements.

The accident conditions assumed for containment purposes include the release of very large amounts of fission products and gaseous and particulate forms, whose escape from the contained plant volume must be controlled.

The radionuclide release is derived from core melting experiments. But containment design is based on the assumption that core cooling is maintained, and thus, that no fuel melting will occur.

The reactor safety studies, WASH-1400, shows that the probabilities of accidents involving core melting without adequate core cooling were high enough to deserve attention.

Prior to the reactor safety study, the ACRS had for many years urged the nuclear industry to look beyond the design basis accident for circumstances that might warrant mitigation treatment by design.

More recently, the floating nuclear plant had been required in response to environmental impact evaluations to provide features permitting the consequences of a core melt.

The foregoing suggests a need to re-examine the design basis accident used for safety evaluation purposes. The NRC evaluates the consequences of design basis accidents under conditions where engineered safety features are provided to cope with the accidents.

The approach has been described as defense in-depth. It presumes that the plants are well engineered, that some things will go wrong in spite of good engineering, but normal engineering practice for nuclear power plants would provide for such normal contingencies.

For very unusual events, there is a second line of protection — engineered safety features intended to keep unusual accidents within public safety consequence limits.

The severity of the accident under which engineered safeguards must function is arbitrarily established by the design basis.

The severity of the design basis accident is one of the crucial technological issues. Should core melt be assumed and if so, how completely? If not, is the core damage experienced at TMI 2 the appropriate basis for establishing containment leak tightness?

Did the escape of hydrogen from the TMI 2 reactor vessel as a result of zirconium-water reactions indicate that hydrogen combustion effects had been underestimated? Were assumptions concerning containment integrity as a design basis well founded?

The technical basis for the accident assumptions involve the most complicated logic intended to bound the potential accident circumstances. The logic does not always involve totally consistent assumptions.

The one possibility for establishing severity levels was to use the probabilistic accident consequence analysis approach as was done in the reactor safety study. Quantitative safety goals would be needed to use this approach and they would have to account for very low probability events where actual statistical experience is weak.

The method would have to include consideration of both consequence uncertainty and engineering reliability questions involving applications where little experience exists.

In spite of these limitations, this approach appears to have the best opportunity for displaying the appropriateness of the NRC's regulatory requirements to the knowledgeable public.

The risks associated with these goals would be compared with other known societal risks. Recognizing, however, that probabilitic methodology is slow to evolve and will include much subjective judgment, it appears necessary for the immediate future to continue the current policy of specifying arbitrary accidents as a basis for regulation.

The NRC clearly has an obligation to assign requirements in accord with its views of public risk. It should be able to show the public and the regulated industry how these requirements are established and clarify the reasons for inconsistencies when they appear.

A more conservative position assigned to one particular installation or one area as opposed to all the rest makes all the others suspect.

A major contribution to public acceptance of the regulatory process would be to clarify how the constantly changing regulatory position, whether more or less conservative, are founded and how they compare with other societal risks.

PROF. KERR. Is there any significance of clarifying?

MR. BENDER: I guess the thought I had in mind was that we've got some design basis accidents and nowhere have I been able to find anything that says why those were selected.

PROF. KERR: Well, clarify the reasons for having chosen a particular design basis accident.

MR. BENDER: Yes.

PROF. KERR: Okay.

MR. BENDER: Fine. And maybe that ought to be developed more clearly. This thing says, look at the design basis accidents again and even though we could use probabilistic analysis, it's going to take a while to get there.

DR. OKRENT: A couple of quasi-editorial kinds of things.

On page 6-2, where you talk about prior to the application study, ACRS since 1966 has urged the AEC, the NRC, and the nuclear industry. That's when it all began.

And if you wanted to, you could say that the floating nuclear plant thing is in response to ACRS concerns. But that's not a very major point.

And on page 6-4, when you talk about, at the end of the first paragaph, you say, in spite of the limitations, the approach appears to have the best opportunity for displaying the appropriateness. I would say for examining the approriateness.

MR. BENDER: Okay.

DR. OKRENT: I would like to come to a substantive point. What isn't in here is whether the design basis accidents should be changed.

It is sort of hinted at a little bit and sort of hinted about a little bit in the next section.

I was wondering what your intent was, your thoughts, or however you want to put it?

MR. BENDER: I guess Max had a fairly strong recommendation on this. My thought was that we probably need to make some judgment about whether it should be. But what it should be changed to was hard to say.

And the thought I was trying to convey was that the first thing to do was to try to figure out whether it should be changed and if so, to what extent. But not to say right now that it must be changed because I really don't know whether it should be changed or not.

That's my personal judgment.

Right now it's an accident that involves a substantial release of radionuclides. As a matter of fact, it really is just about the TMI 2 accident right now.

That's about what the design basis is. And whether you ought to have something that goes beyond that or not, I don't know. For the purpose of designing containment and engineered safety features, what would be accomplished by going beyond that, I'm not sure about.

I don't know what we mean when we say we would go beyond it.

That's what I'm talking about.

MR. RAY: Is there a staff effort underway examining whether or not they should be changed?

MR. BENDER: I think they're thinking about it, but I think they're in the same dilemma I am.

DR. OKRENT: The title of this section --

MR. BENDER: The title is bad.

DR. OKRENT: Yes. Because in fact, you don't really --

MR. BENDER: I was going to do something else, Dave, when I started out and I threw a lot of it away. I just wanted to make it design basis accidents.

MR. RAY: Is it possible that you wouldn't have to have a decision incorporated in this memorandum as to whether or not it should be changed but simply indicate that a study must be undertaken in this area?

MR. BENDER. I think that this is the point that Dave is getting at. How should we go about saying that, though? I wouldn't argue that it may need to be changed. I just don't know how to say that we really want a change or how you can decide.

PROF. KERR: Well, a position in that direction would be to say that since a particular set of design basis accidents now used have been used for at least a decade, I guess, that one should re-examine to see if the experience since the early adoption would still indicate that those are appropriate.

MR. BENDER: Well, we could take that tac.

PROF. KERR: That is a very mild beginning. Maybe not going far enough.

DR. OKRENT: I would say it was all right for two years ago.

PROF KERR: Well, unless we know or unless we can conclude that some reasonable amount of discussion, to what design basis accident one should shift, it seems to me what

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we'd have to say is that we have some misgivings about the present set and we think that the question ought to be looked at carefully.

MR. EBERSOLE: May I suggest a sentence to be put in here along this line?

Design basis consequences, and even risk consequences, can be obtained without the necessity of having spontaneous quench failures. I think that's important. That's what happened in TMI.

MR. BENDER: That's one kind of design basis accident.

MR. EBERSOLE: But it's not considered that. It's not a design basis accident now.

DR. MOELLER: It seems to me that we also should take into the equation or insert the fact that a facility designed to handle a given design basis accident won't necessarily not handle one of a different size, an accident of a different size.

Am I making myself clear?

DR. SHEWMON: If I understand your double negative, you're saying that you think the design basis accident provides a good umbrella?

DR. MOELLER: Yes, it provides some umbrella. I don't know if it's good.

MR. EBERSOLE: But it beclouds —

DR. MOELLER: Whether it's adequate, I don't know. But it certainly provides an umbrella. We should keep that in mind.

MR. EBERSOLE: What it doesn't do, however, is reveal the causal potential for having the design basis accident. It relegates it to the concept of spontaneous pipe failure, which is low, the probability.

It doesn't need to be that.

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MR. BENDER: I think that's only one thing covered in design basis accidents, spontaneous pipe falure. It's one of the mechanisms used to determine accident consequences.

I think others are inferred by the design basis accident.

PROF. KERR: It seems to me, Jess, the present design philosophy assumes the proability of spontaneous pipe failure is one. And given that probability one has to be able to live with it.

So it doesn't assume that the probability is low.

MR. EBERSOLE: That's true.

DR. CARBON: I want to clarify a point. I did not make a recommendation to change from the DBA. I urge studies, but not changing the DBA.

MR. BENDER: I apologize for the misinterpretation.

DR. CARBON: Okay.

DR. OKRENT: I am not at the moment trying to propose a committee recommendation or an individual position that sort of goes to the end or that we know what to do.

But I do think that this is an area where, in fact, as part of writing this, we should come up with some recommendations.

In my mind, I would say that I have two categories: First, they are the existing reactors that you have to think about, and I suppose that means operating and under construction; and then reactors under construction that have not yet begun, where you might again try to subdivide it into two parts.

For the existing reactors, it would seem to me a constructive step would be, one, to do a risk profile on them, which you might call a WASH-1400 study, at least with regard to which seemed to be the more probable sources of serious accident, but not necessarily, just assuming the same sequences of WASH-1400, because that won't get you the right answer, necessarily.

In any event, getting some kind of risk profile this way and also, looking at what measures, either preventative or mitigative, would change this. What do these measures cost? What additional risks might they introduce? And then somehow, and this would involve policy considerations, it wouldn't be strictly, I think, to arrive at some kind of judgment, whether the features that have been provided in response to the existing design basis accidents remain adequate or changes are appropriate.

We heard from Harold Denton yesterday that for other reasons, namely the concern about the ability to evacuate out to 10 miles, they are thinking down this line in the mitigative end for design at Indian Point.

But it's the kind of thing, I think, that one could recommend or consider recommending as a step for trying to make a rational decision.

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In other words, one can look to see what is your best judgment now about contributors to the probability of an accident, in these things here or for mit:.gated features.

Actually, you may not do radically di:ferent things for a new design, except in new designs, from the beginning you can look at how it's laid out to see whether you unnecessarily introduced unreliabilities. Considering the feedwater system, you might just as easily may have made that more reliable or maybe with not much effort, provided the ability to ride out a loss of all power for 20 hours instead of one hour, and so forth.

You know, when you think about some of these things, you can make relatively simple changes from the point of view of overall cost or complexity that provide certain abilities.

I think it's worth the committee's thinking about whether it wants to consider this kind of recommendation. That's sort of in my mind not saying, here are other design basis.

In my mind it's saying, let's look at what seemed to be the probable source of accidents and seeing, are there things that one can do to reduce these? And also, are there features we think can mitigate accidents in a meaningful way and at least develop the information?

Now I think that that recommendation is going to be made by somebody else, whether we make it or not myself, or a policy may be adopted.

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I really think the committee may want to recommend it.

MR. BENDER: I had covered a little bit of the mitigation business in the discussion on siting. Maybe it should have been put in there.

DR. OKRENT: In fact, the ideas are suggested in what you have written, but it doesn't come through as an actual recommendation. But you have suggested much of what I've said.

MR. BENDER: Let me ask whether we can take this approach in order to have something that represents a closure position on this section.

Did I follow the thought that Dade offered that since TMI 2 came very close to design basis conditions, that perhaps -- probably there should be an examination to see whether the umbrellas should be brought to deal with other kinds of contingencies?

Would that be an overstatement or an understatement?

PROF. KERR: I didn't hear him say that, but maybe you did.

MR. BENDER: Maybe I didn't hear him say that.

DR. MOELLER: I think that says -- I think that's a worthwhile statement.

PROF. KERR: You think you should have said that even if you didn't? Dave, I thought you were saying something that really didn't have much to do with design

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basis accidents; rather, you were saying that we ought to look at existing plants to see what the risk profile is to see if there are some obvious things that one can do to reduce the risk. And one ought to look at new plants to see if similar changes that are perhaps easier to initiate could be introduced.

DR. OKRENT: In effect -- no, that's what I said. I'm in effect saying that the design basis accidents that we currently have been using, or have been used in the recent past, don't of themselves automatically provide inadequate --

PROF. KERR: I would interpret that approach to be a rather significant departure from the design basis accident approach.

DR. OKRENT: Yes.....

DR. CARBON: Would you finish your sentence before Bill interrupted there? You said that you don't feel the design basis accident necessarily what?

DR. OKRENT: Provides an adequate protection to public health and safety.

That's an understatement of what I think.

DR. CARBON: I would like to support this quite strongly. I tried to say in that write-up there not that we should do away with the design basis accident, design beyond Class 8, necessarily, but that we certainly ought to look at

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and study and explore beyond Class 8 to know what can happen, might happen, what kinds of changes we might easily and readily make which would appreciably increase safety at low cost and/or just to know what we may get into in some of these accidents.

I don't think we should have been caught with our pants down at Three Mile Island, and we were.

MR. EBERSOLE: When you say "beyond Class 8," are you thinking in the context of worse consequences?

DR. CARBON: I'm really speaking in the context of what we get into when we have partial, when we have cladding melt, core melt. Not necessarily consequences, no.

MR. EBERSOLE: I think the critical thing is not maybe the worst consequences, although they can be worse, but rather, the different routes by which these same effects can be produced.

DR. CARBON: The routes, the kinds of things that lead us into questions about are there steam explosions, was there a hydrogen problem?

MR. EBERSOLE: You know, the innocent beginnings with the terrible, ultimate consequence.

DR. CARBON: Bill?

PROF. KERR: It's hard to be against additional study, and I'm not sure I am.

I think the study of existing plants and the conclusions

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that one reaches would have to be balanced against two difficulties that appear to me to be very important.

One is a concern I have about backfitting existing plants. I don't know how to evaluate the ..crease in safety that comes from backfitting. I am sure it is significant.

Anything you do to try to go in and change an existing system is just very likely to foul things up. It also may improve things. But I don't know how to evaluate. You can do the paper studies and convince yourself that you would have a decreased risk, but I don't know how to do the study that describes the damage done by workmen and other people to an old system which is critical to a new system.

It doesn't mean that you don't do it. But I think not a sufficient amount of attention has been given to this in the backfitting problem. Maybe implicitly it has.

The second difficulty is one with which we are beginning to wrestle with already, and that is having the risk numbers, how you decide how far you go? Do you conclude that all existing plants are too risky and therefore, we have got to reduce the risk? And so anything we sort of start with those items of increasing reduction and work down until we run out of resources?

Or do we, in endorsing this approach, attempt to set a risk basis, or do we take a, what is it, not an ALARA, but what was the thing that was coined yesterday, AGARA?

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That strikes me -- we are going to have to do explicitly or implicitly if the study has any significance. Otherwise, we just study and find out where the risks are, but we don't know what to do about them.

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DR. OKRENT: I think we are always taking an AGARA approach, as it were. If you make no changes, you decide that what you now have is as good as is reasonably achievable, because anything beyond this is not worthwhile. And I certainly am not in favor of trying to make every plant that's built the same as a plant I would build. I think that's not the central approach. I think there are two or more advantages, major advantages, to trying to look at existing plants to see where you think there may be weak spots. By that, I mean potentially high probability sources of problems.

In the first place, some of them you may not have known about and they may be really not all that hard to remedy rather quickly. They will also bear on your operating experience, on how you interpret operating experience and so forth.

I think that kind of study is worth recommending. I think it's going to be done. As I say, it's starting to be done, in fact, the staff is doing it. Right now they have been doing a systematic evaluation program, not in those terms. This is sort of what bothers me a little bit. They are looking at -- expending a lot of effort and they're looking at these plants in what I will call the old-fashioned framework.

As part of that, one could be doing this other kind of look instead. What is going to happen, probably, it will be done sequentially or as two separate things. But yet, the things they arrive at by their current look, in their systematic way, they may or may not pick up things which are of as much interest, let's say, as you would get by an event treee kind of look at these plants.

DR. SHEWMON: I don't like what I'm hearing, I think. We haven't got more than half way through the current safety evaluation program, or whatever it is we have for older reactors, and now you're suggesting that we hurry up, tell them to hurry up with that so they can start off with yet another one which uses different approaches -- and do it all over again?

DR. OKRENT: No, what I'm saying is I think that's what's going to happen, is that they're going to do it --

DR. SHEWMON: So that we might as well hurry up and get in front of the cow because we're their leader -- pardon me, finish your sentence.

DR. OKRENT: I'll try. What I said was: the existing systematic evaluation program is not being done using an approach like, for example, they are going through at Crystal River, looking at different possible contributors to risk and so forth. I think more and more, if not all the plants, in fact, are going to get a look at their systems like was done for the auxiliary feedwater systems. But it will be done system-by-system or plant-by-plant, or both. I don't know about that, but I have little doubt that that's the trend.

PROF. KERR: Dave, I don't think I disagree with what you suggest. I am suggesting that, I think what you have come up with isn't complete unless you decide what you're going to do with it. You know, it's a start, but at some point, you know, we can look at the auxiliary feedwater system and conclude that out of 100 there is one that's more reliable than all the others. So maybe there's one that's 100 times as reliable as all the others, and we have sort of got the feeling that probably that one ought to be eliminated.

That doesn't really tell one, however, how much one has contributed to the reliability of the total power plant or to the reduction of risk, unless I know something about the way in which auxiliary feedwater systems contribute to overall risk. We have a feeling that they are bad because of TMI and we had a gut feeling, I think, that it was bad, even before that because you certainly don't want something that you are depending on in an emergency to be extremely unreliable.

But if we're going to do this in a systematic way, I think we have to look at these systems in the context of what they contribute to the total plant risk. And I haven't

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seen anything that necessarily demonstrates what the system contributes to the total plant risk yet. Rather, we are concentrating on auxiliary feedwater systems. I don't think that's all bad; we do the same sort of thing with diesel systems. We've got a nice criterion for the reliability of diesels to start, in the context in which we don't really have a requirement for what the reliability of the emergency power system should be.

Well, you're more aware of these examples than I am. So I'm saying, it has to be embedded in some sort of --

DR. OKRENT: That's why I said larger profile.

MR. BENDER: I would like to suggest this: as this thing is written, it says when we get it we ought to use the risk methodology, but we don't have it right now. And I think that's somewhat evident by the discussion.

MR. EBERSOLE: Don't we have it in a relativistic sense, though, and usefully so?

MR. BENDER: I don't know how useful it is for making judgments.

MR. EBERSOLE: I'm talking now in a purely relative way.

MR. BENDER: Relative means you can decide whether X is better than Y. I think you can do some of that.

MR. EBERSOLE: That's important.

MR. BENDER: But it won't help you very much in

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determining whether you should decide to design the engineered safety features on the basis of the core being melted down in the containment, as opposed to the core being -- sitting in a coolable configuration.

MR. EBERSOLE: I think you start with the latter, in the "prevent" logic.

MR. BENDER: That's the kind of thing I am trying to establish now. The design basis says you can maintain the core in a coolable form, and that you can provide safety features that will assure that, and that the containment will hold in the radionuclides. Now, how we get there involves a lot of things. Some of them have to do with how long we have emergency power, and some things have to do with whether we can have auxiliary feedwater supply if the primary feedwater disappears.

But still, those are implementing things associated with just keeping the core in a coolable form, being able to get some cooling to it. Now, my question is really: are we satisfied to say the design basis should stay where it is, as a coolable core that is contained by the secondary containment device or primary containment device around it? That's the kind of questions being asked right now, I think.

MR. EBERSOLE: It's not first design basis, though, is a reasonable cost to never let the core be

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damaged?

MR. BENDER: That's a reasonable objective, one which we all want and everybody is striving to get, some people with better judgment than others, Jesse, but everybody is trying that.

DR. CARBON: Doesn't the Rasmussen study say something about that, and doesn't it say the chances for core meltdown or non-coolable geometry are relatively probable?

PROF. KERR: What does relatively probable mean? Relative to what?

DR. CARBON: Something that's going to occur occasionally.

MR. BENDER: They predict core melting. What about one in every 10,000 reactor years, is that the number?

DR. LAWROWSKI: 20,000.

DR. CARBON: 10-to-the-minus-four.

MR. BENDER: That doesn't necessarily mean anything more than that some of the fuel melted, but it didn't necessarily mean that you couldn't cool the core after it melted. And consequently the premises might be, never be any different if you have some core melting than if you do.

MR. EBERSOLE: By the way, I'd like to get a clarification on the melting problem. We talk about fuel

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melting, when we ought to distinguish between clad failure and fuel melting, because clad failure is not necessarily fuel melting. I don't guess TMI has had any fuel melting.

MR. BENDER: I do, in fact, differentiate between them. I don't know whether TMI has fuel melting or not. Some people say it has and some say it hasn't.

MR. EBERSOLE: Anyway, it's an important difference. Clad melting is not going to propagate through the containment, probably.

MR. BENDER: The only thing that will permit propagation through the containment is uncoolable fuel sitting in the bottom of the reactor of the containment.

MR. EBERSOLE: That's the top side. Pellets.

MR. BENDER: Where the heat has to be dissipated through.

MR. EBERSOLE: Right.

MR. BENDER: The point I'm trying to establish now is whether we're satisfied to let the staff develop a design basis and say that its engineered safeguards are designed to deal with the event where the core is coolable.

DR. OKRENT: Well, the staff is departing from that design basis.

MR. BENDER: I know that. That's exactly why I am pushing the point right now.

DR. SHEWMON: The evidence we have of staff design

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deviating from that is the fact that they are willing to talk about core melts again yesterday?

DR. OKRENT: It's in the long-term lessons learned final report, or whatever you want to call it. They recommend rulemaking for substantial amounts of hydrogen buildup and for filter vented containment and other measures that relate to accidents involving large-scale or full core melt.

DR. SHEWMON: Large amount of hydrogen buildup doesn't require core melt.

DR. OKRENT: But I said both of those are in the recommendation.

DR. CARBON: You're talking about FNP.

DR. SHEWMON: I'm not talking about FNP.

DR. CARBON: No, no, the staff is. Also, core ladles at Zion, Indian Point.

DR. OKRENT: In fact, they're talking about implementing these things on Indian Point and Zion long before the -- or the possibility of it, not about implementing, but they're starting to study it well before they would get into rulemaking in a general way.

DR. CARBON: I think our past practice of sort of just drawing the curtain at the Class 8 accident and refusing to look at, think about and study anything having to do with core melt is totally wrong. I personally believe

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that. And I think that that policy is what caused all the ruckus at Three Mile Island.

If we had been prepared to handle the hydrogen problem without scaring people out of their wits, and had had answers to the steam explosion problem without scaring people, there wouldn't have been any serious sort of thing at TMI.

DR. SHEWMON: What scared them was the staff not knowing how hydrogen got recombined. That wasn't a matter of the nation's lack of understanding; it was their own staff people opening their mouth.

DR. CARBON: That they hadn't looked at it.

DR. SHEWMON: Other people in the country knew it. The staff never headed in the right direction.

DR. CARBON: But the staff hadn't.

DR. SHEWMON: The research program ought to be to educate the staff before they open their mouth.

MR. BENDER: I guess I would have to say Roger Mattson hadn't thought about it, Vic Stello had. They had thought about the same length of time, but they had come to different conclusions.

DR. CARBON: Okay, but somebody should have studied this thing ahead of time so that people didn't get caught by surprise. But people got caught by surprise and

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they shouldn't have been.

PROF. KERR: Well, it would be nice if we could ensure that nobody ever got caught by surprise, but I guess I'm not that sanguine about the future. Hal Lewis pointed out, I think it was yesterday, that the Rasmussen study predicted a Three Mile Island type accident about once every 500 reactor years, and that's sort of what we got. So it wasn't really lack of study or lack of knowldge that caused the difficulty.

DR. CARBON: To a considerable extent it was. People weren't prepared for it. They hadn't thought about it.

PROF. KERR: It wasn't because the situation hadn't been studied, Max, it had been studied very carefully.

DR. CARBON: By whom? Who expected hydrogen?

PROF. KERR: If people didn't expect it, they just hadn't looked at the results of that study.

DR. CARBON: They must not have.

DR. SHEWMON: Max, what scared people was the staff announcing that there was a probability of hydrogen inside the pressure vessel exploding. That's physical nonsense. Everybody who looked seriously at it since the first water reactor knew better than that.

DR. CARBON: Yes, but all I'm saying is that our

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current staff people, when that hydrogen showed up it caught them by surprise. They hadn't thought through, Will this explode or won't it explode? You may have, but they hadn't. And not having anticipated it, not having thought about it, not having had answers to it, they came out with some ridiculous statements and as you say, scared high hell out of people.

MR. EBERSOLE: Why were they ridiculous? In fact, if just hydrogen was there there was a spike, wasn't there?

DR. SHEWMON: In the containment.

MR. EBERSOLE: That was in the containment. That spike could have been of a nature to blow the containment -- it would have to be out in the containment. It would have to be released to a point where it could explode because of the presence of oxygen, but then, it could have produced a spike which -- in particular in the case of these 12 psi containments -- could've absolutely blown it.

I really don't think the evacuation instruction was all that much out of order.

DR. SIESS: Based on the wrong reasons.

MR. EBERSOLE: Yes, that's all.

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My point was the staff should have gone through some areas like this, looked at this, had some areas like this, prepared their answers ahead of time.

PROF. KERR: You're sort of saying instead of a design basis accident the staff should study every possible accident including ones we haven't thought of. If one is not going to be surprised, one is going to have to study every possible accident that can occur.

DR. CARBON: No, I think you go at it from the standpoint of assuming partial core degradation, some more core degradation. Worse. I don't know how you get there.

MR. LEWIS: One thing you can do, though, which many people have said -- of course you can't study every possible accident. You wouldn't want to. But what you can do is start at the top of the maligned Rasmussen list and go down them one at a time and make yourself sufficiently educated that you won't be surprised if Rasmussen is right and the relative ranking, let alone the absolute numbers, even with you know 30 percent or 50 percent exceptions in which they are dramatically wrong, then doing that for the top 50 accidents is going to give you a reasonable assurance that you won't be surprised by the next accident. That's a way of doing it.

PROF. KERR: But that's already been done.

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MR. LEWIS: I don't think it has.

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PROF. KERR: I mean the study is there. People have looked at it in enough detail.

MR. LEWIS: But they are gun shy about taking it seriously now for reasons we needn't discuss.

PROF. KERR: But now you are back to the Kemeny Commission recommendations which is that the attitudes have to be changed. We aren't really asking for additional studies, we're asking for different attitudes.

DR. MARK: The problem here seems to be really more fundamental than what you are saying. It is impossible to think of anyone knowing enough and certainly not many people knowing enough so that they may not be surprised by something to which they haven't given much attention. What you've got to hope for and which might even be manageable is either to persuade people or have such people that they are unwilling to give opinions about things of which they know they haven't thought. And unless you have that you are always going to have goofy opinions appearing.

DR. CARBON: But let's think about some of these.

DR. MARK: Think as much as you can. You will still be surprised. You ought to recognize what you know and what you don't know and only talk about the things of which you know you've got a basis for talking. And unless you have that you are always going to have somebody saying something wrong.

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DR. CARBON: Paul?

DR. SHEWMON: Let me come back to Mike's point about coolable geometry. I guess the thing I would hope would come out of this staff study, or whatever, is some reasonably careful thought be given to getting the first fuel melting someplace in the core, the molten core at the bottom of the pressure vessel.

For example, whether Pigford's comment -- sorry, the staff of the Kemeny Commission saying indeed they couldn't get the core disassembled and down it.

I am particularly concerned or interested in the possibility in the modes of transition between the first bit of fuel melting someplace in the core and this transforming to what is often assumed of as a core melt which is, gee whiz, we can't think of how it got there, maybe, but let's assume it is down there as an uncoolable mass and then see what happens. That's certainly worse than what other possibilities you might come up with.

This offense may intellectually vary substantially. I think the Germans have done a much better approach at this than we have. They have at least considered it and apparently the Kemeny Commission staff looked at it. And if we get into this I guess the only thing I would urge is that a fair amount of work be done on the possibilities and probabilities of that transition instead of what I look upon as a cop-out to go to

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this uncoolable mass and talk about it migrating towards China.

DR. OKRENT: Actually, the methods for calculating the pathway of the fuel, assuming you lose an ability to cool it where it originally was, were developed in the U.S. before they were developed in Germany.

DR. SHEWMON: My point was when the first bit of fuel melts to the core -- now, once you can't cool it, I grant you are headed downhill on grease skids, but that is a big assumption from where I started.

DR. OKRENT: But there are some events where you lose your ability to take the heat away. Now, if you are going to say let's not consider any events where you lose your ability to take the heat away, you've got a situation where you won't be able to take the heat away. I agree.

DR. SHEWMON: The most recent cop-out is ATWS. If we yield any part of the core we assume a meltdown. That was the staff's best effort. And there is a long way between yielding the highest best part of the pressure vessel and melting a whole core I would argue.

MR. BENDER: Mr. Chairman, what I would like to pose to the Committee that I do with this section is to just make the point that the present design basis which is no core melting with containment will probably continue to be used as a basis for design. But both the probabilistic

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analysis and some broader overview of other accidents probably should be continued in order to get a better understanding of what the potential risks are from using the current design basis.

Now, that sounds like sort of copping out, but right now I don't see how I can say much more than that. We are still working on the basis that we expect to keep the core cool. Now, in the event of a serious accident, TMI 2 notwithstanding, that the engineered safety features should be designed with that thought in mind.

Now, there is a question about whether the survivability of the engineered safety features should be evaluated beyond that point. And I don't know whether that has come out of this discussion.

DR. OKRENT: I don't agree that we are working on the basis that you have described. I think that was the basis, but I think the staff is moving away from the basis. If the Committee wants to stay with it, I suppose it can, but it is going to be left behind. I am not myself prepared to say that that's going to be the case.

MR. BENDER: We don't know where the staff has gone. They are going off helter-skelter in a lot of directions as nearly as I can tell with not knowing as Bill pointed out, I think rightly, whether the changes that might be made in existing plants wouldn't do more harm than good.

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DR. OKRENT: It might. But we can use that argument to say don't look because it might, but that's not what Bill did. But I am saying that it can be turned around that way. I think the handwriting is on the wall. People are going to try to do more to prevent these things and there's going to be a lot of effort. But they are also going to try to do things to mitigate them as they see that there are ways to do it.

DR. CARBON: Dade?

DR. MOELLER: I thought we were beginning to zero in on the following conclusion or statement. That is, that the design basis approach, accident approach, does provide an umbrella, but we do not consider that umbrella broad enough particularly at the top end. In other words, we do not consider that the DBA as currently envisioned provides an adequate basis for the design of plants that provides sufficient protection to the health and safety of the public and it needs to be expanded. And I think that's what we have to say.

DR. CARBON: I don't believe that the DBA is adequate. To go back to Jesse, you were talking about -- I assume that you would define TMI as the core was not cooled. There's no question about that. So, hydrogen was released and we are talking about venting the hydrogen to get it out of the top of the pressure vessel because it's down there. I don't know whether we are still going to do that or not.

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And then we get into this possibility of blowing up some of the 12 PSI containment systems. Blow up is too bad a word, I suppose, but I don't think our engineered safety features are enough if there's a possibility of rupturing the containment due to hydrogen release that way. And maybe we came close to it there, I don't know. But I question --

MR. BENDER: Let's take it one step further then and say, Okay, we have to cope with the next level, whatever that is.

Let's presume it's a hydrogen explosion and core melting of some degree. How do you plan to draw the next line?

DR. CARBON: I don't know because I don't know what the next line is. I would hope -- I would want to do at least two or three things, and one is to find out what these lines are and to try to put some probability to it and I guess beyond that I don't have the answer. I don't know.

MR. BENDER: Well, in the interim period here are the plants built. There are engineered safety features that deal with the existing design basis accident. There are about 70 plants in operation today, as I understand it which have that design basis accident. And I have to ask myself if I want to have some different accident than that, what am I telling myself? What am I telling the public? And what do I expect to do to make those plants conform to my new designs?

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DR. CARBON: I guess I can answer part of that. If I were to carry out the studies and to conclude that, gee, truly there is a potential for rupture of a containment in the current plants due to a hydrogen explosion in a TMI incident, I think the thing I would immediately do is to try to explore vented containment on maybe a crash basis or some such thing.

PROF. KERR: Max, you don't have to carry out a study to know that there is a potential for hydrogen explosion in every containment that exists. We know that. It isn't a question of whether the potential exists, it's what the probability is.

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PROF. KERR: So, you have got to decide that either you're going to have an absolutely risk-free system or else you're going to have to decide what level of risk you're willing to accept.

DR. CARBON: But we have concluded, I believe, that unless we get the amount of hydrogen from clad melting that we can take care of the hydrogen in the containments. The probabilities are very, very low.

PROF. KERR: But I don't think we have containments which we can take all of the hydrogen that would be generated, all of the cladding --

DR. CARBON: No, no, we don't. In the past, we have based our --

PROF. KERR: Then there is a potential. We don't have to do any studies to know that there is a potential for a hydrogen explosion in every containment that exists. So, if I follow your statement to its logical conclusion, it seems to me you would recommend shutdown for all the operating reactors.

DR. CARBON: No, because I don't know today whether we came close to getting enough hydrogen to rupture.

PROF. KERR: But you know that a potential for hydrogen explosion exists in every reactor containment.

DR. CARBON: But I want to put it partly certainly on the basis of probability. I don't want to put things

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totally on potential.

PROF. KERR: What probability are you willing to accept?

DR. CARBON: I don't know. I have not studied it. I haven't thought about it.

PROF. KERR: There isn't a lot of point in making the probabilistic study unless you have at least some idea what probability you are willing to accept. I don't mean you have to have an exact number, but within maybe a couple of orders of magnitude you need to know. Otherwise, when you get through, the numbers won't help you make a decision, either.

DR. CARBON: I guess I would say if the Rasmussen report says probability of core meltdown is 10-4 and then if the Lewis study says it may be off by a factor of 10-2, raising it to 10-2, I am concerned.

PROF. KERR: See, the Rasmussen study really said -- and perhaps not with the proper conclusion -- said hydrogen didn't have much to do with the probability of core melt.

DR. CARBON: May not have much to do with the probability of core melt. But what did it say about the probability of rupturing the containment and having the kind of --

PROF. KERR: I am simply saying if you're willing to accept the Rasmussen study risk numbers -- using those kinds of containments, of course -- then you don't have to worry about hydrogen.

DR. CARBON: But obviously, we — I can't accept it, then. It appears that we had a hydrogen problem at TMI. We had some sort of burp on the containment.

MR. EBERSOLE: Mr. Chairman, isn't it true that the Rasmussen report did not couple a core melt to a containment explosion and thereby did obtain the low probability of containment failure via that route? In short, if one looks at the core melt probability, there is now recognized a potential for consequential containment failures as well as hydrogen explosion.

DR. CARBON: There is now because of our TMI experience. But you are saying, are you then, that the Rasmussen study didn't couple those?

MR. EBERSOLE: I think they looked upon -- somebody can say.

MR. BAER: Yes, I worked on the Rasmussen study. We ducked the question of partial core melt. The assumption was made that if you exceed a design basis condition, you got a complete core melt. In that event, you penetrated the containment by one means or another, either by melting through or gas generation from disintegration. And in that event, the hydrogen was, I think, judged to be probably the

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least probable mode of containment failure. But the assumption was made that you had a probability of one of failing the containment once you melted the core.

MR. LEWIS: That was a deceptive probability for many people because the major fraction of that was what Jane Fonda would call the "China Syndrome." That is, going through the bottom wall of the containment, whereas the kinds of -- and then that leads to all kinds of questions of liquid pathways and things like that. But the kinds of catastrophic release that people are most concerned about was a small fraction of the core melt instances. And it was, as I recall -- and you correct me on this -- it was either overpressurization over a period of time or a steam explosion.

So, you're quite right that hydrogen explosions were a small fraction of that, and the probability for steam explosions given in the Rasmussen report was, as I recall, drawn entirely out of the whole cloth.

MR. BAER: Very broad range. I don't recall --

MR. LEWIS: It was invented. It was given as .1, and it was simply invented.

MR. BAER: I think a major point was we didn't consider partial core melts. Three Mile Island situation was never considered.

MR. LEWIS: That's certainly right. And if you

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took the methodology and you started with what actually happened at Three Mile Island, you would have gone all the way. That is, no mitigated featueres once you started --

MR. BAER: That was one of the assumptions.

DR. SIESS: I need some help. If there is enough hydrogen released to the containment that you cannot control it with recombiners, what's the probability that there will also be a significant amount of radioactivity in there? It seems to me it must be close to one. So, what we are saying, then, is that a hydrogen explosion that reaches containment automatically releases radioactivity.

MR. LEWIS: Yes.

DR. SIESS: More than Three Mile Island, obviously; less than a PWR-2, I assume.

DR. OKRENT: Yes.

DR. SHEWMON: I don't know whether it is too wild-eyed to take any credit for, but there is a significant range variously quoted from 10-15 and 15-20 percent hydrogen and air at which the stuff burns instead of explodes. And the best thinging is that that's indeed what happened in Three Mile Island. So, they call it a "pulse" and not an "explosion." I think that's the distinction we probably should stay with.

MR. ETHERINGTON: I think the same study, pressure either way. The pressure depends on the temperatures you

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get --

DR. SHEWMON: So on the ice condensers you are out of luck; on the others you may end up sort of expanding things with one case but not --

MR. ETHERINGTON: That's right.

DR. CARBON: But, Paul, this is exactly what I am aiming at here. You're speculating. You bring a point up here, and it may be completely correct, but I think somebody ought to be able to walk in this room and tell us exactly what the story is in each of these cases, that there is -- that something will explode or it won't, burn or it won't, that the pressure will be such and such, that we don't have to sit around here and speculate.

MR. BENDER: Look, there's a lot known about when hydrogen will or won't burn. What is not known is what the concentration of hydrogen is under the circumstances when the accident occurs. Where is the hydrogen and what kind of mixes do you have.

Now, if that's to be decided, it's to be on the basis of pure speculation, because the mechanism for getting out is not very well known, and there's no way to determine it. We'd have to go through 15 different accidents --

DR. SIESS: I was trying to get back to what Harold said. Suppose there were an ignition point or points inside the containment so that as soon as hydrogen reached

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the flammability level it burned, but the supply of hydrogen was continuing, the static pressure would still build up. Right?

MR. ETHERINGTON: (Nodding affirmatively.)

DR. SIESS: From the temperature.

DR. PLESSET: Chet, you're releasing energy, you're going to heat up the containment.

DR. OKRENT: It depends on whether your sprays are on or whether you have an ice condenser and the ice will condense.

DR. SIESS: Unless you postulate some ignition source. If you're going to let the hydrogen build up to an explosive level and then ignite it, you've got a problem: the containment is going to be breached, and the reactivity is going to be released.

MR. BENDER: There is a move going on in the staff to consider inerting some containments on the basis that they might not be able to withstand the pressure built up by the hydrogen pressure.

DR. SIESS: I don't think there's any containment built up to the hydrogen burn if it's uncontrolled, unlimited.

DR. MARK: It is almost certain that what went on in TMI was an explosion and not a burning.

DR. PLESSET: What was that?

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DR. MARK: I say it seems to me it's at least essentially certain it was an explosion and not a burning.

MR. LEWIS: It was a spike.

(Simulataneous discussion.)

DR. PLESSET: It wasn't a real detonation.

DR. MARK: I agree with that. But that pressure was down in four seconds.

DR. SIESS: It does matter, because you can get a higher pressure transient if it explodes. You get a shock wave --

DR. PLESSET: That's not necessarily bad.

DR. SIESS: Not necessarily, but you have to analyze it.

DR. PLESSET: I don't think we know enough about that kind of an effect if we get a shock compared to a gradual pressure rise.

DR. SIESS: As far as the resistance of the containment to it, I don't think so, especially if it's localized.

DR. PLESSET: How can it be localized?

DR. SIESS: I worked a lot in the dynamic resistance of structures, and I don't think we know all that much about it.

DR. PLESSET: Localized in what sense?

DR. SIESS: A local explosion.

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DR. PLESSET: But the explosion is going to propagate in the containments; it's not going to hit at one point.

DR. SIESS: No, but it won't hit all of it at the same time, either. If it starts from one side, you get unsymmetrical loadings, for example. It depends on where the shock wave originates. But I don't get that much automatic comfort from the dynamic resistance for dynamic impulse versus the static. I would have to go into it a lot farther than we have.

MR. LEWIS: This kind of question, the kind of question you are discussing, depends on the relative speed of sound in the concrete and the shock wave in the air and that sort of thing. And you're right: that has to be analyzed on a case-by-case basis. But there's not that much difference, is there, between the sound speed in the concrete, reinforced concrete, and the shock speed in the air of a hydrogen explosion?

DR. SIESS: It's not quite that simple. It's the response of the structure, not just the transmission through it, and there's been a lot of work done in connection with weapons blast on both steel and concrete, but not on this type of contained thing, that I know of. Maybe it's in the classified literature. What I know about is building shelters, that type of thing.

But I just say it's not that simple. I don't want to dismiss the dynamic load problem.

MR. ETHERINGTON: It's not particularly easy to get a shock wave of any significance in a large space without pretty close to stoichiometric compositions, and I think what we have is a deflagration and any shock --

MR. LEWIS: Could somebody educate me on what the facts are? We all know the t.eory, but the spike itself, what was the width of the observed spike and what fraction of that was instrumental?

DR. PLESSET: I think it was just instrumental.

MR. LEWIS: It was simply an instrumental width, so it could have been zero width as far as we know.

DR. SIESS: We got something on that.

DR. MARK: You got something on it from the staff. The pressure was back down in four seconds. That could not have been done by a spray.

DR. PLESSET: Not a microsecond or a millisecond. It was seconds.

DR. MARK: But it takes --

MR. BENDER: We really need to zero in on how to decide whether we want to stay with our current design basis accident, and, if we don't, where do we want to draw the next line. And the best I have heard, really, is still Max' suggestion, even though I am puzzled about where to draw the line. I suspect that about the best we can do is say we are going to need to study more in order to determine where to draw the line. And that's about all the recommendation we can make right now.

But I would be very much inclined to say we should change the design basis at this stage of the game without knowing where we were going, even though I think Dade suggests we ought to broaden the umbella. I thought I interpreted right what you are suggesting.

MR. LEWIS: Mike, isn't there a suggestion, at least on the record, which we also accept or reject that one rational way to broaden the umbrella is by reference to WASH-1400?

MR. BENDER: Yes, I think so. But there is a matter of when things are going to -- when something is going to be done about something. I very much would like to see a good probabilistic basis for designing things. But things being what they are, I don't expect to see much that engineering kinds of people can use for a few years or a few decades. I am not sure which is right. It's not going to be very fast.

So, I don't know much to do but to say, "Well, let's look at what the consequences can be." In the old days, what we did was say, "Well, let's see whether we could go farther and still tolerate it in the sense of being able

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to go ahead with whatever the project is."

PROF. KERR: Mr. Chairman, I am not in favor of progress in the wrong direction, but I do think we ought to make some in some direction. Would it be possible for Dave, for example, to prepare a paragraph, somebody else to prepare a paragraph? There seems to me to be some consensus that we need to move in the direction of a change. I would be willing to consider some alternative paragraph and see if we couldn't arrive at something.

MR. BENDER: I think that would be a constructive thing to do.

DR. OKRENT: Would you write one, too?

PROF. KERR: I am willing to try to write one, sure.

DR. CARBON: It's been suggested, Dave, will you write one?

DR. OKRENT: I am willing to. In fact, I am going to try to write a series of recommendations -- not necessarily a complete set -- but I am going to try to go through Knight's report and see what possible recommendation would occur to me as being related to these, some of which may be there openly or under the surface already. And I would suggest that other people try to do the same thing, because, in the first place, different things occur to different people; and also, some of the same topics will

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come out in a different flavor. And I will try to include one in this area as part of it. I haven't gotten very far. I think I have written one such or two such. But as I say, I will try to cover this also.

DR. CARBON: Bill, if you think your views would differ from what Dave might come up with, I would welcome your writing one, or use your own judgment.

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PROF. KERR: My views are not that well settled, but I can write us a different version so that we will have something to consider. Not necessarily because I disagree with him. I am not sure, but I have to decide an appropriate direction at this point.

DR. CARBON: Mike, I wonder if we ought to take a break here.

MR. BENDER: It sounds reasonable.

(Brief recess.)

DR. CARBON: Gentlemen, let me have your attention. Before we start with the report again, let me bring up a scheduling matter. It seems very desirable that we put as much time on this report as possible. Mike cannot be here tomorrow. Unless it is going to work a hardship on anyone I would like to propose that we stick with today's work until about 8:30 this evening. We are only scheduled until 7:15 now, but we will continue to about 8:30. And I imagine that if we work on this, 7:30, 8:00 and so on, we'll all be snapping and biting. So, what I would actually propose is that we will move the NUREG 0600 activity back -- deferred until late in the day such that we will be working on Mike's report in the afternoon. Is this going to work a hardship on anyone if we stick with it until about 8:30?

DR. PLESSET: It works a hardship on everybody.

(Laughter.)

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DR. CARBON: Having heard no great complaints --

DR. MARK: Just stunned.

DR. CARBON: Just stay that way until I get this set up. Fine. Let's go ahead with the report then.

MR. BENDER: Let me go to the next section, and I'll just read it through.

"Criteria for nuclear power plants siting have revolved around definition of power plant exclusion areas, low population zones and the dependence which should be placed on engineered safety features to assure the health and safety of the public in the event of unforeseen accidents.

"At one time in the period of active power plant licensing the capability of engineered safety features was a major consideration in determining how closely a power plant could be sited with respect to population centers. More recently there has been a tendency to discount this dependence on engineered safety features.

"The effects of meteorology are still an important factor in airborne radioactivity dispersion and leak tightness of the containment system determines the availability of radionuclides to be dispersed.

"The recent accident at TMI-2, while not exposing the public to damaging radiation has shown that neither containment, leak tightness nor meteorology by themselves

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are safety controlling features. Other factors within the containment can have an ameliorating effect on dispersal."

MR. EBERSOLE: Do you want the comments as you go on?

MR. BENDER: No, let me read through. We can go back to it.

"The internal trapping capability of steam and water, tankage and internal surfaces all contribute to the reduction in potential for airborne radionuclide dispersal following an accident. All measures are of some consideration in determining the consequences of the more likely accident. At the same time, minimum low compilation, zone radius and maximum population density are undoubtedly important if site evacuation is to be relied upon by the public as the ultimate safety protection.

"The reactor safety studies show the likelihood of core melt was high enough to deserve consideration in siting. The extent of core melting determines the threat to public safety."

And then if you just skip the next three lines and start with the fourth line, "The WASH 1400 study indicated that the hydrological path for dispersal in a direction adversely affecting the public health and safety was generally long enough to eliminate it as a short-term threat to the public in the event of a melt-through

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accident. The longer range implication of a melt-through, as with other nuclear waste consideration was not considered adequately by the reactor safety study and more attention to the ultimate consequences of such events is needed.

"Siting criteria should be aimed towards establishing sites best able to accommodate core melting contingencies over the long term. In particular, the hydrological considerations involving potable water systems should not be ignored. Methods for protecting potable water systems from radionuclide exposure should be practical for nuclear power plant sites. Hydrogen generation by metal water reaction is also seen to be a potential safety problem by recent events. Hence, the question of potential for hydrogen combustion as a threat to containment integrity is a site-related concern.

"Experience at TMI-2 indicates a need for further attention to the potential for hydrogen combustion because consequential overpressure could rupture containment and open direct airborne pathways to the environment beyond the nuclear site."

And then I have added this sentence instead of the one that's down there. "This containment failure should be evaluated to determine whether siting practices are influenced by this circumstance."

Now, to some degree that's an extension of what we

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talked about in the previous section. But the orientation is slightly different. It doesn't address the design basis accident. It just says look at how we are deciding about sites and consider hydrology in terms of what we might do to protect potable water systems if there were a core melt-through and consider whether the hydrogen combustion -- does this make us want to worry more about airborne pathways? That's the substance of it.

Jesse, did you want to comment?

MR. EBERSOLE: Yes. Over on the first page there I thought there was a sort of a reversal of logically you say in the first sentence, the fourth line,"the health and safety of the public in the event of unforeseen accidents." In fact, siting has always considered foreseeable or postulated accidents, which is the LOCA, the mitigating systems that mitigate it.

So, I think where you say unforeseen you should say postulated and further down you say it one time in the period of active -- the capability of the engineered safety features with some major considerations. You ought to add up engineered safety features mitigated unforeseeable or postulated accidents.

In short we'd have a package there.

MR. BENDER: Okay. Good point.

MR. EBERSOLE: Finally over here on the second page

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where you discount the concept of penetration, containment by core melting, I call your attention to the fact that penetration characteristically are located between the equipment and environment rooms and the primary containment. Penetration failure therefore may not have the benefit of atmospheric diffusion but release radionuclides as well as steam and water into the equipment environment, thereby compounding the difficulty of maintaining long-term core cooling because of the ultimate effect on the equipment.

MR. BENDER: I don't argue with that. As a matter of fact, I think that will come up later in another part of this discussion. This was just oriented to the question of when we want to decide where a plant can be located, what should we keep in mind?

MR. EBERSOLE: Not just luck. It's beyond that, now.

DR. SIESS: Mike, you say hydrogen combustion is a threat to containment integrity is a site-related concern. Does that mean that there are sites where we don't need to be worried about hydrogen combustion?

MR. BENDER: Let me put it this way: If the site is remote enough, and the containment ruptures there would still be a lot of opportunity for getting people out of the path of the dispersed radioactivity, and the threat to the people that are in the environs might be relatively small.

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DR. SIESS: I read that report by Von Hippel and what's his name -- Belia, where they postulated larger releases than Three Mile all the way up to Three Mile-2. And I don't think I have to go up to the PWR-2 to find very few places where containment breach wouldn't be a significant concern for population and for property damage.

MR. BENDER: Well, I didn't say there wouldn't be of significant concern. Again, as a matter of relative risk we have to look at which property and which people are threatened and you can't reduce the threat to zero. You can decide --

DR. SIESS: A class 9 accident is a site-related concern.

MR. BENDER: I don't know whether I should have picked on hydrogen.

DR. SIESS: You know, containment breach by any of the alpha beta through delta methods, other than the ground release --

MR. BENDER: I think Jesse's point --

MR. EBERSOLE: May I comment on the whole argument? The consequences may only be multipled by a fraction of two, three or four depending on the size of the nuclear part, because at presently operating environment is not protected from these sorts of events. It's not a design practice to protect the operators from this, so therefore they would be

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victimized by this containment failure.

PROF. KERR: Unless it is multiplied by a factor of ten it's inconsequential.

MR. EBERSOLE: On an investment basis that may not be true.

DR. SIESS: It seems to me you could divide this up into two parts; breach of containment through the bottom where you then talk about the hydrological, and breach of containment upward which you have the second paragraph doesn't mention meteorology and so forth. Then you go to hydrology and back to hydrogen generation. It should be lumped into with that first one, I think.

DR. MOELLER: One aspect that this discussion does not cover is the one that Jesse just mentioned. That is: multi-unit sites versus single. I summarized what I hoped were the thoughts on this in my summary of the site evaluation subcommittee which is in the folder. Would it be appropriate to look at a couple of paragraphs and see if you want to -- if any of them would be appropriate.

PROF. KERR: You had some paragraphs left over?

DR. MOELLER: It's in 7.1 and it's the last thing in 7.1.

And Mr. Chairman, let me just ask if the Committee would look it may be almost the last page. Well, we may have to sort of look at most all of it, but it has a first page in

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which -- are you able to find it? It's the last thing in Tab 7.1, the last three or four sheets -- three sheets. The draft for -- first of all we did look at NUREG 0625, and in that task force report they suggested two items which were on the middle of the first page: A, that we establish various parameters in determining the acceptability of proposed sites, and two, we consider establishing minimum standards for the number, type and level performance required for engineered safety features to be incorporated into the nuclear power plants so that you couldn't let distance negate having to put those in.

Well, then at the bottom of the page we say, well, these proposals have merit and should be evaluated. The ACRS believes in terms of overall safety attention is also to be directed to improving the effectiveness of existing sites. This is particularly appropriate in view of the fact that existing sites are in use while it is doubtful that many new sites will be selected over the next few years.

And so there are several changes and approaches that may have th potential for contributing to enhance safety. These changes which have been proposed by among others, the Institute for Energy Analysis would be directed to what's considered by that group to be a more complete and effective utilization of the best of the existing sites. And under that approach, A, the new sites would be licensed by exception, not

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by rule. This would result in an increasing number of existing sites serving as a location for multi-unit stations. And they claim certain advantages for that.

And in the last page one of the major impacts would be to limit the number of utilities licensed to operate power plants and this Institute group claims that those that do operate plants would have larger staffs which would be better trained and qualified.

Now, the final paragraph points out, if on the other hand one assumes the probability of an accident at a multi-unit site, say a five reactor site, is five times or even greater than that as a single-unit site, the wisdom of this approach could be seriously questioned. And an accident at any one unit would have serious consequences on any of the other units.

And perhaps as Bender has suggested, we should share expertise, rather than sites. If such an approach could be made effective, and if the concerns are valid, this would represent the better policy. Therefore, for siting we need someone to look into this situation to gather the data so that we can make a proper judgment.

PROF. KERR: I just want to determine what the probability is at our five-unit site.

DR. MOELLER: I don't know offhand, but I do know again, being a proponent of LER that you could look at the

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frequency of LER so the types of LERs that are occurring at multi-unit sites versus single-unit sites and at least begin to get some handle on the probabilities of failures at single versus multi-unit sites.

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DR. SIESS: In view of the uncertainties and the probabilities expounded on in WASH-1400 and as enhanced by the Lewis report, are we really worried about a factor of five in probabilities?

DR. MOELLER: (Indicating negatively.)

DR. SIESS: I am concerned about that. I suspect I could offset that by several things. I have a question about Mike's draft here. In the first paragraph it's sort of reviewing the history. It seems to me we ought to start off with the idea that the early siting practice did rely on distance of population. That was then changed to rely more on engineered safety features. And the trend now in the very recent sites study is going back to distance.

And in the second paragraph, I don't really see how Three Mile Island showed that either containment leak-tightness or meteorology are by themselves safety controlling features.

MR. BENDER: I guess the interpretation I put on it is something like this.

DR. SIESS: I think it showed the opposite.

MR. BENDER: There was a direct opening in the containment, and yet the radioactivity didn't get out in large quantities into the environment.

DR. SIESS: But it seems to me to say that there were other factors that kept it from getting out besides leak-tightness. Where was the direct opening in the containment?

MR. BENDER: When the sump pumps operated --

DR. SIESS: But the activity that got out got out through leakage in the auxiliary building.

MR. BENDER: That's exactly the point I was trying to make. They said they were providing entrapment capability. It wasn't really the containment itself that was protecting the system. You may be right, Chet. There are ways --

DR. SIESS: What this says to me is that there were other factors that had an ameliorating effect, and my thought was that there were other factors that had the opposite effect. The fact that the containment was tight was fine, but there were other leak paths that allowed these small amounts of activity to escape.

MR. BENDER: I couldn't find the containment being tight when there was an opening that allowed the stuff to get out.

DR. SIESS: The opening that allowed it to get out was the connection between the containment and the auxiliary building through the RHR system or the letdown system or whatever it was. I don't think enough got out through that sump. I don't think that was the source of the activity. That was closed off before the core was uncovered.

MR. BENDER: I don't think anybody really knows that.

DR. SIESS: The studies I have read --

MR. BENDER: The studies I read was that the source --

DR. SIESS: The pump seals or rupture seals in the auxiliary building have been blamed for most of it. They postulated that they might have got a siphon effect af:.r the pumps were cut off. I menticned this before. The staff has been reviewing leakage from pump seals or rupture seals during the long-term period following the LOCA, and I have never seen how much does they've figured on that. They computed it and said it's small compared to the Part 100 dose. Well, what got out at Three Mile Island was small compared to the Part 100 dose, but it wasn't small on an absolute basis.

MR. BENDER: I guess my point is if there hadn't been some other things in the way of that radioactivity besides containment, it would have been all over the place.

DR. SIESS: Besides the containment?

DR. OKRENT: The bulk of it stayed in the containment.

DR. SIESS: To me, this was a triumph for the containment.

MR. BENDER: Not necessarily, because the containment wall itself was so tight.

MR. LEWIS: The Rasmussen report has five mechanisms for the stuff leaking out of the containment. The dominant one was melt through the bottom, and the second dominant one was what they call "beta," and beta was failure to isolate for one reason or another, no damage to the gadget, just that you didn't cover it up. And Three Mile Island falls into that category. It's clearly a threat. Does one need to define it more closely to know what we are doing here?

MR. BENDER: I don't know that we do.

DR. SIESS: If the containment had been completely isolated, we might have had other problems.

MR. LEWIS: We might, conceivably.

DR. SIESS: I mean, if all the valves had been closed.

MR. LEWIS: Yes, we might have.

MR. BENDER: There's no sense in belaboring the point.

DR. SIESS: I don't see how the meteorology, what we learned about the meteorology --

MR. BENDER: I think the point I was trying to make was what the meteorology was didn't have much effect on how the public was protected.

DR. SIESS: You didn't say that. You said neither containment leak-tightness nor meteorology by themselves are controlling features. I agree to that, but I don't agree that I learned that from Three Mile Island, which is what the sentence says.

MR. BENDER: Okay, I will accept that as a valid comment. I think all Three Mile Island does is illustrate the point.

DR. SIESS: Now, Jesse made a stat ment a few minutes ago that we don't look at class 9 accidents for siting -- and I think he said "we." That's not true for this committee. This committee has always looked at class 9 accidents for siting. Our SPI's value was clearly based on class 9 values, and I think has been based on it for a long time. And I have never been able to feel that the siting criteria made any sense except for a class 9 accident, what little there was to it, the population center distance.

So, I can't accept that as a statement that refers to this committee, and I don't know whethe we want to make that distinction in here or not.

MR. BENDER: Does anybody but us know that?

DR. SIESS: Well, I told the Congress that when they asked me why we asked for evacuation plans, but not in low population for Newboldt Island. I was testifying, and I was asked specifically why we said that, and I explained that the low population zone exclusion boundary requirements could not keep you away from the city and the population center distance didn't keep you very far, and we were concerned about accidents greater than the design basis accident and we thought evacuation was the only solution. That's on the record.

I don't know whether it's been said in anything we wrote or not, but when we put out our SPI index or SPI value, finally, we modified it down somewhat, but it was still looking at larger releases than Part 100. The history of it went out, not just the final document. We published everything we churned out in all those papers, and the first thinking of it, we were alking about -- what -- a thousand rem at various distances and how many people would be killed and how many people would be injured. Those were our two values we averaged. We later changed the "people killed" to "people evacuated" or something like that.

But the record shows otherwise, so anybody who wants to dig into it, we can document our concern, our way of thinking about it.

MR. BENDER: Does the committee have any concern with the major points in this thing; namely, that we could be looking at whether sites could deal with a core melt in terms of controlling what happens to potable water systems if there is a melt-through, and the other question of whether we can consider potential containment bursts due to something like hydrogen combustion? Are those points that the commitee wants to accept, or believes that we've got to have something different?

DR. SIESS: When you say "hydrogen," you mean consider potential containment bursts due to hydrogen burning for something less than a core-melt accident?

MR. BENDER: Something less.

DR. SIESS: Because if you're going to talk about core-melt accidents, that's just one of them, one of the mechanisms.

MR. BENDER: I am not a proponent of these things. I am just putting myself on this thing. That's the question: do we want to accept those things?

DR. SIESS: I think one of the lessons learned is that the potential breach in containment release of radioactivity for an event of less than a core-melt accident, and probably more probable than a core-melt accident, is something that has to be thought about, has to be considered. If we didn't learn that lesson, I don't know what we learned.

DR. MOELLER: Mike's comments on hydrology are certainly in line with what we have been saying, and I think they should be repeated.

DR. SIESS: Let me take this opportunity to present something I dug up on siting policy in terms of population. I asked the staff to get me the last 20 sites that were approved and the SPI values for them. And just for your information, I think they got me 24 plants. 18 of these had SPI values of less than .1. There were four between 12 and 14, one in 16 and one in 22. And with one exception, all the high ones were New England sites. One of them was Davis-Besse, including Sumner, and I don' know what the year average would be.

But it seems to me that there has been a fairly consistent trend to get sites into very low population areas, and I don't believe you can have a population center very close to a plant and get a SPI as low as 10. I would have to check that, but I don't think you can to it, even though we averaged around the sectors to get that. So, I think there has been a trend.

.1 is 10. I am sorry.

I think there has been a clear trend in siting, whether it's coming from the industry, whether Newboldt Island precipitated it, I don't think that was the final -- it might have been the last straw.

But the distribution is skewed very differently heavily toward the low values. It looks like exponential distribution.

DR. CARBON: Mike, I think the answer to your question is "Yes."

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MR. BENDER: Okay. Why don't we go to the next one.

DR. MOELLER: I gather no one is interested in commenting at all on multi-unit versus single-unit sites?

MR. BENDER: That question got lost, Dade. Maybe we ought to come back to it. We ought not to leave it open.

DR. MOELLER: Well, I would appreciate a resolution.

MR. BENDER: This thing says there are some pluses and some minuses to it.

DR. MOELLER: (Nodding affirmatively.)

MR. BENDER: Is the thrust of what you are suggesting that this report say something about trying to say something about those pluses and minuses? I wouldn't see anything wrong with adding that. It's certainly a valid thing, that we've talked about a lot of times, how many plants ought to be at one site. We don't have much position on it.

DR. MOELLER: Well, my point is we're supposed to be an advisory committee on reactor safety. Well, if through putting three units per site we can enhance safety, or if it decreases safety, we should know it and we should have a position and it should be based on facts. And if those facts don't exist now, we should ask for them.

MR. BENDER: Well, at the time, we agreed to to -- was Shearon Harris the first one that was a four-unit plant? That was a long, long discussion.

DR. MOELLER: And when Dr. Burwell, from Oak Ridge, spoke before our subcommittee, he pointed out that they're actively meeting with the utilities and encouraging the utilities to change the site for given plants, move them to an existing site where there's another reactor. And so people are taking action, and we ought to know whether that's the proper action.

MR. BENDER: Let me take what you've got. I haven't looked at it enough to know how to use it, but I will incorporate it in some way.

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DR. OKRENT: The question of multi-unit sites is not necessarily coupled to the use of existing sites. And I don't think that we should present it only in the framework of the use of existing sites.

In fact, one could make arguments that if you are going for the multi-unit site approach, you may not want to use existing sites because you would like to better design each reactor to be able to accommodate a serious problem at one of the neighbors on the site than you might be able to do with the existing reactors.

I just mention that thought.

MR. RAY: There might be good economic reasons for not considering existing sites, too, because you may not be able to get the transmission in and out of the site. You may, therefore, be forced into a very, very expensive underground cable at 500 KV, for instance, which is tremendous.

MR. BENDER: The practicality of it, and also the whole utility organizational structure.

DR. OKRENT: I just don't want to tie the multi-unit site idea which has advantages to the use of existing sites if that's the only way it should be done.

Do you understand?

DR. MOELLER: Right. It could be tied in, but it also need not be.

DR. OKRENT: Need not be.

DR. MOELLER: Yes.

MR. BENDER: Can I go to the next section? The next section is 6.3. And I suggest that we start on page 69 and ignore everything above paragraph 70 and let's start with paragraph 70, and I will read from there.

The rest of it can probably be thrown away.

The NRC has placed great reliance on the separate lines of defense in its regulatory philosophy. The engineered safety features are provided to back up the normally anticipated high reliability of nuclear power plant equipment.

These engineered safety features work independently of other equipment, other plant equipment, and are intended to assure the safety of the public even if the plant itself does not perform as expected.

So the reliability of these features has to be very high.

Emergency core cooling, for example, requires ultra-reliable pumping circuits, valves, heat transfer systems and instrumentation.

Since some portion of these features could suffer failures during service demands, the NRC depends upon redundancy, testability, and similar reliability practices to assure functional adequacy of the engineered safety features.

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Hence, when some portion of a safety feature is reported to have failed, the question to be considered is whether the failure represen..s unacceptable loss of function in the safety feature or merely an acceptable failure included in design.

One aspect of the issue is the single failure criterion. It was originally derived from electrical circuitry design practice. That's my opinin. It may not be right, but I think it is -- intended to assure that one relay or one circuit breaker failure could not jeopardize the reliability of an electrical system.

When the single failure approach is applied to an entire system, the number of single failures that may be involved in system action could make the probability of several failures high and thus make the reliability premise meaningless.

There is a need to re-exam'ne the failure questions associated with the use of the single failure criterion since it may be used improperly in more complex systems.

A second important aspect of failure definition is how to establish acceptable levels of failure. Although piping systems, for example, have suffered stress corrosion cracking, the extent of such cracks has not yet led to significant loss of coolant accidents.

Failure control of such problems usually involve monitoring with the intent of taking corrective action before the condition reaches serious failure proportions.

For steady state conditions under normal operating circumstances, this seems to be good practice. There is some concern, however, that other types of transient conditions caused by external phenomena could accelerate the failure propogation rate.

The acceptability of failure conditions like stress corrosion cracking thus requires determination of how such conditions would change under the transient circumstances to be considered in nuclear power plant operation.

The effect of transient conditions needs clarification for failiure evaluation purposes.

A third problem is failure incurred because of environmental conditions not totally expected by design. I decided to use Jessie's case instead of fire.

A ruptured steamline, for example, could totally destroy the redundant capability of an emergency safety feature, thereby negating the contingency provision intended to establish the need of such reliability.

Whether such failures are acceptable in nuclear plants depends upon the frequency with which such environmental disturbances arise and whether they involve a loss of function permitted to design.

A fourth aspect of the failure question is directed towards methods of preventing serious failures from occurring. These are physical constraints, ultra-reliable circuitry, and alternative protection measures have all been included in NRC regulatory considerations.

It is possible to overcorrect and to introduce contingent provisions which, while useful under some circumstances, may on the whole degrade the reliability of the installation by increasing the demand on engineered safety features.

A balance between failure prevention and tolerance for failure of consequence must be established. But the balance point is not defined adequately. The tolerance which most plant designs have a design error, equipment malfunction, construction mistakes, and even operator errors determines their acceptability.

Failures reported with much public attention in the communication media are often permitted by design at some frequency rate as an acceptable characteristic.

The issue is how much tolerance exists for these failures, when are they minor and when are they major, and can their occurrence be symptomatic of conditions which may with time worsen sufficiently to cause public safety concern?

The NRC reporting systems are intended to identify such failures. The ability to analyze them and evaluate their potential to cause public safety problems is fundamental to the reliability premises on which safety arguments are based.

The reporting devices such as licensing event reports in use by the NRC and the nuclear industry has not yet been adequately applied in the licensing process to establish whether tolerance limits are being met.

This list of failure considerations could be extended further. The intent here is only to characterize technological issues and show how it relates to the regulatory process.

The problem of failure definition requires the best engineering and scientific skills available to the industry and the regulatory organization.

The current practices and requirements and probably generally appropriate to public safety needs but may need changes in detail.

The question of how to define failure importance and how to identify the extent of its consequences and how to treat the failure by design are all matters of continuing concern for those involved in nuclear power plant safety.

Such matters are getting attention and the NRC staff is concentrating much of its review in these areas.

Nevertheless, because it is important to public safety for failure matters to be addressed in the regulatory process, a broader effort is needed in this aspect of the regulatory program.

That last paragrapn has a lot of words in it that it could be boiled down to a couple of sentences.

What I tried to do is just bring all the points that have come up about what acceptable failure is into one place. I don't know whether I did a good job or not.

DR. SIESS: If this is addressed at least in part to a layman, it seems to me that it would be worthwhile to try to explain what you are referring to as a single failure criteria a little bit more completely.

From the layman's point of view, it's really a double failure criteria. First you have a pipe break or whatever it is that constitutes the failure. Second, you have a failure of one of your engineered safety features which was intended to mitigate the consequences.

And that, I think, would be worthwhile in explaining that it isn't just one failure.

Now that doesn't solve a lot of our problems. The biggest objection that I can see in the single failure criteria, it doesn't give you any quantitatively measurable -- quantitative guarantee of reliability and it doesn't give uniform or even necessarily desirable levels of reliability related to consequences.

The other point is in something you read that has changed where you talk about the steamline break could totally gsnMMM

destroy the redundant capability.

I don't quite know how to interpret "could," but if that is true, we have a terribly significant deficiency.

MR. BENDER: That's the point that Jessie keeps raising and I sort of put it out here to see if people wanted --

DR. SIESS: This whole recent flap about high level breaks -- is it that obvious that it could --

MR. RAY: I guess "could" mean potentially --

PROF. KERR: Jessie doesn't really say that it destroys the redundant capability. He says that you have to postulate a failure of one of the redundant valves, a consequent failure, and then you have to postulate the failure of the other, which is a redundant capability.

So it is not the accident which destroys the redundant capability; indeed, it leaves the redundant capability accident intact.

But if you do not have a failure of the second one of these two redundant valves, you are in trouble, he says.

It destroys the redundant capability if by that you mean that you no longer have a redundant set of valves available. But in some senses, that's why you have two, it seems to me.

MR. BENDER: The problem is how you get there, I guess.

DR. SIESS: The most serious disruption of redundancy is allowing equipment to be out of service for maintenance or test for significant periods of time now. On the reliability basis, that can be quantified.

But let's face it, there are a lot of systems in the plant that are not redundant for appreciable periods of time.

I'm talking about mechanical, because mostly electrical is such that two out of three, or whatever, becomes one out of two, or something.

But I guess the word "could" --

MR. BENDER: I can fix that.

DR. SIESS: You can postulate this. The studies that have been made indicate that it may be a problem. But if it is, we're going to fix it. But it's not inherent --

MR. BENDER: I want to fix this thing so that the single failure thing by itself didn't become the whole concern.

I think we're still worried about all the other things that could go wrong in a plant as well as the single-failure criterion.

That was all I was trying to do when I put this together. I don't know whether I was successful in doing that.

DR. SIESS: What you are trying to do here, I gather, is to try to make a distinction between component

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failures -- I use that as a simplified term -- maybe even a system failure that might get reported in the newspapers on LERs, and the ultimate failure which endangers the health and safety of the public.

We could argue whether Three Mile Island was that ultimate failure or not. But you are trying to make that distinction that you have to go down several steps before a component failure is the ultimate failure.

It didn't come through quite that strong somewhere.

MR. BENDER: If there is nothing wrong with the principle that I have stated here, I will try to work on it in an editorial sense to make it read better and bring the points out a little better.

I have so many of these things to do that I don't know that we can do much more than just agree that something has to be done with it, at such point, I'll do something with it.

6.4, in systems interactions. In the prior discussion of failure, reference was made to interactions between various operating systems and how they might lead to significant failures from the public safety standpoint.

The term, "systems interaction," as currently used, refers to all of those circumstances that may arise where events occurring in one system might impose a safety stress on another.

A fire, for example, which spreads suffiently to destroy all controls, could invalidate the capability of all engineered safety features.

This assumes interaction questions involves such matters as the relationship between the control systems and the so-called safety protection systems that are presumed to be isolated from each other, but could have interactive effects.

The release of radionuclides or steam into the operating environment of engineered safety features do interfere with their long- or short-term performance and possibly negate their safety functions.

And three, a cross-over of short circuit fall from one circuit to another. That could destroy redundant electrical equipment from adequate public safety reliability purposes.

Most of these matters are given some consideration in the licensing process. The regulations are intended to avoid deleterious safety interactions. But some recent experiences suggest that the whole subject should be under constant surveillance by personnel who have insight to potential system interaction difficulties.

That one really doesn't say much.

PROF. KERR: I am surprised to see fire classified as a systems interaction, when I guess that I would have tended to classify it as a common mode failure agent.

I had thought by systems interaction, here's a system over here and it may have an unexpected influence on another system.

MR. BENDER: I probably should have used the firewater system instead of the fire.

PROF. KERR: Okay.

DR. PLESSET: I don't think the Browns Ferry fire is typical. We haven't had too many of those.

DR. OKRENT: If you want an example, th Quad City raw water recirculating system failure flooding the turbine building and affecting other pumps would be an example.

MR. BENDER: I think your point is well taken. One is not typical, famous, but not typical.

This thing doesn't say all that much. I'm not sure whether it was worth saying at all.

DR. SIESS: I don't see how this committee could write a report without talking about systems interactions.

DR. PLESSET: Yes, it has to stay in, Mike. It's good.

DR. OKRENT: I have a question that comes to mind on this topic in thinking back to a presentation we had this morning by a member of the staff.

It is the following. In writing this, do you want in any way to refer to what the staff is doing? Remember, he told us that they are going to have the recommendation from the gsbMMM

lessons learned task force?

I'm not urging anything. I'm just raising a kind of question.

MR. BENDER: I think that's something that we need to think about. They criticize the Kemeny Report because they didn't -- the Kemeny Committee did not take into account what the staff was doing.

And I suppose we shouldn't be guilty of that.

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MR. BENDER: We shouldn't be guilty of not recognizing what they're doing, although I must admit a lot of what they're doing represent words rather than deeds. But nevertheless, many of their approaches are the kinds of things that are talked about here, and probably somewhere at the end of these chapters we might be able to point out what the staff is doing in these areas. I would try to do that.

DR. SIESS: Maybe we should encourage the staff to start licensing plants so we can find out what they're really going to do.

(Laughter.)

MR. BENDER: Why don't we plan to try to recognize what the staff has in its plans, if we can find out.

DR. CARBON: (Nodding affirmatively.)

MR. BENDER: Let me go on to Section 6-5, separation. This is a section I really spent some time massaging. Most of these others I just tried to put in a logical sequence without trying to worry too much about whether they said exactly what I thought or you thought, just to get something out for you to think about. But this one has been worked on.

"The NRC regulations are generally founded on the idea that if systems important to safety are carefully reviewed and the plants are properly constructed under suitable engineering criteria, then when credit is given for "emergency," the ECCS is classified as a system important-to-safety and receives commensurate treatment and attention.

"On the other hand, decay heat removal during normal shutdown, an even more compelling need, does not receive the same emphasis because it is considered a part of the non-safety related portion of the plant.

"The end product of this separation philosophy is the creation of two systems which are treated differently in the safety reviews. The safety sytem is scrutinized carefully but the non-safety system may be totally ignored in the review process. Important safety matters could be excluded from review if improperly classified.

"The concept of separation in some cases places overdepenednce on a specialized safety provisions whose safety capability would be better realized if considered as part of the whole operating plant. Feedwater systems to steam generators cannot, for example, be rationally separated into safety and non-safety categories.

"The separation of safety from non-safety functions is a desirable approach primarily when the two functions have independent and perhaps contradictory requirements. 'The Reactor Safey Study,' WASH-1400, pointed out some fallacies in thie emphasis on the separation of safety and non-safety functions and some adjustments have

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resulted. Nevertheless, the separation concept has not changed markedly.

"Because it is impractical to impose all of the safety stringencies on every plant detail, the separation concept must be used. A few very important features having extremely hig' public safety protection value will need special quality, redundancy and testability properites that cannot be extended to every plant element. The extent for this type of treatment may need to be greater than has been provided in the past. Alternatively, new approaches could be developed where the safety treatment placed less dependence on such safety-related features. Higher reliability may be attained in some cases if the separation concept is discarded so that the entire system can be considered as responding to the safety requirements. Credit for the capability of features previously considerd outside the public safety provisions may also be justifiable.

"Indeed, the review process itself cannot be permitted to follow arbitrary lines of separation between safety and non-safety features since this could easily result in overlooking important systems interactions or malfunctions that have public safety importance. The whole principle of safety separation needs to be redefined with the intent of developing a more logical and more effective result."

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DR. OKRENT: When I read this, I end up a little bit unclear as to what it's saying with regard to separation of safety from non-safety systems, whether it's arguing this concept should be dropped or what. The idea that you cannot separate the systems into safety and non-safety systems, and not look at the non-safety systems for their possible implications on safety, I think that's one that you make here. I think the staff has accepted that now and so forth, and I think we adopted it in one of our TMI type recommendations.

I don't think that recommendation or approach is at all incompatible with the idea that for some safety systems you avoid having any unncessary functions connected with it. For example, Ebersole has on occasion suggested that if you want some batteries available to provide vital D/C power, you might do well not to give those same batteries which are service functions, which indeed you don't need in a safety role, because this could lead to various complications. I find that kind of position by Ebersole not inconsistent with the idea that you don't ignore the non-safety systems when you are reviewing safety.

But one could read this and get the idea we didn't support the idea of trying to make a demarkation where it made sense, in the design of specific systems.

PROF. KERR: You could reach exactly that same conclusion without talking about separation at all. What you're talking about is reliability, and you conclude that the reliability of the system is enhanced if you only have those batteries available to those systems. We're not talking about separation at all. And indeed, unless you do increase reliability thereby, there's no point in doing it.

DR. OKRENT: Well, I'm not going to argue with you, because the people who are talking in favor of separation in that case are trying to get enhanced reliability when they need it. And if you want to say, "I'm going to favor reliability," they'll say they're favoring reliability, and that's the way they think for those systems you should get it.

PROF. KERR: To me, the weakness of their approach, when it has one, is that one can eventually begin to use separation as an end in itself. And I don't think it's an end in itself. It's desirable only if it enhances safety. There may be cases in which safety is not enhanced by separation.

DR. OKRENT: Certainly the answer is, yes, safety is not enhanced by separation if you only look at half the systems. But that's not a necessity; in other words, you could say, "I'm going to keep my protection system separate from my control system" -- assuming you can really do this

-- "but I'm going to also look at my control system and thereby I will have a more reliable protection system. And I will also have evaluated the control system.

PROF. KERR: You can say the "therefore," but it really doesn't demonstrate it.

DR. OKRENT: In any event, I am not clear, in fact, what this section is trying to say in that regard, so I don't know whether I agree with it or not. That's part of my problem. I can't disagree with the need to look at safety and control systems, whatever you want to call them, on overall systems, but there is more than one thing mixed in here now.

MR. BENDER: Dave, the point you made about needing to keep some things separated probably doesn't come across here as well as it should.

DR. OKRENT: It's in there, in fact.

MR. BENDER: It just doesn't come across well enough.

PROF. KERR: Let me read an alternative to help us out in the second paragraph, which may not be acceptable -- I think it's the last paragraph, I'm sorry. It may not do what you want to do because it doesn't talk about separation. It begins with the "Because it is impractical to impose. . ."

And I would suggest that it might read: Because it is impractical tc impose the same level of safety stringency on every plant details, different parts of the plant must be constructed to different safety standards. Few of their important features having extremely high safety protection will need special quality, redundancy testability -- cannot be extended to every plant element.

These quality standards may need to be applied to a larger fraction of the plant system than has been the case heretofore.

Then I would continue to read as is.

MR. BENDER: Would that help, Dave?

PROF. KERR: That doesn't emphasize separation. It just says, view the plant with different qualities --

DR. OKRENT: I don't have any particular problem with what Bill read. I'm just saying, reading through the whole three pages it sort of wanders around in this area, and I think you see what --

MR. BENDER: What I probably need to do is to just put something in there that directly makes the point that you made. In a sense, I wanted to -- in writing this thing, it was sort of trying to rebuild what Bill had done, primarily. I reorganized some of it. I don't know that I did it well.

PROF. KERR: Dave, would your concerns be met? It seems to me what Mike is suggesting to be a weakness is an effective separation has been an emphasis on the safety grade system has been -- okay, it's that part of separation that you would like to see eliminated. So perhaps in some fashion you can make that clear. The physical separation which, to some extent, is what you're talking about, not that all together, but physically separate the batteries from anything other than safety systems. You may want to retain that.

MR. BENDER: I thought the point that Dave was bothered about as not coming out too well was this thing jumps back and forth. It says, in some cases, it's good to separate; in some cases it's better to combine. I really think that, and that there's no hard-and-fast rule.

But I think we could say in this that there could be more design emphasis on trying to separte where separation could lead you to a more reliable type of system. I think Jesse -- I heard him make this point a number of times -- has said, Well, look, if I could find a few things that I could design very reliably, I could probably let the rest of the plant go to hell.

DR. OKRENT: Dedicated function.

MR. BENDER: Yes. I don't know that I wholly agree with his idea, but I don't reject it, either. And that point doesn't come out as well.

DR. OKRENT: If I can raise a couple of less

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sweeping questions.

On the bottom of page 6-15, it wasn't clear to me what you thought the Reactor Safety Study had pointed out were fallacies in the emphasis of separation.

MR. BENDER: I'll turn that to Bill Kerr. I'll let him answer.

DR. OKRENT: What are the examples?

MR. BENDER: Do you remember any, Bill?

PROF. KERR: I can't think of a specific example, but my impression is that it showed, in some cases, non-safety grade system malfunctioning -- the malfunction of non-safety grade systems could leads to difficulties and if one does not eliminate this, then one is going to be unaware of possible significant contributors.

DR. OKRENT: Well, the way that paragraph is written, first there's a sentence about independent or perhaps contradictory requirements. Then the next sentence sort of follows on as if there is something in mind which has independent and perhaps contradictory requirements. It would help me if I could see that there was an example that fit this, or something else.

PROF. KERR: That's a good point. I'll try to look on up.

DR. OKRENT: The only other thing, as I recall, somewhere in here you talk about auxiliary feedwater?

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MR. BENDER: It's just in the footnote.

DR. OKRENT: Yes, it says "feedwater sytems to steam generators cannot, for example, be rationally separated for safety and non-safety categories."

I don't know that you would be unanimously supported on that point of view.

MR. BENDER: All I can say is one is the alternative for the other. If you wanted to make one of them more reliable, you can sure do that.

DR. OKRENT: But the auxiliary feedwater system is looked upon, certainly in the German plants, and I thought in the U.S. plants, as a needed safety function to PWRs.

MR. BENDER: Feedwater is a needed safety function.

DR. OKRENT: The main feedwater system, if you wish to have power, the auxiliary feedwater system, you need to have for removing decay heat if you don't want to open up the power system, and even then that may not work too well.

So I'm not prepared to say I can't rationally separate those two, and as I say, I think there are people who think they have rationally separated them.

MR. BENDER: I know I can file better examples than that. I just happened to pick that one.

DR. OKRENT: I suggest you find a better example.

PROFESSOR KERR: Maybe the separation has been rational but not logical.

(Laughter.)

PROFESSOR KERR: For example, if the main feedwater system works and works well, you may not need the auxiliary feedwater systems in a good many cases. You can certainly look at LERs and see examples in which malfunctions of the feedwater system has caused the plant to shut down. Now you can argue that [illegible] plant did not thereby become unsafe, and so you don't worry about it, but it does enhance the frequency with which the safety system is called upon to function, about which we have said we have some concern.

DR. OKRENT: I'm not arguing that the main feedwater system is unable of itself to cause a transient obviously, but I think you can set up a rational and log'^al separation of the main feedwater and the auxiliary feedwater sytem into different categories. If I lose offsite power, I also lose my main feedwater.

PROFESSOR KERR: Sure, you can put them into different categories, but the categories won't be safety and non-safety. They'll be safety and perhaps less-safety.

MR. BENDER: I think my point had to do with whether they were interrelated and really separated from each other. They are both feeding the same water into a steam generator. About the only difference between them is, one has a little less capacity than the other and can operate with a little bit less power demand. I'm sure that there's much else of a differentiation.

DR. OKRENT: That little less power demand is the difference between being able to use offsite and onsite power.

MR. BENDER: I understand what your saying, but that's not really separation of the feedwater systems. That's power supply provision. I can put a motor on the feedwater, main feedwater system, and accomplish the same thing. And I wouldn't do it that way, but I could.

DR. OKRENT: I agree you could. But if I follow Bill's point about everything affecting safety, almost everything, anything that can cause a transient affects

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safety. So therefore, if we go all the way back down the power line and every telephone pole -- well, telephone pole near it as well as power and so forth is related to safety.

PROFESSOR KERR: But on a frequency basis, the telephone poles don't cause as many transients as the feedwater system.

DR. OKRENT: It depends on your reactor.

MR. BENDER: I think we are belaboring a point which maybe we shouldn't belabor. I understand what you were saying. Dave, I didn't think it was that bad an example, but I can look for others that may be better.

PROFESSOR KERR: Mike, in paragraph 81 --

MR. BENDER: I have your note, incidentally.

PROFESSOR KERR: I suggest that you may be talking about systems here rather than functions.

MR. BENDER: It could very well be.

MR. MOELLER: In paragraph 79, I can give you this in the last sentence if you buy it. It seems to me that we should say that "the NRC review practice has been one which separates safety from non-safety systems, with primary attention being given to the safety systems" as contrasted to saying "with no attention being given to the non-safety systems."

MR. BENDER: Okay, Dade. That's good.

Let me go to the next item which is man-machine interfaces.

"Nuclear power stations cannot be operated solely by human action or by machine automation. Operators are needed to establish a state of readiness for the plant, to relate them to the external electrical demands, to provide fuel maintenance and similar service activities. However, the only way to minimize human mistakes is to automate the plants or provide better computerized analysis, so that the likelihood of human thinking errors will be minimized.

"None of the older plant designs have sufficient computerized analysis capability to be useful in analyzing most operational symptoms quickly. Some newer designs have improved computerized analysis capability, but the only purely automated functions are still the emergency power supply systems, reactor safety protection systems, pressure relief containment closure valves, and a few basic mechanical equipment functions.

"There may be advantages to expanding the automated plant features to reduce the need for operator action during transient operating periods. But how and whether this should be done deserves considerable thought. Most of the modern plants are providing additional computerized control capability that could, by computer initiated control signals, ease the knowledge requirements put on operators, but concern has been expressed about such systems causinc undesirable operational actions through computer malfunctions. The safety threat from such malfunction, when it is provided to reduce demands on operator thinking capability, to some extent offsets the desirability of computerized response.

"There may be a need to improve the information displays in control rooms. These have been developed along lines which follow customary display practice for existing power stations, combined with the now traditional display scheme for nuclear controls. This display has considerable merit because operating personnel are accustomed to it, but it may not draw operator attention adequately to the crucial instrumentation needed in emergencies. The alarm systems may be excessively confusing, and some information displays could be better located."

Now that's where it stops. Whether we ought to say something about how to go about this so-called human engineering or whatever it is, I'm not sure what to say.

MR. EBERSOLE: Mike, beginning about1968 or thereabouts, there was a big flap in this business because of the importance of operator indication, as it came to be known, and up to that time, to '79, only considered automated circuitry important to the safety function. Therefore, there was a big issue as to whether those circuits that provide indicating functions should be

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classified as safety-grade, given the benefit of power supply reliability, separation, and all the other good things that you do to safety circuitry.

There is beginning about that time, and certainly prior to it, a mishmash of designs where indicating circuitry is not safety-grade, and after that it is probably a mixture of safety and non-safety-grade, and at best it might come in only redundant configurations, which as you well know contrasted automatic response, permits the operator -- or rather puts him in a position where he must deal with conflicting outputs. Redundancy buys you nothing but potential confusion, and the matter, so far as I know, has not been settled about how you now give the operator truly reliable signal indication, either in the context of making it safety-grade or requiring, in fact, auctioneering input to the operator so he can determine what action he should take.

His potential action could be bi-directional. Unlike most control systems, he can do the wrong thing as well as the right thing, depending on what comes to him. I think there are major issues yet to be settled with the qualification of indicating circuitry which is now recognized to be essential to plant safety.

MR. BENDER: I think you are directing your commentary to a slightly different matter than this particular thing.

MR. EBERSOLE: You're talking about operator interfaces. I'm talking about his information input, the quality of it.

MR. BENDER: I guess this is more directed to the matter of when we should decide to let him do the thinking.

MR. EBERSOLE: And on what basis of information. That can't be separated.

MR. BENDER: Yes. I don't know how to get the instrumentation philosophy cranked into this, which is the thing you're talking about right now.

MR. EBERSOLE: His actions are going to be guided by what he sees. Now, what's the quality of what he sees? It's almost the same argument we had --

MR. BENDER: Tell me what I should be saying.

MR. EBERSOLE: I think we need to say that new investigations of the quality of operator input need to be undertaken to resolve the matter of potential conflicting information which derives from redundant configurations, and maybe to ensure that diversity in the operator signal to do certain things is always available. There is no methodical process by which this is currently done.

MR. MOELLER: It seems to me, Mike, you've covered one aspect of it. When I think of a machine and man use of it, I think of the design and his ability to keep up with what's going on, and obviously prior to TMI, there had been a number of studies done which had told them they needed to, you know, improve control rooms. And subsequent to TMI, there's a lot of action in this area.

So I think what Jesse has said is good, and maybe if it's appropriate, you could have a couple of sentences which say that it is being looked at and that action is underway, and we are happy with it.

MR. EBERSOLE: Control room redesign is a part of this, but having got that put by, now remains the adequacy of the control room information on the redesign basis.

MR. MOELLER: Oh, yes. It has to be the right kind of information in the proper form so he can use it, and in a way so that his natural response will be the correct response.

MR. EBERSOLE: In a way, it's like redeveloping the arguments that have attended the core protection calculator at Arkansas 2, since we now know that operator input is going to largely be by -- it's going to be solid-state computerized, and therefore, it carries with it all the potential failure regimes carried by CPCs, except this time the operator will be the final mechanical element that performs the function.

MR. BENDER: And so --

MR. EBERSOLE: One, it all ends up as to how

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reliable is the operator input?

MR. BENDER: Well, I could say, nevertheless, we should do this. But if we do it, we need to have some way of being sure that we are getting adequate reliability.

MR. EBERSOLE: Yes, in the operator input. That is a field of endeavor that has not gotten much attention.

MR. BENDER: In terms of the quality of the signals?

MR. EBERSOLE: Yes. Potential conflict on redundant systems.

MR. BENDER: Being sure that no ambiguity -- are those the things that you were after?

MR. EBERSOLE: Yes. Right.

MR. BENDER: Okay. I think I can get something in there.

MR. MATHIS: Mike, just one other point. The first sentence say, "Nuclear power stations cannot be operated solely by human action or machine automation." I think they could be operated solely by human actions, but it would be a little tough.

MR. EBERSOLE: Practically? Now, there's just a little bit --

MR. BENDER: Fine. Thank you. I think you're right. It would be difficult. I'll fix it up.

Can I go to the section on safety improvements?

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DR. CARBON: Yes.

MR. BENDER: "Nuclear power stations have incorporated many features intended primarily to enhance their public safety protection as a result of direct regulatory requirements, including off gas filtration, automated containment closure, and hydrogen recombiners for containment. Further improvement may be desirable in some areas.

"A comprehensive study is needed to define the most urgent needs. The discussion which follows illustrates the types of safety improvement which can be of value.

"An important safety contribution would be a filtration system which could recover radionuclides from the contained volume after an accident so that the residual gases could be vented to the public atmosphere safely. However, these filters -- how these filters could be used and the performance reliability required of them would involve some research and experimental work. If provided, the public safety actions after a Three Mile Island type of event would be easier.

"More versatile and more reliable core cooling capability is another area that might enhance public safety. The experience at Brown's Ferry and TMI-2 both point to the desirability of being able to provide reliable core cooling capability from multiple sources. Diversity of the capaoility, its independence o^ .ccident circumstances, its resistance to deliberate sabotage, and its ability to directly cool the core under a range of circumstances could directly reduce the likelihood of TMI-22 type accidents as well as other accidents offering a potential for core damage and even fuel melting. Conceptual engineering studies would be valuable in determining how this capability could be realized.

"The ACRS has identified these two matters as ripe for investigation in the NRC research program. Other types of safety improvements might be envisoned. These include different means for primary system pressure relief, changes in materials of construction, techniques for minimizing accumulation of radioactive materials that directly interfere with in-service inspection, and modifications in existing containment concepts.

"However more independent initiative is needed by the nuclear industry in identifying safety improvements. The public might react more favorably to the future of nuclear power if there were some visible efforts in this direction."

MR. EBERSOLE: There's got to be something added. There is no incentive. An incentive must be created which will encourage this sort of effort, and that incentive, I think, maybe is in reduced costs for safe operation. I

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don't know. But right now, there's no incentive.

DR. OKRENT: Jesse, I would say there may be a very big incentive.

MR. EBERSOLE: Survival?

DR. OKRENT: I suspect that if this is not done by the industry and done seriously, and if they don't try to pursue what I call something that looks like an AGARA principle, it will be survival.

MR. EBERSOLE: That was one thing I was not including. It may well be.

DR. SHEWMON: That may be possible, but I don't see -- That is a sword of Damocles hanging over your head, and you can't see who's got a knife against the hair that's holding it. It seems to me that having something more palpable or more short-term is still a valid point.

MR. EBERSOLE: I think release from existing regulatory requirements where suitable would be a desirable incentive to offer to the industry, to give them the impetus to develop and improve a more simple process for safety. They've always bitched about being hung forever with existing regulations to the point where there was no merit in finding an easier and better way to do something, since it would only be superimposed on what they already had to do. And that's true.

The regulator process is unbending in releasing

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existing regulatory requirements. I think it must bend if it sees truly adequate efforts to do things in different ways and better ways.

MR. MATHIS: When we talk about incentives, it seems to me that the avoidance of the costs that Met Edison has incurred at TMI ought to be enough incentive to do an awful lot of things.

MR. EBERSOLE: Yes.

DR. SHEWMON: You've got them scared, but how are you going to make it effective?

MR. MATHIS: I don't know. But this is why we continually look for improved safety. How do you make that effective to avoid an incident.

MR. BENDER: The safety pressures that have been put on them have diverted their attention in some instances.

DR. SHEWMON: Look at the BWR --

MR. EBERSOLE: Look at the BWR ATWS. If a BW ATWS occurred, you'd lose a multi-unit station.

DR. SHEWMON: I would suggest that you put in some words that at least suggest the staff look into incentives. Perhaps flexibility and dropping older requirements is a better -- or better procedures can be presented.

MR. EBERSOLE: Fire protection, Mike, in its present diffuse form is a good point. We can lock safety functions

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into clearly discernible areas of protective environments, and then we can relinquish a lot of expensive fire protection requirements currently existing for nuclear safety. We might still keep some of them for protection of economic investment, but they wouldn't be nearly so complex.

The horribly complex requirement for unique separation of A function to B function in the heterogeneous environment of an auxiliary building is a terrible thing to achieve when you consider environmental impacts. I'm really talking about compartmentalized functions.

MR. BENDER: We're not going to be able to go through the designs per se here. I think the best we can do is sort of lean toward the idea of them saying, "Well, if effort were made to find some incentives to encourage the industry, this would be a help."

MR. EBERSOLE: Yes. Just even a hint that they would be able to get rid of some of the existing regulations if they found a better way would be enough.

MR. BENDER: We could say they might include relaxation of some regulations, perhaps some caused --

MR. FRALEY: We could abolish backfitting requirements.

MR. EBERSOLE: If we found a better way.

MR. BENDER: Any other points?

(No response.)

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MR. BENDER: Let me go to the section on standardization then.

"The conept of standardization was originally envisioned as a way to accelerate the licensing process by minimizing impact. Most nuclear steam suppliers have established basically uniform configurations. All major equipment is standardized in manufacture and performance. The thrust of recent standardization has been to obtain design approval on a system basis so that system review will not have to be performed repetitiously.

"Balance of plant design by AEs has followed a similar trend. The level of detail provided in standardized designs is not as complete as might be seen, for example, in air transport systems, partially because much plant equipment is purchased in the competitive marketplace after the construction license is granted.

"The adequacy of the system definition including level of detail to be provided for final approval of standardized design has not been yet established. Insufficient experience is available to display the anticipated benefits from standardization.

"Up to now, it seems to extend further the variability of designs from those of existing plants. A variation of standardization that has received considerable support is the replication of existing designs. This approach does reduce the variability since the intent is to follow closely what has been done before.

"As applied in recent licensing actions, replication approaches have unfortunately tended to restrict initiatives for safety improvements on the basis that they violated the principle of design stability which standardization is intended to promote as a means of streamlining the approval process.

"This restriction might also be interpreted as a mechanism for circumventing requirements for public safety improvements that the regulatory process should encourage. There are certainly advantages to standardization that could be realized if the licensing program were to be expanded rapidly.

"It is not certain that the present NRC approach really brings forth the best values from standardization. The mode in which standardization is being used should be re-examined to determine whether alterations would enhance its value without loss of the streamlining effects on licensing that it is intended to provide."

MR. EBERSOLE: I have a paragraph to add here which I am sure is going to be bloody, but I'll read it because I believe it.

"The content set by the standard LWR design for national use has been suggested. Such a design would evolve from careful sifting of the current design to identify the range of reliability and safety developed under present narrative regulations, GDC's reg guides, SRPs, and the like. Such a review would follow the general pattern recently used to comparatively analyze the safety and reliability of current PWR auxiliary feedwater systems. This investigation disclosed systems which has an apparent reliability safety range of upwards of 1 to 100, which suggests" -- hang on -- "what is being done with a degree of freedom made available by narrative regulations in virtually all systems.

"Such a range might well be found in many of the critical systems of the plants and may well in fact show that even the PWR or the BWR should be eliminated from the new LWR designs which will utilize nuclear energy for the near-term future."

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MR. EBERSOLE: That's rough language.

It's the general context that I wonder if on a collegial basis here this committee is willin g to make a statement.

MR. BENDER: I think the letter we wrote to Mr. Udall said --

MR. EBERSOLE: That was a negative letter.

MR. BENDER: That was your interpretation, that it was negative, Jesse. Because it wasn't; it was properly cautious.

(Laughter.)

MR. EBERSOLE: It was the glass is half empty, not half full.

DR. SHEWMON: Your suggestion is to pull the glass away completely?

MR. BENDER: I think some people thought it was properly cautious. You may have thought it was negative.

MR. EBERSOLE: I think my prejudice stems from having looked on a comparative basis at the core design, and having found therein weird departures from the best way to accomplish the same functions.

MR. BENDER: Why don't you write out what you want to say?

MR. EBERSOLE: I will write it out. Better than that, I will have it typed.

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MR. BENDER: We can cut down the red corpuscle content a little bit so that it doesn't look so nasty, and we will see if we can fit it in.

DR. SHEWMON: Mike, in the last paragraph, second line there, that could be realized if the licensing program were to be expanded rapidly. Do you mean if we quadruple the number of NRC people or if we quadrupled the number of reactors to be reviewed?

MR. BENDER: I mean the latter. It doesn't come across that way.

DR. SHEWMON: It seems to me there's a more direct way you can say it. Can't you just say if the number of reactors to be licensed --

PROF. KERR: I am sorry. Where are we?

MR. BENDER: First line of the last paragraph: "If many reactors needed to be licensed rapidly" -- okay, Paul, thank you.

Other comments on this section?

(No response.)

DR. CARBON: Charge on.

MR. BENDER: Let me go to emergency response --

DR. SHEWMON: At the end of 96, is it really generally agreed that we want to have every plant unique, and every time we come up with what we think might be a better one we should go put it in the first plant we can?

MR. BENDER: No, that's not the thrust of what this says at all. At least, that's not what I thought I was saying.

DR. SHEWMON: "This restriction might be interpreted as a mechanism for circumventing requirements for public improvements that the regulatory process should encourage."

MR. BENDER: It's a matter of how hard you want to draw the line on this business. It has, in fact, been the situation in many cases people have said, "We are replicating it; because we are replicating, anything new is absolutely ruled out. That's an agreement which we have reached with the regulatory staff."

MR. MATHIS: That particular sentence sounds like you are circumventing or the regulatory process is encouraging circumventing.

MR. BENDER: I think it's being used that way in some cases.

MR. MATHIS: I know. Shouldn't we just chop it off and say "circumventing requirements for public safety improvements" -- period?

MR. CHECK: Let me see where I am. I haven't thought that much about it.

MR. MATHIS: It's just the way he read it that hit me the other way.

MR. BENDER: Okay. Well, there are some things that have turned up in these replicated plants where the guys that are building the plants have said, "Well, it may e in the regulations, but you agreed when we went to replication that we wouldn't have to meet those requirements." Now you're saying take out the requirements.

MR. MATHIS: No.

MR. BENDER: What are you saying, then?

MR. MATHIS: I am just saying stop the sentence at the end of "public safety improvements." That way, you get rid of the ambiguity --

MR. BENDER: Fine. Thank you.

MR. MATHIS: -- That you are circumventing or recommending certain things.

MR. BENDER: Can I go to emergency response?

DR. CARBON: Go ahead.

MR. BENDER: "Questions concerning nuclear industry capabilities for handling problems associated with accident situations have been of interest since the beginning of nuclear power plant development. Those responsible for the safety of nuclear installations, beginning with the Atomic Energy Commission, recognized the need to develop such capabilities but it was never practical to achieve this goal because of the general disinterest in

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such matters at the state and local level.

"As a result, it has been necessary, even in recent years, for the NRC to require its licensees to establish emergency plants which were heavily dependent on the cooperation of state and local governments even though these groups did not have either the funds or the personnel to participate on an effective basis.

"Also contributing to these problems is the fact that in the past the NRC has had no regulatory authority over state or local agencies. As a result, the NRC staff could only ask to review the radiological emergency plans of such agencies. They have had no authority to make recommendations for improvement, and they could discuss these matters only on invitation by state or local groups.

"With the occurrence of the accident at Three Mile Island, there has been a substantial alteration in this situation, particularly with respect to the interest of state and local governments in such matters. In addition, several bills now pending before the Congress hold promise of correcting certain aspects of these problems. These actions are necessary to implement needed changes in the regulatory process."

Dade, I take it you looked it up to include that one bill I thought had gone up at one time?

DR. MOELLER: Yes.

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MR. BENDER: Any problem with this?

(No response.)

MR. BENDER: Let me go to nuclear power plant waste management.

DR. LAWROSKI: It seems to me that another benefit that you could mention that can be derived from standardization would be that we could more quickly develop reliability and risk assessments -- your data base for any particular design is so much bigger.

MR. BENDER: I think the point I was trying to make -- and it evidently didn't come across very well -- was there isn't anything wrong with the standardization, we probably need it, but the way in which it's being used is not getting you anywhere. Jesse is suggesting a way of approaching standardization that might be constructive. What I said here was take a look here at how it's being done and see if we can find a better way to do it.

I could put some incentives into it of the sort you're talking about, with the intent of -- and then make the points that you made. Okay?

DR. LAWROSKI: Okay.

MR. BENDER: I will do that.

DR. MOELLER: Excuse me. I think you are correct and I am wrong on this. I don't know how to look at a bill, but this says "An act and ordered to be printed as passed."

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I don't know.

MR. BENDER: I recall this. It occurred to me that I didn't know if the House had acted.

DR. MOELLER: We can ask the staff to check that out.

MR. BENDER: If it were in fact enacted, I think it would be a good idea to recognize its existence. If it hasn't been, then, of course, the way we have said it is the right thing.

MR. BENDER: I will fix that up, Steve.

Let me to go 6-10, nuclear power plant waste management.

"Another problem that has received too little attention is the matter of radionuclide cleanup following an accident. Similar problems pertain to the decommissioning processes for nuclear installations. The NRC has in the past left these responsibilities to its licensees. As a result, the associated planning and supporting research have been inadequate.

"This is clearly shown by the inability to handle the large volumes of radioactive gaseous and liquid wastes that were generated by the Three Mile Island accident. Neither the industry nor the involved federal agencies nor their advisory groups envisioned or planned for accident situations in which the character and the magnitude of the

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waste management problems would be so different from those of routine nuclear plant operations."

I would like to strike out the "so." Just say "different." It would be just as well.

"The associated consequences included increased personnel exposures, an inability to collect adequate samples to assess the situation, and a delay in restoration activities. The accompanying public opposition to plans for the disposal of the decontaminated waste fluids" — that probably should be "decontaminated wastes" — even though these involvee risks no greater than those associated with similar wastes resulting from normal operations, has also delayed cleanup of the plant.

"Until recently, the low-level radioactive waste routinely generated in nuclear power plants and that which occurs from the decontamionation and cleanup processes associated with the maintenance of power plant equipment have essentially been ignored. The low-level wastes do not pose serious human hazards if they are properly controlled and confined to keep them out of food chains and away from human contact exposure.

"These wastes have normally been shipped to privately operated licensed burial grounds or to government-owned facilities. The practices followed in the commercial facilities have been less rigorous than desired,

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and the burial grounds themselves contain materials from non-power plant sources that deserve better attention than was provided.

"Because of both NRC's and the public's concern, most of these burial grounds are now being closed. The need for usable low-level waste disposal technology that meets established criteria, policies, procedures, and regulations is apparent. Meaningful regulatory action may dispel public concern for this matter."

Does that cover the point adequately?

DR. MARK: Mike, I think, up at the top of page 6-24, the point pertains to transportation. That's what the governors mainly complained about. That's somewhere at the top of page 6-24. You say the practices followed in the facilities, the burial grounds haven't done so well. Transportation has aroused a certain amount of public concern.

MR. BENDER: I will think about it. I didn't think that --

DR. MARK: Packaging --

DR. LAWROSKI: Say, for example, packaging.

DR. MOELLER: They reported -- what -- 60 to 70 percent of the packages received, and these were reactor as well as medical as well as research -- everybody's -- are leaking or improperly labeled, et cetera.

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MR. BENDER: I will get that into this thing.

DR. MOELLER: Your third line on 6-24 could imply it's mainly the non-power plant sources that deserve better attention. It's really all of them.

DR. LAWROSKI: I think most of the problems with Sheffield have really been with non-power plant sources. Plutonium didn't come from power plants. It came from national labs.

DR. MOELLER: Just so we keep that in mind.

MR. BENDER: It may be an extraneous point, but I think that's what they really show.

DR. MOELLER: Right. And I have heard — isn't it upwards of half of the material there is not from the commercial plants?

DR. LAWROSKI: Yes.

DR. SHEWMON: I have a certain amount of trouble with that line simply in knowing what you're saying. If you want to take out the second and third lines on 6-24, I don't know that it would hurt anything. But if you want to leave that in -- after "and the burial" -- I think we should make it so clear that even I can understand what you're talking about.

MR. BENDER: I might try to make a footnote out of that. I think it might be a better way to handle it and get it out of the body of the discussion. There are a couple of things that I wanted to ask about. One, so far nothing has been said about developing decontamination methods that really apply to something like a TMI accident inside containment, and I don't know what we should be saying about it. I don't know as much as I ought to know about what was done in similar kinds of accidents like the Canadian reactors and the one up in Wisconsin, Elk River. Well, let's see, Elk River was decommissioned, but I was thinking about the one that all the fuel buried -- Lacrosse. In order to get that thing back into business, they had to take out a lot of damaged fuel material and put it somewhere.

And in a way, I think that what they did was relevant to TMI, but I don't know enough about it to comment on it. I wondered whether anybody else here did.

DR. RAY: Lacrosse?

DR. PLESSET: They had a cladding failure.

DR. SHEWMON: They pulled it out and the rest of the pieces were rattling around, and the big problem was to find it, I thought, rather than what to do with it when they got rid of it.

PROF. KERR: As far as I know, most of it is in their spent-fuel storage pool right now.

DR. LAWROSKI: They did not report particularly great difficulty in dealing with all that failed fuel at the last subcommittee — well, not the last -- the

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MR. BENDER: Should we have something in here that addresses the problem of what to do about reactors that have actually been through one of these serious accidents?

DR. MOELLER: We have a suitable paragraph in the July RSR report or one that might be a beginning. I can get that for you.

MR. BENDER: Yes. Okay.

DR. MOELLER: I will do it.

MR. BENDER: What I might do would be to try to find or add a section that covers accident recovery.

DR. SHEWMON: Mike, do you talk about spent fuel someplace else in this?

MR. BENDER: No.

DR. SHEWMON: Well, you know, you've got two bad problems: one, what are you going to do with spent fuel; and the other, what are you going to do with short-term waste. And constipation is tying up both systems just with different time constants.

MR. BENDER: I didn't deal with the spent fuel business, either. You think I should do that? What do you want to say about spent fuel?

DR. SHEWMON: Well, I guess it's perceived as a problem, and what we have done is to avoid it by doubling the capacity of the spent fuels. And maybe you think political — I don't know what's happening. I think it's a long-term major problem.

MR. BENDER: We have doubled the existing pool. We could probably add four more pools to every reactor plant we wanted to. I don't think there's anything that says that those pools need to be exactly in one place. I think taking the pools off site has created some concern, but having another on-site pool wouldn't be all that much of a problem.

DR. SHEWMON: I think that's putting your head in the sand. I don't know whose job it is to worry about what's going to happen to that stuff ultimately, and maybe the NRC doesn't have anything to do with it. If so, then we shouldn't mention it. On the other hand, if the NRC is likely to have any role in what happens to that fuel when we finally decide that six spent-fuel pools per reactor is enough, then I think it should probably be brought up here.

MR. BENDER: What do you suggest we say?

DR. SHEWMON: I guess my feeling is that all wastes are a problem. You have brought up two of them out of three. One, bad accidents are something we haven't looked at, and that's a very timely point. Two, they are closing down all --

MR. BENDER: The low-level wastes.

DR. SHEWMON: -- Which has crisis proportions soon

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and we may be walking around that one. Just as sure as the Lord made little green apples, you're going to have a problem with spent fuel down the road.

MR. BENDER: I could say something like we shouldn't ignore the spent-fuel storage problem even though the present plans to expand spent-fuel storage at the plant sites represent a good short-term solution.

DR. SHEWMON: I think they represent a viable postponement.

DR. RAY: Would you want to point out in conjunction with that if they resumed reprocessing that they would minimize the amount of waste that they would have to store?

MR. BENDER: I think I am going to have to wait until after the next election.

(Laughter.)

DR. CARBON: Yes. We really don't gain much by --

DR. LAWROSKI: By expanding, we simply say it's crucial to get additional land burial sites licensed? That takes care of the low-level wastes.

DR. SHEWMON: I think that's certainly true.

MR. BENDER: Your point is well taken here.

DR. LAWROSKI: That, followed by another one, that until or unless reprocessing is resumed, the other part of that waste management problem is that of the spent-fuel

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storage.

MR. BENDER: If you guys want that in, I will put it in. But I don't agree that that sort of --

DR. LAWROSKI: To me, the spent fuel is not a major --

(Simultaneous discussion.)

DR. SHEWMON: Why do anything to it until it's a major problem?

DR. LAWROSKI: No, no.

DR. CARBON: It is policy, and to me it's more of a point that there is nothing we can do about it. The President has said, "That's it," and we can recommend anything we want to the NRC but they can't do anything about it.

DR. LAWROSKI: That's his point, though.

DR. SHEWMON: Pardon me. I thought part of this was go to up on the Hill with problems that somebody is to worry about nationally. I have never seen this committee before particularly reluctant, that, "Gee whiz, that's somebody else's job connected with nuclear power."

DR. CARBON: I don't mind the "Gee whiz, somebody else's job." I just figure there is nothing we can gain by it.

DR. SHEWMON: You think it's totally political and nontechnical and the NRC doesn't have anything to do about

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it? If asked, they can anytime they want to.

DR. CARBON: I figure they can't do anything -- period.

PROF. KERR: Let me point out that the low-level waste is equally political, and if one uses the same logic, it seems to me one stays away from it. I don't see any logic in leaving out high-level waste if we're going to talk about radioactive waste.

DR. LAWROSKI: I think it's certainly going to be a problem if we don't resume reprocessing.

DR. SHEWMON: Or if you don't, at least get someplace where they can take it out of the pool.

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DR. MOELLER: Let me propose a paraphrase from the words of the RSR report in July. It says more attention should be directed to steps that might be implemented in the recovery and re-entry phase following an accident. This program should include evaluations of designs and procedures to facilitate the decontamination recovery of major nuclear power plant systems and handling the associated waste. It should also include attention to decontaminating and reclaiming buildings and equipment and the establishment of dose limits or guides for their re-use.

MR. FRALEY: But there were also comments in that report about the NRC -- I thought it was, maybe it was a separate letter about the NRC's role in the waste management program and guiding DOE and their expendors and what have you. In fact, they complained that this was not being done in any of its reports.

MR. BENDER: Any other comments on this thing?

Are there other places of things that ought to be covered in this technological discussion?

I had at one time thought something on risk assessment, per se, or to get in here. I was going to put it in the section covered in the beginning, design basis accident, but I didn't feel comfortable putting it in there. But if you want something on risk assessments, methodology, we ought to consider what ought to be said. Maybe Dave and his thought

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processed could crank up something that would be appropriate. Can you do that, Dave?

DR. OKRENT: I can try.

MR. BENDER: Can we take a break, Mr. Chairman?

DR. CARBON: If you would like, we will be knocking off in about 40 minutes or we'll take a break now if you wish.

MR. BENDER: I think we ought to take a break.

DR. CARBON: Let's try and make it a short on? and come back at a quarter to one.

(Recess.)

MR. BENDER: "The intent of the Congress when creating the NRC was to establish a regulatory agent free from promotional bias to oversee the safe use of nuclear energy in order to improve public confidence in the regulatory process. The law implied by its sanctioning of nuclear plant licensing that the basic approach was safe, but the policies and practices under which the nuclear power was regulated might need some modification.

"Public understanding and acceptance of the nuclear power as a beneficial source of energy depends upon effective regulatory management. The regulatory function is extremely complex. Some of it is legal in form, some of it is political, and all of it involves very complex technology. The regulatory process must be stable in the eyes of the industry, it must be vigilant in protecting the

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safety of the public, and it must handle safety questions intelligently, responsibly and expeditiously." That's a lot of words.

DR. SHEWMON: Why do we have protection in there?

MR. BENDER: Why do we have it in there?

DR. SHEWMON: I thought you were going to tell me some particularly urgent management consideration.

MR. BENDER: It was just an introduction to what is going to come on further. It may not be a good introduction. That's why I say it probably should be thrown away.

"Regulatory Responsibility.

"The regulatory organizational structure has five equal offices under the direction of an Executive Director of Operations. The law makes each office directly accountable to the Nuclear Regulatory Commission, thus exempting the EDO from responsibility for public safety decisions. The Commissioners themselves are selected in accord with political affiliations. The Congress apparently intended for the Commissioners to act in a policy making role, but not in an executive role. The Regulatory Staff often has not brought matters involving regulatory action to the Commissioners soon enough to obtain timely policy guidance. Offices sometimes act independently of each other and of the Commission's direction when their actions should be interdependent. The result is apparent confusion concerning

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the source of authority for regulatory positions, adversely affecting public confidence in the regulatory process. Integrated and identifiable authority is needed to correct this situation.

"A matter of equal concern is whether the NRC has delegated too much responsibility for public safety to the licensee. The NRC could interject itself more into operational planning and training. The presence of an NRC representative at the plant offers NRC the prerogative to decide when and whether plants should be started up or shut down. The NRC could also set more explicit requirements with respect to plant design and operating procedures and effluent discharge, and it could require all applicants to follow these NRC directions. Regulatory practice has avoided this in the past because it relieves the licensees of responsibility for design and operational decisions.

"Recent experience shows that the licensees have not accepted responsibility to the extent desired but the responsibility role intended for the licensee by past practice appears to be desirable in order to maintain regulatory balance. The NRC has the authority to require design improvements and enhanced operating controls whenever public safety requirements indicate the need. The objectivity of the NRC reviews might be lost if the agency had to defend its own design and operating initiatives.

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The crucial action is to establish that those who are assigned responsibility are capable of and are accepting it responsively."

That's too many words, and maybe it just ought to say that the responsibilities within the regulatory organization are a little confused, that those assigned to the licensees are okay except that the licensees aren't accepting them as fully as they are expected to be, and that's what it was intended to say.

DR. SHEWMON: What is your basis for the last clause that you just said that they aren't accepting their responsibilities as much as they should?

MR. BENDER: I suppose TMI is the best example of it. The fact that they haven't built up their capabilities as well as they should build them up; the fact that they have not --

DR. SHEWMON: Now you are painting all of them -- tarring all of them with the same brush.

MR. BENDER: It's true they all deserve to be tarred with the same brush.

DR. SHEWMON: That's your feeling. The question is whether it's the collegial feeling.

MR. BENDER: Okay.

DR. LAWROWSKI: I think a good share of them deserve to be similarly tarred.

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DR. SHEWMON: Well, I think they devote a fair amount of effort and money in trying to comply with the regulations that have been put out and to take Mike's position I really don't think they are out to endanger the public for a variety of reasons. So, I guess I would like to have something that was a little bit more explicit as to where we feel they have fallen down so badly or rejected their responsibility. Right now we are just kicking them because it's stylish. That's the way it's done now.

PROF. KERR: Are you pointing to something specific, Paul, or just the general tone?

DR. SHEWMON: Recent experience shows that the licensees collectively have not accepted responsibility to the extent desired, but the responsibility role intended for the licensee by past practice appears to be desirable in order to maintain regulatory balance. Okay. The first half of that. I would just like something more explicit if indeed it's there about where we feel they haven't accepted their responsibility.

I think the EPRI or the programs they have through EPRI are good and quite responsible, and I think there are things that probably the NRC couldn't do near as well with regard to training licensees in some self regulation.

DR. LAWROWSKI: That's again a question of post-TMI or pre?

DR. SHEWMON: TMI I will kick with you or Met Ed.

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but I guess the whole group I would like to have a little bit clearer what we are kicking at or why.

MR. BENDER: Certainly to say all of them aren't responsive may be tarring them all with the brush that is not deserved. But I think more than a small number are not.

DR. LAWROWSKI: How about many?

MR. MATHIS: Just the fact that they have created INPO I think is an admission on their part that they haven't been doing what they should be.

PROF. KERR: That can be taken as a criticism for lack of judgment, perhaps, but it seems to me one can certainly learn by experience. You could either assume that they knew all along that they should have had INPO, that they didn't realize that until recently and now they are doing something about it. I guess I am not sure which. Maybe some of both.

But Mike, if you did not intend to tar the whole group it seems to me you could change that to say recent experience has been interpreted by some to show that or --

MR. BENDER: I think that's a good proposal.

DR. SHEWMON: Or to the extent desirable.

MR. BENDER: Actually I was thinking in terms of whether we ought to be saying something about whether the role of the licensees and their responsibilities should be shifted and more turned over to the regulatory side of the business. And I was trying to develop an argument which said they may not

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be doing as well as they could, but it's better to make them do what they ought to do than to take the responsibility away from them. And I think I could fix it up so it says that instead of being -- having the thing written so it is interpreted as saying they are all doing the wrong job.

DR. MOELLER: I have trouble with it -- with the sentence, I guess, just from understanding it. It says recent experience shows they haven't accepted responsibility desired. But the responsibility is desired. I guess what you are saying is that they have not accepted the responsibility to the extent desired even though this responsibility must be assumed if the regulatory process is to function?

MR. BENDER: That's what I intended to say. I didn't say it very well. That I agree with.

Why don't I shuffle it around a little bit along the line that Bill Kerr suggested. Would that take care of your concern, Paul?

DR. CARBON: Charge on.

MR. BENDER: "Legal Framework.

"A legal basis for regulation is essential to the regulatory functions. The reviews by the ASLBs are apparently intended to establish that the NRC has a basis for its rules and regulations, and is following its own regulatory requirements and policies, and is satisfying the intent of NEPA. The NRC Legal Staff acts as the advocate

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of the NRC licensing actions before the ASLB, sometimes as the channel through which the Boards can probe the staff positions on licensing actions.

"There are some significant advantages to the public in this process. It sometimes provides an opportunity for legitimate safety concerns not fully exposed in the ACRS reviews to be examined further. It provides a valuable forum for discussing NEPA issues of concern to the public. Nevertheless, the hearing process tends to lean more toward legal maneuvering than a total exposition of public safety and environmental concerns. It seems to encourage minimal discussion of safety issues in the Safety Evaluation Report and other documentary evidence intended for Hearing Board review, and legally oriented oral statements by staff members. The regulatory staff is discouraged from discussion of controversial subjects of safety concern in open meetings including those with the ACRS. These restraints are probably intended to eliminate extraneous matters from the record that might unnecessarily delay the hearing process. Unfortunately, they may also be preventing full exploration of some significant safety issues because of concerns for licensing delays.

"Since the SER now seems to be prepared mainly to provide information for legal purposes at the ASLB Hearing, it consists primarily of repetitive "boiler plate" which

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tends to obscure the safety issues and provides little amplification. The result is that the SER has become a document of little value to the safety reviewer attempting to gain understanding.

"Public safety is not well served by this legal style of safety issue presentation. If the SER included a discussion of the various aspects of each significant safety issue together with the judgment basis for the NRC Staff conclusions, the report could serve in a more appropriate role at the ASLB hearing. Its reasoning could be examined by the ACRS and the ASLB without the need for advocacy by the NRC Legal Staff. Where a basis had been previously established, the reference basis could be identified. The public would then be able to see why, where and how the NRC Staff's safety conclusions were drawn.

"The hearings of the ASLBs are frequently adversarial in form, and the NRC Staff has developed an approach to coping with this aspect of its function that might be interpreted as more a legal defense of its position than a safety analysis of the proposed nuclear reactor station and a technical basis for the Staff judgment."

I think that paragraph just ought to be struck. It didn't say anything.

"ASLB rulings on specific safety issues have sometimes,

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because of legal considerations, tended to circumvent public safety interests as the following illustration shows. The ASLB has on occasion ruled that the NRC could not require planning for emergencies beyond low population zones. It has also ruled in some cases that the low population zone radius must be reduced because of population growth near the plant site. These two rulings combine to permit more intensive local population density adjoining some sites without planning for emergencies.

"The ASLB hearings are also used as a mechanism for determining whether the NRC staff has an appropriate basis for rule making. The hearing does provide an opportunity for open debate, but it is sometimes outside the context of specific licensing actions. Whether this provides the proper forum for establishing technological validity is not entirely clear."

DR. SIESS: Is that right to use boards for rule-making?

MR. BENDER: I think they do. They appoint boards to hear the rule making arguments.

DR. SIESS: Was there a board for the ECCS hearing?

DR. BAER: Yes, although the Commission limited them to compiling a record.

DR. SIESS: Was it an ASLB?

DR. BAER: I don't know.

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DR. SIESS: Because I thought there had been rulings in ASLB hearings that the Commission's rules were not in question.

DR. BAER: Once a rule has been promulgated by the Commission, from whatever source, the boards are not allowed to rule out the ruling of those regulations.

DR. SIESS: Okay. That goes back then to Paragraph 107 on that.

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MR. BENDER: Skip over the next page, because for some reason the rest of this paragraph got on 7-6.

"Adversary proceedings lasting more than a year resulted in the development of an ECCS rule-making concerning analysis techniques to show its performance adequacy, but some reliability aspects were never adequately during the hearing process. If the hearing process is to be used as a basis for rule-making, the manner in which the issues are to be addressed and the rules established need further study."

Then going back to the previous page, "The attention directed to the National Environmental Policy Act may be directly interfering with public safety review by diverting attention to other NEPA interests such as power system growth, cost benefits of alternate power sources, antitrust considerations, and other environmental matters. These are matters of major public interest, and the NRC is probably justified in its diligent attention to them. However, there has been a tendency to move NEPA matters ahead of public safety matters deserving of attention.

"The selection of a power plant site, for instance, is weighed carefully by NRC with respect to its economic benefits, social impacts, power system demand, but in most cases, safety alternatives are weighed only with respect to whether a particular site meets the minimum

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safety requirements. The public hearings" -- going back to 7-6 -- "The public hearings are an important aspect of the nuclear regulatory process, but some consideration needs to be given to changing the style of the hearings so that safety issues can be exposed fully without unnecessarily delaying licensing actions.

"The combining of NEPA and safety reviews in the ASLB hearings may be a contributing complication. To the extent practical, it would be desirable to separate them in the hearing process."

DR. SIESS: One comment is -- I believe the rule-making hearings and the ASLB hearings are mixed up in here, and I don't see any objection to having them both in the same chapter. But I think they could be separated out a little bit.

In your first paragraph, you say, "The reviews for the ASLBs are intended to establish the NRC as a basis for its rules." That's a rule-making hearing, and that's really not a normally ASLB function. It may be occasionally.

Then the paragraph 113, which does talk about rule-making, I think is appropraite. But, you know, separate the two functions.

MR. BENDER: Okay.

DR. SIESS: And we might ask Herzl to check whether the rule-making hearings are -- the special boards

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are ASLBs.

MR. BENDER: That's probably a good point. What I did was just look in the regulations.

DR. SIESS: In paragraph 114 on NEPA, you say "power system load growth, cost benefits, antitrust, and other environmental matters." Do you consider antitrust and power systems environmental? The figures -- antitrust is not under NEPA. That's clearly not a NEPA item. That's a separate part of the law, and I believe there's a separate -- is there a separate law for antitrust hearings?

MR. BAER: I don't think so.

MR. BENDER: We'll get that looked up, too.

MR. MOELLER: You could delete the word "environmental" -- just "in other matters."

MR. EBERSOLE:

DR. SIESS: You ought to get environmental matters in there somewhere.

MR. BENDER: I think I can get the antitrust business separated.

DR. SIESS: Leave the other out, because NEPA review does cover need for power, cost benefits, and environmental matters -- snail darters and things like that, but it's not "other" environmental matters. That's the first mention of it.

MR. BENDER: It's so broad, it doesn't say

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anything about need for power. It's just the NRC's way of saying --

DR. SIESS: I don't think if the NRC had its way, it wouldn't do any of it. It was a decision by a judge in Calvert Cliffs that told them what to do.

MR. BENDER: You're right. We'll get that looked at.

Let me go to this next section on regulatory staff competence.

"Taken as a whole, the professional competence of the NRC staff is impressive because of its size, its varied talents, and the high level of academic training and experience which its members have obtained. Nevertheless, each time a significant new safety event appears, it usually points to a weakness in the regulatory staff expertise. The areas that now seem to need the most attention are systems analysis and plant operation.

"With respect to systems analysis, the staff which has been highly compartmentalized needs to build a stronger capability to understand and anticipate the interactions between plant systems, the effects of accidents on environment, systems distrubances from external phenomena, and other comparable matters.

"Relative to plant operations, the I&E staff in particular needs to understand the behavior of operating systems, assess the capabilities of operators, and assure that operational activities do not jeopardize public safety because of design, construction, or operational errors.

"The recent organization of a Systems Engineering Group will be helpful in reducing the compartmentalization of technical skills and may ultimately satisfy the systems analysis need. The operational aspects of nuclear power plants have not yet been examined sufficiently to clarify how the staff capability should be strengthened. Training methods, improved procedure format addressing symptomatic analysis, broadened accident simulation capability for operating plants, improved radionuclide effluent control methods, improved in-service inspections of public safety features are all representative of matters requiring attention.

"These suggest a need for reorientation of review attention, rather than the addition of new staff skills. If the present staff is already preoccupied with existing tasks, new sources of manpower may need to be obtained.

"One way to expand the I&E capability is throughj the use of third-party review. The development of outside review sources to review other plant features on a system basis might be a useful approach. This approach is already accepted by the NRC for the primary coolant circuit and containment structures under the ASME boiler code.

Qualification of the reviewers' capability would need to be established, but in principle this could extend the staff capability directed to the nuclear quality assurance process without requiring significant additions to the NRC staff.

"In order to avoid oversight concerning these capabilities, the NRC should consider the establishment of ad hoc review bodies to examine staff capabilities in order to determine whether they are adequate for regulatory purposes. While the ACRS can contribute to this activity, its limited time may not be best used for this purpose. Other arrangements for reviews of this should be sought. Individual ACRS members might be able to lead ad hoc reviews by consulting experts.

"It is important that such reviews be conducted by people who appreciate time, funding, and responsibility considerations as well as technological matters."

Any comments on that? Discussion?

DR. SIESS: Several. In 116, that statement that "each time a significant new safety event appears, it usually points to a weakness in the regulatory staff expertise." I'm not too sure of that. I suspect you could find somebody on the staff that was expert on just about everything, including whether you can generate oxygen in a PWR. But it's the process or the procedure or the system that has a weakness. Otherwise, it wouldn't be -- I mean a

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new safety event, whatever "event" means --

MR. BENDER: Okay. Are you saying a weakness in the process?

DR. SIESS: Yes. But since you're talking about the staff's competence here, I think we need to think whether you want it in there at all. I don't think that sentence -- every time a new event -- you said down at the bottom of the page that we don't need additional new staff skills, and I believe that's wrong. The staff has admitted that they don't have skills in human engineering.

MR. BENDER: Let's get rid of the sentence.

DR. SIESS: They need people there. I don't think they've admitted that they don't have the skills in systems analysis.

DR. CARBON: Mike is dropping the sentence.

MR. BENDER: I'll have to say something. Nevertheless, some areas still need attention.

DR. SHEWMON: Are you on paragraph 116 or 118 now?

MR. BENDER: 116.

PROFESSOR KERR: Let me comment --

DR. SHEWMON: But there would still be question, then, down in 118 at the bottom of the page as to whether you want to modify that one, too.

PROFESSOR KERR: May I comment on 116? Mike, I assume in line 3, you don't mean to imply that the staff has a high level of academic experience. If you don't, then I would suggest inserting between the "and" and "experience", "of professional."

DR. PLESSET: They have a high level of experience. Put that first, and also have academic training.

DR. SIESS: Max has been counting Ph.Ds.

PROFESSOR KERR: You're changing the sense of what he said. I was only trying to help him say what I thought he was trying to say.

DR. PLESSET: I wanted to change the sense of it.

MR. BENDER: Not literally, Chet, but you may be right. I haven't checked on how much training the staff has, but they've got a lot when you look it.

DR. SIESS: They go together. I don't put that much faith in a Ph.D without the experience.

PROFESSOR KERR: Mr. Bender, I don't want to lose a word of what you're saying. If you hold the microphone in your lap, it sure makes it tough --

DR. CARBON: Other comments on this?

DR. SIESS: I've got a couple still. Second line of 118, it says, "The operational aspects of nuclear power plants have not yet been examined sufficiently." By us? Because I&E just came out with a pretty comprehensive report on what they think ought to be done, so the question is, by whom, examined sufficiently?

DR. OKRENT: Or in what way?

DR. SIESS: Or in what way, yes.

MR. BENDER: Well, I think the I&E staff report provided some information. I don't know that I would be prepared today to say that that particular report, particularly since it wasn't exactly one written by somebody that was standing back, necessarily was representative of the kind of evaluation that ought to be made, particularly with respect to operations. But I don't want to say it wasn't a good report.

DR. SIESS: But that list of things requiring attention --

MR. BENDER: I think it just says it's representative.

DR. SIESS: Okay. I'll leave that to the Committee to decide.

In the next to last line, the last three, it says they don't need new staff skills, and this is an area where they are completely lacking in the human engineering expertise, and they are looking for people. So I think that is not quite true.

MR. BENDER: Perhaps I should say "and probably the addition."

DR. SIESS: I've got one other question on the

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next page. You're talking about outside review sources, and you say this is done for -- using ASME Code, Section 3. For the Section 3, Division 1, I think there is an independent stress analysis stress report called for, isn't there, on the vessel?

MR. BENDER: Yes.

DR. SIESS: Is that true on all the piping?

MR. BENDER: Primary piping.

DR. SIESS: Okay. But I don't think that's called for for the containments, is it? In Division 2?

MR. BENDER: My recollection is that it is, Chet.

DR. SIESS: I think we ought to check, yes.

MR. BENDER: I'll be glad to look at the thing.

DR. SIESS: I didn't remember it for containments. I think for the vessels in Division 2 it is. You know, I don't think it is for containment.

MR. BENDER: The whole primary coolant system has been dealt with. I have to see about containments. I thought it was.

DR. CARBON: I think Dave asked for the floor next.

DR. OKRENT: Take Paul.

DR. SHEWMON: I&E worries about operating plants. Is that right?

DR. LAWROWSKI: No, construction, too.

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DR. SHEWMON: So the review you are talking about in paragraph 119, then, is for a plant before its operating. Is that correct?

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MR. BENDER: No, I didn't quite try to be that definitive. I was trying to leave open where you would go with it. I don't really know how you could go with it.

DR. SHEWMON: Well, paragraph 120 bothers me a reasonable amount, I guess, partly because maybe we should recommend it, but if we do I wish I knew a little bit more of what you had in mind. Are we going to come in and certify them periodically? Do we want a group that would look over their shoulders and redo their calculations? What would these review groups be? And are we limited to I&E now, or are we talking about the whole staff or whatever?

MR. BENDER: Well, I think I am not talking about the staff, but some outside organization becoming the potential group.

DR. SHEWMON: And would recertify the staff?

MR. BENDER: I think the way in which the ASME code does it --

DR. SIESS: He's in the next paragraph. 120.

MR. BENDER: Oh, I see. Okay.

DR. SIESS: If you want to stay on 119, I have got another question.

MR. BENDER: Let me get answers. I didn't understand your question, Paul. Say it again.

DR. SHEWMON: Well, in 120, I am not sure -- building from 119, I would say, "Well, you wanted to come in

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and redo calculational work for you, that they don't have the time to do it." And I guess that's where the ASME group does before it's built.

We come down to 120 and say these are review bodies. This is more to certify the staff or their competence?

MR. BENDER: That paragraph isn't written right, because it clearly didn't get the right message across. They are two separate thoughts. The one in 119 was intended to say, "Look, if you don't think we want to build up the staff anymore, then an alternative is to find some outside way of doing reviews."

But separate from that ought to be some group on the outside that is taking a look at the way in which the organization is running itself, to see whether it has got the right slant on doing business. And I don't think that we necessarily are the right group to do it, although we might be able to help organize such a review. My inclination would be to decline to do it if I were asked. But I didn't want to rule out that possibility.

Do you understand what I am -- the message I am trying to get across?

DR. SHEWMON: Yes. I don't like it, but I guess I understand it.

DR. LAWROSKI: Is it your concern that because it

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is seemingly limited to I&E?

DR. SHEWMON: No, it is just -- well, we haven't called ECPD inspections. It has to do with somebody who comes in as a one-day expert and says whether you should be allowed to continue educating students or not, and, yeah, maybe it's useful, but --

DR. LAWROSKI: It's two days.

DR. SHEWMON: I am not too enthusiastic about that way of increasing the competence of the staff or certifying it. Partly, that's the management's approach, or business now. But I just don't think you are going to get together a group that will come in -- you know, we can each point out staff people we kind of wish were working for somebody other than the NRC, but I don't know, once you get the list and it's certified by a bunch of outside experts, what are you going to do with it?

MR. BENDER: Well, I guess I haven't really thought about it. I have seen a few management review groups' work that were really good review groups, as opposed to some that I know that didn't deserve the name. The good ones will look at what kind of people are doing the job and whether they've got the right slant on their job, and if they have enough outside experience, they will be able to see whether the people that are there are able to cope with the assignment they have been asked to do. And it's really

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very helpful to the internal management to have some intelligent advice. At the moment, they are sort of operating in a vacuum, and I think if they could get the right kind of advice it would be helpful.

That's the thought that I have: if they get poor advice, it's not worth anything -- just a waste of time.

DR. SIESS: Going back to paragraph 119 on the outside review, you explained that to me, and I guess I looked at it a little differently. That is sort of complicated. You are talking about outside review to do what the staff does, but to do more of it. Right?

MR. BENDER: Yes.

DR. SIESS: And not necessarily an independent outside review. Certainly, the stress report under the ASME code is just another person at the same level as the applicant or the vendor doing it. It's an independent review, but it's not independent of the owner, let's say.

What do you call it when the staff goes out to the Franklin Institute to review all the unresolved issues of the supplemental evaluation program? Is that an outside review?

MR. BENDER: I hadn't quite envisioned that, although that's an alternative. I had envisioned that the staff would require the applicants to get these reviewers to do the job, and that the applicant would pay them, but the

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staff would make sure that they were qualified.

DR. SIESS: That would be like the stress report, then.

MR. BENDER: Yes.

DR. SIESS: And not like the Franklin Institute thing where the staff is buying outside help?

MR. BENDER: That's right.

DR. SIESS: And not like a third-party inspection of the TUV type where they are essentially independent of the applicant -- I don't know whether that comes in the same as the Franklin --

MR. BENDER: The thing to me is not a way unlike the the ASME code and they function independently of the group they are inspecting. But they are paid by the organziation that they are inspecting through some kind of a fee system that can't be refused.

DR. SIESS: Who pays for it I am not sure is all that important.

MR. BENDER: I don't think it is, either.

DR. SIESS: They use a proof engineer approach in some places in Europe. When the building official doesn't feel — or the insurance agencies it might be — doesn't feel competent, they go out and hire somebody of suitable stature to do it.

The thing is, other reviewers or other outside

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review sources of various levels of outside. And I wonder if this paragraph with this particular example is exactly what you want or whether you want to rule out the others.

MR. BENDER: I didn't want to rule out others, and I didn't necessarily want to say that what's done should be exactly like this. The point I am really trying to make was this concept is not new to the NRC, they already have some times when they are accepting outside independent review of this sort, so they are not breaking new grounds. Now, the approach which might be used in this case would have to be -- I think would vary a great deal depending on what you were planning to look at.

DR. SIESS: I remember under the code the staff was having a problem accepting the third-party review -- that is, the boiler pressure vessel inspector review -- because they had no way of auditing what that third party was doing.

MR. BENDER: The state inspectors.

DR. SIESS: The state inspectors, the authorized inspecting agencies, who are certainly paid for by the applicant. Did they resolve that by having the state inspectors agree to be audited?

MR. BENDER: I think they finally got around to it.

Do you know, Bob?

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MR. BAER: No, I don't.

DR. SIESS: Does the staff have a way of auditing stress report preparers to know whether they have got a QA program? But they do accept stress reports; don't they?

MR. BENDER: I think what they do there is follow the codes technique of saying the code requires that the guy be qualified, have experience and be qualified in the area in which he's reviewing.

DR. SIESS: See, that was true of the authorized inspector, which the staff didn't accept because they said we can't check on it. The staff's feeling is they have got to have that responsibility. They have to have that responsibility and know whether it's done right. Unless they have some way of auditing, they can't accept it.

MR. BENDER: The state inspectors must submit their qualifications. That is one of the issues. At one time --

DR. CARBON: Let me give the floor to Dave here, and we will try to knock off in about five minutes for lunch.

DR. SIESS: Okay. Let's say we'll knock off when Dave gets through.

DR. OKRENT: I have a short, easy question. The title in front of all of this is "Urgent Regulatory Management Considerations." I have the impression that the

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single most urgent regulatory management consideration is whether there should be a five-commissioner NRC or an administrator or some third form. I don't think that's addressed in this section.

I have two suggestions: one is that the committee decide whether it's going to talk about this and see whether it has an opinion. I think you should seriously consider the matter. You might decide you have no opinion. But I think it's worth some committee discussion myself. It would seem to me that should be an area where we might individually have some thoughts, and if they turned out to be in one direction or another that would be worth knowing. If not, then I think we ought to change the heading and call these "second priority."

(Laughter.)

MR. BENDER: That's just a matter of perception, Dave. What's most important to you --

DR. SIESS: He didn't say "most important to him." I think he said "most urgent in the whole arena." And I have to agree 100 percent. I would like to see us comment on a function --

MR. BENDER: I am not convinced you're right.

DR. SIESS: I would like to comment on it functionally rather than procedurally. I really don't care much whether there is a five-man commission, an independent

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agency, or an administrator within the executive. I guess I am not quite sure of the difference between an executive office, executive department office, and an independent agency. But functionally, I would like to see somebody in charge and somebody -- a single person -- responsible, I think, both in charge and responsible, and leave it to the Congress to work out how they do it.

PROF. KERR: How do you get a single person in charge with a commission?

DR. SIESS: It has been suggested that you could have a commission chairman with a great deal of authority and additional commissioners that advise and so forth.

DR. MARK: You have the chairman be named either Dixie Lee Ray or Stronson.

MR. EBERSOLE: In the 7-3 regulatory function you discussed on page 7-7 the general regulatory staff competence. All at once you jump to the I&E capability. I remember when we had a flap with Volgenau about extending the I&E capability beyond what I will call "comparative effort," wherein he had well-defined bases for his inspection and enforcement activities, and we suggested he extend his activity by an order of, say, 20 percent to do engineering assessments in an area not ordinarily evaluated by the ordinary review process; namely, in situ examination of installations on a system-to-system basis, including

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intersystem relationships. That effort, so far as I know, fizzled out to nothing.

I think we still must identify the I&E group as currently performing against what they think to be perfectly adequate standards against which they will do their work. But they should consider that they should examine, in an engineering evaluation sense, whether what they see is adequate.

MR. BENDER: I might not have put it in the right place, but I think I had something -- a paragraph in there -- plant operation of the I&E staff particularly needs to go forth, and just showed operational activity have not jeopardized the public safety because of design and construction of operating errors.

MR. EBERSOLE: I am asking you to look for that, that thing in the battery room.

DR. OKRENT: One other kind of a general question that arises out of this. When we spoke with the Rogovin group, one of the questions I threw back at them in order to keep them slightly off balance was were they asking themselves how would the weaknesses that have turned up in the overall regulatory system, including the industry role, how would these weaknesses have been exposed if there had not been a Three Mile Island accident, was there a mechanism? I think it's something we ought to try to

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address here somehow. It's been hinted at, but maybe we ought to address it more directly.

MR. BENDER: We ought not to have to have an accident in order to get staff shaken up.

DR. CARBON: With that point, let's break for lunch.

(Whereupon, at 1:30 p.m., the meeting was recessed, to reconvene at 2:30 p.m., this same day.)

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AFTERNOON SESSION

(2:30 p.m.)

DR. CARBON: Let's begin the afternoon session. Chet?

DR. SIESS: Okay, this is nothing but Reg Guide 197, correct?

DR. CARBON: Correct.

DR. SIESS: Gentlemen, you have a copy of Reg Guide 1.97 Revision 2 in Tab 6.3. And you have also been handed out three other things. I think they were left on your chair. One is a collection of comments that have been received from various people including members of the committee and consultants from industry. Another is a revision to page three of the Reg Guide draft, a single sheet. And the other is a draft of the proposed ANS 4.5 standard that is referenced in the guide.

Now, staff has prepared a revision to Reg Guide 1.97, the effective version of which -- and I use the word "effective" advisedly -- is Revision 1. It's the staff's desire that we look at this and then give them our desires regarding it before -- let me put it to you differently.

The staff would like our approval to issue this for comment. Usually approval to issue something for comment is given by the Reg Guide Activities Committee, but this is clearly in a different category. It is not out for i 75 1 / 02

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comment. There were copies made available in connection with the meeting, and some comments have been received from the industry and the others I mentioned. Some of these were discussed at the Reg Guide Activities Committee. The subcommittee agreed that detailed comments that we had in writing, or could be submitted in writing, should be pursued by the staff along with the other detailed comments they get during the comment period, and that the main thing we were concerned about now was whether this was in such shape that it could go out for comment so that we could begin to deal with the industry.

It is the staff's intent, if this does go out for comment, that they will arrange for a meeting with various owners groups to discuss their concerns and explain what this means.

With that introduction, the staff has a presentation. Al Hintze has an excellent summary of the history of this and how they got to this and what the philosophy is. We also have Wenzinger, who has served on the ANS 4.5 Working Group. And then you have a request for oral comments by Mr. Polanski, representing the ANS 4.5 Working Group. So I would suggest that you let Mr. Hintze start with his summary.

DR. CARBON: Fine. Mr. Hintze.

MR. HINTZE: I just wondered, do I need to hold

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this to make it work?

DR. CARBON: I think you do.

MR. HINTZE: Our purpose in requesting a review by the ACRS Regulatory Activities Subcommittee was to obtain comments and suggestions on the proposed Revision 2 to Regulatory Guide 1.9, to obtain subcommittee input to whether we were going in the right direction and to obtain concurrence in submitting the guide for public comment. We were subsequently asked to make a presentation to the full committee.

Development of Regulatory Guide 1.9, Instrumentation for Light Water Crude Nuclear Power Plants to Assess Plant Conditions During and Following an Accident was begun in July 1973. The preliminary development of the guide was based on a staff-sponsored study at Batelle Columbus Laboratories. The initial draft of the guide contained an extensive list of parameters, approximately 78, to be considered for post-accident monitoring instrumentation.

There wee strong objections to the specificity which the guide contained by those attending the open session meeting of the ACRS. Upon consideration of these objections, the guide was rewritten to provide guidelines for the selection of post-accident monitoring instrumentation, leaving the actual selection of the instrumentation to the applicant. The guide was subsequently issued for public comment in December 1975. There were a large number of public comments received. The resolution of these comments required about 20 months' time and five ACRS open session meetings.

The main problem centered around what was called the "open-endedness" of the objectives of post-accident monitoring and the so-called ambiguity of the requirements. The open-endedness was claimed because no limit was put on the number of accidents which should be considered in determining accident monitoring instrumentation. It was the staff's contention that accident monitoring should be prepared for any eventuality.

After several modifications, the guide was finally issued as an effective guide in August 1977, with one additional position pertaining to core parameters, to be provided with high level measurement capability. This new position resulted from addressing a specific concern of the ACRS outlined in their letter of August 17, 1976. The letter stated that the committee believed that a relatively limited number of primary indicators -- pressure, temperature, radiation, et cetera -- should have instrument ranges which go beyond the Class 8 accidents, and that these instruments should meet the various environmental qualification criteria cited as practical.

After Regulatory Guide 1.97 was issued, the applicants were reluctant to implement the guide because they felt more definitive guidance was needed to define acceptable means of compliance. The applicants also objected very strongly to the requirement for the high level measurements. The reasons given for not accepting the requirements for the high level measurements were that it was likened to the camel's nose in the tent -- first they would be required to provide the measurements for high level conditions; the next step would be a requirement to design plants to be able to withstand those conditions.

They contended that there was nothing in the regulations that required consideration beyond the maximum limits of Class 8 conditions. Subsequent to the issuance of Regulatory Guide 1.97 in August 1977, Task Action Plan A-34 was initiated to develop guidance to help applicants, licensees and staff reviewers in implementing the guide. The A-34 Task Force was preparing to issue its report about the time the incident at Three Mile Island occurred in March of this year.

The report was not finalized, however, because it was deemed advisable to evaluate TMI-2 before formalizing a staff position. The preliminary report did include a minimum list of variables, 36 for PWRs and 32 for BWRs, which should be included for accident monitoring.

On July 12, 1979, an effort was initiated to revise Regulatory Guide 1.97, which was to include a basic list of parameters to be monitored. Concurrently, ANS 4 initiated the Standards Working Group to develop an ANSI standard on accident monitoring. The staff task force was assigned to work with the ANS 4 Working Group to develop the standard, with a commitment to endorse the standard with the revision of Regulatory Guide 1.9, if it could be done in an acceptable manner.

A very short self-imposing schedule was laid out. The draft standard included as part of the proposed Revision 2 to Regulatory Guide 1.97 is the first released draft beyond the purview of the ANS committee and the NRC staff. Admittedly it is very preliminary and requires more effort. However, its developments were sought by public comment. It was thought that the development time could be shortened by concurrent public review and comment in conjunction with the guide.

During the comment period, effort by the ANS 4 Working Group would continue. The staff effort in developing the endorsing regulatory guide would work closely with the ANS 4 Working Group in deterimining the plant variables that should be monitored.

The draft ANSI standard and the regulatory guide use a systematic approach. Five variable types are identified. The first type deals with operator manual actions during accidents, which are identified in the plant safety analysis, and are anticipated or pre-planned. These variables are defined as those variables that provide information to indicate information needed for pre-planned manual action. They are designated as Type A.

The second type addresses whether the plant safety functions are being accomplished. The functions of concern are reactivity control, reactor core cooling, reactor coolant system pressure control, primary containment pressure control and radioactive effluent control. These variables are defined as those variables that provide information to indicate whether plant safety functions are being accomplished, and are designated as Type B.

The third type deals with the conditions of the barriers to fission product release, that is, fuel cladding, primary coolant pressure boundary and containment. The information desired is: are the barriers being threatened by an extreme condition? Or have they already been reached? These variables are defined as those variables that provide information to indicate the potential for, or actual breach of, the barriers division product release, and they are designated as Type C.

The fourth type deals with variables that will provide the operator with information as to whether the individual plant safety sytems are functioning, so that he can make decisions as to their use. These variables are defined as those variables that provide information to indicate the status and functioning of individual safety systems, and they're designated as Type D.

The fifth type are those that provide in-depth information and they are designated as Type E.

The five classes are not mutually exclusive, in that a given variable or instrument may be included in one or more types, as well as for normal power plant operation. And it should be stated that wherever a variable is included in one or more types or for any other safety function, the most stringent requirement applies. The guide contains two lists of variables, one for PWRs and one for BWRs. The list took into consideration the list of variables developed by the draft report of Task Action Plan A-34 and the TMI Lessons Learned Task Force recommendations. It also includes suggestions by the NRC staff and the industry representatives who were invited to comment on the preliminary draft of the ANS 4 standard.

We might mention that the list contained in the regulatory guide used the aforementioned procedure to come up with the final listing. As is often the case when an industry standard is endorsed by a regulatory guide, there are some exceptions taken. The principal questions and differences between the NRC staff position and the ANS 4 Working Group position are as follows:

Question one: should the standard address the monitoring concerns of only the control room operator, or should it include all accident monitoring requirements required by the plant operator or licensee? It is the staff's position that the standard should cover all accident monitoring requirements for the plant. Most of them will be the concern of the control room operator.

However, there are other measurements which are necessary for protecting the health and safety of the public. These should also be addressed. Hence, position one was included in the regulatory guide.

Question two: should the standard include measurements to indicate an approach to breach of the fuel cladding and the primary coolant system pressure boundary in addition to the approach to breach of the containment? The standard includes a requirement to measure the actual breach of the fuel cladding, the primary coolant pressure boundary and the containment. However, it only includes the potential for breach of the containment.

It is the staff's position that the standard should also include a requirement to measure conditions that would indicate an approach to breach of the fuel cladding and the primary coolant pressure boundary. Thus, possible mitigating actions can be taken to prevent a breach. Hence, position two was included in the guide.

Question three: should the standard include monitoring requrements for all design basis events requiring pre-planned manual action, or just those defined as actions which may occur during the lifetime of a plant, excluding those expected to occur during a calendar year.

It is the staff's position that in order to have an integrated system, all design basis events should be included. Hence, position three was included in the guide.

Question four: should Type B variables be included in accident monitoring or are they less important and should not be included? We might mention again that Type B are those variables that provide information to indicate performance of individual safety systems. It is the staff's position that for the operator to take mitigating actions, he must know what systems are functioning and which failed. Therefore, Type B is important to accident monitoring; hence, position four was included.

Question five: should the standard include a specific list of accident monitoring variables? It was the staff's position that such a list should be provided; hence, Tables 2 and 3 were included in the guide.

I might mention that the standard does give mpHEE

recommendations or suggestions for Types A and B. If we make a comparison between the guide and the standard on those two types, the standard requires for PWRs 11 -- or at least suggests 11 paramenters for Type A and B. The guide has 17. For BWRs, the standard suggests 12; the guide has 17.

The standard requires that the length of time for phase two should be 100 days, unless a shorter time could be justified. The standard defines phase two as that period of the accident between when the plant is brought under control and when access can be obtained to areas requiring inspection, repair or replacement. The staff position is that in light of TMI-2, 200 days is more appropriate. Hence, position nine was included in the guide.

Since we transmitted the guide to the ACRS in October, on October 16th, we have received several sets of comments from ACRS members and consultants. Some written comments were handed to us at the Wednesday meeting. These written comments contain a number of detailed comments on the guide. With the agreement of the ACRS Regulatory Activities Subcommittee we will address each commentor's input during the public comment period. We will, however, try to respond to comments given here today.

Our principal aim is to obtain your input on the approach we are taking and to get concurrence in sending the kapHEE

guide out for public comment. The purpose of this comment period will be to solicit input on the technical basis for selecting accident monitoring variables, the proposed minimum list of variables to be monitored and the design criteria to be applied to the instruments. The guide was written for forward thinking.

During the public comment period we intend to meet with the various owners groups to obtain input on backfitting recommendations and impact which will, at a future meeting, be presented to the ACRS and the RRRC.

That concludes my presentation.

DR. CARBON: Thank you, Mr. Hintze. Dade?

DR. MOELLER: There is a Reg Guide 1.97, so to speak, that is out now. This is a revision. Are the applicants or the licensees supposed to continue with the recommendations in the existing reg guide?

MR. BENERAYA: Mr. Moeller, the reg guide --

DR. CARBON: Could you identify?

MR. BENERAYA: Vic Beneraya, Operations Systems Branch. The Reg Guide 1.97 must be -- regards what we have now and what we're concerned about is who will have the rules. And we will discuss it with every one of you, and then we will decide which road to take.

DR. MOELLER: So nothing much will be done until this new version is revised and approved?

siting, the public will be adequately protected. The NRC review practice has been one which separates safety from non-safety systems and addresses only the safety sytems.

"The initial intent of the separation philosophy was probably to avoid conflict between demands from normal operating modes and those peculiar to safety functions. As now applied, the philosophy is also used to distinguish between safety-related and non-safety related functions with respect to their quality and reliability.

"An advantage of a properly implemented spearation philosophy is that safety-related functions requiring very high reliability can be designed specifically to meet their requirements without imposing these costly and sometimes impractical requirements on those non-safety related features which require less rigorous design.

"A disadvantage of teh separation philosophy is that it cannot be implemented perfectly and is therefore sometimes arbitrary and artificial. For example, a control system and shutdown protection system should be considered in an integrated control system because they are interactive.

"As reactor licensing has broadened in scope, the separation philosophy has permeated the design process, but not with consistent logic. One important example of this type is decay heat removal. In what is perceived as an

MR. BENERAYA: I would think that we will hope to get the revisions or the backfitting conditions pretty soon and pretty fast implemented once we get going. Once we get the approval of the ACRS.

DR. SIESS: A limited amount of implementation of the high level instruments will be done under the Lessons Learned recommendations.

MR. BENERAYA: Yes, sir, those have already gone out and they are being implemented at this time.

DR. MOELLER: Have any surveys been conducted of licensees operating plants, to see what impact the existing reg guide has had?

MR. BENERAYA: We have had some unofficial meetings with some of the engineers to get a feeling and we are looking into it. And the first reading is that it might double the price.

DR. SHEWMON: Double the price of what? The whole plant?

MR. BENERAYA: For instrumentation, the cost of instrumentation.

DR. SHEWMON: Instrumenation only for one guide, 1.97, 1st and 2nd Revisions or all instrumentation in the plant?

MR. BENERAYA: 1.97 one.

DR. CARBON: What is the magnitude of that?

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MR. BENERAYA: I don't know that.

MR. EBERSOLE: Is that a real price, in your opinion, or a synthesized price to discourage the installation of this equipment?

MR. BENERAYA: From what we understand from the industry, it is not a prohibitive amount.

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DR. SHEWMON: What percentage of what you're requiring here is indeed established material, equipment they can buy off the shelf? I notice one has a 10 to the 12 range on it, which is impressive to a non-instruments man. It may seem trivial to you. One of the comments earlier was that the staff had picked upper limits on their range which were beyond the capability of what you could buy off the shelf.

MR. BENERAYA: No, sir. The only item that we have that is not developed yet is the level in the reactors or pressurizers. The other equipment, if it is not available in the market right now, it can readily be built with the information knowledge we have.

DR. SHEWMON: That is your judgment? Or the ANS' judgment?

MR. BENERAYA: The people we talked to in the industry.

DR. SHEWMON: Now the ANS Committee on this, you have been working with them over the last couple of months. Is that right?

MR. WENGINGER: My name is Ed Wenginger. I'm with the Reactor Systems Branch in the Office of Standards Development. We asked the question of availability of several industry organizations and have only gotten fragmented answers. If I can summarize the answers, I think the biggest problem is not with the availability of instruments that provide the required range, although I think I might let somebody else answer with regard to radiation monitoring, but in the area of process instrumentation other than radiation monitors, the instruments are generally available, again with the exception of the level sensors for the vessel.

The problem with with regard to the qualification for environmental conditions and seismic events, and in a number of cases, the instruments, although available, would not be off-the-shelf available or already qualified in accordance with such standards IEEE 323 and 344 and that there would be some testing as a minimum requirement in order to make instruments available for those qualifications.

DR. SHEWMON: Now part of the reason you had fragmented answers is the very short time constants you asked for responses on.

MR. WENGINGER: Yes, sir. That's correct.

DR. SHEWMON: But is your decision to -- instead of let these Committees study it at what they feel is a doable pace, to go ahead and send out the Reg Guide before you have their comments and try to do three things at once.

MR. WENGINGER: The purpose right now is to go out and obtain their comments. That is what we would like to do.

DR. SHEWMON: If you obtain comments on getting codes at a couple of different times --

MR. BENERAYA: May I add something here, please? We did check with an architect engineer, a big one, and we asked him if there was a single instrument there that could not be provided right away, and the answer was, "No, everything can be available."

DR. SHEWMON: No, I'm not on that subject anymore. You answered that once or twice for me, and I'll take that. I guess this is maybe more to check as to whether he feels that, indeed, the approach being taken by the staff this time is the best way to get industrial participation in the development of what is a reasonable and doable guide.

DR. SIESS: I don't usually worry myself about that. If it is a Reg Guide and it is approved, it will be done. What they have done is to take Position C-1 and C-2 of the previous guide -- and by "they" I guess I mean everybody from Batelle through the ANS working group -- and try to make those studies that were recommended there to decide what implementation is needed and then to actually list them.

You see the original guide simply said they should study all the accidents in Chapter 15 and try to picture

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scenarios in their course and decide what instrumentation was needed to follow them.

Now what they have done now, somebody has gone through that process at some level, and actually at the working group they went through five phases -- the accident and several post-accident phases -- decided what instruments were needed and they are now listed.

So the implementation is a lot easier of this in one sense. One of the problems with the implementation before was that nobody when they said they didn't know what the guidelines were for making those analyses, and those have now been made. Now it is just a question of what instruments. There are still a lot of detail questions left to be worked out, but I don't see how they can be put in the Reg Guide, at least not now.

DR. SHEWMON: Well, let me ask one more detailed question, then, and I will quit.

The way I heard what you read was, you wanted instrumentation to approach, to indicate the approach to breach of cladding. What do you propose to monitor for that?

MR. BENERAYA: In this case, we had the thermocouples.

DR. SHEWMON: Which presumably will read above 750 degrees Fahrenheit?

MR. BENERAYA: Yes, sir. We have the pressure and temperatures of the system, so that we can start looking at that as we are getting in trouble, and the level of the boiler. I think that is about all right now.

DR. SHEWMON: Now do they have to integrate these into a system which will read out in the control room a probability of core breach or percentage of weight of core breach? Or what is it you are requiring for them?

MR. BENERAYA: No single instrument is going to give the whole story, sir, and we don't claim that. What we are saying he is going to have enough information so that the people that are in the control room and behind his support can start analyzing and find out where it is going and whether they are getting in trouble.

DR. SHEWMON: I guess I just wouldn't take an approach or a percentage of the weight of core breach as being the most useful thing for an operator who wanted to avoid a bad accident.

MR. BENERAYA: You start taking samples from the water, also.

DR. SHEWMON: Well that won't tell him how close he is to making his breach. And what you said was approach to breach.

MR. BENERAYA: Yes, sir. The temperatures would tell him that.

DR. SHEWMON: I guess, Mr. Chairman, I just have the impression that things have been done with such haste that I have concern about this being the best way to sort things out, but maybe it is.

DR. SIESS: I don't quite know what you mean by "haste." The ANS 4-5 Working Group has been working on this for how long?

MR. HINTZE: Since July.

DR. SHEWMON: Professors don't work too much in the summer. Don't you think those guys should go back and do the surveys they want to? They've yanked them out before they've had a chance to answer them.

DR. SIESS: I don't think many professors were working on that, were they?

MR. BENERAYA: No.

VOICE: Monty Schultz and John Posten are two that were involved as well as a fellow from Ohio State.

MR. WENGINGER: So you may be referring to some work we asked Ohio State to do for us. Is that what you're referring to?

DR. SHEWMON: There was a committee in which my impression -- Miller was asked to chair.

MR. WENGINGER: Yes. We asked that committee if they would be able to put together a list of instrumentation availability. We gave them our list of instruments and said, "Would you please not comment on the list." That is not what we asked them to do, but "Would you please tell us which of these instruments are available with which qualifications", and so on. We did not explicitly for their comment on whether this was the right list, although we said, "If you wish to do that, we'll be glad to accept those comments also."

DR. SHEWMON: The last thing I heard, you're time constants were so unreasonable that they, in a sense, came back and said, no.

MR. WENGINGER: No. They, in fact, sent us a list of what was available. At the time, they had it available. They gave us a fairly reasonable response. In the area of radiation monitors, the list was reasonably complete. In the area of process instrumentation, the list was not too complete, and we did the work that Victor Benaraya referred to in inquiring of the architect engineers.

DR. SHEWMON: I'm not prepared to debate this subject, but I still have the feeling that it has been prepared with such haste that we're making extra work for ourselves.

MR. HINTZE: If there's a complaint from that work, that's not the ANS group. That is the ASI group that we asked to determine if we were asking the impossible or whether it was practical to ask for the instruments we were

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asking for. They were willing to give us a college-try at answering that in a very short period of time. If they had complaint they did not relay that on to us.

DR. MOELLER: I have question which I'd like to ask of the staff, which Chet could help me with.

I understand that certain key pieces of equipment to follow the course of an accident, certain key pieces, are being required through the Lessons Learned approach. Now are you happy with the instrumentation required there versus the instrumentation that is required in Reg Guide 1.97, which will be delayed until it is finished?

DR. SIESS: What they required from the Lessons Learned, if I recall, were four high level instruments and C-3 of Reg Guide 1.97 Revision 1: coolant pressure, containment pressure, radiation inside containment, those three. Now the fourth was radiation at identified release points. I don't believe that is being required, but that is part of this.

MR. BENERAYA: Hydrogen concentration.

DR. SIESS: Well that was in Reg Guide 1.97, hydrogen concentration. But the main three -- pick the ones out of Position C-3. What the Reg Guide said before was to make all these analyses and decide what you need. It said, however, we want these -- no matter what you come up with, and those were C-3, and those have been the Lessons Learned.

So that's no problem to me.

DR. MOELLER: All right. That is helpful for me. Thank you.

DR. CARBON: Chet, do you have concerns on haste and speed here, as Paul is expressing?

DR. SIESS: No, I'm not concerned about the speed with which it is done. I have usually complained the other way, and we shouldn't confuse speed with writing or speed with implementing. It's still going to take some time to get it implemented. When it goes out for comments, there are going to be a lot of comments. I'm sure the Working Group does not agree with what the staff has done, and we will hear, I think, from Mr. Polanski on that. But the sooner we can get it out and get the comments and get them cleared up and the staff explains this, the better. And then they can start implementing it.

DR. CARBON: Is this the appropraite time to have Mr. Polanski speak?

DR. OKRENT: Can I ask one or two questions? There is a reference to gamma ray spectrum measurement. Could you tell me a little bit -- a minute's worth -- about what it is supposed to be able to do, and what it is not able to do?

MR. STODDARD: Phil Stoddard, NRC staff. The instrument you are referring to is a portable instrument mcGHEE

designed for use offsite in the event of an accident, which would essentially run everybody out of the site. It is designed for taking air samples offsite and getting a kind of rough spectrum analysis. It is not designed for use in containment or any of the high level samples. The 100 channel battery-operated spectrometer, it is not a high solution device at all.

DR. OKRENT: Say there would be no gamma ray spectrum capability for what is inside the containment if you have a substantial release? Is that what you are telling me?

MR. STODDARD: That is essentially correct. The Lessons Learned Task Force does require the capability for taking primary coolant samples or containment air samples and for measurement of those samples on site by gamma spectrum analysis. However, the analytical equipment is not within the containment, and it would be somewhat remote from the containment in a raw shield background area.

DR. OKRENT: Well, I don't think I want the analytical equipment in the containment.

PROFESSOR KERR: We agree.

MR. STODDARD: I believe some of the comments addressed being able to identify this equipment, and there is no provision for any direct measurement of that sort.

DR. OKRENT: But I am interested in knowing what your ability would be to measure whether there is one level or another of cesium, and that is a fine isotope in containment. Could it be done? How long would it take, and what would it take to do it continuously? Or is that impossible?

MR. STODDARD: To do that sort of thing continuously is impossible, as I understand, in the state of the art.

DR. OKRENT: When I say, like, you know, every minute as contrasted to every hour. Let me specify that as a definition of continuous.

MR. STODDARD: No, it would be on the order of perhaps once an hour, or perhaps more than that. It requires taking a sample at a remote sampling for an external to containment, packaging that sample, transferring it to what amounts to a hot lab, treating that sample perhaps by dilution, and then running a spectrum analysis on it. Your requirement in the Lesson Learned Task Force was to be able to take a sample in one hour and then analyze that sample within two hours.

PROFESSOR KERR: Are you talking about analyzing a sample of water?

MR. STODDARD: Either of containment water or of containment air. They are both covered in the same requirement under Lessons Learned.

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MR. GUPPY: My name is Gerald Guppy of the Nuclear Regulatory Commission Policies and Standards Office, previous experience in the Navy using 1000 channel analyzers and 100 channel analyzers. It would take between an hour and two hours to get the information that you want. That is based on low level background. Dilution with high level, I don't know how long it would take.

DR. OKRENT: And what is it, that it takes an hour, in your experience?

MR. GUPPY: From the sampling time to the point that you get an answer out as to what you have would take between one and two hours.

PROFESSOR KERR: Aren't you talking about rather low levels of isotopes. If you had to do long term counting, what you say is true, but if you have a very high level of cesium, I hope that you would have it calibrated.

MR. GUPPY: No, you shouldn't have to do. As I say, I haven't any experience with high level so I don't know what the procedures are when you're counting the high level.

DR. OKRENT: I would suggest that you are answering a different question than the one in which I'm interested. I am not going to propose that you hold up the Reg Guide for this purpose, but I would like to suggest that the staff look at what it would take to obtain on what I would call a semi-continuous basis an estimate -- two, five, or ten percent -- of the amount of cesium, as a good example, and you could add in one or two other existing isotopes -- what it would take to do that, only when you have a substantial amount. I really don't care if it is a low level.

PROFESSOR KERR: If continuous means once a minute, does semi-continuous mean once an hour?

DR. OKRENT: Let me tell you what I have in mind, and I think you will perhaps judge that once an hour is probably not quite often enough for the purpose.

Should you have a substantial amount of activity in the containment, and at the moment, you have only a single gross reading, but you don't really know if this is primarily noble gases; noble gases and iodine; or noble gases, iodine, and cesium -- and I won't go further down the chain -- if you don't know how this is distributed among those, and then should you drop, for anomalous reasons, in containment pressure, suggesting perhaps it opened up, it would be convenient if you had an idea of what had been in the containment when the pressure was high so you could better guide offsite actions because you might, indeed, get rather different information, and the instructions might be different depending on the distribution of the same amount of activity among those isotopes.

PROFESSOR KERR: I agree with you wholeheartedly. It seems to me, once a minute -- I think it might be a mistake if you required it that frequently. I don't think you could do it once every fifteen minutes or once every half an hour, maybe.

MR. GUPPY: That is probably feasible. I think your limiting factor with high levels is going to be the time to get from drawing your sample and getting to Point A to B and in the analyzation.

DR. OKRENT: Again, I think if you stop and think about the objective, one can work back and get an estimate of what is enough accuracy, and you don't look for more. What is the range in which you're interested, and what is the range where you don't care, as it were? And, in fact, you might decide that you can get enough information in the previous thirty minutes, as it were, to have guided you or something. I don't want to guess. I will guess once an hour is not likely to be adequate under all of these scenarios of interest. I will just speculate that way. And I don't know, if you decided you wanted it once every ten minutes, you might be able to automate some feature. It might be handy to be automated anyway if this is the thing you are interested in.

Well, let me leave it as a thought for both the staff and the Working Group, and unless this is outside the

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range that the Working Group like to think in.

DR. CARBON: Chet, is this an appropriate time for Mr. Polanski?

DR. SIESS: I think so.

DR. CARBON: About how long do you anticipate taking, Mr. Polanski?

MR. POLANSKI: About ten minutes.

PROFESSOR KERR: Is he going to tell us what AMI is? I presume he will.

MR. POLANSKI: Sure. My name is Xavier Polanski. I work for Commonwealth Edison, but I'm here to represent ANS 4.5, which is the Working Group which prepared the standard on which this Reg Guide is based. I am speaking today because the Working Group doesn't think that the Reg Guide in the form it's written is the proper approach to accident monitoring objectives.

But before I talk about our view of accident monitoring and the philosophy we used, I would like to mention what we've been doing and what the progress of the standard is going to be.

As Al Hintze of the NRC staff mentioned, we started work on the standard in July. By the middle of September, we had a complete draft. Before the standard is issued officially, it has to pass votes by two bodies -- ANS 4 and NIPSCO. It has been balloted by ANS 4, but not

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successfully. We are resolving those comments as best we can right now. And considering the time that we need for review and comment in balloting by NIPSCO, we expect a final approved standard in April or May of 1980.

DR. MOELLER: Excuse me, now. What ANS 4.5 is doing is essentially covering the same ground that Reg Guide 1.97 would cover?

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MR. POLANSKI: That is correct. The intent was to prepare an industry standard that would be the basis for a regulatory guide. Now, as we took a look at accident monitoring, we had the following objectives in mind.

(Slide.)

AMI became our abbreviation for accident monitoring instrumentation, and post-accident monitoring has been used before, but we decided this name was better. So this is what AMI stands for.

DR. CARBON: Mr. Polanski, would you use a pointer and stand back.

MR. POLANSKI: Sure.

We think there are three important objectives for accident monitoring instruments:

The first, of course, is that we have to be able to characterize the status of the plant, and that means that we have all of the instruments we need, everything that's necessary.

The second requirement is that the information be clear and understandable, and we felt that human engineering then demands that we provide the minimum instrument set, that which is sufficient. So we need everything which is necessary, but nothing more.

And it was with this point of view that we approached this standard of making sure we had what we needed, but only

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what we needed, so that it would be easiest to use and easiest to install.

The other requirement, for it to be clear and understandable, is that of being uniquely identified. And then the third requirement on the instrumentation must be that it is there and available when it is needed.

Now, with those objectives in mind, we set out to write the standard.

(Slide.)

And in order to make sure that we provide what is necessary and sufficient, we took a very systematic approach to the whole accident monitoring subject. The first thing we do in the standard is to define three accident phases, and those are just chronological periods in the course of the accident and post-accident period.

The second thing we do is define the accident monitoring functions to be performed. And from this comes the four instrument types or categories earlier mentioned by Al Hintze. We have four in the standard and he has five in the reg guide.

And the requirements and qualifications for each of those types of instruments are differing because of their different functions.

The third thing we did is to provide for the designer a procedure for selecting the variables he would monitor for

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the accident and post-accident period. We told him what kind of an analysis to do and gave him guidance in picking the variables.

The fourth thing is to put some requirements on the qualification criteria to be applied to the variables, so such things as environmental and seismic qualification, accuracy, display, format, and that kind of thing, are in the standard.

And with those four things in the standard, it is our intent that the designer pick the variables and the instruments for his particular plant. We specifically wanted to avoid just writing a checklist so that a designer would figure he had gotten one of each of those and he could forget about the problem.

We want the selection of the instruments to accomplish the function to be tied to the design of the plant and the overall safety picture of the plant.

(Slide.)

Now, an important part of that approach to the problem is the definition of the accident monitoring functions and the four variable types.

Type A are the instruments that the operator needs for preplanned manual action, and these are instruments already in the plant. They are safety grade. They are required by the existing safety analysis reports for the postulated

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accidents in Chapter 15 of the safety analysis report.

The second type of variables are those which monitor what we feel are the five critical safety functions for the plant. These are the instruments we propose to cover the operator for those unexpected circumstances and unexpected chains of events.

The trouble with monitoring for that whole big set that is the unknown is in limiting it. And so our approach was to say: Well, let's look at these basic safety functions, and if the operator knows that he is accomplishing those, then that is what really matters. And those functions are: controlled reactivity, keeping the core cool, keeping the primary system intact and the containment intact, and keeping track of radioactive effluents.

There is a third type of variable we identified and those are those monitoring the three barriers to fission product release, monitoring the fuel and the coolant system and the containment.

We identified a fourth type of variable, Type D variables, and those are instruments monitoring the specific performance parameters of specific safety systems, such things as high pressure core spray pump flow. We did not set criteria for those variables, because we felt that they are properly decided when the safety system is designed, should be covered by such standards as IEEE-603.

But another reason why we did not deal with them is because we were concentrating on what we felt was essential to safety, and the point of our standard was principally to deal with what is needed, absolutely needed, in the post-accident period.

MR. EBERSOLE: May I ask a question? In the point, primary containment breach, the general picture I get from that is a primary containment breach anywhere with some predesigned source term inside the containment to deal with. But in reality, a primary containment breach may well be within the region where penetrations exist.

MR. POLANSKI: That's right.

MR. EBERSOLE: And these penetrations characteristically are within the boundary of the auxiliary building and face directly into the equipment regions and into the control room regions. If a breach should occur in there, you do not have the benefit of refusion and dispersion, an aspect of getting rid of the fission produts. Rather, you have a concentration of effluents of all kinds in a critically needed region, and you expect to run on with continued mitigation equipment.

As you do this sort of study, are you looking at the potential for running people away, even from the control room, under the present design considerations, which don't allow for these high levels of radioactivity, but rather use the old design basis within which the control room is submerged.

MR. POLANSKI: I guess that is a case that I'm not sure anybody is really prepared to deal with.

MR. EBERSOLE: But I'm really trying to afford an environment wherein you're going to read all of this fine instrumentation you are providing.

MR. POLANSKI: Right. I guess the answer is that that is probably one of the cases that is awfully hard to cover unless you put the control room 15 miles away.

MR. EBERSOLE: Well, certainly your efforts are in vain unless you say this instrumentation readout will be within a region of safety.

MR. POLANSKI: Yes, except, first of all, there is no guarantee you will have the problem you highlighted.

DR. SIESS: The standard says this shall be in the control room.

MR. EBERSOLE: Well, you certainly have to have a place to put the instruments.

DR. SIESS: Do you think the staff should say that they belong other than in the control room?

MR. EBERSOLE: I don't know where they belong. They may belong ten miles away.

DR. SIESS: That is an interesting point. Has the staff thought about that?

MR. EBERSOLE: They may belong in the control room

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if they can be made to survive in the core area, along with the people who must read them and do things.

DR. SIESS: Well, they have got to survive the environment.

MR. POLANSKI: But part of the answer is, if you can't be there to read the instruments, you can't be there to do anything about it.

MR. EBERSOLE: So what's the use?

MR. POLANSKI: So you put your control room 15 miles away. Now what do you do? You aren't going to start any pumps.

MR. EBERSOLE: That means you must multiplex the functions to that distance.

MR. BENDER: It seems to me the points you're making would be valid, but I don't understand the concept. Most accidents are not going to require control room evacuation.

MR. EBERSOLE: Well, in the fraction which leads to control room evacuation, you might as well not even bother to put the instruments ther.

MR. BENDER: Well, that fraction of that fraction, if the control room is contaminated, of course, you can't do anything, and that might be the ultimate case where we have to consider that we have to abandon the system.

MR. EBERSOLE: But it's clear within the spectrum of things he's adding is radioactivity monitoring at high

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levels.

PROF. KERR: Well, Jess, it seems to me that if this occurred, at least you would know that you had a serious accident.

MR. EBERSOLE: You could then run if you could get out.

DR. SIESS: Let me ask a related question. We do have some control capability outside the control room.

MR. EBERSOLE: That is not shielded or protected.

DR. SIESS: But it is outside the control room, because presumably the control room would not be habitable. Has the staff considered whether any of these instruments should be provided at that location?

MR. HINTZE: Yes. It is included in the revision.

MR. EBERSOLE: Would that be any of the radioactivity monitoring measurements?

MR. HINTZE: We have not defined exactly what those are, and I don't think anybody else has, either.

DR. SIESS: Am I correct that most of your thinking in terms of radioactivity monitoring has been in terms of what might get out to the public, rather than what gets to the people in the plant, or both?

MR. HINTZE: I think we have considered both, yes.

MR. BENDER: I don't really think I understood the answer you just gave. Could you make it more specific?

MR. HINTZE: It is under Criterion 19, where it concludes, the remote control for hot shutdown. The instruments are also indicated; they should be there, also.

MR. EBERSOLE: Well, typically that system --

DR. SIESS: Are you talking about this reg guide?

MR. HINTZE: Yes.

MR. EBERSOLE: That remote control system --

MR. HINTZE: We added that one to this guide, which was left out of 1.97.

MR. EBERSOLE: Well, typically, that remote control or that control for remote shutdown is not anywhere near as well protected as the control room area. It is off in the plant someplace, unshielded, in an environment which is not protected, as is the control room.

MR. BENAROYA: It would also be -- the key is in the control center, which is being looked into. And those key parameters would be monitored from there, which would be a distance from the control room.

DR. SIESS: Not 15 miles, though? You won't let anybody put it that far?

MR. BENAROYA: There will be some in Bethesda, as I understand it.

MR. EBERSOLE: How do you get back to control the plant from that distance?

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MR. BENAROYA: I don't think you can control the plant. That is only for information.

MR. EBERSOLE: But the information does you no good unless you can do something with it.

DR. SIESS: Isn't the solution to keep the control room habitable?

MR. EBERSOLE: Yes, exactly.

DR. SIESS: And don't we have some standards on habitability of the control room?

MR. EBERSOLE: Not for these conditions.

DR. SIESS: For what conditions?

MR. EBERSOLE: These beyond design basis conditions.

DR. SIESS: By the time you breach containment, everybody is running. You've had it.

MR. EBERSOLE: Not if you have hardened the control room, by no means.

DR. SIESS: What are you going to do to protect the public after you have breached containment?

MR. EBERSOLE: Prevent it from being worse.

DR. OKRENT: There are some sequences, at least hypothetical ones, in WASH-1400, where there is a containment failure prior to core melt. I mean, there would be some activity, but not lots.

DR. SIESS: I saw some mention of a proposal where the control room would be sealed off, complete internal recirculation, et cetera.

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MR. EBERSOLE: It may well be that it is possible to modify control rooms with moderate attention to detail to make them invulnerable to these kinds of conditions you postulate here for accidents. I don't know that, but I think that it may well be that you don't have to go far to fix them.

MR. POLANSKI: There are ventilation systems already, but the other problem is shielding from filling up the aux building with containment.

MR. EBERSOLE: But that may well be adequate already.

MR. POLANSKI: Although I doubt it.

MR. EBERSOLE: Well, I know one case where it is.

DR. SHEWMON: Could we get on with Mr. Polanski's presentation and just acknowledge that the question is not going to be answered in the next five minutes?

DR. CARBON: Go ahead.

MR. POLANSKI: Because we are very concerned about this necessary and sufficient set of instruments, and because we were so careful to take a systematic approach to accident monitoring, we have got some objections to some aspects of the way the regulatory guide included and supplemented the ANS 4.5 standard.

(Slide.)

The first of these is that, as we read the guide and read the two tables, 2 and 3, that list specific

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instruments or variables to be monitored, that it doesn't appear that a systematic approach was used in developing that list. The format of the list even is by location rather than by function, and we feel that the way you make up a list is by asking yourself what job needs to be done first. And without a clear connection between accident monitoring criteria and the list that you see in the reg guide, you can't really tell anything about the necessity and sufficiency of that list of instruments.

And in fact, our working group took the list of instruments in the regulatory guide and reorganized it, resorted it according to our accident monitoring criteria and our four variable types. And I don't have an overhead transparency for it, but that list is within the last three pages of the handout I provided. And if you would just glance at that.

The table shows the monitoring functions, and then the Reg Guide 1.97 instruments that we concluded were in there to do that job, and then the ones that we recommended where we made recommenda .ions in the standard. And you can see that in some categories were more than one correspondents -- in many others, there are far more instruments than we thought was necessary to accomplish tne job. And there is one or two places where the regulatory guide missed an instrument which we had included.

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DR. OKRENT: Could I ask a question or two about that table?

MR. POLANSKI: Yes.

DR. OKRENT: The Topic E, nice-to-have, which presumably means ANS 4.5, doesn't specify it, and furthermore, it is not covered by some other standard.

MR. POLANSKI: Right. That category was invented by the NRC staff for the regulatory guide.

DR. OKRENT: Let's see, now.

DR. SIESS: The nice-to-have is the staff's terminology? The staff added that list on Item E, did it not?

MR. POLANSKI: Yes, that is correct.

DR. OKRENT: But it is not in 4.5, as I understand it?

MR. POLANSKI: That's right.

DR. OKRENT: Now can I try a couple? Containment temperature. You feel this is not a relevant measurement under any accident conditions?

MR. POLANSKI: No, we feel it is not an essential measurement under any accident conditions of interest. I think on that particular one, we felt that pressure told you more than temperature, and just about in any accident we could think of.

DR. OKRENT: Well, I would suggest to you that there might be sequences when the structural people would be

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interested in knowing what the temperature had been for some hours when they were getting up in pressure. And I for one question the judgment of ANS 4.5 on that particular measurement.

MR. POLANSKI: Mr. Okrent, of what value would that measurement be? Say the structural people knew what the temperature was.

DR. SIESS: Some structural problems vary with temperature.

MR. POLANSKI: I understand that. But you're in the control room after the accident and your job is to keep the core cooled and keep the containment system intact. And how will knowing containment temperature make you do anything different than you would have otherwise?

DR. SIESS: How would knowing pressure make you do anything different?

One reason I want to know pressure is to have some idea of how close I am to breaching containment. Now, if the strength of the containment decreases with temperature and the pressure and temperature are both going up, I need both pieces of information to estimate when I'm going to exceed the strength.

MR. POLANSKI: Perhaps.

MR. EBERSOLE: There are certain classes of accidents not related to LOCAs, but rather to very small breaks or

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simply dry heatup of the containment from sustained conditions of temperature and pressure of the primary and secondary systems, wherein the containment atmosphere may well approach the 400 to 500 level without much water in the air. This is just dry heatup.

MR. POLANSKI: This is an accident scenario?

MR. EBERSOLE: It was in small break accidents, where you had som release of steam inside. It is not a LOCA, which tends to suppress the temperature. It is a dry heatup.

MR. BENDER: Mr. Chairman, I'm sure we can find a number of places where the reg guide and the ANS group have selected things that are nice to have, and they may be even more than nice to have.

DR. SHEWMON: And I want to know of a few others that are on that list.

DR. OKRENT: Well, one is enough, because we were told we had a complete set. And I wanted to indicate a question.

MR. BENDER: The thing that we ought to be zeroing in on, though, is the fundamental question of whether the staff's list is too extensive, as opposed to the type of approach that the ANS group has suggested. Now, you can get too much instrumentation and not be able to absorb the information.

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I had been a little concerned about how much the staff is asking for. I don't know that I agree with everything that the ANS group is suggesting, though.

DR. SIESS: Incidentally, I might mention to the Committee that there was quite a bit of dis sion in the Subcommittee about what was going to be done with this instrumentation and the information presented by it, with this large amount, and whether there would be any possibility of integrating it into the status of the plant. And much of this revolved around the man-machine interaction type situation and the staff agreed that they just needed -- that this did need to be considered, and this reg guide addressed itself primarily to what instrumentation that had to be further worked on integrating it into the control room and the control room display.

And I think we agreed that there did need to be additional work along those lines.

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DR. SHEWMON: Did they also express a willingness to drop one or two things that they felt would be redundant and therefore possibly confusing?

DR. SIESS: Well, redundancy is something they are depending upon, I think, because all of these instruments are not going to work, no matter how well they are made. There is always a possibility of failure. And I guess diversity is more important than redundancy, their having two things to look at to know what the situation is.

There's a possibility they will drop some of them. If they get enough flack from the industry and the ACRS, they probably will. They have in the past. But right now I think they are pretty well inclined that this is the list.

MR. HINTZE: I think it would be well to point out that the difference really is between ANS 4 and the reg guide, are really the Type D instruments. Now, they have zero Type D. But they did not mean that there were going to be zero Type D's selected. They just didn't choose to make a recommendation as to how many or what they should be.

The staff took this on and said, we can't ignore that. We will make a list. When we compare what ANS came up with and what the staff came up with, it was a difference of 17 to 11 or 17 to 12.

DR. SHEWMON: Could you tell me Type which?

MR. HINTZE: Type A and B -- or excuse me, Type B and C.

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I'm talking about D when I say that is the difference between what the reg guide has and the 12 that the standard had.

DR. SIESS: But you also added Type B, did you not?

MR. HINTZE: That is correct.

DR. SIESS: And that is a pretty good list.

MR. POLANSKI: And Al, if you count indications rather than variables, redundancy required, and all of that, we got from the NRC list something like, depending how you count the thermocouples, somewhere between 90 and 100 separate Class 1-E safety grade indications, as compared to 24 for the ANS standard.

And part of our concern with the ANS standard, again, was because trying to keep to simplicity the use and maintenance and training concerning those Class 1-E instruments, we again aimed at the minimum set rather than anything anybody ever thought might be nice.

DR. CARBON: Dave, unless your question is urgent, I would like to urge him to wind up.

DR. OKRENT: I have two short questions. And I hope the answers are short.

In reading this draft standard, I notice that they propose that these instruments work if you lose off-site power, but they are not required to work if you lose all AC power. I may have read it incorrectly, but that is what I thought it said at one point.

What happens to the instrumentation that you would require if you had a station blackout for an extended period of time? Would some of it be available? And if so, what?

MR. WENGINGER: There are different criteria, whether you use the reg guide or the ANS standard. Let me tell you what the reg guide says on the question of power source. For Type A, we have called for emergency power. For Type B, we have called for the critical bus, if you will, zero time outage, no break power.

And for the Type D and E, we have called for emergency power, which allows for outages of something like 30 seconds or so to get the diesel started.

DR. OKRENT: Again, if I lost all my AC power, would I be able to tell what the pressure was in the containment, if it were going up?

MR. WENGINGER: The answer is yes, that the zero time outage power would be the DC-backed plus, which we would provide on both the Type D, which is the status of fulfilling the safety functions.

DR. OKRENT: All right.

MR. WENGINGER: But there's a difference between the guide and the standard in this regard. The standard would not have required the zero time outage power in the case of monitoring for the breach of the containment, and so on.

DR. OKRENT: The only other thing -- and I will

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just make it as a comment -- I notice that in the guide, in the standard, it is proposed that for an inert containment you measure oxygen, possibly. I would suggest that there would be an interest in knowing the hydrogen concentration and whether the containment is inerted or not. And I will just leave that as a comment.

DR. CARBON: Mr. Polanski, will you charge on, then, and try to wind up quickly?

MR. POLANSKI: Sure.

Our second disagreement with the regulatory guide has to do with the Type D and Type E variables. We chose specifically to address Type D variables with safety system design. We do not feel they are directly related to plant safety during the accident period.

The Type E definition defined by the regulatory guide we see as only an open-ended catch-all with no criteria for the inclusion or exclusion of those instruments. And in fact, the definition in the regulatory guide is those variables to be monitored as required to provide defense in depth and for diagnosis and for other useful purposes. And in line with our intent of only including instruments that have good rationale, we just don't see the need for those at all.

And then we have listed here some of the differences with the standard that we can discuss if you are interested. But the major ones are the first two.

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So in summary, our concern was that the accident monitoring instrumentation set be necessary and sufficient. To make sure of that, we took a systematic approach to the selection of those instruments. And we feel that the reg guide, in the way it incorporates the standard, does not maintain that systematic approach, and adds other instruments that really are not essential. So we disagree with the reg guide in its current form as an answer to the accident-monitoring objective.

DR. SIESS: Are there any things that are in the reg guide supplementing the standard that you don't object to?

MR. POLANSKI: I guess it depends how you mean it. Many of the things that are in the reg guide supplementing the standard which are not safety grade turn out to be in the plant anyway, and I think most plant designers would put them in anyway.

DR. SIESS: But you did not think it was necessary to put them in the standard?

MR. POLANSKI: That is correct.

Well, I think there is a body of opinion that says maybe such a list should be developed. But we were concentrating on those things we wanted to make sure were in the plan and wanted to make sure were there and available for the accident period. We were trying to identify and concentrate on that minimum and necessary set.

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DR. SIESS: Well, a lot of the instruments that are both in the reg guide and the standard are already in the plan.

MR. POLANSKI: That's correct.

DR. SIESS: Some of them are already at the grade that is required; is that not correct?

MR. POLANSKI: Some of them are, that is correct.

DR. SIESS: The reg guide requires that these be identified. I think I said located all in the same place, but that is wrong, isn't it; just identified?

So I guess I'm not quite sure. If the instruments are already there, it is just a difference in the scope of the guide and the scope of the standard that you are talking about?

MR. POLANSKI: Yes, and also in the consistency.

If you follow through the logical conclusion of including many of the things that were inserted in the reg guide supplementary to the ANS standard, we think you'll also have to include a lot of others, too, and we would rather see that done on a systematic criteria-oriented basis, rather than through what sort of looks like a wish list as it appears in the standard.

DR. SIESS: I assume that the working group will have some comments in writing to submit during the comment period when this goes out.

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MR. POLANSKI: If the working group doesn't, other facets of industry certainly will.

MR. SOMMERS: Dr. Siess, if I could answer. Excuse me. Dave Sommers from Consumers Power. I was a member of the ANS 4.5 Working Group.

To try to get a little more specifically to address your question --

DR. CARBON: Hold up, if you will.

Chet, I need some guidance. We have got to wind this up quickly, if possible, and get on with our previous topic. What do you suggest here? Can we wind it up soon?

DR. SIESS: The only question before the Committee is whether the staff should send this out for comment. Obviously, we are going to have to compare the positions or work with the staff on it once they have gotten their comments and come up with their final recommendation. And right now we can say, yes, send it out for comment, or we can say, no, we want to hash this over.

But I think that that primarily requires discussion with the staff and probably more people from the industry than are represented here. So I would suggest that, if the Committee is ready to decide or has heard enough as a basis for deciding whether to permit the staff to send it out for comment, we can either decide now or tomorrow, whenever you wish.

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DR. CARBON: Do you have a recommendation?

DR. SIESS: The Subcommitee has a recommendation, that it be sent out for comment.

DR. MOELLER: Can't we vote to have it sent out, without saying we endorse it?

DR. SIESS: We are not endorsing it. We did not concur. We just tell the staff it looks good enough to send out, get it out. We will give you more comments. You will get more comments. And when you think you've got them resolved, come back.

DR. CARBON: Do you care to make a motion?

DR. SIESS: I will so move, that the Committee approve the request of the staff to send this out for comment.

DR. CARBON: Is there discussion?

All in favor, hold their hand.

(A show of hands.)

DR. CARBON: It is obviously carried.

Thank you, Mr. Polanski and Mr. Hintze.

Let's take a ten-minute break.

(Brief recess.)

DR. CARBON: Let's take up Mike's report again.

MR. BENDER: Let me first say that Dave Okrent was kind enough to make a list of things that the ACRS has been involved in, good and bad, over the past. And I would like to get that passed out, with the intent of having the Committee take a look at that. I think we need to look at it for a

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little bit before we discuss it. And I would like to go ahead with the report, suggesting that the Committee look at this list and try to make some judgments about whether things that are in here need to be put ir o the report in some form. We might collect them into a few items and list them as they are, or not do anything.

The other thing I would like to distribute is also something that Dave worked on. He made some corrections in Section 3. They are not, I think, substantive to the report at this time. They are what I would consider minor editorial improvements. But I will pass them out so you know what they are.

DR. OKRENT: There was nothing substantive that I changed there.

I would like to pick up at Section 7.4. I believe when we stopped, we had just about come to some conclusion what we were going to say about the staff, the section on industry competence.

"The nuclear industry infrastructure is broad enough to satisfy any capability need, given the financial support and management backing. Thus far, the industry has tended to limit its interests to complying with the specific requirements of licensirg, managing, engineering of the power plants in accordance with conventional utility practices, and developing its operating forces along the line" -- and I'm going to take out this "Nuclear Navy. "Along recognized nuclear plant operating arrangements" or something like that.

"The operating organizations rely heavily on outside consulting services for technical guidance, even though some large utilities have established substantial nuclear engineering knowledge. Events of the recent past indicate that the operating units need more basic capability to prepare for accident contingencies, to diagnose and respond to unforeseen accidents, and to provide backup resources in serious emergencies.

"The operating organizations cannot become totally knowledgeable about all nuclear steam system transient characteristics, but they can strengthen their understanding through training programs and professional staff additions. The organization of this additional capability will have to be adapted to existing operating situations, but it is extremely important that each licensee or license applicant establish direct top level management interest in this capability on a continuing basis. The Nuclear Steam System Suppliers and the Architect-Engineers also need to strengthen their capabilities in support of the operational units.

"It would be appropriate for the NRC to bring together management representatives from each major participant in the nuclear power plant business to establish a commitment as to where, when, and how to attack the

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improvement process. Unless such initiative is shown by all of the industrial participants, there is little likelihood that regulatory action alone will satisfy public safety interests."

Now, that doesn't say how to do it, but it suggests that if you get all the people together in the right places, they collectively might agree on what we're going to do. My feeling is that that is safer than us trying to decide what to do for them.

Any comments on that?

(No response.)

MR. BENDER: Let me go on to 7.5, then:

"The ACRS originally developed a list of safety matters that it believed to need attention, but not of such urgency that they required immediate action with respect to specific license applications. It was intended" -- make that "licensing actions" instead of "applications."

DR. MOELLER: Well, I thought, too, that we resolved them on a case by case basis. What made them generic issues; is that what you mean?

MR. BENDER: No. That is not what I mean. Quite the opposite, I don't think we have to deal with them on a case by case basis. There are a certain number of things that need to be dealt with, you can set aside and come back to, if you have a resolution.

DR. MOELLER: Yes, but we always had to find some acceptable alternative for a given plant. At least that is what I thought. That's the way I have always viewed the generic items.

MR. BENDER: Well, it depends upon what you mean by acceptable alternatives. That didn't necessarily mean that we found a way around the problem. And I think to that extent, I think we are on the same wavelength. Maybe I did not say it right, but I will try to fix it up.

DR. MOELLER: Well, if you said "final action" or something, in the third line, that they required "final action."

MR. BENDER: Okay, let me see. "Final" might be the right word. I would rather leave open what is going to be used there.

"It was intended that these matters be treated by the NRC and its licensees over the long term and problems corrected as solutions were found. The rate at which these "generic safety items" were being examined and acted upon was relatively slow and has caused considerable public concern. In the past two years, the NRC staff established a more complete generic items list of its own that incorporated all of the ACRS items and established priorities for addressing these matters. The NRC staff list was much more extensive than the ACRS list, but there was agreement between the ACRS and the staff on most of the high priority matters. Action

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plans for the high priority matters have been established and an "Unresolved Safety Issue Task Force" was established recently by the staff to assure that the high priority matters are given adequate attention.

"Although the NRC staff action in the past have appeared to be tardy in implementing the solutions to generic problems once they are known, current efforts appear to be more aggressive. Some matters cannot be resolved by physical changes in the short term and will require surveillance types of controls to minimize public risk. Others may involve implementation of major plant changes during planned outages. The correction of generic problems can be handled on a longer term basis if the risks are well understood and appropriate defenses are maintained. The current staff actions appear to be responsive to regulatory needs, and they should be continued in an aggressive mode. Establishing positive implementation plans once resolution actions are known is essential to maintaining public confidence in the regulatory process."

MR. FRALEY: The first sentence, 125, it seems to me what's really been tardy is the resolution of the generic items.

DR. OKRENT: I would say: "Although the NRC staff actions in the past have not always been aggressive in resolving generic problems or timely in implementing the solutions once they are known."

It's not just the question of appearance.

DR. SHEWMON: It seems to me if we want to talk about the pros and cons of what the ACRS has done, this is one of the places where we have been least aggressive. We have sort of watched what has gone on. We have tuned our list and done nothing to get their resolution, except occasional outbursts like this.

MR. BENDER: Well, I don't intend to take any credit for the staff not being aggressive.

DR. OKRENT: I might note, historically, back in 1967, when these were called the asterisked items, but some of them are still the same, the ACRS tried to be aggressive. It was aggressive to the point that it wrote to Harold Price, who was the Director of Regulation, and it wrote to the general manager, whose name I can't recall now, asking what programs they had or would develop to help resolve the asterisked items.

I think they get a response from the representative to the general manager that their program was pretty well set, sorry; and from Mr. Price that, well, it is really the responsibility of the applicants.

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So that was not an auspicious beginning.

DR. SHEWMON: I don't think that that is a response to my comment, either. Some of us can remember things that were tried once many decades ago and didn't work.

DR. OKRENT: I agree with you and you will find it in the list of deficiencies.

MR. BENDER: Well, the committee will have to decide which of the deficiencies and which of the accomplishments it wants to take credit for. Maybe there are some others that aren't on the list in both areas.

DR. OKRENT: It is intended to be a trial example list. I'm sure that it can be expanded.

MR. BENDER: It didn't say very much about the priority of our reports. Should I go on?

DR. CARBON: Yes, why don't you go on?

MR. BENDER: Reporting of safety problems.

New safety problems will appear in nuclear installations and it is unrealistic to assume that all will be predictable.

The NRC requires all licensees to report safety-significant happenings promptly so that necessary regulatory actions can be taken. The comprehensiveness of the reporting requirements may not have been extended adequately to cover all areas of interest or all participatnts who might make a safety contribution.

Action should be taken to make certain that nuclear plant owners and operators, constructors, nuclear steam system and other equipment suppliers, inspection and service organizations, craftsmen, operating personnel, and even the public at large report matters of public safety significance as soon as they are known.

While this may occasionally cause unnecessary reaction to minor safety matters, it will assure that maximum time is available to correct serious difficulties.

At the same time, the reporting system should not be excessively burdensome. Effort should be made to define the informational requirements in such a way that those involved in reporting can, without excessive effort, provide information needed to assess the safety significance of such matters.

Of particular importance is the need to avoid a prosecutional environment for those reporting errors, faults, and maloperations when deliberate malfeasance is not evidence.

Only in this way can the regulatory system assure a positive response from licensed participants, their contractors, and their employees.

MR. FRALEY: Again, when you say that the agency should take action to make certain that the public at large reports safety issues, I think the best the agency can do is encourage the public. It can't make certain in a democracy.

MR. BENDER: They can make as certain as they can.

DR. CARBON: Other comments on this, or is it acceptable?

(No response.)

MR. BENDER: I am willing to look at, say, not making certain.

DR. CARBON: Then we can go on to 7.7.

MR. BENDER: ACRS effectiveness. The ACRS is assigned the responsibility for reviewing nuclear installations prior to licensing and reporting to the NRC.

In the committee's view, some monitoring review of current license applications will always be needed to assure current and comprehensive treatment of safety matters.

The ACRS review of NRC's safety requirements, as embodied in regulations, standards and standard review plans, must be continued since they provide the basis for staff judgments concerning public safety adequacy.

The ACRS also needs to keep itself currently informed of safety research and international nuclear safety matters. When special public safety matters appear, the ACRS will probably be asked to use its range of expertise to assist the regulatory administration in defining a path for minimizing public safety risk.

These matters would appear to deserve priority over others the ACRS has been asked to address.

Since the ACRS members' time is limited because of their part-time employment constraints, the committee should be discriminant in accepting other tasks from the Commission, the NRC staff, the Congress, USDOE, or other federal agencies.

Now there is this whole list of things which Dave has here. If you would like, I would just read it.

DR. OKRENT: I have an alternate suggestion. I prepared those last night sometime close to midnight just trying to put down some possible items that could go on the good and the bad side.

I would myself suggest that the members look at this list, see what they think belongs from there and what doesn't and what could be added, from their point of view. And after they have done that, it might be a better time to talk about it.

That would be my own suggestion rather than starting cold.

MR. BENDER: Well, let me offer a couple of typical things that aren't on this list to stimulate people. On the positive side, I think considering the amount of time the committee has spent looking at reg guides and the like, it would be appropriate to say that the committee has constructively reviewed the regulatory documents. And I think we have.

DR. OKRENT: That would have been on except I thought of it after I had gone to bed, as it were. I had put down that we had helped in formulating general design criteria and participated in reg guides.

And when I woke up in the morning, it slipped my mind again.

MR. BENDER: But it is things like that that could be added to the list as well.

DR. OKRENT: I think people should write out the ones -- I don't necessarily propose to write any more. I want to see what others have in mind.

MR. BENDER: And on the other side is the clear quality with which our letters are written. They could be held up as models.

Let me go on. Public communications. The public anticipates that the NRC will keep it informed in an intelligent and responsible way concerning safety problems, licensing actions, regulatory deficiencies, health effects, waste disposal, and similar matters.

The public, as well as the NRC licensees, often have difficulty in determining which sources of information are authoritative and whether information provided by staff members is fact or opinion, official or private, preliminary or final.

Clearly, in connection with an accident like Three Mile Island, a single well-informed spokesman would be very important to avoid confusion in responding to the emergency.

The NRC organization should be prepared through a designated spokesman to explain, clarify, correct, modify, amplify, or otherwise inform the public of matters appearing in the public information meeting in a timely fashion so that the public can identify the authoritative regulatory voice and discern the public safety significance of the information.

The provision of a designated spokesman to express the official NRC viewpoint, however, should not be a mechanism for stifling expression of divergent views.

Indeed, some commissioners and some members of the staff may differ with the official position and they should be encouraged to express those views. But speaker should state whether they are expressing personal views that are not consistent with the collective NRC viewpoint if their intent is so directed.

When appropriate, the NRC may even wish to have its spokesman discuss divergent positions that are under consideration. The benefit from having a designated spokesman is that the press and the public can see the regulatory thought processes at work in both the official and the independent positions and can have some

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understanding of their basis.

Although often less directly meaningful to the public, the various relevant safety matters which the NRC finds important to discuss outside the context of actual licensing proceedings could also provide the public benefit from a discussion by a designates spokesman who would give a rounded view of the issue, place it in perspective, and present the current position of the NRC, including its basis.

Any comment on that?

MR. ETHERINGTON: This is not a unique example, but I'm a little bit embarrassed about this clearly in connection with the action of a single well-informed spokesman.

This has been so amply recognized by others that I don't like to see it coming in in the form of a recommendation at this time.

DR. SHEWMAN: Do you mean other organizations or other parts of the NRC?

MR. ETHERINGTON: Well, I think it was acknowledged in the newspapers in the early days of the accident and the chaos before Denton went up there is a big talking point.

Maybe we could say that it has already been recognized.

MR. BENDER: Well, that is a point well taken,

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Harold, clearly, as illustrated in the case of the Three Mile Island accident.

MR. ETHERINGTON: Yes, I think the point is it is better not to make it look like a recommendation.

DR. OKRENT: As has been recognized since Three Mile Island.

DR. CARBON: Does that first paragraph end up, and is the aim to say that the NRC ought to always be prepared with a spokesman-designate whenever an accident comes up? Is that what you are saying?

MR. BENDER: Well, at least that. I think I'm saying more than that.

DR. CARBON: Well, I thought that you had been speaking about a lot more than that. But that is all that I read from this. I'm not sure what you meant.

MR. BENDER: Reading from it only that it has to do with an accident.

DR. CARBON: That is the impression that I get from it.

MR. BENDER: Maybe I ought to work on it a little bit. For an accident, in particular, they need a spokesman. But for practically anything that gets announced in the press as a safety problem, they need somebody to say what its signficance is, because otherwise, the only people telling the public what's going on is some newspaper.

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DR. CARBON: I don't get that from this paragraph.

MR. BENDER: I will try to fix that up. Any other points?

(No response.)

MR. BENDER: Let's go to the section on the preservation of the regulatory base.

The nuclear power industry has operated without public injury for almost 25 years. I'm going to strike that even though it is true and put something else there instead. I will say something like the safety record of the — the good safety record of the NRC is largely attributable to its safety regulations and those of its governmental predecessors and to the self-imposed safety constraints of the nuclear industry.

In considering the need for change in the regulatory process, care must be taken to preserve the many good qualities of the regulatory system while seeking improvements.

The use of the current regulatory documents is well understood, even though some may not be interpreted in a desirable way. Some should be more definitive and some new material is needed.

It is important to work with the existing base to the maximum extent practical. If a whole new set of documents were introduced, the interpretation process its[illegible] [illegible]ould lead to regulatory chaos.

The experienced people involved in the regulatory process in both the regulatory and licensee organizations are also an important part of the base. Management changes are needed and the definition of responsibility should be improved. But those knowledgeable about the safety logic and the implicit but unstated cost/benefit balance must be permitted to function in a system not overly encumbered by procedural requirements or arbitrary management edicts.

DR. SHEWMON: Mike, would you tell me, in other words, what it is you are trying to say in that first paragraph?

MR. BENDER: The first paragraph? What I'm trying to say is we have already got a bunch of regulations. We have already got a bunch of regulatory standards. We have got a bunch of documents that have been approved. People know what is in them.

It wouldn't be a good idea to start all over and say that we are going to develop a new set of regulations and a new set of criteria and forget about what is already there because you wouldn't have any frame of reference to work from.

That is what I was trying to say.

DR. HEWMON: Would the report suffer greatly if you just took it out? Is this something that is imminent,

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that we are advising Congress against?

MR. BENDER: I don't know whether it is or not. I think there probably is a viewpoint that says that the documentary system and the set of documents is so massive and there is so much in it that nobody can use it or understand it.

And there are people that think, well, what you ought to do is boil it down to a few simple things. And I wish that were so. But I really don't think that we can do much but hold on to what we've got and try to fix it up where we can.

DR. SHEWMON: I don't know what's the inverse of setting up a straw man so that you can knock it down, but it just seems to me that you are belaboring what doesn't need to be said or sort of poking at a shadow or something.

MR. BENDER: I'm not going to sit here and argue very hard for keeping this in. Somebody said that we should make a point of being sure that we remind people that there is a base we are working from.

And so I decided to put something in here.

The only reason for reminding people there is a base and you ought to retain it is that somebody's thinking about throwing it away.

DR. MARK: I think that the most particular content in the third and fourth sentences ought to be preserved. I don't know about saying very much else.

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MR. BENDER: I do, too, Carson.

DR. PLESSET: I think they give a defensive flavor to it from the beginning, which, if you leave it out, would be fine.

Is that what you are getting at?

DR. MARK: No. I'm saying that I think the things said in the third and fourth sentences deserve to be said. Maybe in just about that form. Maybe not much else is needed.

DR. SHEWMON: Starting with "in considering" or starting with "in the use of"?

DR. MARK: Starting with "in considering." That is the third sentence.

MR. BENDER: That is where I would propose to start.

DR. MOELLER: You're saying that we could delete everything else prior to that?

DR. MARK: Well, I'm not sure it would read very good if you did.

DR. MOELLER: No, it would read all right.

DR. CARBON: I see nothing wrong with the paragraph, personally.

DR. BENDER: Well, making a point that if there has been a good safety record, it is because some safety regulation exists, seems to be something that you could say without seeming to blow your horn very much.

DR. MARK: It does introduce things.

MR. BENDER: Anything else? Let me go to the next item. Back and forward fitting safety improvements.

The public risk associated with omitting or delaying desirable safety improvements or correcting safety deficiencies may be quite small if only a few plants are involved and operating organizations can provide compensating surveillance.

Changes in existing plants are often costly and redesign sometimes delays the licensing process. These factors must be accounted for when the NRC intends to impose some new requirements or safety improvement.

Nevertheless, a limit must be established with respect to the cumulative risk from such actions. Some matters currently under consideration have been deferred for such a long time that they might be viewed as the object of deliberate procrastination.

The NRC needs to show how its judgments concerning backfit or forward fit actions are established. Cost and schedule cannot be overriding considerations if there is real concern for public safety.

MR. EBERSOLE: In the footnote, the five years should be eleven years.

MR. BENDER: For the reactor pump trip?

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MR. EBERSOLE: Yes.

MR. BENDER: I didn't think it was that old.

MR. EBERSOLE: I have all the correspondence.

DR. OKRENT: From the ACRS point of view, the problem is it is not 11 years old yet, but it is going on 11.

MR. BENDER: I remember that it was 1972 when there was some discussion about safety.

MR. EBERSOLE: You read that little thing I wrote called HEWS?

MR. BENDER: I will make it a little longer.

MR. EBERSOLE: My experience was in January of '68 in San Jose.

DR. OKRENT: We began in January of '69.

DR. CARBON: Are people happy with the subject? Shall we move on?

MR. BENDER: The next section was an attempt to pull out some things. I don't think that I have pulled out everything that was in the report and tried to sum up, to some degree.

The regulatory base being used by the NRC is substantial. Over the 25-year period of development, the regulatory process has evolved a methodology for accident assessment. In the interest of public safety that covers virtually all the major issues, the strong points of the regulatory

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process include an established review methodology that is commonly understood and used by the regulatory staff and the regulated industry, a regulatory staff on the whole of high caliber who addressed the technological issues knowledgeably and act with dedication and a system for identification of problem areas that draws attention to safety matters in time for corrective action.

The shortcomings of the regulatory operation relate mainly to the lack of attention given to operating facilities and to assuring a high level of operating skill.

The inspection and enforcement capability is not focused adequately on operational matters and improvement is urgently needed in this area.

I suspect that several people will want to say more on that.

The nuclear industry has a somewhat diffuse understanding of its public safety responsibility under the Nuclear Regulatory Commission rules. Too much of the response to regulations is directed to compliance with the detailed rules and technical specifications.

These details are important, but the upper levels of nuclear industry management need other motivation for being sure that public safety is not jeopardized because of industry error or oversight.

The current trends in the industry seem to be directed

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toward the establishment of qualification systems for its personnel and methods along the lines of the successfully developed ASME boiler code for unfired pressure vessels.

This is a desirable approach provided it is not too heavily weighted with membership from the electrical utility organizations.

Participation by nuclear steam supplier organizations, the several important service industries, and possibly including the U.S. DOE laboratories is essential.

Further, the judgment of the group overseeing this activity should include technologically knowledgeable representation from outside the nuclear industry since these representatives might contribute balanced understanding of the public risk associated with the use of nuclear power.

There are several areas in the public provisions for regulation of nuclear power to assure acceptable risk that need strengthening. These are discussed in the following.

One, risk evaluation methodology is not adequately developed. And the public does not have enough understanding of the relative risk from the use of nuclear power as compared with other societal risks.

In the interest of knowledgeable governmental regulation, this methodology must be established in usable form.

The siting practices for nuclear installations do not now consider all of the relevant public safety matters. The

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design basis accident assessment methodology being used allows too much credit for the pre-established behavior of engineered safety features without consideration of the consequences of degraded function.

The ultimate public safety actions available to the public, including evacuation of the environs, need to be established and shown to be workable.

The existing installations cannot be resited, but accident controls can be correlated with realistic site conditions.

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"The time taken to implement safety improvements, once the need has been established, seems excessive. More needs to be done to show that regulations requiring physical changes are implemented as fast as practicality would permit.

"The information supplied to the public about plant failures and quality deficiencies need clarification in order to help the public understand what matters are important to public safety, as opposed to those of non-safety significance.

"The actual split in responsibility between the regulatory function, the regulated industry and other governmental functions, needs to be defined and the actions to assure responsible response need to be established.

"The problems of low-level radioactive waste management need definitive solutions.

"The skills of the plant operators in coping with accident circumstances and the skills of the regulatory staff in assuring that licensees are responsive to the intent of regulations need improvement.

"The regulatory interpretation of public safety assurance requirements should be reexamined with respect to safety feature separation, failure definition and systems interaction.

"The methods for correcting these areas of

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weakness need careful scrutiny, and when selected, they should be monitored to determine whether they are really satisfying the need. The Regulatory Organization should establish provision for technical knowledgeable management review independent of its present organizational structure on a continuing basis as a help in guiding the regulatory management.

"The existing regulatory system has shortcomings that need improvement. Nevertheless, it cannot be judged a complete failure when its record shows no evidence of measurable public health damage over the entire quarter century of commercial nuclear history. The public perception of its effectiveness has been distorted to a major degree by the sensational type of communications media coverage at Three Mile Island and other events of lesser importance. Contingent provisions for the highly unlikely but nevertheless possible serious accidents is the regulatory area that needs most urgent attention. The good qualities of the regulatory process should be recognized and retained."

I throw that out for suggestions. People might want to chew on that quite a bit.

DR. CARBON: I don't mean this to be editorial at all, but reading the last paragraph, you said, "Nevertheless, it cannot be judged a complete failure." Did kapHEE

you do that --

MR. BENDER: I put the word "complete" in. To me, that change is the tenor of the whole paragraph, quite significantly. I read that in.

DR. SHEWMON: Mike, back on paragraph 137, you start off in one vein and you end up in another. And down about the third line of A-2, you say "participation," but I'm not at all clear -- by that time, participation in what? And I don't see it by going back up to the first two paragraphs.

MR. BENDER: I'm kind of lost.

DR. SHEWMON: I was talking about paragraph 137 and by the time I get into the middle of it over on the top of page 8-2, the second sentence there says: "Participation by nuclear steam supplier organizations" et cetera, but it's not clear what they are participating in.

MR. BENDER: I understand what you are saying. I should say the qualification system.

DR. SHEWMON: Well, you could start another paragraph there.

MR. BENDER: Okay, I will fix that up. I understand what you're talking about.

DR. MOELLER: In looking at this list, one item which we discussed yesterday was the need for goals. Do you want to mention that here? What are the goals of the regulatory process? You couched this in the sense that these are the items that need strengthening.

MR. BENDER: I might do it by saying, with reference to the controls listed, because I really don't want to go back and repeat those. I haven't really matched that up. That is something Chet made a point about, and I'm sure he's right. We need to be sure that what we say at the end matches up.

DR. MOELLER: And secondly, when we discussed siting, I believe we might acknowledge that they have had the siting task force. Maybe I could give you some words on that.

MR. BENDER: Why don't you do that? I think in any case, one of the things we need to do is to try to acknowledge if they are doing something.

DR. MOELLER: And a third point, in a general way, on page 8-1, paragraph 136, I think if we itemize the strong points then we ought to itemize the weak points.

MR. BENDER: I agree. I do not have a very good list of weak points.

DR. OKRENT: I have a general observation that this particular section and the one which discusses the ACRS are areas that we should reflect on. Will we have time for this tomorrow?

MR. BENDER: I'm not going to be here, but that

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doesn't prevent people from thinking about it. As a matter of fact, I had sort of thought that I might try to canvass the committee next week, individually, in some way, to see if people have thought about what is in here and to get any other thoughts you might have. I am going to do some paring down of it.

DR. CARBON: We certainly, Dave, could discuss this tomorrow afternoon.

DR. OKRENT: Well, it depends upon how the time goes, but anyway, I assume that we will be giving particular attention to that.

DR. LAWROWSKI: I think 6 could be made more inclusive if you struck out the words "low level," and substituted for the word "definitive solutions" by saying "resolution." We have the technical solutions to the management.

DR. CARBON: Carson?

DR. MARK: I think I had almost the same point as Steve, except a slight addition that item 6, and all of the things except 6 seem to me to bear on it, on procedural kinds of things, regulatory kinds of things -- 6 looks like a technical problem and it would seem to me, perhaps, that it ought to go down out of the middle of the list, anyway, and come at the end. And perhaps even say problem of a different sort, such as that, needs resolution.

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MR. BENDER: It seems to me that the whole matter of accident recovery probably ought to be included in this. And whether decommissioning belongs in that context or not, I don't know, but I think accident recovery ought to be in there some way.

DR. CARBON: Is that a major point?

DR. MARK: Well, I don't know. Back on page 7-15, Mike, in the second line of the bottom paragraph, that shouldn't be "correcting deficiencies." it should be "correction of." That is vastly different. The public risk of correcting deficiencies is small, is what it says here now.

MR. BENDER: Where is this?

DR. MARK: The second line of the bottom paragraph on page 7-15.

MR. BENDER: And you are suggesting what, instead?

DR. MARK: "Correction of."

DR. CARBON: Mike, should we jump back and bring in the letter at this point?

MR. BENDER: Yes, let me say about the opening letter, that I wrote it to stimulate thought and I have given less thought to it than a letter like that ought to have. Has it been distributed, Ray?

MR. FRALEY: Yes, I have distributed it. I have passed them around.

DR. PLESSET: We don't have it, Ray.

MR. FRALEY: I'm sorry, here it is, right here.

MR. BENDER: I will just read it through in total, if you don't mind.

DR. CARBON: Fine. Why don't you just let people get their copies?

(Pause.)

MR. BENDER: Since the accident at Three Mile Island, the ACRS has been continuing its review of the accident implications and concurrently reexamining the regulatory process to identify its strengths and weaknesses and where changes might be desirable. The attached review of regulatory processes and functions provides the substance of that reexamination.

The ACRS believes the nuclear regulatory process has been effective in protecting the health and safety of the public. The experience of almost 25 years of public injury-free nuclear power use testified to that belief. However, the experience at Three Mile Island is a dramatic and graphic reminder that some improvements are needed, especially in assuring the effectiveness of the multiple defenses essential to protecting the health and safety of the public.

This review points out where attention is needed in both the management and technolgical areas of nuclear power plant safety. The ACRS believes it is important to clarify to the public how these areas will be addressed, with the intent of bringing the public safety protection to a suitable level of quality and capability.

The TMI-2 accident is occasionally used as the frame of reference, but the review applies to all of NRC's nuclear power licensing activities.

The in tial phases of the accident at Three Mile Island are within the spectrum of events foreseen in the safety basis on which nuclear power plant regulatory practices are founded, but the situation was permitted to degrade to a serious degree by failure to anticipate all of the situations which might require emergency core cooling. The containment did serve the functional need, but the containment itself did not work as expected. That, as well as the specific TMI-2 operational errors, equipment malfunctions and instrumentation weaknesses previously identified, should be the focus of attention. Further attention should be devoted to the integrity and isolation provisions for containment for an array of accidents which may include some events with consequences exceeding those of the design basis accident currently used for containment design.

Keep in mind also that while the first line of defense continues to be the primary coolant boundary, the

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ability to provide continuing core cooling when that boundary fails is an essential safety requirement.

Because the emergency core cooling system at TMI-2 was not allowed to perform as intended, the serious fuel failure resulted. The containment itself is designed to handle bulk fuel failure provide that core cooling is not disrupted long enough to result in the core becoming distorted into an uncoolable configuration that would ultimately melt through containment. Core melting probably did not occur at TMI but the potential for an uncoolable core existed because all circumstances under which core cooling might be needed had not been taken into account in operator training and operating procedures.

The review draws attention to the importance of diversity core cooling provisions to assure coolability as an important aspect of plant design and operation. The review also draws attention to the need for further study of systems interactions, a number of which were important in the TMI accident.

The importance of not depending too heavily on engineer perception to assure the health and safety of the public is noted in the ACRS review, but the testability and maintainability are still essential to attaining adequate reliability and TMI-2 showed that deficiencies in these areas exist in licensed power plants. The ACRS review

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indicates that attention to these operational functions in nuclear power plants should be more effectively covered by the regulatory process and management action is required to correct the situation.

The review reiterates an ACRS recommendation that study of accident consequences should extend well beyond the regulatory "design basis." The character and consequences of accidents having severity beyond the design basis should be understood and provisions for practical mitigation techniques should be identified to protect the health and safety of the public in the unlikely event that these low probability and unexpected accidents occur. Public evacuation and control of radionuclide releases are particularly relevant to this matter.

The problem of low level waste management has been exacerbated by the TMI-2 accident. The accident, as the review points out, has clearly shown that inadequate attention has been given to accident recovery procedures. The handling of water containing low levels of radioactivity is foremost among the matters needing attention.

The skills available within the nuclear industry and within the regulatory organization are extensive, but there still seems to be a need for improvement. Understanding of systems interactions, particularly those which involve multiple failures, does not seem to be sufficient and the knowledge within the nuclear industry appears to be too fragmented for public safety purposes. The nuclear power plant owner, although carrying the primary licensing responsibility, places high dependence upon the nuclear steam supply system suppliers and the architect-engineer organizations to meet licensing requirements.

The review emphasizes the importance of establishing a commitment by the industry to meet licensing obligations. The industry-sponsored Nuclear Operations Institute and the Nuclear Safety Analysis Center seem to be efforts in this direction. But the committee believes that a high level of competence must be established in the organization of each licensee. The committee believes the implementation actions to meet this need require the attention of the industry as well as the regulatory organization.

The ACRS has not found in its review that there is any lack of dedication on the part of the regulatory organization as a whole, or any deliberate attempt by the regulated nuclear industry to compromise the health and safety of the public. An inability to implement safety-related decisions is a deficiency in the regulatory process that needs correction. More human motivation is needed and it should be brough about through joint efforts of the industry and the regulatory functions, rather than prosecutional threat.

The obligation to inform the public responsibly is emphasized in this review. The ACRS believes the public should be able to discern the difference between minor and major safety issues from the information provided by the regulatory organization, taking into account the manner by which it is handled by the communications media. The present manner in which safety information is disseminated is not adequate.

The ACRS is aware of the recommendations of the Kemeny Commission report, the active legislative review underway by the U.S. Congress and the internal review by the Rogovin Task Force. The ACRS does not believe that response to its review should be deferred until all of these actions concerning NRC functions have been effected. The large number of nuclear power plants now operating and under construction represent a major national commitment to nuclear power. Reactivation of an expanded nuclear program is unlikely to occur in the near future. Regulatory attention should be focused on the existing plants and those in construction and operational licensing status. Emphasis on other matters would result in unwise use of the limited public safety protection resources.

The ACRS wishes to assist the NRC in any way it can to reestablish public confidence in the nuclear regulatory process. The committee hopes that its review will be helpful in that respect.

I'm sure in the last paragraph we had better say to "maintain" instead of "reestablish." My thought was to send this letter to Mr. Hendrie and to send copies to other agencies that would be interested. You might send a copy to other people. I had thought this letter could represent some kind of executive summary. It is not good enough for that, right this minute.

DR. SIESS: I would like to see this letter keyed to the appropriate paragraphs in the report so I could cross-check it.

MR. BENDER: I think that is appropriate, Chet.

PROF. KERR: I have difficulty with paragraph five, the last sentence, because it seems to me to say that until we can take all circumstances under which core cooling might be needed into account, in operator training and procedures, that we can expect core melting to occur. And I'm not quite sure what my inclination would be to recommend deletion of the sentence.

MR. BENDER: I'm not too strongly married to that sentence.

DR. SHEWMON: It bothers me, right behind the sentence which equates any core melting to equate uncoolable

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configuration, because even if core melting did occur at TMI-2, it is in no way equivalent to what you have in the sentence before.

DR. CARBON: Do you have additional comment, Bill?

PROF. KERR: Just one. In paragraph 11, I think the first two sentences carry a message but the sentences that begin with "A large number of nuclear power plants," I'm really not quite sure what we're trying to tell the Commission, unless we're telling them not to worry.

DR. PLESSET: I have a fix for that that is simple, I think.

PROF. KERR: Well, my fix would be to remove it.

DR. PLESSET: Well, that paragraph, I was suggesting since reactivation an expanded nuclear program —

PROF. KERR: It just seems to me that we're saying something that is so obvious — that there are times when one needs to say the obvious and maybe this is one of those times.

DR. SIESS: What are we telling them there? Not to wait for other people to go ahead and do these things?

PROF. KERR: That is what the first two sentences look like.

DR. SIESS: Does the rest of the paragraph relate to the same subject?

PROF. KERR: No.

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DR. SIESS: Then I had better learn to read differently.

PROF. KERR: I don't think so.

DR. SIESS: Or Mike could learn to write differently.

Let me go back to that one that says don't wait, do all of this right now. Is there anything in here that somebody already hasn't said to do that they haven't started on?

MR. BENDER: That I don't know. That is one of the things we need to look at.

DR. SIESS: It talks about isolation provisions, and they've already got bulletins out on that.

MR. BENDER: It may not be necessary to say start right now. I put that in because it always bothers me that everybody says, "Let's get all the reports in before we do something."

DR. SIESS: Well, the staff sure didn't do that here. They have been putting out bulletins and orders like mad. Maybe a little too fast sometimes.

It seems to me the two things in the paragraph aren't that separate and that the point is that a lot of these things have to be looked at hard in connection with operating plants. We have got 70 of them. And that may be all we have for a while, is what you are saying.

MR. BENDER: Well, that is what I was saying, is there are 70 operating plants, and there are a number of them that are in construction now that we had better find

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out about and do something about them rather than sitting around for two or three years while all of these task force reports are coming in.

PROF. KERR: I can see the importance of this paragraph if this report dealt mostly with power plants. But it doesn't. It deals with a lot of the history of regulatory commission and the ACRS and organizational matters. And I would guess maybe -- what -- 40 percent of it deals with power plants.

MR. BENDER: That is a good point. A lot of the things are not things that are going to be done. Some things do. We could say "system interaction studies." Any improvements we want to make are not going to be helped by sitting around on their hands while somebody tries to figure out what the Rogovin report says.

DR. PLESSET: In your third paragraph, I think you ought to point out that this review is needed. Other people have presented their views.

MR. BENDER: But ours is only one.

DR. PLESSET: The other thing, in paragraph 5, you start out with this command, "Keep in mind." I think you should say "One should keep in mind."

PROF. KERR: Or even "Keeping in mind."

DR. PLESSET: I don't like participles.

Then on line --

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DR. CARBON: Gentlemen, let me interrupt just a second. We had better wind this up in about 10 minutes. And certainly, we ought to take any major points that anyone has, but I wonder if it would be well to jump at this time to a discussion of planning for what we have got to do between now and December and what we want to do in December so as to hopefully wind this up then. And right now, this next 10 minutes is about the only time we have got for that planning.

MR. BENDER: I think you are making a good point. Let's find out whether we get any comments on the letter first.

DR. CARBON: Well, people can call you with comments. And I have got some, for example, that I wanted to do so.

DR. OKRENT: I have a general comment. I am going to need to go back and look at what I think should be in the final section, which is where any significant recommendations will be, and then go back and try to think about what constitutes a letter. I am unprepared to think seriously enough about the letter until I have looked at what I think should be in that last section.

DR. CARBON: What kind of time schedule do we have to be on in terms of having information to you for a final writeup, for example?

MR. BENDER: To get this thing in in December, what I would like to have is comments from you by the end of next week. I will then try to find a way to put all of those things into one more nearly finished report, and send out copies to everybody. If I get the comments by next week, by the end of the following week, I could have copies to everybody.

I think, Mr. Chairman, if we designated people to review several chapters for whatever review individuals can make of them.

DR. CARBON: Of the several chapters of your newer version?

MR. BENDER: The newer version. I will keep the same organizational structure.

PROF. KERR: Which is the newer version?

MR. BENDER: It is the one called "Draft 4." Look mainly at the table of contents.

DR. CARBON: I am sorry. Maybe I spoke wrong. You're talking about people reviewing each chapter before you send them to us two weeks from now?

MR. BENDER: That would be my thought.

PROF. KERR: So there is no point in keeping this?

MR. BENDER: Not unless you want to comment on it specifically.

DR. SIESS: Dave said something about the letter.

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You want to review the report before the letter. Does the letter have any different status than the report? Is the letter the formal submittal?

DR. CARBON: It's my understanding that the two go together.

MR. BENDER: I want to propose that the letter --

DR. SIESS: Was Dave thinking differently?

DR. OKRENT: No. You don't write the summary until you know what it is you're going to summarize.

DR. SHEWMON: If you haven't finished the report, why try to write the summary?

DR. SIESS: I am not sure it is all in the report now.

DR. CARBON: Gentlemen, we have got four weeks from today is the end of the December meeting, so we have got to get comments to Mike a week from today. He gets the report out two weeks from today, and it probably gets in our hands about a day or so before Thanksgiving or about that time, which is just about one week ahead of our December meeting. So, really, effectively, we have got about a week in there.

And I think Mike's suggestion of assigning someone to review each chapter makes a lot of sense. And I would propose to do that. And I guess I would welcome volunteers to take particular chapters. And I will call people, pv HEE

otherwise, to wind it up and have a review.

How much time should we set aside in the December meeting?

MR. BENDER: I hate to be controlling the schedule all of the time, but I am planning to be here on Thursday of the December meeting only. By that time, the report ought to be on the table, and I leave it to the committee to decide what it wants to do with i .

DR. CARBON: It sounds like we ought to set aside a full day. Thursday.

MR. BENDER: If you could do that, I would ap reciate it.

DR. CARBON: I don't know how much more time we would need.

MR. BENDER: I am hopeful that the response we have gotten from the committee sort of indicates that the substantive report is okay. It editorially needs a lot of work. I don't think anybody would argue about that.

DR. CARBON: After the reviews of each chapter, should we try for another version before Thursday of the December meeting?

MR. BENDER: Well, I was going to make a different suggestion. Even though I said I was coming up on Wednesday, if you could designate the reviewers and find some way for us to have the reviewers get together in

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advance of the full committee meeting, this could expedite things.

MR. FRALEY: Well, we are scheduling a meeting of the procedures subcommittee on Wednesday. Why don't we include some time during that meeting?

DR. CARBON: How about three hours?

MR. BENDER: That would make some sense to me.

DR. CARBON: Maybe it would be well if we are going to ask and assign people to review the chapt rs right now. I presume the chapters aren't going to change.

MR. BENDER: We don't necessarily have to leave it as chapters.

DR. CARBON: I would think we could take at least the first three chapters as one in bulk, the introduction of goals and the review background. Would someone volunteer to take that?

DR. RAY: Sure.

DR. CARBON: I think we need someone with a more extensive background than you, Jerry, when we bring in that Chapter 3.

Harold, would you take the first three, particularly, because you can take care of Chapter 3 well, the history, the aspects of it?

MR. ETHERINGTON: Yes.

DR. CARBON: Thank you, however, Jerry.

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Chapter 4, the regulatory organization. Do we hae a volunteer? Carson?

DR. MARK: Okay.

DR. CARBON: Chapter 5, the nuclear industry organization.

DR. RAY: Okay.

DR. CARBON: Fine. Chapter 6, major technological issues. Chapter 5 is Jerry.

DR. OKRENT: Well, I will take 6 if nobody else wants it.

DR. CARBON: Fine. 7, urgent regulatory management. Chet or Bill, do either of you have time?

Bill, were you about to volunteer?

PROF. KERR: I learned one thing in my long and distinguished military career.

(Laughter.)

DR. CARBON: I was in the Army, too.

It has been suggested that Dade would be good for 7.

DR. MOELLER: I will read it.

DR. CARBON: All right. Take 7.

8, overall assessment.

DR. OKRENT: Well, 8, I think the sticking points on Thursday of the next meeting are going to be 8, maybe a little bit on this question of where the ACRS did well or not. But that should probably not work out too bad. So, I think 8 is going to be very important, and then the letter, really, and I suggest that everybody pay attention to 8 and the letter, myself.

DR. CARBON: That will be fine, unless we want to try and fold something in Wednesday. I guess there will be several people at the meeting Wednesday.

DR. OKRENT: Again, on 8, I would suggest that Mike prepare a draft, but we ought to have a collection of all of these submissions on 8, just as maybe those that relate to the ACRS role, so that we can see how they look differently. But I think you should put one together that fits, and we ought to be able to have the raw material.

MR. BENDER: I haven't really tried to make sure every one is covered.

DR. CARBON: Need we do other things on this now?

MR. ETHERINGTON: It would be helpful if we had a copy of any changes that might have been made as a result of today's meeting.

MR. BENDER: I think about all I can do is suggest that we try to provide those that want it with a copy of the transcript. There is no master copy.

DR. CARBON: A copy of the transcript, though, will be available. We don't have copies. So, let me ask how many people would like copies of the transcript of our

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discussion?

DR. SHEWMON: When do you expect to take another crack at this, Mike?

MR. BENDER: I plan to start Sunday, if there is something the committee can have, I want to get it in the mail by a week from next Friday, and I will try to send it directly.

DR. PLESSET: You are going to send a new copy of the whole thing to everybody?

MR. BENDER: Yes.

DR. MOELLER: So, we wait and review what we get?

DR. CARBON: Well, he is asking for comments by a week from today on everything we have been discussing; and then two weeks from today he hopes to have a new version mailed out to us.

Jerry?

DR. RAY: You have answered my question.

DR. CARBON: If there are no more important things to bring up here, we will take a break and launch into NUREG-0600.

(Brief recess.)

DR. CARBON: Let's move on to the NUREG-0600 activity. Harold, may I call on you.

MR. ETHERINGTON: The subcommittee met with the I&E staff on October 30 to review NUREG -0600.

Representatives of Met Ed were also present and were invited to comment.

Today's agenda, which you have, is essentially a contraction of the version that was used by the subcommittee or used at the subcommittee meeting. Your tab 6.4 contains reports by consultants Catton, Michelson, and Lipinski. You also have a good summary of the meeting by Mr. Moeller and some additional comments by Mr. Abbott, a senior fellow.

The stated scope of NUREG-0600 is limited to investigation of the licensee's operational actions prior to and during the course of the accident and his actions to control release of radioactive materials and to implement his emergency plan during the course of the accident. Consistent with this limitation, emphasis in the report is placed on departure from technical specifications prior to the accident and departure from the licensee's procedures during the course of the accident, with little consideration of other contributing factors.

Other investigations and other NRC group studies have considered not only the actions taken by the licensee, but also other facets of the accident, including review of peculiarities of the nuclear steam supply system intended to inhibit recovery or confuse the operators by having pressures levels and to divisions of the control room and system design that degraded the quality of information

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available to the operator. These were not covered by the intended scope of NUREG-0600.

NUREG-0600, then, includes a factual chronology of the vent descriptions and the finding of operational and shortcomings and errors. It includes a total of 35 items of potential operational and administrative noncompliance.

I&E subsequently, by letter of October 25 to the Met Ed Company, imposed fines in respect to 17 violations, infractions, and deficiencies, many of them multiple occurrences. We don't know at this time whether Met Ed plans to appeal any of these findings.

The subcommittee noted that two incidents have not been adequately explained: first, is the sequence of events consequence on water hammer associated with water entering the instrument line and with turbine trip.

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The second is the explanation of the action of tripping the diesel fuel racks and failure to reset them. The Subcommittee believes that, at least on information on water hammer caused by turbine trip, it should be explained, and that it should be possible to obtain more information on the diesel tripping sequence.

Because the limited scope of the report tends to lead to a catalogue of violations, with only limited recognition of other factors that contributed to errors by the operators, the Committee has some concern that it may be concluded from the charges that failure to follow accident procedures is automatically a violation. Accident procedures, in the Subcommittee's view, are prepared -- first of all, accident procedures are prepared by the licensee and are not approved by NRC.

But the licensee is required to follow his own procedures. The Subcommittee believes that an accident procedure cannot be sufficiently detailed to encompass every possible sequence of events; and that they must be based upon the assumption that a particular set of conditions exists. A deviation from this set of conditions may make it necessary to depart from the procedure.

As an example, TMI-2 emergency procedure 2202-1.3, loss of reactor coolant/reactor coolant system pressure, which is referred to in NUREG 0600, was examined by one of our

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consultants and found to provide confusing symptoms and instructions for the case of a loss of reactor coolant at the top of the pressurizer.

He also found that emergency procedure 2202-1.5, pressurizer system failure, which calls for pressurizer level control, was unacceptable for the TMI-2 accident and for any other loss of reactor coolant at the top of the pressurizer.

The question that arises, then, whether an operator using his best judgment is guilty of a violation if he consciously takes an action that is at variance with procedures which in themselves contain misleading symptoms and instructions, or which may be otherwise incorrect, obviously, this is a difficult question, and it will involve some post facto appraisal of the operator's judgment.

Among the lessons learned from the Three Mile Island accident are that the procedures need to be radically improved and more carefully reviewed. This perhaps is somewhat beyond the scope of the Subcommittee's charter, but the Subcommittee did discuss this and believes that procedures should be examined carefully for ambiguity, for consequences of failure to follow procedures, for conditions that may require the operator to depart from written procedures, and for any continuing requirement to conform to tech specs during an accident.

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When we have an accident, some tech specs go by the board. But apparently they are expected to follow out, as, for example, the prohibition against going solid is a tech spec, and the operators clearly consider that a management requirement.

The Committee, because of the limited scope of NUREG-0600, which seems to place essentially all of the blame on the operators, the Committee suggests that consideration be given by NRC to issuing a summary report that puts into context the findings of NUREG-0600 with the actions taken by Bulletins & Orders and by conclusions of the Lessons Learned Task Force, which it is felt will present a better overall picture of the responsibilities associated with the accident.

That is all I have to say, Mr. Chairman, at this time.

DR. CARBON: Are there any questions of Harold?

DR. LAWROSKI: You said there was a report by Miller?

MR. ETHERINGTON: It was a handout, wasn't it? You had a summar report.

MR. MULLER: Yes, that was a handout yesterday. That was a summary of the meeting.

DR. CARBON: Any other questions of Harold or comments by other members of the Subcommittee?

PROF. KERR: Did you receive any comment from the staff on your comments about what should happen to procedures

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and tech specs once one gets into an accident? It struck me as I read the fines and reasons therefore that one seemed to be stretching things a bit to insist that an operator follow all of the procedures once an emergency came into existence. Did the staff react to the Subcommittee's comments at all?

MR. ETHERINGTON: These comments were developed mostly during the executive session after the meeting.

MR. LEWIS: This specific issue of the extent to which one ought to be authorized to violate tech specs and adjust to the rules in response to an accident is a terribly important issue which needs to be resolved. And just to remind you, the aircraft equivalent situation is that in an emergency a pilot need only say, "I declare an emergency," and then he can violate every rule in the book. Later he is accountable for having done so wisely, but he is authorized to do it automatically.

That is quite a different situation, and we need to talk about that.

MR. ETHERINGTON: Mr. Chairman, I did not invite you to comment.

DR. CARBON: I thought you did an excellent job and I have no additional comments.

If there are no further questions, let's then turn to the staff. Vic?

MR. STELLO: Thank you, Mr. Chairman. I'm grateful to have the opportunity today to come down and talk to the Committee. I have not had an opportunity for quite some time, and there are a number of issues, I think, that have been raised in the summary that I would like to speak to, since I spent quite a bit of time dealing with them.

I think this summary was a fine summary that you just heard, and it raised a number of issues that I think are indeed very, very important.

One of them I wish to address rather directly, and perhaps by doing so I will be writing part of the summary or a supplement that was suggested to NUREG-0600 about possible misinterpretation. It has never been our intent to point a finger and say that the operators are in fact the cause of this accident.

It is my view -- and I think it is shared by many, and I know I have heard Chairman Hendrie also make the comment -- when it comes time to blame individuals and organizations for this accident, that that blame will have to fall on many. It will include -- and I would like to start with, first and foremost, perhaps, the NRC itself. We need to examine ourselves very carefully because we in many respects didn't do the job that we could have and should have done. That could have also prevented this accident.

I think the vendor, in terms of what he could have done, could have also prevented this accident. I too believe the operators, by using the basic equipment that was there, could have also prevented this accident. I want to come back and speak to that point a little bit more forcefully.

So, to illustrate, if those were the only three that ought to be examined, and each of them could have prevented the accident, then perhaps they each deserve a third of the blame, if that is the right way to characterize it. And I can't say emphatically enough that, because of the limited scope of our report, it unfortunately had the capability to be read in such a way that that was the way it came across. It was not our intent. And I would like to emphasize that, in order to try to find where you come down in terms of that blame, there clearly are other studies that must be finished before we can make that decision.

The Kemeny report is now out and it tells the story it does. I have heard some statements made that suggest again clearly an implementation of inadequate operation and management in terms of its responsibility for the accident. And I also think it suggested inadequacies in the system itself. And I think each of you need to read it and have your own reaction to it.

I think the Rogovin study will also shed some light on this same issue with regard to blame. So these studies are critical, they are important.

Your evaluation and your review is also important before a final evaluation can be made. So I can't emphasize enough and agree with the summary Harold has just presented to you, that one ought not to do just what has been suggested, say that the blame for this accident lies with that operating staff completely

That is just not our view and I can't emphasize enough that we ought not to allow that conclusion to be drawn.

I would be happy to supply you with the letter that Harold Denton and I signed to the Commission, that spoke to, at least in some general way, this particular point and tried to clarify that that ought not to be the interpretation. And if I just might read briefly from part of it. It is a letter dated October 4th, 1979, and if the Committee doesn't have it I will make sure you get a copy. I will check. I think you have a copy. But it says:

"Subsequent to the issuance of NUREG-0600, some statements and reports have suggested, contrary to our intent, that inappropriate operator action was essentially the sole cause of this accident. In our opinion, some of these statemen ave placed undue emphasis on the operator deficiencies disc. sed in NUREG-0600. This may have resulted from a misunderstanding as to the scope of the investigation by our Office of Inspection & Enforcement, which is reported in NUREG-0600.

"This investigation was limited in its scope to the actions of Met Ed over a specific time frame."

And then it goes on to explain that there are a number of other studies that have to be done before one can come to that conclusion.

I don't know if what I have said puts that in its context. I hope so, because I can't emphasize it enough. Our study was in fact very limited. It is more of the traditional explanation that's done by I&E in a more traditional way.

We have, in addition to the study, asked ourselves interally what we learned from the accident, what more is there to be done. And we have transmitted to the Committee, I know, a copy of our lessons learned, in which there are some -- I believe there are about 200 recommendations about what more needs to be done, that look much broader than the immediate implication of the accident itself and NUREG-0600.

In addition, the investigators that participated in the NUREG-0600 development have also come up with a number of recommendations and suggestions. I haven't counted them. But there are more than 100 that relate to what we have learned. So there is going to be an awful lot that goes on the table.

I think this report is a fine report. It has gotten to the very purpose for which it was intended. It is the result of an awful lot of hard work by a lot of dedicated people. It involved over 200 interviews and it involved 15 people essentially full-time -- and I mean nights and

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weekends -- from April through August.

So the report is a good report. It speaks to the issues it needed to. But one has to be extremely careful that one doesn't get out of the context for which it was intended.

One other comment I guess I wanted to make in regard to several other issues that have been raised. One refers to a particular procedure that I personally feel very strongly about, one for which essentially the total fine -- that was, the civil penalty imposed on Met Ed relates to a procedure that they had in place, that if they had followed before the accident -- and that procedure was in place for six months -- that that blocked valve would have and should have been closed.

Beyond whether you would argue whether it should or shouldn't be closed, having a procedure in a control room for six months that either wasn't being removed, covered, augmented, or changed, is a demonstration of an attitude that I don't think we can tolerate.

It is for those kinds of reasons, I think, that the civil penalty on Three Mile Island is what the civil penalty is.

There is a number of other things that relate to the accident sequence that are also identified in our notice of civil penalty, for which I recognize there can be considerable debate. We had considerable debate among ourselves as to

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which of these items ought to and ought not to be included, because of the potential, again, misinterpretation of intent.

One last comment I would like to make, again related to this same issue, one that was discussed a moment ago, is the issue of the technical specifications. It is my view that once you do have an accident in a plant, the technical specifications and the requirements therein are not to be followed. The philosophy which we have built for plants is that you are to have procedures that guide you in the event you have emergencies. Those are the things you ought to try to use to tell you where to go in the event you have an accident and what to do.

And, yes, we also have learned that those procedures are not what they should be. They need considerably more work and they are going to get more work and emphasis.

The whole question of operator training and the inadequacies the operators have -- again, this whole concept of the human element -- in terms of how much improvement we can get with safety through that mechanism is one clearly you will see in all of the things that we have done since that accident. It is essentially the focus or the theme.

There are equipment problems, too, and they are getting attention. But if I had to put my finger on the one issue where I think that that is also the theme and the issue in the Kemeny report, it is that you have to pay attention

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to the people problem. And that is where we are putting our emphasis, and that is what we will be doing in the future. And I am now taking a lot more time than I thought I was. I thought I only had a few brief comments.

And if the Committee has questions of me, I would entertain them.

MR. EBERSOLE: One observation. Before you quit leaning on GPU and Met Ed, though, I would call your attention to the fact that I think it is entirely proper that you relieve the operators of what appears to be an undue share of this blame.

But if we go into the engineering complex represented in GPU and Met Ed, I believe they should have studied this plant to a greater degree of detail than they did and should have listened harder to what was going on elsewhere, and otherwise prepared themselves to have instructed their operators about the potential inadequacies of their instrumentation system, in a matter in which they did not. I am going to the engineering sector of GPU and Met Ed, not the operators.

MR. STELLO: Well, let me just reinforce what you said by citing an example to illustrate this maybe a little more clearly. And I will have to ask someone to help me. I think my memory might fail me. But a question came up some time following the accident whether we ever did or didn't send the Davis-Besse transients in terms of some LER reports and

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some other reports that we issued.

Indeed, we found we did, and that the Met Ed engineering office and the GPU office had them. And the question that came to my mind was: Well, maybe they weren't as adequately written as they should have been. Bu: was that not enough to have engineers ask the question, what does it mean, and get an answer?

And I think that is the thrust of what you have said, and that is precisely the point I was trying to make earlier, that that is the kind of thing that has to be examined. And there are problems there, too.

MR. EBERSOLE: I agree.

DR. CARBON: Other questions?

(No response.)

DR. CARBON: I guess not for the moment.

MR. STELLO: Then if I may, I will turn the briefing over to Mr. Allen, who is going to -- I assume you are going to cover the background.

MR. ALLEN: Thank you, Mr. Chairman.

I am James Allen. I am the Deputy Director of Region I Office of Inspection & Enforcement. And I will briefly describe the I&E investigation, the scope and methodology.

I would like to tell you, though, that we have distributed two memoranda, one dated April 20 and one dated

June 8th, to you that does describe in fair detail the scope of the I&E investigation.

The Office of Inspection & Enforcement investigation of the March 28th accident at Three Mile Island Unit 2 extended over a four-month period. Approximately 3500 man-days of effort were expended by the investigation team and the support functions.

The on-site investigation team consisted of 12 technical specialists and two investigation specialists drawn from the regional and headquarters staffs of the Office of Inspection & Enforcement.

The investigation team was divided into two groups of seven members each, and each group had a team leader. One group was responsible for examining the area of reactor operations, while the other group was responsible for examining the radiological and emergency response actions of the licensee.

During the course of the investigation, as Mr. Stello indicated, there were over 200 interviews conducted.

The I&E investigation had two basic goals: One, to establish the facts concerning the Three Mile Island accident; and, two, to evaluate the performance of the licensee in association with the accident as a basis for corrective action or enforcement action, as appropriate.

The operational part of the investigation covered the time period from the surveillance testing of the

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auxiliary feedwater system on March 26th until restart of reactor coolant pump 1-A about 8:00 p.m. on March 28th. The radiological part of the investigation was from the beginning of the accident on the morning of March 28th until midnight on March 30th.

The findings of the investigation team are published as NUREG-0600. In addition to the report, as Mr. Stello again had indicated, the investigation team has prepared a list of items identified during the investigation as individual concerns, and they have been forwarded to the Office of Inspection & Enforcement headquarters for evaluation.

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The I&E investigation did not include the following -- and I think this is very important -- any evaluation of the actions of the NRC or any of its organizational components during the course of the accident or during the recovery period, any evaluation of the actions of other agencies during the course of the accident or during the recovery period, any review -- any evaluation of the NRC regulatory process as it relates to the Three Mile Island accident for Lessons Learned.

In addition, I&E did not collect information concerning nor evaluate the following: legislative authority of the NRC, rules and regulations of the NRC, safety research, the licensing process, or the inspection and enforcement process.

At this time I would like to introduce Mr. Robert Martin, who will discuss the operational aspects of the investigation, and Mr. Al Gibson, who will discuss the radiological aspects. Mr. Martin will discuss the operational aspects first.

PROF. KERR: May I ask a question. What is the significance of telling if you did not investigate the legislative authority of the NRC?

MR. ALLEN: Again, this was a limited scope of investigation by I&E, and assuming that the other ongoing investigations would look at that process.

PROF. KERR: Well, I guess I am not sure why you would have investigated. I am not sure what you mean.

MR. ALLEN: The investigation did not touch on the legislative aspects.

MR. JORDAN: I guess what we mean is if there were aspects of the TMI accident that would indicate a change is needed in the Act itself, we were not looking at that aspect.

PROF. KERR: Oh, you mean the legal authority that NRC had?

MR. JORDAN: That is correct.

PROF. KERR: Okay. Thank you.

MR. ROBERT MARTIN: Gentlemen, my name is Robert Martin, and I am a section chief in Region 2 of the Nuclear Regulatory Commission office in Atlanta, Georgia, and I was assigned to be the leader of the operational aspects team for th I&E investigation that has generally been described to you. I will not attempt to go through a complete recounting of all of the events as we found them to be. Clearly, you have been dealing with that issue for some period of time.

What I will do is summarize some high points and perhaps, although I am not sure it's really needed, just go through some high points of the sequence of activities that occurred and our general findings, and then be prepared to respond to questions as best I can.

As was indicated, the period of time of the investigation was from the time of the closure of the emergency feedwater valves on March 26 through the time of the startup of reactor coolant pump 1-A, which reestablished circulation in the core following the accident about 16 hours after the start of the accident. The time extension, the previous time of March 26, came about primarily because in the very early stages when we established the time period for the investigation, there is a certain significance attached to those valves, and that was a starting point. We knew that was a clear point at the last time that the valves were manipulated. That was the reason for that particular selection of time sequence.

In general terms, the conditions prior to the turbine trip -- and I am sure these are things you are aware of -- the reactor is at 97 percent of the integrated control system in full automatic. The plant was operating under normal makeup and letdown conditions. The volume control was normal.

One of the things that we looked at relative to conditions prior to the turbine trip was the maintenance history on the components which were identified as being either apparently or really of great importance to the sequence of events, such as the electrical motor-operated valve, the safety valves, the feed pumps, the auxilary feedwater pumps. Their maintenance history, based upon our experience at other plants, did not indicate anything unique in terms of having any higher rate of failure or maintenance problems than other plants we are familiar with. They were in one identified action statement. And it was, I would say, relatively minor in the sense that they were recirculating the borated water storage tank contents. This is a technique for circulation either prior to sampling or to make sure you have a homogenous system.

All of their surveillance was current and up to date prior to the accident. Now, I will address that again somewhat later. In fact, at this specific point at which the reactor cooling system unidentified leakage we found to actually be in excess of the technical specification limits. That was because of an error in the calculational method used in the procedure which we came across.

So, in fact, they were -- had the procedure been correct and implemented as they had been implemented, but implementing it but had used the correct procedure, they would have determined that in fact they were outside of their unidentified leakage limits, and they would have been forced to shut the plant down.

Now, immediately prior, in the four or five hours at the start of the graveyard shift on that day, March 28,

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the 11:00 to 7:00 shift, it turns out that the rate of addition of water to the primary system, which is to maintain the volume available in the makeup tank, did in fact increase substantially. They normally had a makeup rate of about 2600 gallons every shift. That was the normal makeup rate to make up for the total leakage out of the system. It jumped to an equivalent of about 3600 gallons per shift. So, there was a marked increase during that period of time.

The EMOV and safety valve tailpipe temperatures were above procedural limits. This has been discussed at some length previously and during the subcommittee meetings that were held. And new procedural guidance was not provided to the operator, so the operators, for some period of time almost since the period of hot functional testing, if my memory serves me right, had in fact been operating at tailpipe temperatures in excess of procedural limits.

Staff on duty that night met the technical specification requirements. They had in fact just been coming out of a refueling outage on Unit 1; and as result, they actually had additional staff on hand. There were two shift supervisors on duty, which is not normal staffing for that plant except during a refueling outage.

(Slide.)

And the last item, item 8, is included only to identify the fact that -- oh, by the way, with regard to that previous comment with regard to staffing, we also checked that all the training requirements were up to date. Their retraining of all the staff was up to date. Please note in the context that Mr. Stello mentioned previously, the training was compared against the requirements that they were obligated to have through their FSAR and their tech specs and through the regulations for training requirements on the people.

Now, of course, we did look into some of the content of material in those training programs in order to understand some of the operator actions, but with regard to the requirements that were imposed on them during that period of time, all of the training requirements for that staff had been met.

DR. MOELLER: The unidentified leakage, was some of that through the relief valve?

MR. ROBERT MARTIN: No. That would be considered identified leakage. It was an unidentified leakage that had increased. I had to quickly go back through the numerical evaluation again. I think we would probably ascribe the great majority of that to, based on later events, I think, perhaps to leakage in the letdown and makeup system.

MR. EBERSOLE: Was secondary blowdown in operation?

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MR. ROBERT MARTIN: I believe it was. I don't recall them having secured blowdown.

MR. EBERSOLE: It is, of course, eating up the secondary feedwater flow, which was nonexistent.

MR. ROBERT MARTIN: I am sorry?

MR. EBERSOLE: It accelerated the loss of secondary feedwater, if it was left open.

MR. ROBERT MARTIN: I am not familiar enough with the isolation logic on that system to know whether or not it would automatically isolate in the event of any transient.

All right. There were two auxiliary operators and a foreman working in the condensate polisher area, which is the water purification system for the secondary feedwater. The turbine trip occurred at 0400, 37 seconds, on March 28. It was caused by a loss of all feedwater. We were not able to definitely determine the cause of the loss of feedwater, although we have strong inclinations to believe, based upon looking as we did, that it was related to the actions of the operators working in the area of the condensate polishers.

Please understand the way I phrase that sentence, I am not alluding it was an overt action on the part of them, but because of the operations they were conducting.

MR. EBERSOLE: Before you leave that, though, wasn't that a sloppy operation which should have been recognized as having the potential to trip the main

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feedwater?

MR. ROBERT MARTIN: Based upon their previous history with operations in that area, I would say they were aware of the fact that they had the capability to induce trips working in that area. To speak in terms of a "sloppy operation" --

MR. EBERSOLE: I understood it had the potential for getting water into the air system.

MR. ROBERT MARTIN: Yes.

MR. EBERSOLE: Now, that is not very good practice.

MR. ROBERT MARTIN: I would agree that it is not good practice, at a minimum. The reason I am hedging somewhat is that there are many activities that go on in a power plant that, up to March 28, the NRC did not specifically address itself to because they were outside of safety-related systems and safety-related components. I am a little reluctant to assure myself that I am answering you in the context of pre-March 28 inspection activities, considering the eight months that has passed.

MR. EBERSOLE: Well, I looked upon it as an analyst plugging in a soldering iron in a control bus.

MR. ROBERT MARTIN: I hear what you are saying. I am somewhat reluctant to just respond to it.

DR. RAY: And a lot of that goes on.

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MR. EBERSOLE: We hope not.

MR. ROBERT MARTIN: Well, essentially, as you know, there was a turbine trip. That was the nominal initiating event. The detailed sequence is contained in the appendix to the report. If I look at just certain selected aspects, all of which you know, and perhaps I could just very briefly run through, during the -- following the opening of the EMOV, which is an anticipated action following a turbine trip. It failed to reclose. The ultimate effect was a large loss of inventory.

(Slide.)

The pressurizer level remained high despite the inventory loss. The RCS pressure dropped. The trip reactor coolant pumps tripped at 74 and 101 minutes without establishing natural circulation. That was not successfully achieved. About two hours and 18 minutes after the trip, the EMOV was isolated, but at this point they were not able to either run the reactor coolant pumps and get forced circulation; there was too high a temperature and pressure to be able to establish shutdown cooling, and they weren't solid in the primary system. So that they could not establish natural circulation.

So, basically, at this point, even though they isolated the leak, they were now stuck with the difficulty in obtaining any kind of cooling, forced cooling, either by natural circulation or by pump circulation of the reactor core.

Now, there was some interest, we understood, as to when were we able to establish when core damage occurred. I am very reluctant -- and in fact am not in a position -- to establish when core damage occurred, without a definition of "damage." We can address when the operating staff was aware that there had been fission product release and high radiation levels.

I don't think we would have established that at any time during the accident up to and including the time the pumps were returned to operation 16 hours later any member of the operating staff who, as part of a group, believed that the core had been uncovered. They did believe there was fission product release, but during the course of that accident there was not a recognition or an acceptance that the core had ever been uncovered.

So, during the period of time that -- basic actions were always with the presumption that they had a covered core. Based on a number of instrumentation reviews, we could say that by 2-1/2 hours into the accident, about 6:30 in the morning -- general numbers, 6:30 in the morning -- there seemed to be some evidence of releases of radioactive material from the system. And I think Mr. Gibson will address this to some extent in his review of

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the radiological aspects.

In terms of operator awareness, that occurred at about 7:00 a.m. in terms of the general operating staff, when they attempted a restart of one of the reactor coolant pumps. That was about 6:55, on that order. So, about almost three hours into the accident, when they did that, they received all of the -- basically every radiation alarm in the plant alarmed at that point. And at that point there was a general conviction on the part of the operating staff that they had suffered fission product releases.

MR. BENDER: Are you saying that the interpretation of the core --

MR. ROBERT MARTIN: I am sorry, sir?

MR. BENDER: Are you saying that the main interpretation of the core uncovering came from a recognition that fission products existed?

MR. ROBERT MARTIN: No, sir. I am saying that there was no recognition of core uncovery throughout the accident. The recognition of damage, if we include fission product release as core damage, occurred for the operating staff at about 7:00 a.m., about three hours into the accident.

DR. SHEWMON: And what caused that? Why did they realize it then?

MR. ROBERT MARTIN: That was when they attempted a

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restart of the reactor coolant pump. I think they were able to run it for a matter of — I don't remember, but it's in the report -- on the order of 19 minutes, I believe, was the time period.

And during that period of time, almost immediately after starting the pump, they got every radiation alarm in the plant went off; all of their monitors alarmed, all the radiation monitors alarmed, and at that point they felt they had had a fission product release from the core. But they did not believe that they had had total core uncovering. That did not come up during their deliberations.

So, for the remainder of the sequence -- and now I am obviously repeating things you are well aware of -- they attempted to repressurize, to fill the loops, to establish natural convection. That being unsuccessful, they attempted to depressurize in order to use the decay heat system. That similarly was unsuccessful. And they repressurized to fill the loops and start the reactor coolant pumps. That subsequently was successful at about 16 hours after the start of the accident, or at about 8:00 p.m. that evening.

DR. LAWROSKI: Did they ever have total core uncovering?

MR. ROBERT MARTIN: Total? I think, from what I have been able to understand of analyses that were done elsewhere, my understanding is they had some degree of core

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uncovering. We were never in a position during our review of the information available to the operators to form a conclusion as to whether or not or the extent. Part of that is an input; I am merely indicating that they never alluded to core uncovering during the accident.

DR. MOELLER: And the reason, now, for the shutdown of the pump that they restarted was this cavitation, again?

MR. ROBERT MARTIN: They received all of the same indicators they had before: loss of flow indicators and vibrations on the pumps. And it was ineffective, and they shut it down.

MR. EBERSOLE: You went through G-2 mighty fast by saying they tried to depressurize but couldn't do it. Could you tell me why they couldn't do it? Because I am interested in why, in fact, the RHR system appeared to be unavailable, on the grounds that it should have been available for a LOCA and therefore should have been available for this. It was supposed to be standby, on standby for a LOCA; was it not?

MR. ROBERT MARTIN: I believe -- I always get a little uncomfortable moving into the design area -- but I think the decay heat system is more standby in the event of a l[illegible] LOCA and would only be used in a piggyback mode for a small LOCA to feed water to the high-pressure injection

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pumps because in the small LOCA you have great difficulty depressurizing the sytsem down to the point where you can put decay heat in.

MR. EBERSOLE: I understand. But I mean the functional aspect of the decay heat removal system should have been available.

MR. ROBERT MARTIN: Oh, yes.

MR. EBERSOLE: And why was it not?

MR. ROBERT MARTIN: It was available. The functioning system was available. They could not successfully achieve depressurization of the primary system down to the point where they could cut in the decay heat system. It has an interlock on the order of 350 pounds, and they could only bring it down to about 450 to 500 pounds at the low point.

MR. EBERSOLE: Now, why couldn't they get it down?

MR. ROBERT MARTIN: They couldn't get cooling. It would appear that they could not get sufficient cooling to bring down the pressure in the primary system. They still had enough --

MR. EBERSOLE: On natural convection?

MR. ROBERT MARTIN: On natural convection.

MR. EBERSOLE: So, they locked up because they don't have the main coolant pumps?

MR. ROBERT MARTIN: They had neither the main

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coolant pumps, nor did they have natural convection. So, it could not take the energy out of the primary system and depressurize.

MR. EBERSOLE: Thank you.

MR. BENDER: I might as well --

DR. PLESSET: Could I interrupt, Mike?

Mr. Moeller reminds me, Mr. Martin, that some people may have to move their cars because 6:25 is the deadline on that. So, maybe we might allow them to do it.

DR. MOELLER: Actually, the garage closes at 7:00, but if you've parked on this street, 6:25 departure from here is a good time.

DR. PLESSET: If you have your car in a garage, you ought to get it out.

MR. BENDER: I don't have one. Can I ask my question, Mr. Chairman?

(Laughter.)

MR. BENDER: I wanted to follow up on Mr. Ebersole's question for a minute and just ask if more relief valves had been opened up, would they have been able to depressurize enough to have started the reactor heat removal pumps? Has that been established? I never did know whether it was or not.

MR. TIM MARTIN: By 10:30 in the morning, the direction had been given to the shift to not secure

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high-pressure injection, so they were running at least one pump delivering at least 100 epm. There was sufficient -- apparently sufficient -- core uncoverage that there was very hot metal in there. With that flow in there, there was not a large enough orifice using both the pressurizer event and the EMOV and its block valve to get the thing depressurized. They were not able to get the flow below 400-and-some-odd pounds.

MR. BENDER: That's the only valve they could operate?

MR. TIM MARTIN: The code safetys cannot be opened from outside. They do have a letdown capability, but everytime they took it above approximately 70 gpm they got high-temperature alarms on their cooling water, and so they cut it back to 70 gpm. So, they were just sitting there draining. They could have used sample lines, but now we have a very high radiation levels; it would have taken them into the auxiliary building. At this point they just could not depressurize.

MR. EBERSOLE: Does this exhibit a need for better depressurization capability on the primary loop, like an ADS?

MR. TIM MARTIN: I can't speak to that design consideration.

MR. EBERSOLE: Well, the BWR, you can always get

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down. Here you can lock up. Okay, go ahead.

MR. ROBERT MARTIN: I think that falls into the area that everyone is a little aware of. Now we go basically to our conclusions regarding and looking in.

(Slide.)

Now, as has been discussed, clearly, we looked into the operator actions because during the period of time certainly in the first several hours of that, the only staff members that represented, if you will, the licensee and the licensee's activities were the on-site staff.

Basically, part of the background in looking at the aspect of training the operators, the operators had been trained and had been strongly cautioned to avoid a solid pressurizer.

MR. EBERSOLE: But that would always be a consequence of a small break in the region of the pressurizer upper head.

MR. ROBERT MARTIN: I certainly recognize that now.

MR. EBERSOLE: So, the operators were deliberately trained not to respond to a small break in that region?

MR. ROBERT MARTIN: I have difficulty phrasing it in that fashion.

MR. EBERSOLE: How else would you phrase it?

MR. ROBERT MARTIN: The difficulty I have in phrasing it in that fashion is that they were deliberately trained not to respond to a small break in the upper region of the pressurizer. I think there was not a recognition amongst the training staff and amongst many other people at the time of their training and as of the time of the accident that the result of a break in the top of the pressurizer would be to flood the pressurizer and give the appearance of being solid.

MR. EBERSOLE: That is the automatic thing that would occur when they hit the injection system.

MR. ROBERT MARTIN: What I am trying to say is that that was not recognized universally, and certainly not at TMI as of the time of that break.

MR. EBERSOLE: But every time in a licensing hearing came up, we were always told this would occur and let it occur. You could do nothing about it. The system would go solid.

MR. ROBERT MARTIN: I'm sorry. I thought you were speaking of the in-rush as a consequence of the small break on the top of the pressurizer, and that is what I was addressing myself to.

MR. EBERSOLE: No, I'm talking about the solidification due to high pressure injection.

MR. ROBERT MARTIN: All right. In that regard, they were trained to avoid the solid pressurizer and they were trained to be concerned about the possibility of carrying away the safety valves or pumping water through the safety valves.

MR. EBERSOLE: They were trained to defeat the automatic safety.

MR. ROBERT MARTIN: In that, I would have to agree with your statement.

MR. EBERSOLE: Yes.

MR. ROBERT MARTIN: By the same token, similarly, the operators were trained that any RCS inventory loss would be seen as a low pressurizer. And there I'm addressing myself to this, to my prior comments. And part of their operating experience based on prior trips that had occurred at the plant was basically that if they recovered pressurizer level in a system with no leaks and no LOCA present, although not in those terms did they recognize it, but if they were able to recover pressurizer level then pressurizer pressure followed shorly behind.

So therefore there was a tendency to tend to concentrate on maintenance and control of pressurizer level during such transients, and not a combination of both level and pressure.

In reviewing their actions -- and clearly, we have already discussed even this evening the number of critical statements and critical evaluations we have made with regard to operator actions, and that is what a great deal of that report addresses -- there were two items that we would assert to be the most significant actions on the part of the operator, and that was throttling the high pressure injection flow to a minimum when they had low pressure conditions in the reactor coolant system; the other was the failure to isolate the EMOV, which addresses also the prior temperature history of the valve prior to the day of the incident.

Now, actions that were also taken which did not, in our view, contribute to the accident as it evolved that day, but might have had adverse effects had the accident taken another direction, was their action to disable the automatic start capability of the emergency diesels after the first high-pressure injection. This was when the diesels had run for approximately 28 minutes and they were tripped by dumping the fuel racks and never reset until about 9:30 that morning, which would make it about five hours after they were tripped.

And then a manual remote start capability from the control room was established.

MR. EBERSOLE: Is that a plant-unique requirement, to go down and have to manually reset the rack? That is not true of all plants, is it?

MR. ROBERT MARTIN: It is true of a large number of plants, when they have an emergency start in which all of the normal interlocks are bypassed except for certain critical interlocks under a safety start condition. So it is not

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atypical.

MR. EBERSOLE: I see.

MR. ETHERINGTON: At the Subcommittee meeting, I think you hadn't fully explored who did this and why, and I think Mr. Arnold indicated that he knew more about it. Have you any further information on it?

MR. ROBERT MARTIN: No, sir, I do not. I do not know if Mr. Arnold has conveyed that further information. As I recall in reading the transcript, he said, we believe we know who did it and we plan to pursue why it was done. I don't recall him saying he planned to report that necessarily, that information, to the Commission.

MR. ETHERINGTON: Had you tried to find out, then, or had you not explored it?

MR. ROBERT MARTIN: We tried to find out. We found out what had occurred, what actions were taken. We did not -- we attempted to some extent to establish who took the actions. But who took the actions was not considered by us to be a critical issue.

MR. ETHERINGTON: Except if you found out who, you might understand why.

MR. ROBERT MARTIN: That is a reasonable statement.

We did not pursue it beyond the point that we felt was reasonable to attempt to ascertain who the person was. And we have not pursued it since that time.

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DR. SIESS: Did you assume or do you know that it was a member of the operating staff?

MR. ROBERT MARTIN: We assumed that it was a member of the operating staff, but that would not necessarily be a licensed operator, but a member of the staff that was on duty as part of the operating staff. Because it occurred -- it would have been about 4:40 a.m., and there was a limited number of staff consisting of primarily the operating staff and some auxiliary people during that period of time. And it is a locked building requiring a security key for access. And so therefore it would have been a group of individuals having authority to have access in that fashion.

MR. ETHERINGTON: Does automatic start involve moving the rack?

MR. ROBERT MARTIN: Moving the rack?

MR. ETHERINGTON: Yes. What does automatic start do?

MR. TIM MARTIN: The rack controls the fuel injectors into the diesel. If it is not connected to the governor, it will not function. The connection link between the fuel racks and the governor is tripped out of the way by an overspeed trip or it can be done manually.

MR. ETHERINGTON: I see.

MR. TIM MARTIN: What was done here was that link was broken.

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MR. EBERSOLE: Well, aren't there designs that can recall the fuel rack to its normal position?

MR. TIM MARTIN: Not remotely, sir.

MR. EBERSOLE: No designs?

MR. TIM MARTIN: If you trip on an overspeed trip, you certainly want the operator to go find out why.

MR. EBERSOLE: Is that the rationale?

MR. TIM MARTIN: I believe so. I would not want to remotely restart something that had tripped on overspeed.

DR. SHEWMON: I understand that the German counterpart of this same plant, when they license it, has that EMOV isolating automatically. I realize that design is not your part.

Have you heard why the NRC does not require that same automatic?

MR. ROBERT MARTIN: No. I would feel very uncomfortable even attempting to conjecture why.

DR. SHEWMON: If I wanted to find out, what part of the NRC should I ask?

MR. ROBERT MARTIN: I would presume the licensing function.

MR. JORDAN: The licensing function is correct.

(Slide.)

MR. ROBERT MARTIN: Falling into that same category of actions that were taken which did not affect the sequence of

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events and the outcome of this particular incident, but also gave us concern because, had the incident gone in another direction it might have been a problem was that during the very early period -- and we are not able to ascertain precisely when this occurred, but we were able to ascertain that during the early depressurization period they isolated the core flood tanks, they closed the EMOVs on the core flood tanks during the first low pressure period.

Now, the best we can ascertain is that the rationale was that they did not need the water because they had a full pressurizer and therefore they had a full system, and they didn't need any more water and that could have just complicated things. So they isolated the core flood tanks.

They were subsequently unisolated -- and again, I am working on my memory. I don't think that we have ever been able to ascertain, either, when they were isolated, except that the general time frame, and that they were in fact unisolated, because later in the day, when they went to the low pressure period, they did in fact get a partial discharge from the core flood tanks.

Now, if we look at the management actions, which was clearly management being a part of the licensee organization -- if we look at the management actions that took place, and by management we include those people who came to the site in order to support the activities -- that is, personnel of the utility, Met Ed, that arrived at the site to support the emergency recovery -- now, in general terms, we think the plant parameters were in general fairly effectively used in the attempt to recover.

Now, you must realize that basically plant management arrived after the reactor coolant pumps had been tripped and during the period where no natural circulation had been established. So basically they were arriving at a position where they had neither natural nor the capability for forced circulation.

Now, the exceptions to that was that there was a general disbelief of high system temperatures as displayed by the RTD displays for reactor coolant temperatures; and also, any information that they had obtained off the in-core thermocouple system.

So it was basically a general disbelief of the high system and in-core temperatures.

When they evaluated, later in the day, the effect of the core flood tanks, it was not recognized that both of these core flood tanks have a large loop-type seal, not as they are drawn in the FSAR drawings, which show basically a straight line from the bottom of the tank and then into the vessel. There is actually, I think, in one tank about a 14-foot loop seal, and I think it is about 16 foot in the other tank. So that when they interpreted the small discharge that occurred

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from the core flood tanks during the depressurization period as being indicative that the system was solid, and their recognition of the loop seal -- it would well be possible to limit the discharge from the tank without the system being solid. But that was a conclusion they drew.

PROF. KERR: Bob, could you speculate on why they disbelieved this temperature indications? Was it because they simply didn't think there was any way you could get that temperature? Or would you prefer not to speculate?

MR. ROBERT MARTIN: One of the reasons given to us was the fact that they had, all the individual RTDs, had moved outside the callibrated range. They were indicating levels in excess of 620, which was the limit of the callibration procedure. And therefore there was a conviction -- I won't say a conviction, but a feeling, if you will, that: I don't know what they are telling me, because now they are outside the range.

Now, there was an auxiliary recorder in the control room which had an 800-degree display capability, and those same RTDs were displaying on that recorder. I do not recall any reference by the staff to the fact that they had pursued looking at that particular recorder, but they were working off the normal displays for the RTDs

Similarly, the in-core thermocouples were addressed in the same fashion. The numbers being received or displayed -- well, not displayed, because they had exceeded the display limit of 700 degrees Fahrenheit. So therefore, when they took data by using a resistance box and determining what those RTDs were telling them, they were again concerned because the in-core thermocouples are not safety grade equipment.

And their rationale was: Since it is not safety grade equipment, I don't know what they are telling me.

The one thing with regard to the in-core thermocouples, recognizing -- the emergency staff which was directing emergency activities and the operating staff that was carrying out orders, it was not -- we know how much data was taken by the instrument technicians who read the in-core thermocouples. We do not know fully how much data was transmitted in to the management people who were making management decisions. The management people allude to the fact that they received a few numbers from zero to 2,000 degrees Fahrenheit.

The technicians, at the other end, allude to the fact that they had taken substantially more data. We really were not able to track whether in fact it all got in or just a part of it got in.

And then the pressure spike in the building, which occurred about ten hours, about nine hours and 50 minutes into the event, which turned out later to have proven to be a hydrogen detonation.

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MR. EBERSOLE: Excuse me.

MR. ROBERT MARTIN: That was not pursued aggressively by the people on the staff at the time.

MR. EBERSOLE: Could you briefly tell me from what point that hydrogen got into the containment?

MR. ROBERT MARTIN: All during -- if you will permit me to make reference to a thing we had no knowledge of in terms of the report, and that is that hydrogen had been generated some time during the two, three, or four hours after the start of the accident.

MR. EBERSOLE: I know.

MR. ROBERT MARTIN: And there was a continuous period during one high pressure phase which lasted approximately four hours of venting off the reactor coolant system. Then, similarly, they did a major venting of the reactor coolant system as they came down to depressurize.

MR. EBERSOLE: That went out through the PORV?

MR. ROBERT MARTIN: That would be my conclusion as to the manner in which it got into the containment. And it was shortly after they had reached that point of minimum pressure in the RCS when the detonation occurred.

MR. EBERSOLE: I think what I'm trying to get at, it had to bubble through the water in the pressurizer to get out, which it did.

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MR. ROBERT MARTIN: I would have to presume that was the only mechanism for it getting out. We know of no other. We can think of no other mechanism right now. Now, it would either be the PORV or the vent valve on the pressurizer. At various times, they would swing between the vent valve on the pressurizer and the PORV, because there was concern about the reliability of, what if the PORV fails again by manipulating it too much. So there was some degree of movement between those two valves.

DR. MOELLER: If the pressure spike occurred, as you say, at about ten hours or nine hours and 50 minutes, what would you have assumed they would have done if they had recognized this?

MR. ROBERT MARTIN: Our comment was really addressing whether or not management took as much advantage as they could of information that was available to them. We did not try to go into the conjectural, we really didn't. We would have had to start that back at minute one, and I think we never would have completed the fault tree under that condition.

Now, in terms of off-site interfaces, our general conclusions are that the off-site interfaces with the licensee engineering staff, with Babcock & Wilcox, with the architect-engineer, and with the NRC -- some degree of interface had been established or attempted. And we find that in general all of these were in effect, they really were, to the course of actions taken during the course of the accident, with two

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very specific exceptions.

There were specific individuals in Met Ed having contact with the plant at the vice president level, and we think we can identify at least two clear decisions that were reached as a result of directives from those people. I would say if you give me the proviso that that particular relationship is a little outside of what I am alluding to in the licensee engineering staff, then I would say in general the off-site interfaces did not really affect the course of events that were taken, or actions that were taken, during the accident.

The two exceptions to that were the order from the vice president of Met Ed to shut down the steam dump. I don't recall the exact time. We have it postulated. But for something on the order of four to six hours they had lost the turbine because of circ water. They had lost the vacuum on the turbine, so therefore steam dump was not available; and therefore that mechanism for connection to the ultimate heat sink was not available.

They shut down the atmospheric steam dump. That eliminated the atmosphere as a potential heat source release.

So in both of those cases there was, I think, on the order of a six-hour period in which there was no ultimate heat sink, if you will, available. All the energy was having to be disposed of in other fashions.

MR. EBERSOLE: When they blew the dump tank early on --

MR. ROBERT MARTIN: The reactor coolant drain tank?

MR. EBERSOLE: The one that takes the discharge from the PORV.

MR. ROBERT MARTIN: Right.

MR. EBERSOLE: Was that -- was the position of that disk in such a point as to drain the dump tank?

MR. ROBERT MARTIN: The disk is mounted on the top of the tank.

MR. EBERSOLE: So it would have remained full of water?

MR. ROBERT MARTIN: Except for whatever energy content was in that water and whether or not it would be vaporized. But it of itself will not automatically drain that system.

MR. EBERSOLE: Well, did the tank drain?

MR. ROBERT MARTIN: I don't know.

MR. EBERSOLE: I'm looking toward --

MR. ROBERT MARTIN: You see, we had no level indication on that tank. We had pressure indication.

MR. EBERSOLE: Well, it may well be a case where it could drain and then it would subsequently fill with hydrogen and oxygen and have the possibility to explode as a vessel.

MR. ROBERT MARTIN: I see the route you are going in and I cannot really address definitely whether we know whether or not that tank drained or was emptied during the course of

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the accident.

MR. EBERSOLE: Well, it would afford you to have an opportunity to have a vessel explode.

MR. ROBERT MARTIN: I believe, as I recall the drawings, the rupture disk is mounted on the top of that tank.

MR. ETHERINGTON: The tank does have a level indication normally, doesn't it?

MR. ROBERT MARTIN: I am trying to remember very quickly the controls on that. Tim, can you recall?

MR. TIM MARTIN: It does have a level indication, temperature indication, and pressure indication. It so happened that the pressure was patched into the reactimeter, so we have that information. But I don't think we have the others.

MR. RAY: You say that the pressure spike was not pursued. When were they aware of it? Did they realize when it happened?

MR. ROBERT MARTIN: It depends upon who you are speaking of. There was one shift supervisor who was standing -- happened to be positioned in front of the reactor building pressure indicator at the same time that an operator opened the EMOV in a further attempt to try to depressurize the primary.

Coincident with him opening the EMOV, the shift supervisor saw the pressure spike occur in the reactor building.

And he concluded that apparently they were discharging so much steam into the building that we had better stop using the EMOV. And he went and transmitted the information, as best as we can establish, to the plant manager, that, I think we had better stop using the EMOV, because it appears we are getting pressure spikes.

He did not relate the exact nature of the pressure spike.

Another shift supervisor was in a different location when it went off, that is, when the pressure spike occurred. They also had two electrical buses go out. At the same time, they got containment spray and all of the alarms associated with high pressure in the containment and the actuation of containment spray.

Him, seeing the electrical panels go off, presumed that they were in the same general area as the instrumentation pressure switches which initiate containment spray. And he thought he had an electrical problem, and he actually discharged or dispatched some instrument techs to go down and see what the electrical problem was.

They apparently are unrelated to each other, but they occurred. And I'm saying only apparently or relatively unrelated.

But there were two interpretations of the same event. But not all of the information ever got fed back to management.

MR. RAY: It wasn't recognized?

MR. ROBERT MARTIN: It was not. It was not completely fed back in terms of an information chain. A part of it, with an interpretation by the operator of the information, was fed back.

Now, also during that period, the plant manager was on his way out of the building and going to brief the Lieutenant Governor. And it virtually occurred while he was getting ready to leave the plant.

So there were a number of things going on at the same time.

PROF. KERR: Let me make sure I understand your statement. There was one person who interpreted the pressure spike as an electrical equipment malfunction?

MR. ROBERT MARTIN: No. He was not looking at the reactor building pressure recorder. He saw the alarms go off indicating containment spray had started. He also saw the electrical panel fault, and those panels are located in the general area where the pressure sensors which trigger containment spray are located. So he thought containment spray had started because of an electrical panel fault. So there were just two actions being taken for different reasons.

PROF. KERR: Thank you.

MR. EBERSOLE: I think we had a happy state of

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affairs, in that the containment valves were preclosed; is that correct, they were standing closed?

MR. ROBERT MARTIN: I don't want to say that unequivocally. The containment had been isolated. Clearly, the containment had isolated when the --

MR. EBERSOLE: Well, under placid conditions it had been isolated.

MR. ROBERT MARTIN: I don't know whether the purge valves in fact had been closed prior to the start of the incident altogether. But containment isolation had occurred early.

MR. TIM MARTIN: A couple of things I would like to add.

In reviewing the computer traces, the loss of the motor control centers, the electrical buses, occurred some time after the detonation. And we believe that that was associated with the loads on those buses, which happen to be in the containment, that got sprayed down; and that he connected the two.

It is unfortunate because they were separated in time. The various things that occurred during this period -- one of them was that the plant manager, who was getting ready to leave with other people, heard, and I quote, "a double thump." And he is quoted as saying, "What was that?" And someone conveyed to him, "Oh, it was probably the ventilation

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dampers that are being shifted," because they were changing the isolation conditions of the control room.

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Other people, seeing these spikes on the instruments, thought they might be electrical noise. No one really connected the events together. They did allow the spray pumps to run for about five minutes, and that was simply one individual who wasn't ready to turn those off until he was satisfied whatever had caused it was no longer there.

MR. LEWIS: Could I understand one point about the one guy who actually saw the pressure increase and interpreted it as a steam discharge through the PORV? I am missing a point. A steam discharge would make a spike or a step increase in pressure in the containment?

MR. ROBERT MARTIN: The basic thrust, he was saying, was that as soon as the valve opened, he saw the pressure spike. So he is getting spiking pressure in the containment every time -- in his mind, whenever they open that valve, we'd better stop opening that valve.

MR. LEWIS: You led me to believe that he interpreted it as a discharge of steam through the valve.

MR. ROBERT MARTIN: No one thought of anything else going through that valve except steam.

MR. LEWIS: Right. But I'm trying to understand whether a discharge of steam for that valve would lead to a spike or to simply an increase in containment pressure.

MR. ROBERT MARTIN: I cannot answer why he would

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believe, or what he felt had occurred to the system, which would now suddenly make the containment exhibit pressure spikes when he opens the PORV.

MR. LEWIS: What I'm having trouble with is of thinking of any level.

MR. ROBERT MARTIN: I would have to get into his mind and understand why he made that conclusion.

PROF. KERR: You may have difficulty believing a lot of things he was seeing at that point.

MR. EBERSOLE: Excuse me, the time pressure response must have been rather slow. So the spike was probably a lot more abrupt than it was seen on the instrument; is that true? Do you know what the time constant response was?

MR. ROBERT MARTIN: Unfortunately that was the kind of answer I was going to give you. I don't know what the time constant was.

MR. EBERSOLE: Well, you may have only seen the instrument time constant and not the real time.

MR. ROBERT MARTIN: Well, what I'm trying to remember is: are the same detectors -- and I don't know if this is the case -- is the same detector used for the recorder as are used in the starting logic for the safeguard system which initiates containment spray and the pump operation? Because on the computer output we were also able to indicate -- get a sequence in terms of seconds, as to the duration that these various safeguards conditions were established and then reset.

MR. EBERSOLE: Well, there's no particular need for it to be fact, because it wasn't anticipated that it would measure this thing.

MR. ROBERT MARTIN: I would have to agree, but I do not know what it is.

MR. ETHERINGTON: I have another question. At the subcommittee meeting, it was mentioned during speculation as to what would cause the pipe vibration, that there is always water hammer when you have a turbine trip.

MR. ROBERT MARTIN: Yes, sir.

MR. ETHERINGTON: Can you say a little bit more about that?

MR. ROBERT MARTIN: No, sir, the gentleman -- I would have to defer to the gentleman who said that. His background credentials include having been an operations supervisor at a three-loop Westinghouse nuclear power plant, and also having extensive experience in the power industry in general. I have heard such comments made by others that you always get some shaking pipes on -- I know he used the expression "water hammer," and I have to defer to his expression, but that you always get shaky pipes or oscillation in the turbine building after every turbine

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trip.

MR. EBERSOLE: Well, the main steam stop valve is a monster. It's like a cannon going off.

MR. ROBERT MARTIN: Again, what I am doing is deferring. I cannot shed any further light than what the gentleman told you at that point.

MR. ETHERINGTON: You agree, Jesse, that it is common?

MR. EBERSOLE: Yes, it is absolutely astounding what takes place when the stop valve trips. It would frighten you to death.

DR. SEISS: It is water hammer, and not just noise and vibration?

MR. EBERSOLE: This is a huge gate valve.

MR. LEWIS: You're saying it's not water hammer?

MR. EBERSOLE: No, it is impact of steel on steel.

MR. ROBERT MARTIN: I think -- I don't want to speak or modify the words that the man used, whether he meant water hammer in the same exact terminology from a technical standpoint that you mean it, or he was talking more in terms of jargon, I cannot address that.

DR. CARBON: Any other questions of Mr. Martin?

(No response.)

DR. CARBON: Well, thank you. I would like to

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raise a question following his presentation that I think I want to address to you, Ed. It has to do with the breadth or scope of NUREG-0600. The emphasis in 0600 on procedures -- and it pretty much, basically, or essentially compares the action of the operators and how they did or did not follow the procedures -- and yet there was extensive evidence that something else was going wrong, core damage, fission products being released. There were radiation monitors on the scale. At one point they got temperature readings of 2600 degrees. They read a radiation monitor and got something over 1000 R per hour.

But during the first 24 hours, they almost didn't mention this. In fact, if you look at the sequence of events, you find that the words "fuel failure" or anything like that, are mentioned only about once, I think, in the first 24 hours.

My question to you is: why, in this investigation, in NUREG-0600, didn't you explore and look into one question? Why did the operating staff, and not just the operators, fail to recognize that there was core damage? And why did they fail to recognize that the procedures that they were following weren't appropriate and didn't apply? And then subsequently or consequently, why did they fail to recognize that, Gee, they have got to do something quite different than follow some procedure that

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was not applicable there?

My question, again, is: why didn't 0600 look into that subject?

MR. JORDAN: Dr. Carbon, I think the answer is in the charter of the 0600, in trying to establish facts of when they had the opportunities and then what procedures and training they had in terms of using those opportunities. But as far as trying to get into the though process of the operator, we did not explore that.

DR. CARBON: But it seems like it is thought process but also training and so on. And I would think you would have looked into it.

MR. JORDAN: I think we established that the training was inadequate in those areas.

DR. CARBON: All the way through from the operator, the shift supervisor, the engineers, the management, the plant superindendent.

MR. JORDAN: I would think so, because they should have recognized the degree of damage. What Bob was addressing earlier when we tried to cover that was insofar as fuel damage, I think the operators believed that they had gap gas released. And I think that is what the NRC staff believed on the first day, based on bits and pieces of information.

But the true magnitude had not been conveyed

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throughout either the licensee, staff, nor certainly back to the NRC.

DR. CARBON: And it was deliberately a focus of your report not to look into that kind of thing?

MR. JORDAN: It was not the focus of the report to probe into that thought process, or to assign a blame in that fashion.

MR. LEWIS: May I just ask -- and I'm tending to react these days -- everyone says the operator training was inadequate and you just said it -- I wonder what we mean by that. Do we mean that they should have had a college education? Or is that simply an acronym for saying we think they should have done better in this accident?

MR. JORDAN: Well, I think clearly the staff believes that the accident was preventable, and that the combination of design, training, management and operator action and procedures, all strung out together in this particular case, to cause an accident.

MR. LEWIS: I know that the actions were inadequate. It is just the translation of that into the training was inadequate, that I would really like to be able to spell out more in the period to come now, because many people don't go beyond it. And I'm not clear, again, whether you mean that if they had known more about the steam tables, or if they had been trained for this specific accident, which is hopeless, because there are many different kinds of accidents -- or they had just spent more years on the job -- I just don't know what is meant by saying that their training was inadequate.

MR. JORDAN: Okay. I think that the training, that at least I'm talking about, in understanding the basic principles of the operation of the plant.

MR. LEWIS: I see, training on how plants work?

MR. JORDAN: Yes.

DR. SEISS: If a man with a Ph.D. had been through the same training course they had, do you think they would have done better in the accident?

MR. JORDAN: I think, certainly, if the Ph.D. had been in Nuclear Engineering and Core Analysis, yes.

DR. SEISS: But what about mechancial engineering?

MR. JORDAN: I would hope so.

DR. CARBON: I think it is more someone knowing something about thermal hydraulics than nuclear engineering per se.

MR. EBERSOLE: Just basic plumbing, where the water level is.

MR. ETHERINGTON: I think we should remember that three different individuals forecast this accident, not necessarily at Three Mile Island, and the accident was forecast not from the basis of stupid operators,

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undereducated operators, or undertrained operators, it was based entirely on something else.

I agree that the operators need more training. I am not sure that I agree that we should have recognized that in advance.

DR. CARBON: Other questions?

(No response.)

DR. CARBON: Go ahead, then.

MR. GIBSON: My name is Al Gibson. I am section chief in Region II of the office of Inspection & Enforcement. And I was assigned as team leader for the radiological aspects of the I&E investigation of the TMI accident.

(Slide.)

You were told earlier that one of the objectives of the I&E investigation was to determine facts and assess licensee performance regarding the radiological aspects. We sought to assess performance and determine facts relative to emergency preparedness prior to the March 28th accident, and then to assess the response to the in-plant and environmental radiological conditions that existed following the accident.

(Slide.)

The scope of our investigation can really be explained in a two-fold fashion. First, it was to

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investigate the emergency preparedness that existed prior to the accident, and secondly we investigated the response that the licensee took from the time of the accident until midnight on March 30th — which is a little longer interval of time than the operational aspect included.

(Slide.)

We conducted our investigation from a trailler at the TMI site, from the period of April through July of this year.

(Slide.)

The team make-up consisted of specialists in various technical areas. As you will see here, each specialist was from an NRC regional office. Incidentally, Mr. Yuhas is with us today.

(Slide.)

Sources of information were licesee logs, licensee records, transcripts of telephone communications, discussions with plant staff and many interviews.

(Slide.)

I would like to very briefly summarize our findings relative to pre-accident conditions. On the morning of March 28th, the normal radiation and protection and chemistry staff was on-site. This consisted of about four technicians. The normal staff at TMI was 39 indiduals. The normal Health Physics staff was 39

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individuals, which included a superintendent of administration and technical support, supervisor of radiation protection and chemistry and supervisor and a radiation protection foreman, and 20 technicians. Seven emergency drills were conducted by the licensee in 1978 to evaluate the adequacy of emergency response capability. One of these drills was observed by an NRC inspector.

Critiques were held following each drill to discuss results and define action to correct problems identified. We found in review of these critiques that most identified problems had been corrected to the extent that they did not recur following the March 28th accident.

Exceptions to this were an environmental iodine survey instrument was taken from the plant to Goldsboro for use without first verifying that it was operational, and a similar problem had been identified during an earlier drill. Another example was that during a previous drill the need for operations personnel to review site emergency criteria was identified. And as I will discuss later, there was some confusion among operations personnel regarding classification of this event as an emergency.

We did review emergency plan training that had been conducted prior to the accident. We found that in addition to drills, the site emergency plan in implementing procedures for personnel who would be assigned emergency responsibilities had been carried out. With few exceptions, this training had met the requirements of the site emergency plan. One exception was that off-site monitoring team members had not been trained in the use of instruments which would be used for measuring airborne iodine in the environment. And this lack of training did cause some problems during the accident.

We reviewed routine radiation monitor training. Although most of the radiation chemistry technicians recieved some technical training in their job functions shortly after beginning work with the company, no retraining program had been implemented to maintain their proficiency. Most technicians interviewed expressed concern about their technical competency and their responses to technical questions by investigators revealled the need for more training.

We reviewed supplies of radiation protection equipment. Although equipment and supplies were adequate to support normal plant operations, shortages did occur following the accident.

In summary, less than one-half of the portable radiation monitoring instruments were operational at the time of the accident, and the 50 self-contained breathing apparatuses and 175 full-face respirators that were available were not adequate to provide respiratory -- all of

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the respiratory protection needed during the accident re.overy operations.

DR. MOELLER: Were those survey instrume ts checked out during each of the seven drills?

MR. GIBSON: That specific problem was not identified during the drills. Emergency instruments were maintained. Instrumentation dedicated for emergency use was maintained in emergency kits, and these kits had been checked out during the drills. Now, there were only four kits and the instrumentation in these kits certainly would not be adequate alone for recovery operations.

DR. MOELLER: Well, the answer -- did they have records on them, when they were calibrated?

MR. GIBSON: Yes, the 50 percent that were not operational were in the shop for some kind of calibration or maintenance.

MR. EBERSOLE: Are you the folks who are keeping up with the accumulated dose on the plant components now? The soup has been sitting in there for nearly nine months. A case in point -- let's say the main coolant electrical penetrations have been getting a dose of some sort.

MR. GIBSON: No, sir. We have not.

MR. EBERSOLE: It might be extremely important that these penetrations not be challenged by an inadvertant closure to those switching pumps, because we would surely

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see a short-circuit.

MR. GIBSON: Yes, sir, I understand your comment.

MR. EBERSOLE: Who's keeping up with that sort of thing?

MR. GIBSON: I don't know the answer to that. Ed, do you?

MR. EBERSOLE: This is the accumulated dose on such matters as the penetrations, and other significant parts of the containment itself. Is this dosage accumulating to any significant level?

MR. JORDAN: I'm not personally knowlegeable about that. The staff that is doing the TMI recovery reviews at the site is tracking that as a part of the post mortem. We will be looking at the equivalent performance in terms of their accumulated dose.

MR. EBERSOLE: Do you know whether or not the plant is carefully locked out against inadvertant introduction of heavy electrical currents into the now-dead motors inside the plant?

MR. JORDAN: I don't personally know that, but the procedures are being reviewed and approved by the NRC at this point, rather than simply sample reviews in the normal operating plant.

MR. EBERSOLE: Well, it certainly would be prudent to be sure that the cables are almost sawed in half.

MR. JORDAN: Yes, I agree. I'm just simply not personally aware of that aspect. I am not following the recovery efforts at this point.

MR. EBERSOLE: Okay.

DR. MOELLER: Mr. Gibson, is there anything in the tech specs that limits the number of instruments that can be in the shop for maintenance and calibration at a given time?

MR. GIBSON: No, sir. The routine environmental monitoring program required by tech specs was in effect, and this consisted of environmental air samplers at eight off-site locations and TLDs at 20 locations. We reviewed the status of the rad waste system. The reactor building sump was allowed to pump water to the auxiliary building sump tank. About 800 gallons of surge capacity remained in this tank. Other tanks in the liquid rad waste system were about 60 percent full.

The auxiliary building and fuel handling building ventilation system were operating normally, exhausting air to the plants vent via charcoal absorbers and high efficiency filters. The waste gas system, including the vent header, had not been leak-tested since prior to unit operation. But such testing is not required by any regulatory requirement. Small leaks from this system would not normally be of great radiological significance, but following the accident were probably the prime contributors

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to off-site dose.

(Slide.)

The emergency director, who was the plant manager, when he arrived on-site shortly after 7:00 o'clock, was responsible for classifying the situation as an emergency in accordance with conditions in Table 1 of the Emergency Plan, and for initiating actions according to this Emergency Plan, and the implementing procedures, and his own best judgment. The Emergency Plan requires the actions listed in Table 1 be considered for each type of emergency but that these actions or other actions be taken only if they are appropriate.

Now, the first criteria listed in Table 1 for the site emergency plan to have been met for site emergency --

(Slide.)

-- was Criterion C, which is a loss of reactor coolant pressure coincident with high reactor building pressure and/or high reactor building sump level. Now, I will hasten to add that nowhere in the emergency plan nor nowhere in the implementing procedures are the terms "high reactor building pressure" and "high reactor building sump level" defined. But by 4:15 in the morning, the reactor coolant system pressure had dropped from 2435 psig at the time of the reactor trip to about 1275 psig.

(Slide.)

I have a slide indicating the reactor coolant pressure drop. This pressure that is 1275 psig was below the reactor coolant trip set of 1940 psig and the set point for an emergency core cooling system initiation, which is 1600 psig at 4:15. A pressure rise of about 1.4 psig inside the reactor building was detected.

The duty shift supervisor was aware of the drop in reactor coolant pressure and increase in reactor building pressure.

Initially, he evaluated these conditions in relation to the emergency plan and determined that they were not indicative of an emergency since the primary coolant system pressure had stabilized and there were no increased radiation levels either in or being released from the facility.

A high reactor building sump level alarm occurred at 4:11 a.m., but the shift supervisor was not aware of this alarm until 4:30, when an operator brought it to his attention.

Since a drop in primary system pressure had been stabilized by this time and there were still no alarms on the radiation monitors in the control room, the shift supervisor did not interpret the high reactor building sump level and earlier noted conditions of decreased primary system pressure and increased reactor building pressure to meet the conditions for site emergency.

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And as I stated earlier, the terms, "loss of primary system pressure" and "high reactor building pressure" are not defined in the site emergency plans or its implementing procedures.

The lack of specific definition of these terms appear to contribute to the failure to declare the site emergency earlier.

Now the site emergency was actually declared at 6:55 a.m. after a brief start of the 2V reactor coolant pump, which, as Mr. Martin mentioned earlier, resulted in several radiation alarms throughout the plant, indicative of some release of fission products into the reactor coolant system.

MR. EBERSOLE: On your curve there, do you know what the accumulated dump tank pressure was? Does anybody know?

MR. ROBERT MARTIN: Our flood tanks are pressurized at 600 psi.

MR. EBERSOLE: Had they been locked out?

MR. ROBERT MARTIN: They had been locked out. That is why they did not discharge. Well, the scale does not show the pressure. The RCS goes to 650 pounds, so it did not get down at least to the nominal set point for the injection.

MR. EBERSOLE: Were they locked out according to procedures?

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MR. ROBERT MARTIN: No, sir.

MR. EBERSOLE: They were just happily locked out?

MR. ROBERT MARTIN: No, intentionally locked out.

MR. EBERSOLE: Why I said that is had they not been locked out, they would have discharged. Right?

MR. TIM MARTIN: They never got down below what would have caused them, the pressure that would have caused them to discharge.

MR. EBERSOLE: But the operators were desperately trying to get it down low, as you pointed out earlier, to get RHR on.

MR. TIM MARTIN: At this time, if you look at the graph, at about 5:30 to 6:00, they were still running one reactor coolant pump and they didn't understand why their pressure was dropping. They just started an emergency boration, which was collapsing voids. But they didn't know that.

MR. EBERSOLE: Well, while they were trying to blow it down to get on RHR, wherein they failed, had they previously locked out the accumulators?

MR. TIM MARTIN: By then they had reopened the valves and they were looking for the core flood tanks to discharge.

In fact, they were happy to see that they only, and I quote, "just slid in." That indicated to them that the core

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was covered.

DR. PLESSET: Somebody evidently was very fond of loop seals.

DR. MOELLER: Well, in the increase shown here in 6, or whatever it is, in pressure is when they closed, finally closed the relief valve, is it not, or the back-up?

MR. GIBSON: Right in here somewhere, yes, sir.

MR. TIM MARTIN: That is affirmative.

MR. GIBSON: Criterion E in Table 1, which I did not show, but it also requires declaration of the site emergency when the reactor building dome monitor reaches its alert set point.

According to the strip chart, that set point was reached at about 6:35 a.m. This went unnoticed. As I stated before, the site emergency was declared at 6:55.

(Slide.)

A general emergency was declared when the reactor building high range gamma monitor reached its high alarm set point, which occurred shortly before 7:20 a.m.

As I recall, it was about 7:18 a.m., and they declared the general emergency at 7:20.

(Slide.)

Once the site emergency had been declared at 6:55, the emergency organization was implemented as required, generally as required by the emergency plan. Notifications were made. The duty shift supervisor assumed control as the emergency director until he was relieved at five minutes after 7:00 by the site manager, by the plant manager.

A radiation chemistry technician initially assumed control of the emergency control station and a radiation proection foreman took control at 7:15 and was relieved by the supervisor of radiation protection at 7:35.

The emergency control station was initially established in the Unit 1 auxiliary building and it is from that location that the director of the ECCS directs activities of the various emergency teams.

I would like to point out that the organization was initially set up like this, but as the accident progressed, there were some changes made to it which generally seemed to improve the effectiveness of the organization.

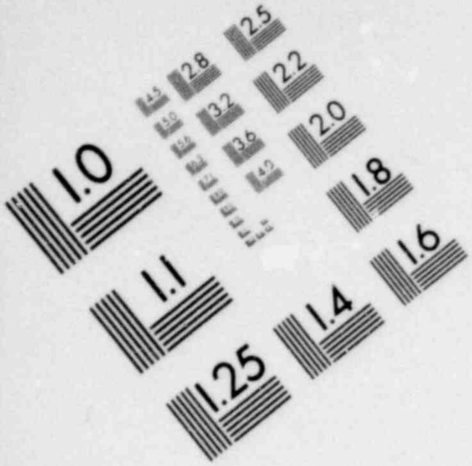
(Slide.)

Following the turbine trip, about 8000 gallons of reactor coolant were pumped from the reactor building sump to the auxiliary building sump tank. This transfer was terminated at 0438 a.m. and was not resumed.

The auxiliary building sump tank overflowed to the auxiliary building sump, causing water containing a relatively low concentration of radioactivity to back up through floor drains onto the floor of the auxiliary and fuel handling building at the 281 foot elevation.

IMAGE EVALUATION
TEST TARGET (MT-3)

6″



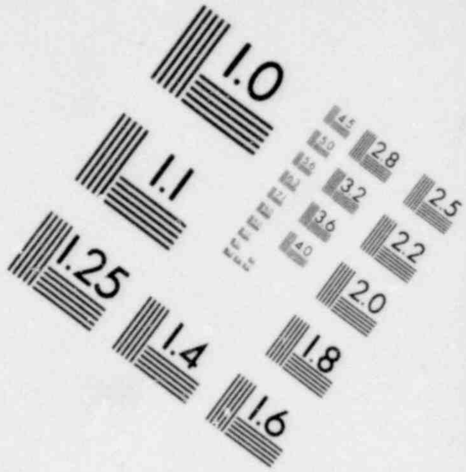
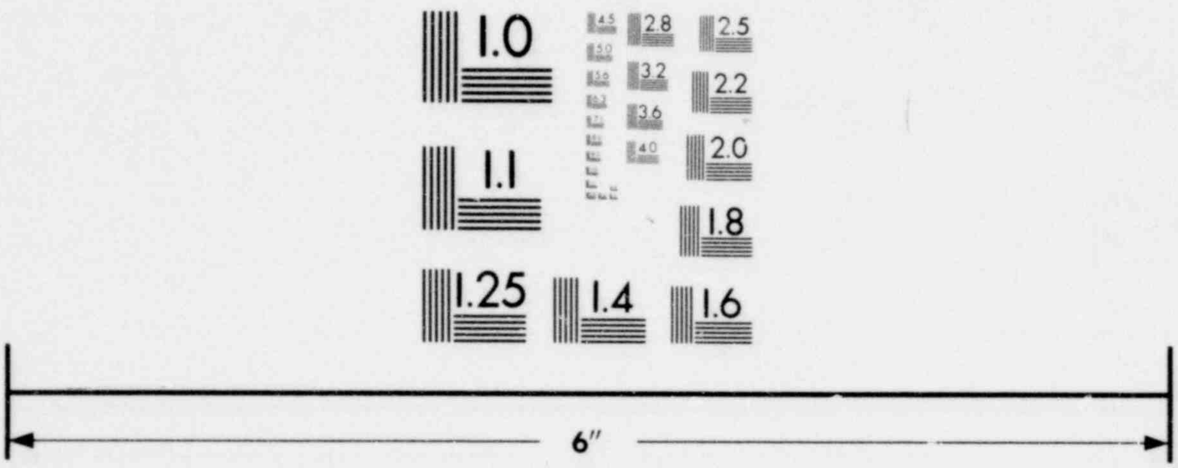
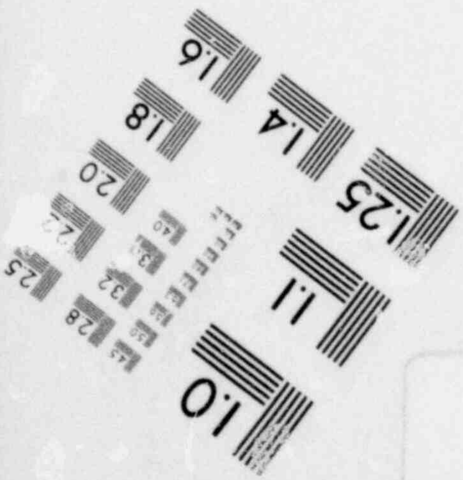


IMAGE EVALUATION TEST TARGET (MT-3)





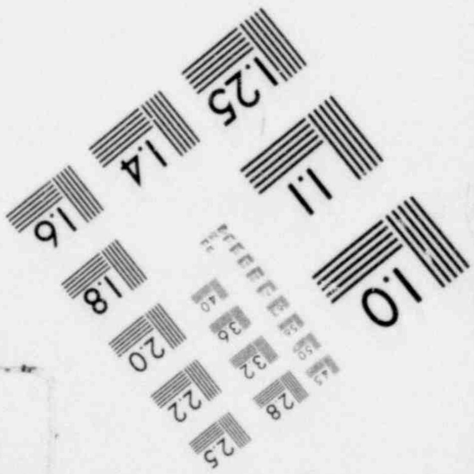


IMAGE EVALUATION TEST TARGET (MT-3)

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IMAGE EVALUATION
TEST TARGET (MT-3)

6"

Following fuel damage, the concentration of radioactivity in the reactor coolant increased by several orders of magnitude and the flow of this highly contaminated reactor coolant was maintained through the make-up and purification system for several days following the accident.

This flow was the principal pathway by which radioactivity was transferred from the damaged reactor core to the auxiliary and fuel handling buildings, and ultimately, to the environment.

Gases evolving from reactor coolant in the make-up and purification system were collected in the waste gas system. Small leaks in the system were of little radiological consequence during normal operation.

However, following fuel damage, radioactive gas leaks caused very high concentrations of airborne radioactivity inside the auxiliary and fuel handling buildings and resulted in much higher than normal environmental releases via ventillation exhaust from these buildings.

I can show a simple drawing of the purification system to illustrate the pathway by which radioactivity was leaving the containment.

(Slide.)

DR. MOELLER: And did they consider it essential to keep this system in operation?

MR. GIBSON: They did consider it essential, yes,

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sir.

DR. MOELLER: Thank you.

MR. EBERSOLE: These conditions that you described in the auxiliary building.

MR. GIBSON: Yes, sir.

MR. EBERSOLE: Can I deduce from what you're telling me there that had the plant in fact experienced a classical LOCA, the ECCS mitigating systems would have performed as designed with these leaking vents and whatnot?

MR. GIBSON: If letdown had been maintained -- I'm not sure that I'm qualified to answer that.

PROF. KERR: You are referring to the activity problem, particularly?

MR. EBERSOLE: The leakage of seals and so forth.

PROF. KERR: I mean your statement said that if the activity normally in the water had been present, there would be no problem.

MR. GIBSON: That is correct.

PROF. KERR: And if you have a LOCA, that is not quite normal, but it is much worse than that.

MR. GIBSON: Without fuel damage, there would not have been a significant problem.

MR. EBERSOLE: But a LOCA implies fuel damage and I'm talking about a classical LOCA.

PROF. KERR: Yes. You're not supposed to penetrate

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any cladding.

MR. EBERSOLE: Well, that's true. But it is not this bad, is it?

PROF. KERR: No, not nearly.

MR. EBERSOLE: Well, I guess it points out maybe the dependence of the ECCS system on not handling dirty water.

MR. BENDER: Would you try and trace that path for us?

MR. GIBSON: I would be glad to. The radioactive coolant leaves the reactor coolant. Pressure is reduced in the block orifice, which is located in the valve gallery in the fuel handling building. It passes through a process radiation monitor, one of two demineralizer filters.

These are actually just filters. They are not demineralizers. They are just filters through demineralizers, another set of filters, and a make-up tank where gases evolve from solution and are periodically vented from the waste gas system through this vent valve, which is a manual operation.

And then the reactor coolant is charged back into the reactor coolant system through these pumps here.

Because of the high concentration of dissolved radioactive gases in this reactor coolant following fuel damage, and because of the large volume of hydrogen

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dissolved in the reactor coolant, there was quite a bit of highly radioactive gas accumulating in the upper portion of the make-up tank which had to be vented to the waste gas system opening this valve here.

Once vented --

(Slide.)

DR. CARBON: Excuse me. Before you leave that, does the block orifice take it down a little bit above atmospheric?

MR. GIBSON: It is about 100 psig. Is that right, Bob?

MR. ROBERT MARTIN: On that order, yes.

DR. LAWROSKI: Are there any measurements of the hydrogen concentration?

MR. GIBSON: Not to my knowledge.

MR. EBERSOLE: For the record, I think I have got to say something here.

Bill, it's not my understanding that a classical LOCA does not fail cladding to a substantial degree. And therefore, you are going to be dealing with dirty water in the RHR in a system such as he described.

Am I not correct?

MR. TIM MARTIN: The letdown system isolates on a containment of high pressure.

MR. EBERSOLE: That won't go away because of high pressure, but you would be handling dirty water in the RHR system.

MR. TIM MARTIN: Your concern is noted, and in fact, they were concerned about the loss of inventory in the borated water storage tank, which would make them go on recirculation, which would then bring highly contaminated floor water into the auxiliary building.

They knew the system leaked.

MR. EBERSOLE: You're telling me that they are not prepared for a LOCA, then.

MR. TIM MARTIN: Not prepared for this event.

PROF. KERR: Don't you agree that the fuel damage here was far greater than one would get in a LOCA?

MR. EBERSOLE: Well, I don't know. What I'm really trying to get around to, the fact is that do we have an RHR system capable of dealing with a LOCA in an aspect of circulating very dirty water?

MR. JORDAN: Tht is one of the lessons learned in the 0578 report, that the RHR should be more qualified.

MR. EBERSOLE: Okay.

DR. SIESS: Mr. Chairman, as I recall, and I looked it up in the TMI 2 safety evaluation report, the staff had been looking at releases from the RHR system following a LOCA.

I think they postulated a pump seal failure and asked the applicants to compute the doses, off-site doses, from that.

Does anybody here know anything about that? All they said about the amount of release was that the doses were a small fraction of the LOCA release, or a small fraction of the LOCA allowable, which, of course, is what it was at TMI 2.

MR. JORDAN: That's right, with very modest fuel damage.

DR. SIESS: Well, I assume it was calculated for whatever fuel damage went with the LOCA or whatever release went with the LOCA. I don't know.

MR. BENDER: Where in the system did the radioactive water get out of the system onto the auxiliary building floor?

MR. GIBSON: There are a couple of possibilities for this. Maintenance records showed small leaks in several systems in several components in this system which could have contributed some.

The pressure indication on this system, although not recorded, was described by an operator to be fluctuating as if a relief valve somewhere in the system were lifting.

These relief valves here are open to floor drains in the auxiliary building and if they did lift, and I think they may well have lifted, if they did, water would have remained on the floor or else gone into the floor drain system and backed up in a different location on the floor in the auxiliary building, because as you will recall, the floor drain system had been filled to overflowing from the auxiliary -- overflow from the auxiliary building sump tank earlier.

So if these relief valves opened, a large amount of water could be released to the floor.

Now this release valve right here is described on drawings as being piped to reactor coolant bleed tanks. One operator said he remembered that valve not having a pipe connected to the discharge nozzle.

Radiation levels in the valve gallery have been too high for anyone to go in and verify. Other operators have stated that they believe that situation was later corrected and that it is now piped to the bleed tank, but that is a possibility.

But we believe that the most likely source of high airborne radioactivity in the auxiliary and fuel handling buildings was not due to gases evolving from water spilled onto the floor, but due to gases that had been vented from the make-up tank to the waste gas system and leaks in the gas waste system.

(Slide.)

Now the next slide is of the waste gas system. And it shows the waste gas vent header, which accepts gas from a number of sources, including the make-up tank vent and gas compressors draw vacuum on this header and discharge into the waste gas decay tanks.

And we noted whenever the level in the make-up tank went up, there was a corresponding increase in environmental releases, as indicated by radiation levels in the auxiliary and fuel handling buildings.

And it became apparent as time went on that there were leaks somewhere in this waste gas system, either in the vent header, perhaps from loop seals, or drain valves in the vent header, or from the compressors themselves.

MR. BENDER: The gases were supposed to go through filters before they went up the stack?

MR. GIBSON: Yes, sir. The gases are stored in these tanks. They are released to a pre-filter, a high efficiency filter, and charcoal before they go to the stack.

Now gases that enter what is known as the waste gas relief header, which is a pathway accepting gas from relief valves, go out the stack unfiltered.

This is also a pathway which is believed to have existed from time to time. The relief valve on the reactor coolant bleed tanks are believed to have lifted and consequently, this was an unfiltered, unprocessed pathway for a period of time.

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MR. BENDER: Do you think that that was the predominant pathway?

MR. GIBSON: It would be speculation, but probably not because it did not exist for an extended period of time.

MR. BENDER: Do I infer from this that the if the filters had been effective, there wouldn't have been as much radioactivity up the stack?

MR. GIBSON: Well, certainly, if filters had been more effective. But you should understand that there was not a release through this pathway here. The release was occurring because gas went into the vent header. The vent header leaked into the room air, which was picked up by a ventillation system. And the ventillation system discharged it through this same stack to the environment.

But it did go through charcoal and high efficiency filters, which are not shown on this drawing. Oh, yes, they are, right here. This is fuel handling and this is auxiliary building.

MR. EBERSOLE: Since relief valves are per se put there to cope with rather unexpected and rather unusual emergencies, what is the logic in not having their through put filter?

MR. GIBSON: That's a good question. I don't know the answer to it. Someone familiar with design basis would have to answer that.

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I would just be speculating.

DR. MOELLER: So most of the releases did go out, then, a 463-foot stack. So it was well elevated.

MR. GIBSON: I believe that's an error on this drawing. That's 463 feet above grade. That would be a very tall stack.

DR. MOELLER: Now the gas decay tanks, those are pressurized.

MR. GIBSON: Yes, sir.

DR. MOELLER: And was their capacity used up? I mean, in other words, they were being vented?

MR. GIBSON: Their capacity was not used up. The capacity, as I recall, was on the order of 70 to 80 psig with relief valve set points somewhere around 120.

But the compressors were unable to increase the presure in these tanks.

Apparently, there was a problem with the compressors.

DR. MOELLER: Thank you.

MR. GIBSON: Airborne radioacti·ity monitors installed in the auxiliary and fuel handling building exhaust systems and station vents were off-scale due to high radiation levels in the vicinity of the detectors.

The response of these monitors provided little useful information during the period of the investigation. However, the samples associated with these monitors were

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used to collect iodine and particulate samples that were analyzed in laboratories for after-the-fact determination of the amount of radioactivity released. In order to provide a perspective of the releases for the first three days of the accident, data for the period of March 28th through April 30th is tabulated in our report, even though this investigation was generally limited to the period of March 28th through March 30th.

These data represent approximately 99 percent of all the noble gas releases. The noble gas values shown were calculated by the licensee by applying atmospheric dispersion factors to TLD results.

The methodology used by the licensee was reviewed but the calculations were not verified by the investigators.

The licensee values are consistent with the preliminary assessment which was made by the NRC staff, which estimated a release of about 1.3 times 10 to the 7 curies for the period of March 28th through April 5th.

MR. EBERSOLE: Was there any significant part to the control room environment under these conditions?

MR. GIBSON: No, sir. There was some increase in airborne radioactivity in the containment.

MR. EBERSOLE: You mean in the control room?

MR. GIBSON: In the control room. I'm sorry. At the time this occurred, the licensee had lost his capability

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for performing isotopic analyses on air samples because of high radiation in the accounting room. And he assumed -- to be conservative, he assumed it to be iodine and put respirators on. But it was later concluded that the radioactivity must have been rabidium 88.

So respirators really were not required.

(Slide.)

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I would like to speak about in-plant radiation protection for a few minutes. The emergency control station was initially established in the Unit 1 Health Physics Control Point in the Unit 1 Auxiliary Building at 6:55 a.m.

At 9:10 the Emergency Control Station was moved from the Unit 1 HP Control Point to the Unit 2 Control Room. This move was made because of airborne radioactivity at the Unit 1 HP Control Point, which was caused by collection of a reactor coolant sample at nearby primary coolant sampling sink.

At 10:12, due to congestion in the Unit 2 Control Room and due the requirement to wear respirators in this area, the Emergency Control Station was moved to the Unit 1 Control Room, where it remained for the remainder of the period of this investigation.

Radiation levels increased dramatically inside the Auxiliary and Fuel Handling Building following the accident. Exposure rates increased by several orders of magnitude from a few millirem per hour to hundreds of rem per hour.

Numerous entries into these buildings were made for purposes such as operations of valves and circuit breakers, inspection of systems for leakage, and performing surveys.

Positive control was not exercised over all

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entries into these buildings, although the Supervisor of Radiation Protection and Chemistry briefed some individuals and at times directed radiation chemistry technicians to accompany repair party teams into the auxiliary building.

Several entries were made without his knowledge. These entries were made into areas of high airborne radioactivity and whole-body exposure rates in excess of 100 rem per hour.

In one instance survey instruments were not used. Two individuals who entered the Auxiliary Building received a whole-body dose of radiation in excess of regulatory limits. Others became contaminated and received unnecessary doses.

At times high-range pocket dosimeters could not be located and were not worn. Items of protective clothing, such as hoods, were not readily available and were not worn, resulting in several instances of head contamination.

Extremity monitoring devices were not worn. Air sampling was not performed in the Auxiliary Building where workers were exposed during the period of the investigation. Appropriate respiratory protective devices were not always worn, and records were not maintained of some radiation doses received.

Emergency plan implementing procedures did not adequately address control of sustained in-plant radiation

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hazards.

DR. MOELLER: Were these errors mainly attributable to the confusion? Or was it lack of training?

MR. GIBSON: I believe there was confusion. There was also lack of training. I think perhaps it could be summed up by saying they were just not prepared for this kind of an occurrence, and I guess that is lack of training.

(Slide.)

A nuclear engineer working in the Unit 2 Control Room completed the first off-site dose calculation at about 7:10 a.m. The result calculated and recorded was 40 R per hour at Goldsboro. The calculations were not retained, and the basis of this result is unknown.

Within the next few minutes the 40 R per hour value was apparently revised to 10 R per hour, and this value was base on the reactor building dome monitor reading and assumed a maximum allowable leakage from containment. The plant staff, including the Supervisor or Radiation Protection and Chemistry, concluded that the value was an overestimate of the actual dose, because the actual reactor building pressure was well below design pressure. And consequently containment should not be leaking at the maximum allowable leak rate.

The investigators have since determined that the error in their projected dose rate was due to an engineer

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misreading of the dome monitor. The engineer apparently did not understand the expanded scale feature on the monitor, and a reading of 400 millirem per hour was misinterpreted to be 30,000 millirem per hour.

A radiation survey was made on the island, between Goldsboro and the plant at 7:48 a.m. and revealed less than 1 millirem per hour. A survey was made at Goldsboro at 8:32 a.m. which also showed less than 1 millirem per hour, confirming that the initial dose projection was in error.

During the period of March 28th through 30th, the Licensee's land-based on-site and off-site monitoring teams made about 500 direct radiation measurements. These measurements were made primarily to confirm the predicted location of the the noble gas, affluent plume, and to determine the does rate produced by the plume, the rate of release of radioactivity or source term from the station was periodically calculated based on the dose rate measurements in the plume and meteorological conditions existing at the time of the measurement.

The calculated source term was then used to predict those rates in other areas when meteorological conditions changed.

Monitoring team survey results were also used to assess the need for protective actions. TLDs were used to perform an after-the-fact assessment of direct radiation

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doses to the public.

In general the Licensees, on-site and off-site survey teams performed surveys in appropriate areas at appropriate times. However, during a five-and-one-half-hour period on March 28th and a two-hour period on March 29th no off-site surveys were performed in the plume.

Both of these periods of time were within the interval when the majority of the noble gases were released and when the plume was well defined because of sufficient wind speed and almost constant wind direction.

Radiation levels on March 28th, with the exception of 50 millirem per hour measured at 1548 hours on Pennsylvania Route 441 at about 1500 feet south of the north gate were not above background until 2238 hours, when a radiation level of 13 millirem per hour was measured near Conkle's School, which is about six miles northwest of the plant.

Several radiation levels above background were noted in this general area prior to midnight. However, the 1300 millirem per hour value was the highest one measured until 30 millirem per hour was measured in Goldsboro at 600 hours on March 29th.

Radiation levels during the remainder of March 29th were generally less than one millirem per hour, with the maximum dose rate of three millirem per hour at

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Royalton.

DR. MOELLER: Were there measurements made, say, simultaneously, inside and outside an building or in a basement and outside, or anything like that?

MR. GIBSON: I'm sure measurements were made in both places, but I don't recall any effort to compare simultaneous measurements.

That is all I had planned to say, unless there are further questions.

DR. CARBON: Thank you.

Are there any additional questions of the other members of the Staff?

MR. EBERSOLE: May I ask the Staff a generic question?

DR. CARBON: Sure.

MR. EBERSOLE: The finding that may be the RHR system is not suitable for handling dirty water; maybe, I guess, generic to these RHR designs. Do you know that to be so?

MR. JORDAN: That is understood to be so for this level of activity.

MR. EBERSOLE: All plant may have leaky seals then.

MR. JORDAN: That's correct. Valve packings, pressurized water reactions. For that matter, BWRs might

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have dirty water, too, after a LOCA, on the RHR system.

MR. JORDAN: Yes

DR. CARBON: Harold, do you have questions of the Staff?

MR. ETHERINGTON: In all these areas where you have a gas leak --

MR. JORDAN: You're saying presently?

MR. ETHERINGTON: No. I know on the flow diagrams that you showed they were all on the suction side of the pump. Isn't there an attempt to keep them subatmospheric to avoid out-leakage?

MR. JORDAN: Are you speaking of the ventilation system of the building or the piping system?

MR. ETHERINGTON: The ventilation system.

MR. JORDAN: The ventilation systems normally go from a high activity toward the low activity zone.

MR. ETHERINGTON: I was talking about the piping.

MR. GIBSON: The vent header in the waste gas system, although it is on suction side of the compressor, is maintained at a low positive pressure, 3 or 4 psig.

MR. ETHERINGTON: Okay.

DR. CARBON: Do you have other questions of the Staff, Harold?

MR. ETHERINGTON: No.

DR. CARBON: Let me make a comment to the

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committee to clarify a point.

My questions awhile ago about recognition of fuel failure -- I was asking why the operating staff -- not the operators, but the staff, including those mechanical and nuclear engineers — why they didn't recognize this.

Thank you all for coming.

I believe that does it.

MR. JORDAN: Thank you, sir.

DR. SIESS: Have the clocks stopped, or are we through?

(Laughter.)

DR. CARBON: If everyone is appropriately stunned, perhaps we could take a first reading of Harold's letter.

(Whereupon, at 7:45 p.m., the hearing was adjourned.)

* * *

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Check slides

CHRONOLOGY

Sept 6	W Owners Group Meeting
Sept 9	PSE&G (Salem 1) LER 79-58
Sept 14	IE Information Notice 79-22
Sept 17	Letter To All Licensees - H. Denton
Sept 18-20	Meetings With Licensees
Oct 5-9	Licensee Submittals
Oct 15	Basis For Continued Operation - D. Eisenhut
Oct 19	AIF/NSAC Generic Submittal
Nov 6	Status Report
Nov 8	NRC/Industry Meeting

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BASIS FOR CONTINUED OPERATION

1. SAFETY CONCERN BUT NO DEMONSTRATED SAFETY PROBLEM
2. MARGINS IN HELB SAFETY ANALYSES
3. SIMILAR UNRESOLVED SAFETY ISSUES
4. OPERATOR CAN COPE

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INITIAL FINDINGS

1. No identified safety problem

2. Concern, however, regarding

   - B&D of systems reviews

   - EQ of equipment

   - Operator action

3. Concur with Rec 9, NUREG 0585

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CURRENT RELATED ACTIVITIES

- Fire Protection Reviews
- EQ of Safety Equipment
- Diablo Canyon Seismic Pipe Breaks
- TAP - A 17 - Systems Interaction
- Standards Development For Non-Safety Grade Equipment
- Consequential Control System Failure

1430 024

NRC/INDUSTRY
STEERING COMMITTEE

- develop Task Action Plan
- establish schedule
- oversee performance

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