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NUCLEAR REGULATORY COMMISSION

In the matter of:

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Combined Meeting of ACRS Subcommittees on
Metal Components and Structural Engineering

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

COMBINED MEETING OF ACRS SUBCOMMITTEES ON
METAL COMPONENTS AND STRUCTURAL ENGINEERING

Room 1046
1717 H Street, N.W.
Washington, D. C.
Friday, May 24, 1985

The Subcommitte on Metal Components and the Subcommittee on Structural Engineering of the Advisory Committee on Reactor Safeguards convened, pursuant to notice, at 8:30 a.m., Paul Shewmon, Chairman, Metals Components Subcommittee, presiding.

PRESENT:

PAUL G. SHEWMON, Chairman
C.P. SIESS, Member
JESSE C. EBERSOLE, Member
HAROLD ETHERINGTON, Member
ROBERT C. AXTMANN, Member
CARLYLE MICHELSON, Member
J. HUTCHINSON, ACRS Consultant
E. RODABAUGH, ACRS Consultant

PRESENT (Continued):

MYER BENDER, ACRS Consultant

S. BUSH, ACRS Consultant

ACRS Staff Member:

ELPIDIO IGNE

SPEAKERS:

L. Shao

R. Vollmer

B.D. Liaw

B. Bosnak

R. Klecker

C. Serpan

S. Hou

J. O'Brien

W. Johnston

B. Elliot

W. Shack

Mr. Vagans

Mr. Shields

P R O C E E D I N G S

MR. SIESS: Good morning. This is a continuation of the meeting that began yesterday to hear reports from the representatives of the Piping Review Committee.

We will proceed with item 2.4 on the agenda, Mr. Bosnak.

MR. BOSNAK: Good morning. I'm Bob Bosnak, the Division of Engineering, NRR.

A couple of loose ends from yesterday that Carl Michelson asked a question about, LARs and snubbers. We checked, and currently, unless the plant that has the defective snubber cannot make the replacement within 72 hours, then he has to come down and then something is required. But if he does exchange the snubber for a good one within a 72-hour period, there is no requirement to come in and report.

Optionally, some do, and what we have heard from checking with a few regions, some don't. So that is the current status with the record.

MR. SHEWMON: Does that also mean it doesn't get caught by NSTD or whoever that outfit is?

MR. MICHELSON: NPRDS.

MR. BOSNAK: We were unable to contact AEOD. There was no one over there yesterday to give us that particular reply. But we did check with the regions, and with respect to submitting an LER, if they can do it within the 72-hour

period, there is nothing.

MR. SHEWMON: Fine

MR. BOSNAK: One other loose end here that I wanted to make sure we understand.

[Slide]

This is the primary loop, and I'm going to come back to this if you would like, but I want to show you where the break locations are.

[Slide]

This is the Westinghouse plant, and I think we talked about 11 yesterday. Actually, the number being done away with with leaks-before-break is really eight, and if you look at the numbers that you see here, the BR means branch; 9, 10 and 11 are branches. The 7 is the longitudinal split in the elbow. All the other breaks are the breaks that are being eliminated.

The branch lines stay.

[Slide]

The three-dimensional view that you have here just shows one of the lines, and that would be a location for a break, pressurizer surge line.

MR. SHEWMON: The break that is postulated there would have to be defended against jets? Or was there a whip in the minor line or what?

MR. BOSNAK: Everything is as it always was.

MR. SHEWMON: So that also means the whip of the main lines of these elephant cages stay at least for those.

MR. BOSNAK: It is this line that is breaking.

MR. SHEWMON: The little one, not the big one.

MR. BOSNAK: The little one, not the big one. It's the terminal end of the branch line.

MR. SHEWMON: Okay.

MR. MICHELSON: Is it clear to you from the Commission paper that that is what is meant by reactor coolant piping?

MR. BOSNAK: It's clear to me.

MR. MICHELSON: It's not clear to me.

MR. BOSNAK: Perhaps I'm too close to it, but if it's not clear, that is exactly what is being meant by the Commission paper.

MR. O'BRIEN: The reason it is clear in the Commission paper is that the Commission paper says that it's based --

MR. O'BRIEN: The Commission paper is based on the resolution of A-2 and what is performed by NRC contractors, and that work is based only on the hot leg, the cold leg and the cross-over. So by inference, since we cite the resolution of A-2 and we cite the work performed by NRC contractors, then by reference it means only those breaks that Bob indicated.

MR. MICHELSON: I am glad you know that because I

didn't from just reading the material in front of me, and I would have thought that a document such as a rulemaking would be self-contained or very explicit where it isn't self-contained as to where to find the information. Even by reference it would be fine, but I couldn't find a reference to tell me what the definition of primary piping was.

So I'm surprised in a rulemaking that it is that soapy.

MR. SIESS: We can always say the lawyers are right and the rule was bad, but I don't think that's true.

MR. BOSNAK: Now what I would like to go into is hopefully to try to clarify for Carl Michelson and Jesse Ebersole, particularly, the questions that were raised with respect to what is going on on plants that are in the licensing strain. While we are commenting on it --

[Chart]

I don't want to confuse the issue, but I think all the questions that were asked, we need to have a little further discussion on. I'm calling these all design improvements. Here we have NTOLs. These are the plants that haven't been licensed. Here we have operating plants and here we have CPs. Of course, there are no CPs right now, but some of the questions that were asked get into what you might call the general rule. I'm calling this now -- this is the limited rule, the primary loop for PWRs.

-- Eventually, the general rule -- you know, it's not limited to PWRs, but right now let's focus on the specific rule. And NTOLs -- I will put a little check mark here. Now, others -- and by others, I mean other than the primary loop. We have had requests. They are in house. But there is no action being taken on other, so this is request.

Principally what they are -- and Ray can correct me if I have left out a few -- but the pressurizer surge line that you saw there, the Class 1 -- typically the Class 1 branch lines. They are the same materials that you heard spoken about yesterday, but we have taken no action on it and we intend to take no action in the immediate future. So basically now we are talking about the primary loop.

I will get into this a little bit later, but this stands for the arbitrary intermediate breaks, and this is the things that we talked about yesterday, trying to put everything together on flexible piping.

MR. SHEWMON: Is that first word damping?

MR. BOSNAK: Yes, damping and spectral shifting. Those two design improvements.

On the OLs, as far as requests are concerned, we have the issue A-2. They need this limited action that we are taking. And again, these are all pressurized water reactors. The CE plants also, since they have not yet gone through the -- the operating plants have not yet gone through the GDC-4 --

are looking for this particular effect, LOCA and SSE. By that I mean decoupled.

We have had some preliminary requests from OLs looking for design improvements, and by that I mean there are two plants that I know of that are expected to come in shortly. They are having problems with the reliability of large steam generator snubbers, and we are talking about 2000 kips, 2 million pound snubbers.

What they would like to do, when the material aspects of leak-before-break have been improved for their plants, would be to do something for the snubbers. One is in a low seismic area. The other is in a high seismic area. I don't know what the end result will be. Perhaps it will be to go to a smaller-size snubber. Perhaps the low seismic plant could totally eliminate the snubber. I'm not sure.

But in the context of your letter of June 14th -- let me quote from it -- because we are looking for a clarification in this area. I can tell you how we are interpreting it, and then we would like to be corrected if this is not your intent. But you do say, "However, any relaxation of requirements to cope with DEGB should be preceded by rigorous reexamination of the integrity of heavy component supports under old design conditions."

We don't intend to touch what might be characterized as the basic heavy component supports, but if we do have a

request from -- and we are talking about operating plants now -- from a utility that has problems such as I have reported -- and again, this is a preliminary report. We don't have anything from the utility yet. These are all what we have heard from telephone conversations via second parties.

So we do want to be sure that if we take an approach such as that, that it would be in consonance with your wishes. We think we understand what you are saying because we don't want to disturb the heavy component supports either. The work that Livermore did and the work that -- particularly that Livermore did, that stressed the effect of indirect components -- we are talking about things such as cranes toppling over, things that might indirectly cause a pipe break, not causing the pipe break, but indirect causes.

MR. SHEWMON: I think another part of that history that may be irrelevant but sits in the back of our minds is about some supports you had which were heavily constrained in their weld design and built up material which had a ductile, brittle transition temperature around room temperature. Where was that, Spence?

MR. BUSH: That was a lot of places.

MR. BOSNAK: Particularly North Anna was one.

MR. SHEWMON: North Anna was where it hit the fan, I guess, but in general, that sort of thing. Also to be sure that they would maintain their integrity.

MR. BUSH: Bob Nichols spent, I think, two years on that at EPRI, and recently, I think, wrapped it up, which essentially was an assessment of what the properties were on the supports, and as far as I know, Bob, a pretty large spectrum of plants, anything that they thought had it. A lot of that was A-36, as I recall, which is not exactly the world's best material.

MR. ETHERINGTON: Even so, the general conclusion was that it's not really a problem; isn't that right?

MR. BUSH: I think it was not considered to be a major problem.

MR. BOSNAK: Certainly on these plants, the NTOLs and the OLs are not changing anything. They are designed for the combination LOCA and SSE, and nobody is changing anything. As I said, the only thing we have heard, there may be people that are interested in improvement, and these are on operating plants. It is in the area. The only thing that we would even entertain, I believe, at this time would be looking at how do we improve the reliability of snubbers that are there because there have been problems.

MR. MICHELSON: Does this mean, then, that the request from Seabrook for the feedwater line arbitrary breaks -- you haven't talked about the arbitrary yet.

MR. BOSNAK: I haven't come to that.

MR. MICHELSON: Except for arbitrary, this is the

situation.

MR. BOSNAK: Arbitrary breaks, and unfortunately they are in the same volume as the fracture mechanics area because they are pipe breaks. These are pipe breaks here. These are what I call improvements in piping design to achieve what we consider to be flexible piping. They are all in the Piping Review Committee report. This is the thing that is now before the Commission, and I wanted to be sure that everybody understood what we were doing there and that we are making very little change.

MR. MICHELSON: Is it clear from the Commission paper that it doesn't include arbitrary breaks?

MR. BOSNAK: I think so. It does not include arbitrary breaks.

MR. MICHELSON: I thought it included all the breaks in the primary piping.

MR. BOSNAK: Again, we don't want to mix these two areas up. The elimination of breaks based on advanced fracture mechanics techniques is one principle. Arbitrary intermediate breaks, which is just the elimination of these breaks -- I will tell you what the trade-off is when we get to those -- is a completely separate area. Nothing to do with the advancing to GDC-4. The fact that they are also eliminated is just a coincidence, I guess, if you will. But they are two separate items.

MR. EBERSOLE: I may have missed this, but I understood you were going to probably permit the removal of motion limiters.

MR. BOSNAK: What we are talking about with respect to this, as John characterized them, we are trying to get rid of the evil pipe whip restraints. What people are doing are getting rid of pipe whip restraints, bumpers. If that is what you characterize as being motion limiters, that's correct. Those are in the primary loop. If people want to leave them there, they can leave them there. What I think many of the NG welds are going to do, they are not going to put in saddles and they are going to shim them.

MR. EBERSOLE: What about the main steam lines?

MR. BOSNAK: We are not talking about the main steam line right now.

MR. EBERSOLE: Okay.

MR. BOSNAK: This is the primary loop only. I think we had the slide of the primary loop before you came in, exactly what we are talking about. This is not main steam. It's a PWR primary loop only.

Now CPS. Obviously, if had somebody wanting to come in and build a new plant, I'm sure if i was a pressurized water reactor, they would ask for that.

MR. EBERSOLE: How was it rationalized since these are PWRs and they don't get the cracks anyway? That's the way

I understand it.

MR. BOSNAK: That's the reason why we started here. We started with the primary loop because it has been good operating experience. There were no large dynamic loads. Apparently I should list some of those things.

MR. EBERSOLE: Isn't it true that the need for detailed and frequent inspection is a good deal less in the PWRs than in the boilers?

MR. BOSNAK: If you are talking about during construction?

MR. EBERSOLE: No.

MR. SIESS: ISI.

MR. BUSH: There is no difference. Unless -- I think I can speak with reasonable authority on this -- Unless you are faced with requirements established by the NRC in addition to the code requirements, you won't have any difference. Now, the reason I say that that way is if you have sensitized stainless steel in there, then NUREG 313 tends to control and you do more inspection in the case of a boiler than you would in PWR.

MR. EBERSOLE: Isn't that controlled in the engine room?

MR. SIESS: These are only PWRs, PWR primary system only, primary loop only.

MR. BOSNAK: If you want, we could have a laundry

list here, but these were the things that were looked at before we decided to even go into this primary loop: that we had leakage detection, there was quality in construction, that we knew the loads. If you don't know the loads, you are going to have difficulty getting into your fracture mechanics if your loads are uncertain.

When you start getting into some of these other lines in the balance of plant, that is what you are going to be faced with. And of course, the material, to understand the material and how it behaves, and whether it will leak before it breaks.

So those kinds of things are inherent in many years of work by the Staff before we were able to say that we believe the primary loop of a PWR is not going to -- it's going to leak before it breaks.

With that in mind, what we were trying to accomplish was really the removal of all of this mass of steel that you have seen. That's the objective.

MR. ETHERINGTON: Did you say it's not going to leak before it breaks?

MR. SIESS: His sentence wasn't a good sentence, Harold.

MR. ETHERINGTON: I thought that was misspoken.

MR. SIESS: He did misspeak.

MR. BOSNAK: So in the OLs, we don't expect they are

going to get into this area of the other lines --

MR. SIESS: The other lines are the broad-based rule? Is that what you mean by others?

MR. BOSNAK: The broad-based rule says that the technique, the advanced fracture mechanics --

MR. SIESS: I just want to know what that column refers to. The first column refers to the interim schedule of exception. The second column is the broad-based rule.

MR. BOSNAK: Yes.

MR. SIESS: Okay.

MR. BOSNAK: I just wanted to point out there are requests in house right now even though the broad-based rule has not even been looked at that goes beyond the primary loop, and we are just sitting on it. We are not doing anything with them. So I think that's all.

If that is fairly clear, perhaps we can move to the next column.

MR. SIESS: That takes care of the rules, the two rules that we had.

MR. BOSNAK: Yes. Again, this is the limited rule that is before the Commission right now. We think it is fairly clear. It's very finite. People are not going to change equipment qualifications, they are not going to change heavy component supports, they are not changing ECCS, not doing anything to containment.

MR. SHEWMON: How about pressure in compartment?

MR. BOSNAK: Pressure in compartment stays the same.

MR. O'BRIEN: The rule does say that pipe dispressurizations can be eliminated from the design basis.

MR. SIESS: Asymmetric loading is affected? That's a compartment break.

MR. O'BRIEN: There are pressurizations due to breaches in the primary circuit from steam generators and seals. That is still in the design basis. The only thing excluded --

MR. BOSNAK: The A-2 aspects of pressurization are the things that are going. When I said pressurization and I answered it stays the same, it does except for the asymmetric effects.

MR. SIESS: Mike.

MR. BENDER: I guess I'm reading something into this that you didn't say. For the plants already designed with the double-ended pipe break loads providing the basis for the compartment pressures, there is not likely to be any change at all. That could only --

MR. BOSNAK: That's correct. That's why I'm saying it stays the same. So the things that we are talking about here, they are not going to change.

MR. BENDER: So that the thing that John O'Brien is talking about really has to do with future designs where you

might, in fact, look to see whether in changing the double-ended pipe break criteria for primary loops, pressures might drop some.

MR. BOSNAK: There is one other wrinkle on it, since John mentioned it. We realize today we have what we call break exclusion regions, and we have limited displacement breaks. These breaks that we see here --

[Slide]

-- particularly in the area of the reactor coolant pump steam generators, there are bumpers so they are limited displacement breaks. What we are saying is if you want to remove that bumper, then they are no longer limited displacement breaks. They were designed for limited displacement breaks, but the design doesn't change. You have in there the peak pressures that are associated with the limited displacement breaks. That's not changing. But you can remove the bumper.

MR. SIESS: They were limited displacement breaks because if you assume the double-headed guillotine break, you have got too much pressure, so you have limited the displacement to where it couldn't be double-headed.

MR. BOSNAK: Correct.

MR. SIESS: And now that you do not require the double-ended break, you can remove the limited displacement device.

MR. BOSNAK: That's correct.

MR. MICHELSON: And still use whatever the pressures and temperatures and so forth were before.

MR. BOSNAK: That's correct.

MR. MICHELSON: Let's postulate for a moment that somebody has got their environmental qualification on a particular device in that region, and it turns out the qualification was inadequate because they couldn't quite pass the test for the particular pressure, temperature and humidity. Are you now going to give them relaxation, then, on that test, or are you still going to make them meet that original requirement?

MR. BOSNAK: We haven't heard of anybody having any problems on meeting it.

MR. MICHELSON: It will get more so when you get over to the outside of containment.

MR. SIESS: We are still on that first column.

MR. MICHELSON: Right. I just want a clarification.

MR. BOSNAK: Inside containment you have the basic pressure, temperature, moisture, humidity that you have always had, and that doesn't change.

MR. MICHELSON: These vary in subcompartments within the containment, of course. You get much higher temperature --

MR. BOSNAK: It can vary, but our experience is --

MR. SIESS: Carl, you are saying that if you had calculated the environmental temperatures and pressures for the limited break, and now you recalculate them for the leak size break, which is permitted under the rule, that you think it might be worse?

MR. MICHELSON: No, no, that isn't it at all. Of course I assume that you are going to have very modest environmental conditions for the limited leak before break. In fact, I'm not even sure how they would set that. The question is, if you found out during your equipment qualification program that you could not pass the test, could you go back now and ask for a relaxation on the basis that you are not going to have a break there anyway?

MR. SIESS: I think if the rule went through, you would not have a break there. Then you would check the qualification for the leak size break. Am I correct, Bob? And if you had --

MR. BOSNAK: What we said with respect to equipment qualification, as we have with respect to ECCS, is that it doesn't change.

MR. MICHELSON: You said that although you didn't say it in the rulemaking.

MR. SIESS. Let's go away from the NTOL to a CP or a step beyond. We would now be qualified for the new criteria, which would be some much smaller leak than the limited break

leak.

MR. BOSNAK: We would depend on our systems people to tell us what the temperature and pressure environment was with respect to the equipment.

MR. SIESS: They would use leak size based on fracture mechanics.

MR. BOSNAK: I would expect in the future that might happen.

MR. MICHELSON: I would hope not.

MR. BOSNAK: All of that would have to be reviewed. We don't have a position on that, but we do have with respect to where we are today and what is covered by the rule.

MR. MICHELSON: They have no position in here on what they are going to do. I think that is wrong.

MR. SIESS: That's the case-by-case business.

MR. BOSNAK: That would all have to be developed and would be developed over a number of years in consultation with this committee, certainly.

MR. MICHELSON: I personally feel that the rulemaking ought to make it very clear that the environmental conditions stay as they were. Rulemaking remains silent now. People can come in and start playing with it.

MR. BOSNAK: I have read statements, and John can correct me, that these things don't change.

MR. SIESS: John, we keep hearing you say that but

we can't find the words in the rule that says that.

MR. O'BRIEN: In the earlier version of the rule, it specifically said equipment qualification is not affected.

MR. SIESS: You are standing by the mike but you are not talking in the mike.

MR. O'BRIEN: In an earlier version of the rule, there was explicit statement that ECCS containment and equipment qualification is not impacted by this rule. That's what you want to be said.

MR. MICHELSON: Yes, and you removed it.

MR. O'BRIEN: However, to get NRR concurrence, they said delete it because we may on a case-by-case basis want to change equipment qualification too. This was not an oversight. They debated it, and they said, we don't want to say specifically equipment qualification, so that is an NRR decision.

MR. MICHELSON: So that remains open and they can now change it, although I'm surprised, since there is a whole lot of history on environmental qualification, how you can change it by just remaining silent. But now they want to remain silent and think they can change it.

MR. BOSNAK: We don't expect anything to change.

MR. MICHELSON: I realize you keep saying that, but you won't put it in words where it counts.

MR. SIESS: Mike.

MR. BENDER: I think Carl has some good points, but it seems to me the way the Staff is proposing this thing gives a little bit of flexibility that is reasonably desirable. Now, it might be better to say something in the rule that indicates in most cases the regulatory staff anticipates no change in the environmental qualification condition. But I can conceive of places where the requirements are so severe that it is creating a situation where you can't put a very useful instrument in a place where it would do a lot of good because of some arbitrary environmental conditions.

As a matter of fact, as you know, people are moving a lot of these instruments out to the ends of long lines where the sensing capability has been badly degraded because environmental qualifications are set in a very arbitrary way.

I think from a practical standpoint it would be desirable for the Staff to have that flexibility, but the flavor of it is the thing you are talking about, and there is a lot of merit in trying to phrase it in that way so that it doesn't encourage people to make changes just because they have got the opportunity to do so.

MR. MICHELSON: What I would really like to see is what you suggest plus a few words to the effect that the Staff is still looking at the failure of other than pipes to determine what environmental effects it would have because there may still be far greater leaks possible than the

postulated detectable leak under this rule.

So I think the issue is far from closed by just saying environmentally qualified only for the leaks they detect.

MR. SIESS: If it is other pipes you are concerned about, it is clear that won't change.

MR. MICHELSON: Not other pipes; other conditions.

MR. BUSH: Those have been looked at in considerable depth, and I don't know of any case -- for example, tops of valves and things of that nature where they represent leakage greater than this because if we talk with, say, a 10 percent upper bound on that, we looked at that years ago with regard to zipper effects and so forth where you get a series of failures, things of that nature.

MR. BOSNAK: I wouldn't be surprised in a few years if we are talking about what we are going to do with new plants when we looked at this whole area, instead of being very mechanistic with respect to what is going to cause the effect, you might be very proscriptive and say as far as the environment is concerned, here is what you have to have to qualify in inside containment.

I would see us perhaps going in that fashion.

MR. SHEWMON: It seems to me when the Germans came through with something about like this, or their removal of this, they said you will postulate only a one-tenth

cross-section area fracture.

MR. BOSNAK: They still keep the whole area for containment for equipment and for supports.

MR. BUSH: That was completely arbitrary too.

MR. BOSNAK: An arbitrary, non-mechanistic break.

MR. SHEWMON: Have you thought about something like that saying there is no pipe whip, but instead of how many gallons will come out the size of some darned crack, just saying we will reduce it by an order of magnitude and that is what they will design for?

MR. BUSH: It was discussed at great length.

MR. BOSNAK: We thought about it and we are still thinking about it.

MR. SIESS: I think what Carl Michelson's concern is, and if I understand it right, I certainly share it, the double-ended guillotine break has been accepted for many, many things as an upper bound, as a result of which you didn't have to check certain other things. If you assume the double-ended guillotine break for equipment qualifications and so forth, that was an upper bound and you didn't have to look at other things.

Once you remove that upper bound, you either have to look at those individually or settle on something else as a new upper bound, and I think this is the thing you have got to worry about.

MR. BOSNAK: Nobody disagrees with that.

MR. SIESS: The things we have been neglecting because we were comfortable with this upper bound in this particular area. What the rule ought to say is we have not decided what the effect is on equipment qualification, or some word that gets equipment qualification in there.

MR. MICHELSON: Or and leaves it as it is.

MR. BOSNAK: That is definitely the intent.

MR. SIESS: Let's don't leave it as it is, but that it be done case by case, if necessary, because it may not make a difference.

MR. BUSH: Could I make a comment on a positive aspect I don't think Bob has put up there? If he were to have that diagram back on, if you were to look at the tech specs on most of the plants now, you will find that all of those welds, the nozzle welds, et cetera are exempted from inspection. You can't get to them very straightforwardly. There is no way you can inspect them.

Therefore, of the primary system, probably a third of the welds you forget about because they are inaccessible, and something I would see as a benefit -- not that I expect them to break, but you certainly would like to be able to monitor things and see if anything is happening -- would be that once this garbage is removed, we will have access, and then, of course, it would revert to the required inspection.

MR. SIESS: Carl Arlotto had an answer, or a question?

MR. ARLOTTO: I've got a comment. I think, Mr. Chairman, the comments made, particularly by Carl Michelson, and the concern of others, are well taken. I think from a procedural viewpoint, I think it is time we recognize that this is going to go out for comment. I think the combination of the comments we get from the public, the comments that we get from the committee, the things we have heard now, will somehow make us write the final rule within the context of this particular discussion.

I think the key item -- and Bob Bosnak has said it several times -- is we are really pushing to get rid of the piping restraints. We can do that by just saying we are not going to be doubling the pipe breaks in the primary system of PWRs. That will do us a great deal of good even if we continue to say that the area for design, that is, the break area for design were the same. Just eliminate the doubling of pipe breaks. You are not going to get the whip even if you did get a split equivalent to that, which we don't see how you can do it.

Secondly, I would like to observe that most of us who have talked to the Germans regarding the 10 percent break have concluded that it was a pretty arbitrary decision that they have made. They do not seem to have the data to support

that decision, and I think that we are now -- if I can now combine the two offices, NRR and Research, we are now in the process of looking at a research program associated with degraded piping, and hopefully perhaps we can put some meat on the bones of fracture mechanics and come up with a definitive upper bound kind of a break, but right now we just aren't there.

But I think the stuff that we have been talking about must be cleaned up, I think at the final rule stage. This part of the process we are going through.

MR. SIESS: I would have thought that 10 percent was not a whole lot more arbitrary than 100 percent.

Jesse, did you have a question?

MR. EBERSOLE: I remember back in the early BWR days one of the more horrendous piping failures was to imagine a vertical split in one of the risers that would create a steam and vapor ejection process that would create a monster centrifuge round and round the drywell and literally strip a lot of the instrumentation off that was needed to mitigate the consequences. You know, like the level columns, et cetera, et cetera.

GE invoked the notion that they had 180 degree equater logic, which has a flaw in it that you only loft half the instruments. That didn't permit the random failure of the first track to mitigate.

When you get into environmental qualification, what I'm hearing is you are just about eliminating the dynamic effects of jets on such equipment. You may permit, and certainly the industry is likely to hop right on it, the actual mounting of critical and sensitive equipment right on the pipes they are monitoring, from which they are taking their instrument taps, because you are eliminating the notion of pipe bursts and just saying that pipes drip.

I can't get it quite through my head yet that pipes don't burst and they only drip, and that seems to be the way you are going. Am I wrong?

MR. BOSNAK: Here again, we are talking about the primary loop right now.

MR. EBERSOLE: I was, too.

MR. BOSNAK: I'm talking about a PWR. We haven't gotten into the BWRs at all. And whether or not we are ever going to be able to get through all of these situations here with respect to loads, materials, what happens with respect to aging of the material -- we started with something that we thought we could be comfortable with.

MR. SIESS: Jesse, were you limiting yourself to BWRs?

MR. EBERSOLE: No, I was being general.

MR. SIESS: I think Jesse was basically challenging the --

MR. BOSNAK: The elimination of jet.

MR. SIESS: No, he is challenging leak before break.

MR. BUSH: He is challenging what I would call the probabilistic fracture mechanics work.

MR. EBERSOLE: To the degree of leak.

MR. BUSH: That effectively would say in these systems you wouldn't have a problem. Now, you may not believe the numbers as such, but they are certainly very low number

MR. BENDER: I think I don't interpret Jesse as saying quite what you are saying. I may be wrong in my understanding. It seems to me that what Jesse is suggesting is that this new proposal should not be taken as a license to locate equipment or instruments or anything else in an environment where they might be threatened by some break like this just because the relaxation gives you the opportunity.

MR. EBERSOLE: That is precisely what happens, though.

MR. BENDER: I understand that. All I am saying is if there were some encouragement not to be too free with that kind of action, you would probably be pretty happy, wouldn't you?

MR. EBERSOLE: Yes, if I had some way to say, oh, he didn't mount this transducer on the very pipe the fluids of which he was monitoring.

MR. BOSNAK: We do have that way of doing it, and I

know exactly what you are talking about because we were faced with all of this when we had to get into what we called the break exclusion region. If you recall, this was back in the seventies when we started with the BWR because we couldn't take the break in the region between the inside and outside various containments. So we had this annular region we couldn't. We then applied that same concept to PWRs.

MR. EBERSOLE: You couldn't take it in the rim of the fluid -- did you get rid of them?

MR. BOSNAK: You couldn't take it because containment would be breached, and that was the basic reason, but people started putting vital equipment in close to the break exclusion region, and we then -- not because things didn't break, but we didn't want those located there for fire and other reasons. It is just bad engineering to not worry about how your systems are arranged.

MR. SIESS: Carl, you are saying that if you had calculated the environmental temperatures and pressures for the limited break, and now you recalculate them for the leak size break, which is permitted under the rule, that you think it might be worse?

MR. MICHELSON: No, no, that isn't it at all. Of course I assume that you are going to have very modest environmental conditions for the limited leak before break. In fact, I'm not even sure how they would set that. The

question is, if you found out during your equipment qualification program that you could not pass the test, could you go back now and ask for a relaxation on the basis that you are not going to have a break there anyway?

MR. SIESS: I think if the rule went through, you would not have a break there. Then you would check the qualification for the leak size break. Am I correct, Bob? And if you had --

MR. BOSNAK: What we said with respect to equipment qualification, as we have with respect to ECCS, is that it doesn't change.

MR. MICHELSON: You said that although you didn't say it in the rulemaking.

MR. SIESS: Let's go away from the NTOL to a CP or a step beyond. We would now be qualified for the new criteria, which would be some much smaller leak than the limited break leak.

MR. BOSNAK: We would depend on our systems people to tell us what the temperature and pressure environment was with respect to the equipment.

MR. SIESS: They would use leak size based on fracture mechanics.

MR. BOSNAK: I would expect in the future that might happen.

MR. MICHELSON: I would hope not.

MR. BOSNAK: All of that would have to be reviewed. We don't have a position on that, but we do have with respect to where we are today and what is covered by the rule.

MR. MICHELSON: They have no position in here on what they are going to do. I think that is wrong.

MR. SIESS: That's the case-by-case business.

MR. BOSNAK: That would all have to be developed and would be developed over a number of years in consultation with this committee, certainly.

MR. MICHELSON: I personally feel that the rulemaking ought to make it very clear that the environmental conditions stay as they were. Rulemaking remains silent now. People can come in and start playing with it.

MR. BOSNAK: I have read statements, and John can correct me, that these things don't change.

MR. SIESS: John, we keep hearing you say that but we can't find the words in the rule that says that.

MR. O'BRIEN: In the earlier version of the rule, it specifically said equipment qualification is not affected.

MR. SIESS: You are standing by the mike but you are not talking in the mike.

MR. O'BRIEN: In an earlier version of the rule, there was explicit statement that ECCS containment and equipment qualification is not impacted by this rule. That's what you want to be said.

MR. MICHELSON: Yes, and you removed it.

MR. O'BRIEN: However, to get NRR concurrence, they said delete it because we may on a case-by-case basis want to change equipment qualification too. This was not an oversight. They debated it, and they said, we don't want to say specifically equipment qualification, so that is an NRR decision.

MR. MICHELSON: So that remains open and they can now change it, although I'm surprised, since there is a whole lot of history on environmental qualification, how you can change it by just remaining silent. But now they want to remain silent and think they can change it.

MR. BOSNAK: We don't expect anything to change.

MR. MICHELSON: I realize you keep saying that, but you won't put it in words where it counts.

MR. SIESS: Mike.

MR. BENDER: I think Carl has some good points, but it seems to me the way the Staff is proposing this thing gives a little bit of flexibility that is reasonably desirable. Now, it might be better to say something in the rule that indicates in most cases the regulatory staff anticipates no change in the environmental qualification condition. But I can conceive of places where the requirements are so severe that it is creating a situation where you can't put a very useful instrument in a place where it would do a lot of good

because of some arbitrary environmental conditions.

As a matter of fact, as you know, people are moving a lot of these instruments out to the ends of long lines where the sensing capability has been badly degraded because environmental qualifications are set in a very arbitrary way.

I think from a practical standpoint it would be desirable for the Staff to have that flexibility, but the flavor of it is the thing you are talking about, and there is a lot of merit in trying to phrase it in that way so that it doesn't encourage people to make changes just because they have got the opportunity to do so.

MR. MICHELSON: What I would really like to see is what you suggest plus a few words to the effect that the Staff is still looking at the failure of other than pipes to determine what environmental effects it would have because there may still be far greater leaks possible than the postulated detectable leak under this rule.

So I think the issue is far from closed by just saying environmentally qualified only for the leaks they detect.

MR. SIESS: If it is other pipes you are concerned about, it is clear that won't change.

MR. MICHELSON: Not other pipes, other conditions.

MR. BUSH: Those have been looked at in considerable depth, and I don't know of any case -- for example, tops of

valves and things of that nature where they represent leakage greater than this because if we talk with, say, a 10 percent upper bound on that, we looked at that years ago with regard to zipper effects and so forth where you get a series of failures, things of that nature.

MR. BOSNAK: I wouldn't be surprised in a few years if we are talking about what we are going to do with new plants when we looked at this whole area, instead of being very mechanistic with respect to what is going to cause the effect, you might be very proscriptive and say as far as the environment is concerned, here is what you have to have to qualify in inside containment.

I would see us perhaps going in that fashion.

MR. SHEWMON: It seems to me when the Germans came through with something about like this, or their removal of this, they said you will postulate only a one-tenth cross-section area fracture.

MR. BOSNAK: They still keep the whole area for containment for equipment and for supports.

MR. BUSH: That was completely arbitrary too.

MR. BOSNAK: An arbitrary, non-mechanistic break.

MR. SHEWMON: Have you thought about something like that saying there is no pipe whip, but instead of how many gallons will come out the size of some darned crack, just saying we will reduce it by an order of magnitude and that is

what they will design for?

MR. BUSH: It was discussed at great length.

MR. BOSNAK: We thought about it and we are still thinking about it.

MR. SIESS: I think what Carl Michelson's concern is, and if I understand it right, I certainly share it, the double-ended guillotine break has been accepted for many, many things as an upper bound, as a result of which you didn't have to check certain other things. If you assume the double-ended guillotine break for equipment qualifications and so forth, that was an upper bound and you didn't have to look at other things.

Once you remove that upper bound, you either have to look at those individually or settle on something else as a new upper bound, and I think this is the thing you have got to worry about.

MR. BOSNAK: Nobody disagrees with that.

MR. SIESS: The things we have been neglecting because we were comfortable with this upper bound in this particular area. What the rule ought to say is we have not decided what the effect is on equipment qualification, or some word that gets equipment qualification in there.

MR. MICHELSON: Or and leaves it as it is.

MR. BOSNAK: That is definitely the intent.

MR. SIESS: Let's don't leave it as it is, but that

it be done case by case, if necessary, because it may not make a difference.

MR. BUSH: Could I make a comment on a positive aspect I don't think Bob has put up there? If he were to have that diagram back on, if you were to look at the tech specs on most of the plants now, you will find that all of those welds, the nozzle welds, et cetera are exempted from inspection. You can't get to them very straightforwardly. There is no way you can inspect them.

Therefore, of the primary system, probably a third of the welds you forget about because they are inaccessible, and something I would see as a benefit -- not that I expect them to break, but you certainly would like to be able to monitor things and see if anything is happening -- would be that once this garbage is removed, we will have access, and then, of course, it would revert to the required inspection.

MR. SIESS: Carl Arlotto had an answer, or a question?

MR. ARLOTTO: I've got a comment. I think, Mr. Chairman, the comments made, particularly by Carl Michelson, and the concern of others, are well taken. I think from a procedural viewpoint, I think it is time we recognize that this is going to go out for comment. I think the combination of the comments we get from the public, the comments that we get from the committee, the things we have

heard now, will somehow make us write the final rule within the context of this particular discussion.

I think the key item -- and Bob Bosnak has said it several times -- is we are really pushing to get rid of the piping restraints. We can do that by just saying we are not going to be doubling the pipe breaks in the primary system of PWRs. That will do us a great deal of good even if we continue to say that the area for design, that is, the break area for design were the same. Just eliminate the doubling of pipe breaks. You are not going to get the whip even if you did get a split equivalent to that, which we don't see how you can do it.

Secondly, I would like to observe that most of us who have talked to the Germans regarding the 10 percent break have concluded that it was a pretty arbitrary decision that they have made. They do not seem to have the data to support that decision, and I think that we are now -- if I can now combine the two offices, NRR and Research, we are now in the process of looking at a research program associated with degraded piping, and hopefully perhaps we can put some meat on the bones of fracture mechanics and come up with a definitive upper bound kind of a break, but right now we just aren't there.

But I think the stuff that we have been talking about must be cleaned up, I think at the final rule stage.

This part of the process we are going through.

MR. SIESS: I would have thought that 10 percent was not a whole lot more arbitrary than 100 percent.

Jesse, did you have a question?

MR. EBERSOLE: I remember back in the early BWR days one of the more horrendous piping failures was to imagine a vertical split in one of the risers that would create a steam and vapor ejection process that would create a monster centrifuge round and round the drywell and literally strip a lot of the instrumentation off that was needed to mitigate the consequences. You know, like the level columns, et cetera, et cetera.

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MR. BOSNAK: We do have that way of doing it, and I know exactly what you are talking about because we were faced with all of this when we had to get into what we called the break exclusion region. If you recall, this was back in the seventies when we started with the BWR because we couldn't take the break in the region between the inside and outside various containments. So we had this annular region we couldn't. We then applied that same concept to PWRs.

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MR. BOSNAK: You couldn't take it because containment would be breached, and that was the basic reason, but people started putting vital equipment in close to the break exclusion region, and we then -- not because things didn't break, but we didn't want those located there for fire and other reasons. It is just bad engineering to not worry about how your systems are arranged.

And we just can't permit anything like that.

MR. ETHERINGTON: If it's just on these structures that are designed to resist the forces, it would be rather hard to construe an instrument in this structure, wouldn't it?

MR. SIESS: Did you hear that, Bob?

MR. BOSNAK: I didn't hear your last words.

MR. SIESS: Say it again, Harold.

MR. ETHERINGTON: The rule is referring to structures not being required to resist the jet forces; isn't that correct?

MR. BOSNAK: That's correct. In other words, if the jet force is eliminated, the jet force is eliminated and you don't have to deal with it.

MR. ETHERINGTON: Isn't that structure used as distinct --

MR. BOSNAK: We are talking about structures -- in some cases, of course, in the past, barriers were used, shields to protect --

-- MR. SIESS: It doesn't include instruments.

MR. ETHERINGTON: That couldn't include instruments by any stretch of the imagination.

MR. BOSNAK: It was to protect vital pieces of equipment generally, either other piping, valves, motors.

MR. ETHERINGTON: I see. So in removing the shield, you are exposing instruments, that's correct.

MR. SIESS: Bob, if we commit ourselves to the pipe whip restraints which you would like to get rid of because they impede inspection and a number of other things, the problem is relatively simple except that either the Staff or the lawyers can't find a way to say don't put pipe whip restraints in. They want to go back and change GDC-4. When you get to the jet impingement, which you have lumped in now with the pipe restraints, you open the door to this whole question of environmental protection and the kind of thing Harold has raised. A small break in the pipe might make a jet that impinges on an instrument out there that would be just as bad as what you have got with a full break, and how do you take care of that?

MR. BOSNAK: The only way, as I say, if we eliminate completely what we are talking about with respect to primary loop, if you believe in the fracture mechanics approach, that we are not -- you know, we are going to get -- before we have a jet that is damaging, we will have detection.

MR. SIESS: That's your premise then.

MR. BOSNAK: That's the basic premise. We don't have with respect to what we are doing right now a replacement leakage crack. There is work that is going on. As Guy mentioned, the Germans use this one-tenth area break. And one of the items that is identified in Volume 5 of the Piping Review Committee Report is the development of replacement leakage cracks. But we are not talking about the primary loop now; we are talking about should this get into other systems.

MR. SIESS: If you had a non-mechanistic arbitrary 10 percent break, that would give you a pretty good-sized jet, couldn't it?

MR. BOSNAK: Actually, what we have now, we still have all the branch lines, and of course, they are limited in their location, but they certainly give you the environment that you need. They are still there.

MR. SIESS: But your basic assumption, now, based on the fracture mechanics studies, is that you will get a leak before a break that is large enough to produce a damaging jet, not just a leak before 100 percent guillotine break. Is that right?

MR. BOSNAK: That's correct.

MR. SIESS: There is leak before there is anything more than just a few gallons per minute coming out somewhere.

MR. BOSNAK: That's correct. But we still think

when we get into these other systems that we need to go further. We need to do some of the things you are talking about.

MR. SIESS: I know, but that is being conservative.

MR. EBERSOLE: This will in turn permit you to mount instruments on the pipes which they monitor.

MR. BOSNAK: I didn't hear what you said.

MR. EBERSOLE: I said this will permit you to mount relatively delicate instrumentation on the very fluid systems that they are monitoring.

MR. BOSNAK: Again, I don't think that's good engineering practice to do.

MR. EBERSOLE: Engineering practice is whatever --

MR. BOSNAK: We have everything in place.

MR. SIESS: You are not changing good engineering practice, you are changing a rule.

MR. RODABAUGH: Bob, one of the breaks you are still going to postulate will be that roughly 16-inch branch line, which I think would be a tremendous amount of -- from this very limited standpoint, it seems to me that your concerns are addressed.

MR. SIESS: A limited location.

MR. BOSNAK: Limited location, but they are still there. They certainly do what the German 10 percent break does, definitely.

MR. BENDER: I think you should at least pay attention to Mr. Arlotto's point. I think the message has been presented and it seems to me the Staff understands it, and what they would like to do now, as I understand it, primarily is to let the proposed rule go out for comment, have the committee present its comments concerning the proposed rule, which it will do anyhow, and let other people comment as well.

And then when the final rule comes out, at least my interpretation is that there will be some conscious effort to take account of the comments that have been made here. That's what I thought he said.

MR. ETHERINGTON: Of course, the industry is not likely to address the points that Jesse is raising. I mean the comments that we will get back.

MR. EBERSOLE: I will give you an example. The early designs of the break segregation system for the boiler use numerous impulse lines to measure the transient pressure gradients in the primary piping. They were strapped to the pipe within which the gradients occurred. And thus, if a jet effect or a break occurred, they were instantly destroyed.

MR. ETHERINGTON: In this particular case, would that matter?

MR. EBERSOLE: Yes, it would destroy the transient gradient measurement that they made and you wouldn't know

which went. This was to swing the ECCS system to the right or left. So the accident itself destroyed the sensing apparatus, which was intended to monitor.

MR. SIESS: Let me try to summarize where I think we are. If we accept leak before break, fracture mechanics, probabilistic and so forth as being exceedingly low probability, and the likelihood of being able to find the leak before you have either a double-ended pipe break rupture or a high energy jet, the objective of the Staff is to eliminate massive -- as John called them -- evil pipe whip restraints and presumably equally evil jet impingement devices.

I think there is a feeling on the part of the committee that the Staff may not have adequately considered other consequences of a rule change which eliminates the double-ended guillotine break, and the implications to other aspects of design. It accomplishes what you set out to do, eliminate the evil structures, but whether you have thought about other things that might be legally done under that same rule may have not been thought of probably because you think further steps down from the rule, Standard Review Plan, whatever, and I don't think we have a complete understanding of what other requirements there are that would prevent these secondary -- maybe not secondary, but other consequences of the rule change.

I think that is where we stand. The committee has

raised several issues, environmental qualification, things Jesse said which are sort of environmental but not quite. Do you understand that position, Bob and Guy? We may get it in writing eventually. But I haven't heard any real serious challenges to the basic premise of leak before break in the primary system of pressurized water reactors as a justification for eliminating these massive restraints, although there may be some that haven't been completely expressed.

If you understand that, I would suggest that we go on to whatever the next step is.

MR. BOSNAK: The next one is the arbitrary intermediate break.

MR. SIESS: Now, before you skip to that, the broad-based rule involves all of these same considerations to a higher power.

MR. BOSNAK: Broad-based rule would get into other lines and all of their ramifications. It gets much more complicated when you leave what I consider to be a system in which we have bounds on all of this. When you start getting into other areas, it is going to be much more difficult even from just the application of fracture mechanics: do we know what the loads are, that certainty. So that is this broad-based rule.

MR. MICHELSON: We are not discussing that today,

then, I guess, because there are a whole lot of questions if we got into that.

Could I ask you one question, though, on the fracture mechanics techniques? How does your confidence change as the pipe diameters grow smaller? Ray?

MR. KLECKER: I'm Ray Klecker from NRR. I think the problem when we get to smaller lines, the fracture mechanics itself will be essentially the same. The technique is there. There is no change in the technology for that. The difficulties probably will be in sizing a crack large enough so that you can be assured of detection and still have that crack smaller by a factor of 2 or whatever as compared to the critical crack size in that line.

For that reason, there may be a cut-off in the size of the pipe that we go down to. Now, we are leaving this as an option to industry. They do not have to postulate leak before break. They can go back and leave their restraint systems in on these small lines if they so choose, and some of them indicated on some restraints they would do that.

MR. MICHELSON: Do you have a size in mind yet where you think it begins to get shaky?

MR. KLECKER: Somewhere around 6 inches diameter.

MR. BUSH: I could comment on the same one. There's an Adelphi technique that is currently on the way that is looking at this whole business of what I call the

probability of break from the spectrum of sizes from about an inch on up to the maximum size of the systems. It is in the second iteration, I guess. It will go through probably one more iteration. How much value it will have, I don't know, but it will certainly converge on some of these problems.

I think what you will see out of it is the probabilities that are cited for small items would be substantially higher. As far as breaks are concerned, they would be larger.

MR. EBERSOLE: Do you have any notion what the variation is?

MR. BUSH: About ten orders of magnitude.

MR. EBERSOLE: Ten orders?

MR. BUSH: Sure. The probability on the big lines is around 10 to the minus 11. On the really small lines, it's more like 10 to the minus 1.

MR. SERPAN: Serpan from Research. On your question, Mr. Michelson, the smaller the pipe, the better the confidence we have in the properties because that's the kind of stuff that we test. We are testing 4, 6, 8 inch diameter right now and having to extrapolate that to the larger stuff. So I think we know better what the properties and characteristics are of the smaller pipe.

MR. MICHELSON: The defect, I think, was the real problem, wasn't it?

MR. SERPAN: We can probably find that easier, too, because it's going to be thinner walled.

MR. ETHERINGTON: Does the Staff have a minimum pipe size for snubber requirements, restraint requirements?

MR. BOSNAK: No. You will see on some small lines all kinds of things.

MR. ETHERINGTON: Small as what?

MR. BUSH: An inch to an inch and a half.

MR. ETHERINGTON: Doesn't it make sense to have snubbers on those things?

MR. BUSH: Don't ask me; I'm biased.

MR. SIESS: You shouldn't ask that question, Harold. Snubbers are not the same as whip restraints. Am I right?

MR. BUSH: That's right. They are a different animal.

MR. BOSNAK: Oh, yes, definitely.

MR. SIESS: Snubbers restrain the pipe in service; whip only restrains it once it breaks.

MR. BOSNAK: Theoretically there is supposed to be no contact. That's one of our fears, that over the years there will be contact between the whip restraint and the pipe. There is not supposed to be any.

MR. SIESS: There are hundreds of snubbers on 1-1/2 inch pipe.

--- Larry.

MR. SHAO: For the smaller lines, I would more worry about the extended events. I think, for instance, this cannot break a 20-inch but it may break a 2 or 3-inch line.

MR. SIESS: Let's go on to AIB.

MR. BOSNAK: Arbitrary intermediate breaks, to refresh your memories, is a situation in which we have the prescription for postulating pipe breaks. Certain stress level, certain in the case of Class 1 lines that are evaluated for fatigue, certain fatigue usage factor. Again, the usage factor is one-tenth, and the Code, of course, permits you to go as high as 1. So we have a factor of 10 there.

The stress value is 80 percent of what would normally be permitted for upset conditions. If you are below those, you don't have to postulate breaks. If you have a given line, you have two anchors in a line configuring however it may. If you do not exceed the stress level or the fatigue levels, you nonetheless have to postulate two breaks, and this is in an area which has low stress and low fatigue usage factors. You have to postulate two at whatever the highest locations are, and these are termed arbitrary intermediate breaks.

MR. SIESS: The location was not arbitrary?

MR. BOSNAK: Their location is whatever the highest value happens to be, and one of the problems, of course, that

keeps changing is as you reconfigure the piping system, you never know where those break locations are going to be. I have in your handout the slides that we presented to the committee here in '83, but right after that, we started with the first owner, and that happened to be Duke Power on Catawba, and we went through their systems and we at that point in time said we are not going to permit this to take place in those systems that are subject to large dynamic loads. In other words, things like water hammer or steam hammer where you have a mixing situation or a thermal fatigue kind of area.

Also on those lines that are susceptible to stress corrosion cracking. So those three diseases, if you will. We said if any of the systems are subject to those, don't ask for elimination of arbitrary intermediate breaks.

If you have looked at Volume 3 of the Piping Review Committee report, based on I guess, some of the work that Livermore did as a consultant to the committee, it was decided that those caveats could be dropped. But up until the present time, those caveats are still in place.

So when we went through the Duke Power Plant, the feedwater system was not included.

Now, what is a trade-off that we get?

[Slide]

This is on your handout. I wanted to point out this

particular one at the bottom, that when we eliminate the arbitrary intermediate breaks, we are saying you have to environmentally qualify for the non-dynamic effects of non-mechanistic break with the greatest consequences on the equipment in that space, and, by the way, in all other areas along that same line.

So we are getting more here from the point of view of equipment qualification than we had before. Before, you had two terminal end breaks, and you might have had two of these arbitrary intermediate breaks located somewhere along the line.

All along the rest of the area, you had whatever the utility chose to give you in the way of equipment qualification. So here we are getting more.

MR. SIESS: What are you eliminating? The whip restraints?

MR. BOSNAK: We are eliminating the break. Whip restraint, the whole business is eliminated. Whip restraint, any jet impingement barriers. Essentially from the point of view of what does it offer in the way of benefits, you get rid of the steel, you don't have to worry about loss of heat because in these locations where you have pipe break locations and you have whip restraints, the insulation is generally not configured as it is on the rest of the pipes, so you have heat losses. It impedes inspection, it does all of the things that

we spoke to you with respect to the large break.

Now, this is not based on fracture mechanics. It is not based on any of those things but it is based on the fact that we know we have low stress, low usage factor.

MR. SIESS: Bob, if I assume an arbitrary intermediate break at point x on the pipe and put in the appropriate jet impingement and pipe whip restraints, how does the probability that the pipe would break at that point x compare to the probability that it would break at a point five feet away?

MR. BOSNAK: With all of these situations with arbitrary intermediate breaks, the probability of breaks in those locations we think are much lower, certainly, than at terminal ends or at points where you have high usage factor or high stress.

Again, the problem is that these points during the course of construction can shift 20, 30, 40 feet.

MR. SIESS: That's what I mean. You picked a certain point due to pipe restraint, but if the break occurs two feet away, the pipe will whip.

MR. BOSNAK: You have no protection unless you happen to have something with an elbow or something that might be so configured, but that would be by coincidence only.

MR. SHAO: The probabilities in the intermediate break area are not that high.

MR. SIESS: My question was how does it vary along length.

MR. BOSNAK: If your stress and usage factors are low, we think the probabilities of having a break at those locations are also equally low.

MR. SIESS: That's not the question. If it's low at this point, I don't think it is that much lower at this point.

MR. BOSNAK: Probably not.

MR. SIESS: I don't know what you get by putting --

MR. BOSNAK: Not very much. That's why we think this is more important than anything we give up in getting rid of the pipe whip restraints. This is not involved in a rule change, but this will be involved in a change to the Standard Review Plan. So these have been processed as deviations to the Standard Review Plan.

MR. SIESS: How did you get into the arbitrary break in the first place? You have got a 30-foot length of pipe, say, and you assumed a break at each end of it where there was an elbow or something. And now you feel that if you put in pipe whip restraint somewhere in that 30-foot length, you are going to reduce the probability of a pipe break. But you pick one spot to put the restraint, and I don't see that you have reduced the probability significantly.

MR. SHAO: Let me give you some background --

MR. BOSNAK: When it was made, it was made to try to

get some degree of coverage, and not necessarily the whip coverage but environmental coverage.

MR. SIESS: You have taken care of that another way now.

MR. BOSNAK: We are taking care of that. Again, people were designing --

MR. MICHELSON: How?

MR. SIESS: That last item.

MR. BOSNAK: People were designing in a very mechanistic way. Unless there was a break there, they said, don't tell me about it, with the qualification, I don't have to worry about it.

MR. SIESS: Will you explain that last item again?

MR. BOSNAK: Yes. That means, not only in this place where I eliminated the break, if we are talking about a compartment along the length of a p'pe, but throughout that entire system, if you have any places in which you do not have environmental qualification -- we are talking about the nondynamic effects. So what we are saying is the pressure that's there in the line, the temperature, and if you have to worry about, if you are talking about liquid system, if you have to worry about flooding, that's why we are trying to get in the break with the greatest consequences if there are any with respect to release of the fluid that is contained in that process line, and that's what you have to consider with

respect to environmental qualification.

MR. SIESS: So except for jet impingement and local compartment pressure, the environmental qualification is not changed from what it is now, not reduced.

MR. BOSNAK: It's not reduced; it's improved for those areas in which you have nothing now.

MR. MICHELSON: You are saying that you must take an arbitrary intermediate break from the viewpoint of environmental qualification.

MR. BOSNAK: If you want to put it that way, but it's not mechanistic.

MR. MICHELSON: I don't find it that way. We have jumped suddenly from the primary loop, by the way, over into the broad-gauge thing.

MR. BOSNAK: Because one deals with fracture mechanics, as I tried to explain yesterday; the other --

MR. MICHELSON: We are mixing them now. I thought we weren't going to get into the broad-gauge discussion.

MR. SIESS: We are on the third column.

MR. BOSNAK: We got into because you asked for it on your agenda.

MR. SIESS: We are into the third column. We are not talking about any rules now

MR. BOSNAK: It's not part of the rulemaking at all. It's part of the Piping Review Committee recommendation,

and that's why we want to report to you on it.

MR. MICHELSON: Okay.

MR. BOSNAK: As far as the NTOLs, as far as OLs are concerned, we have nobody that has asked for it. I'm sure CPs would be interested in it.

MR. SHAO: Let me say something about arbitrary break, what was the original thinking. Suppose you have a four feet expanse of piping; suppose the stresses are very low. You don't need any break.

The original thinking, I think is, suppose there is a pipe break through the pipe. It can be many inches. So even though the break location may not be right, you may have some bumper in there, some apparatus in there and you stop the pipe whipping around. So, it doesn't have to be at that right location, but with certain stops, two stops anywhere, 40-foot, 50-foot pipe, it cannot whip around. That was the original thinking for the piping break.

MR. SIESS: That's poor thinking. If you put the intermediate break in the middle of it, and it breaks just on one side, the pipe on one side is restrained, and the other pipe is free to whip as much as it wants.

MR. BUSH: I would remind the ACRS about the only time I have negative voted or tried to, it was on a 20-foot straight section of pipe where the end loads were minimal and there as an insistence that a dog house be put on the pipe.

That probability of that pipe breaking would be so small that it would be infinitesimal. That is the same philosophy that we are seeing in the arbitrary intermediate breaks.

You know, you have got a usage factor that is extremely low, almost non-existent.

MR. SIESS: I believe the ACRS approved exception on arbitrary lead-in bre..ks on one of the OLs recently, didn't they?

MR. BOSNAK: We talked about this. We talked about this two years ago, and I don't think anybody had problems with it. We talked about it before we got into the first plant. Catawba was the first one.

MR. SIESS: At Nine Mile -- didn't Nine Mile ask for it?

MR. BOSNAK: I'm sure they did. I've got a list here.

MR. SIESS: What about Hope Creek?

MR. BOSNAK: I don't have Nine Mile on the list. Byron Braidwood --

MR. SIESS: It was one of those.

MR. BOSNAK: It was Byron-Braidwood, I believe. This, by the way, we are applying -- and I probably should mention that whether this is a "P" or a "B" doesn't make too much difference as far as we are concerned. The reason that you see more Ps is there was an aggressive owners group that

was associated with pressurized water reactor, and they were interested in pooling their resources and developing a position on the arbitrary intermediate break, so there are more Ps than there are Bs.

MR. EBERSOLE: Let me go to the opposite end of the quality spectrum, the pressure spectrum, and just pick up the surface water lines. I only need two of them as a minimum requirement. What you are permitting here -- I could run them parallel side by side and invoke the fact that I would never get a break in one of them to scour away the earth-filled supports of the other and produce a coordinated failure of both because I would be dealing with dynamic effects of failure. How would cause the designer --

MR. BOSNAK: Before we approve these things, we ask our systems people to take a look and to look for configuration, to look for a layout and to see if there is any reason why there is a problem such as the kind that you have spoken of.

MR. EBERSOLE: There would be dozens, hundreds.

MR. SIESS: Jesse, this is not a rule change now.

MR. EBERSOLE: I know.

MR. SIESS: This only changes the Staff practice.

MR. BOSNAK: Are there any more questions on this column?

MR. MICHELSON: Well, let me -- this dynamic effects

business, now, relative to Jesse's question. If the water is leaking out at a very high rate, is that a dynamic effect even though there is no jet per se from the water system, for instance, of any concern? But there is a flood problem.

MR. BOSNAK: Exactly.

MR. MICHELSON: Is flooding a dynamic effect?

MR. BOSNAK: I wouldn't look at flooding as a dynamic effect.

MR. MICHELSON: I couldn't find the definition of dynamic effects.

MR. BOSNAK: Flooding is covered by this kind of thing.

MR. SIESS: Carl, we are talking about one of the rules of the arbitrary intermediate break.

MR. MICHELSON: Yes, the arbitrary intermediate break.

MR. SIESS: You are not going to find that anywhere.

MR. MICHELSON: Not yet. I was just wondering what they will define as non-dynamic, and I thought Jesse's example is a non-dynamic effect when the water floods and washes the dirt away.

MR. EBERSOLE: I think it's kind of an ambiguous mix.

MR. MICHELSON: Someday you would like to see some definitions written down so you know what they are considering

or not considering.

MR. SIESS: No pipe whips on that pipe.

MR. MICHELSON: That's right.

MR. BOSNAK: They are not generally high energy lines, so you don't have those kinds of situations.

MR. EBERSOLE: You have a very beautiful competence to scour the basic support system.

MR. SIESS: Those pipes don't come under the heading of this issue, though.

MR. BUSH: Even if they did, Jesse, I don't see where it would make any difference because we have more than one example of 100 to 200 feet of pipe with no supports whatsoever that are vibrating without breaking. So why would removal of, say, ten feet of soil have any impact on adjacent pipe?

MR. EBERSOLE: If they would contain a support, it would have none at all.

MR. BUSH: All I can say is I have a difficult time visualizing a wash that would take away 300 or 400 feet of soil, and even then I'm not sure because I'm aware of cases where all the supports have been removed --

MR. EBERSOLE: It just swings across the cavern?

MR. BUSH: It just vibrates back and forth. There is one case it isn't applied and this did occur. It has occurred in China. That is, if you attach the pipe to the

structure and the structure falls down, the pipe falls down, too. If you put it on the side of a hill and the whole hillside comes down, the pipe comes down, too. That's a special case.

MR. EBERSOLE: I know of numerous cases where the pipes are buried in earth-filled --

MR. SIESS: I don't think that comes under the heading of arbitrary intermediate breaks.

MR. EBERSOLE: I don't know. I guess not.

MR. SIESS: It's something that needs to be looked at.

MR. BOSNAK: If we are ready and finished with the questions, I would like to kind of sum up where we are in flexible piping and things that we would like to see the committee act favorably on.

With respect to damping and the spectral shifting that we talked about yesterday, particularly the damping, I don't think we have one plant now under construction that has not asked for the use of the improved damping, the PVRC damping. In the Cook case -- several, and I think you saw from the slides yesterday they identified the plants that have and have not.

MR. BUSH: If the committee hasn't seen that --

MR. SIESS: The implementation of that is via Reg Guide?

MR. BOSNAK: The implementation of that will eventually be via change to Reg Guide, both 161 and 122. In the meantime, we are handling it via a special request to use the ASME Code cases.

MR. SIESS: Okay, because it's not a rule.

MR. BOSNAK: It's not a rule.

MR. SIESS: Just a Staff acceptance.

MR. BOSNAK: In effect, it is basically covered by our 50.55(A) and the ASME. If you will, that is the trail by which we say --

MR. SIESS: Except damping factors have always been in the Reg Guide.

MR. BOSNAK: Damping factors are in the Reg Guides.

MR. SIESS: Now there's a damping factor in the Code, you use that in preference to the Reg Guide.

MR. BOSNAK: In lieu of, and what we do is we ask that they check to make sure there is adequate clearance, and that because of the possible change in accelerations of the lines, that any line-monitored equipment is qualified for that. That goes back in the response to the utility to use this particular set of change in damping values.

So we have damping and we have the spectral shift. The OLs --

MR. ARLOTTO: Just to be sure, Bob, there may be some confusion. The damping is not in the Code yet. It is

strictly applicable in a Code case, and we endorse Code cases through Reg Guides. I want to be clear we are not looking for any change in regulations associated with damping.

MR. SIESS: So unless it's 50.55(A), whether it's Code case or Reg Guide, it's still not regulation, it's a Staff interpretation.

MR. ARLOTTO: Code cases we endorse through our Reg Guides.

MR. SIESS: Reg Guides, not a regulation.

MR. ARLOTTO: Right.

MR. BOSNAK: As far as the OLs are concerned, a lot of them wish to use this particular case. We have had inquiries, particularly from Commonwealth Edison, with respect to support improvement. In other words, removal. They want to go in in particular systems that are difficult to get at and difficult to maintain. Support improvement. Support optimization. Getting rid of snubbers. This is how they intend to use this particular --

MR. SIESS: This means changes in the design?

MR. BOSNAK: They will change their design, change the piping system support scheme.

MR. SIESS: And reanalyze.

MR. BOSNAK: And reanalyze.

MR. SIESS: At the OL stage.

MR. BOSNAK: These are OLs. I am down now in the

second batch. These are plants with OLs, so they would have to come in and modify their FSAR. That's what they have been told.

MR. MICHELSON: Why would they want to do that?

MR. BOSNAK: To get rid of all of the snubbers that have been plaguing them with respect to maintenance, high radiation exposure, change the supports, optimize their supports.

MR. BUSH: Carlyle, in terms of exposure, if you put value on man rem and so forth, you are probably talking of a plant that is, say, at the NTOL stage or a new plant that is in the OL stage of anything up to $10 million to $15 million in savings, and that excluded the fact that if you get into the rat's nest of having to go through the tech spec requirements on testing, if you find failed snubbers, then your sample size increases and your time between testing decreases, and you can be down to six weeks and you may have to test half or two-thirds of your snubbers. That says you are going to be down probably for an excessive outage. So that doesn't include any costs of excessive down time, so you pay a tremendous penalty sometimes.

MR. BOSNAK: We believe the cost of doing this will pay for itself in a matter of just a few years.

MR. MICHELSON: I appreciate what the problems are undoubtedly involved on the primary side, but I think this

part of the business is now throughout the plant, not necessarily limited to the primary piping. I haven't seen this cost benefit that shows all this vast cost saving outside of containment, and I was wondering what are the benefits of removing them outside of containment compared with what we might be losing.

MR. BUSH: They have gone to mechanical snubbers. I could name several systems over the last two years. Quad Cities is a good example. Dresden, where they had a water hammer that was so trivial it didn't even trip the instrumentation, so they didn't know they had it. Every snubber locked up on that system.

You now have rigid systems that won't handle thermal expansion on there, and it's quite possible under some circumstances it could lead to failure in the piping because of that one thing, and that's under a normal operating condition, and that has been happening again and again and again.

MR. MICHELSON: So you are balancing that potential loss of fluid outside of containment versus --

MR. BUSH: These are not for handling pipe breaks, you realize.

MR. MICHELSON: They have something to do with that. They cause a pipe break is, I think, what you are saying.

MR. BUSH: They could cause a pipe break, but their purpose really is seismic.

MR. MICHELSON: The other solution, of course, is to fix the snubbers so they don't lock up.

MR. BUSH: Well, I will give you a 150-break document, if you want, but as to the statistics on failure, it hasn't changed that much in the last couple of years.

MR. EBERSOLE: Don't the designs for these problems show they are basically hydraulic, that they don't depend on gravity?

MR. SIESS: They have two choices, now, Jesse.

MR. BUSH: That has been sort of the puddle on the floor.

MR. EBERSOLE: I'm talking about a cylinder which is dead ended on the bottom.

MR. BUSH: The hydraulic snubbers have about eight or nine seals in them. The most common one to go is the pop-in valve. It's still a problem. They still haven't solved the leakage.

MR. EBERSOLE: It's all gravity loss, isn't it?

MR. SIESS: Jesse, if the hydraulic snubber fails, then you have no seismic protection.

MR. BUSH: They just flap in the breeze.

MR. EBERSOLE: They fail in the context that they lose fluid. Don't you have snubbers which have cylinders dead

ended at the bottom?

MR. BUSH: If they do, I'm not aware of them. I looked at what I thought were all of the types.

MR. EBERSOLE: Then they have got a seal that is capable of draining by gravity.

MR. BUSH: A seal situation. They do have closed reservoirs, if that is what you are talking about. The reservoir is fine. The problem is the seals leak. You get a leak in the seal --

MR. SIESS: There are a number of instances of reservoirs being impotent.

MR. MICHELSON: What do we lose if we take out the snubbers? What is the hazard now?

MR. BOSNAK: I think if you reanalyze the piping system, if you can get by with a rigid restraint there instead of a snubber, so much the better.

MR. MICHELSON: That's what you are proposing here, to do the reanalysis.

MR. BOSNAK: Definitely they are going to do a reanalysis to use the new damping, the GDRC damping, and see what they can eliminate.

MR. MICHELSON: So I guess the net conclusion is safe or safer without the snubbers.

MR. BUSH: On a probabilistic ground, I think it is safer because they are not effective against vibration, which

is where they have been used. They are not effective against the dynamic event. They do not work with water hammer. They just tear up the wall. So you put them in for seismic event. Well, if you have higher damping than the purpose of a snubber, the value disappears. I don't say that you take all snubbers out because you do need some snubbers, but you can reduce maybe 50 to 90 percent.

So what you do is you have to reanalyze your system and establish what you do. That's really the emphasis.

MR. BOSNAK: Or as I mentioned earlier, you might be able to get by with a smaller snubber that is easier to maintain. It is less difficult from the point of view of exposure and maintenance. That's what we understand.

MR. SIESS: But your cost-benefit study was based entirely on man rem, wasn't it? You didn't try to evaluate the possibility of pipe breaks using thermal restraint.

MR. BOSNAK: That's correct. No.

MR. MICHELSON: Man rem inside the containment that I was sure --

MR. SIESS: I might just mention for Carl's benefit that several years ago we asked Diablo Canyon to assume that a snubber had failed -- the probability was about 1 -- and to look at the consequences in terms of risk, if you wish. They assumed, first, that it failed locked, which then led to some fairly high probability of a pipe break due to thermal

latch. They then assumed it failed unlocked, which meant in a seismic event the snubber would not be effective.

And, of course, the probability in terms of the thermal event was tremendously higher because the thermal movements are there all the time and the earthquake only occurs every 200,000 years, whatever. And you have got something in there for that low probability event that if it doesn't work properly, they don't. It puts a much higher risk on something else.

MR. BOSNAK: I'm up to the next column if there are no further questions on that, the coupling of LOCA and SSE. I think that was in your letter a few years ago. It was something that should go forward based on particularly the probabilistic work that Livermore had done on the situation-by-situation basis.

They had at that time, I think, completed Westinghouse, and now they have completed Westinghouse, Combustion and B&W and are working on GE. So that is the status of that.

MR. SIESS: I think at the time we looked at that, they had not completed their work on secondary failures due to seismic. They had only gone as far as the primary failure. Am I correct? I have seen the reports on the secondary failures.

MR. O'BRIEN: What do you mean by primary --

MR. SIESS: A pipe breaking due to stress, a LOCA caused by an earthquake and the normal stresses on the pipe, not by a crane falling --

MR. BOSNAK: They completed the secondary work on Westinghouse plants at that time.

MR. SIESS: That's right. I said I don't think the committee reviewed that, the steam generator falling over.

MR. O'BRIEN: We presented that to you in 1980, and twice we presented that to you --

MR. SIESS: To the full committee?

MR. O'BRIEN: No, just to the subcommittee.

MR. SIESS: That's what I meant. The full committee looked at the primary.

MR. BOSNAK: So right now the only request that we have here on that is on operating plants, and they are the CE plants.

In order to get free of A-2 or to complete the work on A-2, they are not taking the leak-before-break approach because they really didn't have to. The only area that they had that was overstressed was in the area of reactor internals, and only slightly so, and if they decouple, that solves their problem.

MR. SIESS: How is this being handled within the regulatory process?

MR. BOSNAK: Right now it's in ELD. We have asked

the legal staff whether or not there is a need to, because of the experience we had on GDC-4, whether there is a need to do anything with respect to GDC-2, and the tentative answer we have gotten back is, no, we don't have to change GDC-2, we can go forward just on the basis of the work that has been done technically and not make a change to GDC-2.

MR. SIESS: What will you change?

MR. BOSNAK: The only thing that would probably have to eventually be changed would be the Standard Review Plan, to recognize the fact that this is no longer necessary as a valid load combination. We don't have to combine LOCA and SSE. Again, as the recommendation in the Piping Review Committee report -- I think it's in Volume 4, but also Volume 5. If that, when justified -- in other words, when the work has been done -- we can go ahead and do that, and now it has been done for the three PWR vendors, and GE is in process.

MR. EBERSOLE: Will this permit, then, the redesigns of the so-called ECCS system for LOCA mitigation to be non-seismic in character?

MR. BOSNAK: No.

MR. EBERSOLE: Why not?

MR. SIESS: It has nothing to do with the piping systems.

MR. EBERSOLE: You are saying you are not going to have a LOCA --

MR. BOSNAK: We don't have to add the loads together to design the system for both. We would still have to design them for seismic, and if you had pipe breaks, you still would have to design things for pipe break, but you don't have to combine the two.

MR. EBERSOLE: It's not equipment that's highly specialized. It's for a large LOCA mitigation, low pressure, and if you don't have a LOCA coincident with an earthquake, it seems the standard non-seismic design would serve the purpose.

MR. BOSNAK: But you do have seismic loads, and I couldn't conceive of this as being considered non-seismic, so you design it for the seismic load alone.

MR. EBERSOLE: It's just standing on standby, I'm saying.

MR. BOSNAK: I understand.

MR. EBERSOLE: Its failure would be nothing if you didn't have a LOCA.

MR. BOSNAK: That might be something that possibly might be looked at, but currently, no. We are basically talking about here, again -- this happens to be A-2 for the operating plants. There isn't any NTOL that has need for this because once you have leak-before-break, it effectively is moot as far as the coupling is concerned.

MR. SIESS: Bob, I realize this is the Piping Review

Committee, but will the LOCA/SSE load combination in the future be applied to containment?

MR. BOSNAK: We haven't gotten into structures. That is an area that would have to be --

MR. SIESS: This now applies only to piping analysis?

MR. BOSNAK: That's correct. That's all we are talking about here.

MR. SIESS: The stress on the piping will be computed for the LOCA or for the earthquake but not for the two combined?

MR. BOSNAK: That's correct. By the way, the rest of the world has always been doing it this way. They never combined except with a few exceptions. The major countries have never combined LOCA and SSE for piping. Again, we are talking piping.

MR. SIESS: Further questions on that?

[No response.]

MR. BOSNAK: The last is the thing that Shou-Nien talked about yesterday. I'm sure everybody will eventually be interested in it. I should put a check there. But right now that is decoupling of OBE from SSE. The major part as far as piping is concerned is we don't want the OBE to control the design. That's what we are trying to avoid.

MR. SIESS: That, again, is an issue that will go

beyond piping, but you won't be finished with it.

MR. BOSNAK: Probably one that will involve a rule change, Part 100.

MR. SIESS: It would be very difficult to invoke that simply for piping.

MR. SHEWMON: If that goes, it would affect the whole thing.

MR. BOSNAK: What we are trying to do is not to have an OBE load combination control of the design. The Germans, what they have done, and I think I mentioned yesterday, they have just jacked up the allowable limit for that load combination. It said you could go a little bit higher, so that way it doesn't control the design. If we start talking about changes in the way that the systems are analyzed, whether seismic inertial load is a primary, what we do with seismic anchor motion, then this becomes fairly important.

MR. SIESS: And in other structures.

MR. BOSNAK: And in other structures. But right now it is not something we have to deal with immediately.

MR. SIESS: How would that be implemented? That would require a rule change.

MR. BOSNAK: To Part 100 and then all the various Standard Review Plans, both in the structures area and in the mechanical area.

MR. SHAO: Two ways. One way, if you change the

ratio in both in both rule changes.

The other way is just like the Germans do. If you increase the allowable for OBE you don't have to do a rule change.

MR. SIESS: That's a terrible way to do it because you have got allowables for pipe and allowables for structures, you have got allowables for everything.

MR. SHAO: Right now the SSE allowable and the OBE allowable are not the same.

MR. SIESS: No, for structures or anything else.

MR. SHAO: For structures and piping. So all you have to do is jack up your allowable for OBE but not all the way to SSE.

MR. BOSNAK: That's what the Germans have done.

MR. SHAO: Yes, that's what the Germans do. And if that go through, you don't have to change the regulation, you change the allowable.

MR. SIESS: You also have to change the damper.

MR. SHAO: You change the damping. You also have to change the allowable stresses.

MR. SIESS: That's a patchwork way to do it.

MR. SHAO: It achieves the purpose.

MR. SHEWMON: Again, the philosophy of why the OBE and SSE allowables are different in the first place.

MR. SIESS: You can justify that on different

probabilities and get the same level of risk.

MR. BOSNAK: Other than the piping. Then the question is how high should the OBE be. Should it be something that plants should be able to ride through? All of those philosophical things come to the fore.

MR. SIESS: We had it covered once by giving three different definitions of it, which didn't make a lot of sense.

MR. EBERSOLE: This first rule would not affect the tributory pipings off the main loops, will it?

MR. BOSNAK: Which one are you talking about?

MR. EBERSOLE: The first one, the first column.

MR. BOSNAK: No. Again, this slide -- this will help.

MR. EBERSOLE: So we will still have some --

MR. BOSNAK: Does not affect this line and the other branch lines.

MR. EBERSOLE: So we will still have some rather rapid depressurizations to deal with.

MR. BOSNAK: Yes.

MR. EBERSOLE: When you get the second rule in place, those will disappear.

MR. BOSNAK: That is probably the next step. to go to these other lines.

MR. EBERSOLE: When you do that, there is going to be extremely far-reaching system implications. For instance.

you can get rid of the diesels because you can use slow-start turbines. I just use a distant effect that it might have. You have completely eliminated fast-start requirements.

MR. SIESS: They are not eliminating the double-ended break for LOCA calculations.

MR. BENDER: Some of those would be desirable if they could do it.

MR. EBERSOLE: Yes, sure.

MR. BOSNAK: Since we are back on this again, to summarize, it is a limited exemption for PWR loop. Equipment qualification is not changed. The heavy component support integrity will be maintained per the letter, and the structural design has not changed.

MR. SIESS: He is talking about ECCS equipment.

MR. BOSNAK: That does not change. Containment doesn't change.

MR. EBERSOLE: Say we are carrying a heavy burden on fast starts and on diesels.

MR. SHEWMON: I think they are changing the tech specs to where the number of those they need per year is going down.

MR. BUSH: I have been spending most of my time on that problem, and they are modifying. They are doing just exactly what you say, Paul. They are essentially minimizing the number of fast starts, to a major degree, so in essence

they are trying to minimize what I would call the testing phase of the diesels.

MR. SIESS: That is not the point. The point to realize, Jesse, is that this does not change the double-ended pipe break, instantaneous double-ended pipe break as a basis for designing the ECCS on the containment.

MR. EBERSOLE: I understand.

MR. SIESS: It only affects the design of the piping.

MR. MICHELSON: Of course, it's not fully logical since we have now by fracture mechanics, et cetera proved that we can't get these big breaks anyway. Now, the question is why are we continuing to foster designs of ECCS when there is no break to address?

MR. SIESS: What do you decide in the Piping Review Committee?

MR. MICHELSON: What bothers me is I would think somewhere in NRR a presentation could be made. Where are they really heading? What do they see down the road, and how is this a step in finally accomplishing some down-the-road objective? How far are they going to go in this business? It's a mish-mash. It's very illogical.

MR. SIESS: I think if we really believe there can't be a double-ended pipe break, there are lots of other improvements we can make in these systems.

MR. MICHELSON: A lot of simplifications you can make, and why are we picking on one area now? I realize why, because it's a very expensive area and it has lots of problems with it, but where is it going to lead from here?

MR. SIESS: We are sort of going back, Carl. See, the original idea of the double-ended break was a bounding assumption for the ECCS and a bounding assumption for the containment. But we didn't stop there. Then they started looking at that for asymmetric loads, internal loads, and while it was a reasonable bounding assumption for the first two -- and I put "reasonable" in quotes -- it had other consequences that got to be almost ridiculous.

So now that Staff is backing up to where they were when they first invoked the double-ended pipe break to size the ECCS to containment, but in the process, they may have raised the probabilistic issue that they ought to reconsider the other two, and that is your point and I think it's a very good one.

MR. MICHELSON: And are they doing that?

MR. SHAO: The original thinking of the double-ended break is for ECCS, and it goes to everybody. They said, well, you designed to continue for the ECCS. I want support for the other nitty gritty of this particular pipe break. But that wasn't the original thinking.

MR. SIESS: Carl's point is, now that you have got

yourself convinced that you can't have a double-ended pipe break, we ought to go back and rethink the other. Actually the containment has been rethunk. They are looking at containments now for severe accidents.

MR. SHEWMON: Are we ready to hear about combination of dynamic loads now?

MR. RODABAUGH: I wonder if I could clarify one point with Bob before we break. In your report you talk about decoupling the OBE from the SSE. Can you also say that you, for some reason, do not want the OBE to control design, and the word "design" is a kind of very broad term to me. If you are going to adjust things so that the OBE never covers design -- I mean never controls design -- excuse me -- why do you have an OBE at all? Why not just design for the SSE?

MR. BOSNAK: That's a good question, and I think in the discussions that might come up with respect to rule change to Part 100, all of that could be certainly considered and talked about. We don't have any answers to that right at the present time, but it certainly will be considered.

MR. BUSH: In fact, the CEGB is trying to go that very direction.

MR. SIESS: I agree with it completely. There is no safety reason for having two levels of earthquakes. You could have two criteria. One is stress and the other is deformation. One is a pipe break or some break, and the other

is something moves too fa-.

MR. BENDER: The earlier concept was based on something somewhat broader than just pipe breaks. Originally the idea of the OBE was to have a criterion for survival without the need for re-establishing the adequacy of the plant, and that, I think, just incidentally turned out to establish some criteria for the piping.

MR. SIESS: I think if we went back in history, we could find about three or maybe four reasons for having an OBE. I know another reason that came from Newmark that had to do with analysis and the criteria, and I think there are a whole bunch of reasons, none of which I think are good.

MR. HOU: Maybe I can add something.

MR. SIESS: Let's save it till after the break because we are going to talk about OBE and SSE. That comes under Volume 4, doesn't it? Well, we have already covered that.

MR. HOU: I will just make a short statement. The OBE and SSE issues have been intensively discussed in a task group in seismic design. Now we know for safety reasons there is no need for two levels. However, to protect the investment, and also if there is an earthquake occurring and we would like to restart it.

Now, the OBE level will protect that, be sure there is no deformation, no structure integrity impaired and

functioning impaired.

MR. SHAO: So we know when to shut down the plant.

MR. SIESS: I guarantee you if you have an OBE, you are going to shut down the plant and you are not going to accept anybody's statement that it's okay to start it up until you have completely inspected it.

We will take a ten-minute break.

[Recess.]

MR. SIESS: Okay, John, you have got the floor.

MR. O'BRIEN: This is going to be a discussion of Volume 4 from the Piping Review Committee dealing with other dynamic loads and load combinations.

[Slide]

Here is my presentation outline.

[Slide]

This particular task group addressed a number of sometimes disparate issues, such as event combinations, which deals with potential simultaneous occurrence of earthquakes with pipe ruptures, as well as possibilities for earthquakes combined with other events such as water hammer. This should be a bullet here.

Response combinations deals primarily with multiply-supported piping, and Shou talked about that very briefly yesterday. That group did not deal with it. We did, but our recommendations pertain to seismic design.

We have an effort as well dealing with stress limits and dynamic allowables. Water hammer was considered and, finally, piping vibration loads.

[Slide]

Here is a list of people involved. We had Sid Bersen from Bechtel and Don Landers from Teledyne, who were our industry coordinators.

[Slide]

The first recommendation for mechanical design on the first question is mechanical design of what? We say for mechanical design, decouple earthquake primary system double-ended pipe rupture, and Volume 4 made that recommendation only for Westinghouse and CE. But since the publication of Volume 4, work has been completed on B&W, and that falls also within the scope of the recommendation.

We also say decouple earthquake and pipe rupture when you have technical evidence. The task group says the technical evidence exists for the primary loop piping of the three PWR vendors.

If you look at Volume 4, it says mechanical design components and their supports, nothing else. That means no structures. It turns out the interpretation of this is if you have a snubber placed on a steam generator for resisting LOCA effects, it still stays. That is the very large one. As Bob says, he plans to use this here for CE. It applies to

reactor internals as well. Bob Bosnak intends to apply that recommendation to resolve the licensing program for all CE plants.

The task group essentially said nothing new about water hammer. We accepted the guidance from the resolution of the task of USIA 1. We said that unanticipated water hammer, for instance, due to pumping into a voided line, or water-steam reaction should not be part of the design basis. This was discussed, debated, and the task group said, no, accidental or unanticipated water hammers should not be included in the design basis.

However, anticipated water hammer, as, for instance, from a safety relief discharge valve and other sources should be continued to be designed combined with earthquake. I'm into response combinations right now.

MR. SIESS: John, before you leave the first one, in the first bullet the last sentence says adequate technical evidence is presented. Now, that implies that that evidence will be presented by the licensee or an owners group or a vendor?

MR. O'BRIEN: Yes.

MR. SIESS: The NRC plans to do only confirmatory studies on it.

MR. O'BRIEN: Yes.

MR. SIESS: The burden is on them.

MR. O'BRIEN: Yes.

MR. SIESS: Okay. Thank you. Go ahead.

MR. O'BRIEN: Now we are into what is response combinations. The present procedure, which was developed in the seventies by people like Larry Shao for dealing with piping, which have multiple independent supports, is to envelope the support from all the groups of supports, and you use this for basis for design.

There is a new procedure called the independent support motion response spectrum method. It is not really new. It has been around for a long time but never really accepted. The task group recommends this be allowed as an option to the present. It is very, very super-conservative. You ask me what kind of conservatisms are we getting. How about a factor of 30? That means 3000 percent over the best estimate response in some cases in some locations, and we can shave that down to where the conservatisms are only 500 percent, which is an achievement.

The method adopted by the Staff was based on work performed by Brookhaven National Laboratories but is not exactly the same as the recommendations by Brookhaven.

[Slide]

The Staff now will allow an SRS procedure for combining the dynamic and the pseudostatic components of response. Pseudostatic is the same as seismic motion. That

obviously is a relaxment. By the way, that's used for fatigue evaluation. There is a less conservative rule now permitted for the seismic anchor motion for response for the pseudostatic component.

We have also introduced some greater realism for dealing with high frequency mode so it doesn't affect it either conservatively or nonconservatively because it depends on particular cases.

One question that faces us regarding this last thing on multiply-supported piping is that if you implement this and implement the higher damping values, you are really reducing the margins of piping to one. I don't know what NRR is going to do about it, but Research is undertaking studies to find out if you relax in every aspect of piping analytical methods, you might result in no margins and that might not be desirable.

MR. SIESS: You mean no margin at all or no margin from that?

MR. O'BRIEN: No margin in the piping analysis. You may have margin on the input to the piping, you may have margins in the allowable stresses, but in the piping analysis, they come back close to 01.

MR. SHEWMON: Are you saying if you take the higher damping values, then you end up with that?

MR. O'BRIEN: The higher damping is best estimate

damping, and now we are approaching best estimate analysis procedures.

MR. SHEWMON: Let me point out best estimate damping is still not anything, giving any elastic -- any plastic credit for the behavior of the pipe, since you don't build it out of glass but, indeed, out of fairly tough stuff. There is now a whole realm of things which another part of this report says we don't know how to do, take any credit for it yet or use it in any analysis, but it is there.

MR. O'BRIEN: What you say is true insofar as the piping integrity itself is concerned, but if you are talking about functional failure modes, then it might not be true, and this was the issue that Mr. Michelson raised yesterday. If you have got pumps and valves and other things like nozzles, that might not be true. You might not be able to achieve very, very high damping before you will achieve some other kind of failure mode other than the rupture or leaking of the pipe itself.

MR. SHEWMON: It's not at all clear you will, but I agree it's not clear you won't from what I know.

MR. SIESS: Which bullet are you on now?

MR. O'BRIEN: I am just starting this one now. I finished this one.

MR. SIESS: When you are talking about zero margin, you are talking about which one?

MR. O'BRIEN: It's the top bullet here, which began on the previous slide.

MR. SIESS: Okay. Now, let me get clear. There are three kinds of margins. There is a margin in the assumed input, there are margins that we introduce in the analysis, and then there are margins we impose in terms of the allowable, the ratio calculated stress to some allowable. Are you talking about the bottom line or are you talking about the analysis part only?

MR. O'BRIEN: Yes.

MR. SIESS: Because this is not objectionable from m point of view. This is the way we do structural analysis. We put some margin on our loadings, we make the an lyses as good as we can to be realistic and understand what is happening, and then we put some margin on our stresses. I certainly have no problem with an analysis being best estimate.

MR. O'BRIEN: Best estimate means 50 percent chance of achieving the calculated responses?

MR. SIESS: I'll take care of that uncertainty in my loading and my allowable stresses, but I want to do an analysis as close as I can to the truth. I don't want to be dealing with something that is acting differently than what I think the structure is acting. That's just a personal philosophy, but it's one embodied in a lot of structural codes that I deal with.

MR. O'BRIEN: Now we are down to stress limits and dynamic allowables, and this is actually consistent with what Shou said but is distinct from what he said. Our task group said that we do not wish a major shift to inelastic analysis of piping systems using strain limits, and Shou Hou and his test group advocated that performance for inelastic analysis should be established.

We allow inelastic piping analysis on a case-by-case basis, and the reason that the task group made this recommendation is we would first have to benchmark inelastic codes, although there has been some limited amount of that done. In addition, in order to apply general strength criteria for inelastic analysis, our task group felt that strain limits that would result in a uniform margin of safety would first have to be developed, and this does not exist right now.

So actually, we are actually consistent with what Shou Hou said yesterday. He goes beyond this and says take the step of developing these strain limits. We say you can't do it now because these strain limits, which give us a margin of safety, don't exist.

Then a very minor thing is the present Standard Review Plan only allows a 10 percent increase to strain rate effects, and we said in our task group that you should allow more than a 10 percent increase in the design, only of pipe

whip restraints, by the way, which in another group advocated you remove, but some of them won't be removed. Some will stay, and those you can redesign using higher allowable.

So that takes care of that aspect.

MR. SIESS: You mean the restraint itself. You can take more than 10 percent strain rate effects.

MR. O'BRIEN: Yes. Right now it is limited -- for pipe whip restraints, you can increase the allowable stresses by 10 percent to account for strain rate effects.

MR. SIESS: Just arbitrarily?

MR. O'BRIEN: Isn't that right? Arbitrarily. But if you can justify more than 10 percent by test data -- usually test data -- then you should be able to use that beyond the present limitation of 10 percent.

MR. SIESS: The strain rate is some function of excitation frequency, isn't it?

MR. O'BRIEN: This is impact.

MR. SIESS: This is whip restraints. I'm sorry.

MR. EBERSOLE: I wonder if you would clarify something for me. I'm not at the structural end of it, but this business of not having any reliable limits on strain limits, if you have a load which diminishes strain increases to the limit of known importance, can you invoke other strains? I'm talking about an elastic load, like a pressure, just physical load, in which the deformation eliminates the

further stress loading. Do you then invoke those kind of allowances? The material stretches inelastically but the load disappears at the end of that strain.

MR. SIESS: I think his point was he can't develop a consistent set of limits to provide a consistent margin of safety.

MR. EBERSOLE: That's for continued stress.

MR. SIESS: Any inelastic behavior, to try to get a consistent set. We know what is there. He is talking about trying to get Code-type limits that will make some sense.

MR. EBERSOLE: For consistent stress.

MR. O'BRIEN: What we say is uniform margin of safety, but it's the same thing.

MR. SIESS: Uniform margin of safety. You know what's there, but how do you take into account design and get some results that don't vary all over the place, which assumes that what we get now don't vary all over the place.

MR. O'BRIEN: On water hammer, these three bullets are essentially consistent with the Staff Resolution A-1. We recommend that rather than design for water hammer, you try to minimize or reduce the incidence of water hammer, with emphasis on operator training, although you can do things like jockey pumps and J-tubes as well.

The next two bullets reflect the Staff's unwillingness to stick its neck out. We say that the

development of design standards for water hammer should rest with the plant owner or applicant and his designer and not with the NRC. This then gives us a non-uniform way of dealing with water hammer because we say the NRC will not establish standards for specified water hammer. We are going to pass the responsibility to applicants. Some applicants are tough on themselves and some are not.

The difficulty, of course, is how do you define water hammer? Nobody knows how piping responds to water hammer, either.

We even shied away from putting forth a checklist, standard checklist. There is a lot of pressure. Our consultant, John Stevenson, pushed very hard for this. We declined to do it because, as we say, there are a variety of plant designs and operations that work against such development.

Essentially the second and third bullets are just pushing the responsibility to the applicant.

MR. SIESS: Mike has a question.

MR. BENDER: I don't understand the logic of the Staff's position.

MR. SIESS: A little closer to the microphone.

MR. BENDER: I don't understand the logic of the Staff's position concerning this matter. It seems to me the very lack of any basis for designing for water hammer is why

you can't have any confidence that you can protect against it. If you allow every applicant to make his own judgment, and, as you poinied out just now, there is a spectrum of attitudes. There is not going to be any way to have any confidence that it has been dealt with adequately.

It seems to me that John Stevenson's suggestion of at last a checklist to be provided was a pretty good one. Is there any reason why the Staff backed away? Is it cowardly?

[Laughter]

Is it afraid of what it will find?

MR. O'BRIEN: It is not logic, it's emotion.

MR. BENDER: All right, I won't say any more.

MR. SIESS: John, do you have any idea whether designers have checklists?

MR. O'BRIEN: Yes, there are checklists available, but there is no standard one. Actually, it tends to be the AEs that prepare these standards.

MR. ETHERINGTON: I thought the problem was not in the design but in knowing where the hammer load is going to be.

MR. O'BRIEN: That's a major problem, postulating water hammers as well as predicting the ductile piping responding to it, particularly fluid ductile piping.

MR. SIESS: John, your first bullet says the way to handle it is to learn by experience, when you have water

hammers, revise your procedures, put in J-tubes, jockey pumps or whatever. Of course, that's what we have been doing now for 15 years or so. Have we ever had a water hammer that caused an accident?

MR. O'BRIEN: Oh, yes. Maine Yankee. We had one, a cracked pipe.

MR. SIESS: I know we had a cracked pipe.

MR. O'BRIEN: No, not a radioactive release. Indian Point, of course, was a water hammer.

MR. SIESS: So it is implied in the first bullet on the basis of experience that water hammers have been such that they don't lead to -- they don't endanger the health and safety of the public, and then we can learn a lesson from them and fix them. That is the implication I get from you. Is that what you mean?

MR. O'BRIEN: Yes, partly. Part of the problem is water hammers are very likely during other transient conditions like an earthquake and a water hammer. That's a very high probability because you can have a terrible trip, a reactor trip, all kind of transients going on. Your operators are going to see a water hammer, going to get excited. The human factor enters into it. So you have said -- people sitting at this table have said water hammers are probably more threatening than earthquakes, and we --

MR. SIESS: Probably more frequent than earthquakes.

MR. O'BRIEN: We get seven or eight accidental, unanticipated, seven or eight water hammers a year, whereas we don't get earthquakes at all.

MR. SIESS: You cited safety valve blowdown as anticipated. Are there any other examples?

MR. O'BRIEN: Well, due to turbine trips -- where's my list?

MR. SIESS: I know we had one from stop valves closing, that ripped out a lot of pipe restraints, but it didn't fail the pipe.

MR. O'BRIEN: There are a few other anticipated transients -- water hammers, I mear. Turbine trips, vibratory loads. I guess SRV discharge and turbine trips are the two primary causes of anticipated water hammers.

MR. EBERSOLE: HPCI at Browns Ferry was knocked off its foundations because it was called to automatic response from a malaligned position, 10-foot level water heads.

MR. BUSH: That's a water soaking problem.

MR. MICHELSON: That was unanticipated, of course. That wasn't anticipated. You can figure out it can happen.

MR. EBERSOLE: Many of them are.

MR. MICHELSON: I think you can figure there is a real serious water hammer involved in the steam condenser mode on the RHR heat exchangers on boiling water reactors. We are looking into that a little bit now. I have got one of the

fellows doing some research on it. It's an interesting history on how the industry is viewing water hammers, or not viewing them, depending on the particular utility.

MR. SIESS: And awful lot of the water hammers are going to affect the reliability of the plant. Has anybody done any kind of a risk analysis on water hammers? There have been enough of them now that you can factor them into a PRA.

MR. O'BRIEN: Lots of them.

MR. SIESS: Will they tell us about risk of water hammer?

MR. BUSH: The big problem there is --

MR. SIESS: I'm just going to say assume it happens. What does it do to risk?

MR. MICHELSON: The RHR is an interesting one, because, depending on where the water hammer is occurring, it might affect the operation of a single valve between it and the primary system, in which it could blow down outside the containment.

MR. SIESS: Has anybody done the risk assessment that says what type --

MR. MICHELSON: Not as far as we can find so far, but we are looking for one.

MR. SIESS: The Staff position presented here is essentially, we will just take them as they come and fix them. And what is that, restitution or something? And, given

enough time, we will have the frequency down to a low enough level, assuming it isn't already that low.

MR. BUSH: I think John said this pretty much represents the position generated with regard to revolution of the water pressure, with which I didn't agree, incidentally. In fact, I had a few sessions with the persons concerned.

MR. SIESS: This is saying, don't change what we are doing now.

MR. BUSH: That's pretty much what it comes down to.

MR. SIESS: The first one says, when you have one, try to do something to fix it.

MR. SHEWMON It is known as benign neglect, isn't it?

MR. SIESS: It is neglect, but --

MR. MICHELSON: Unfortunately, the history shows some of these utilities have been having, like on the RHR system condensing mode, one utility has had these happening for over two years.

MR. SIESS: And hadn't fixed them.

MR. MICHELSON: It was tearing out supports, it was doing a lot of serious damage, and finally just decided they couldn't handle that mode of operation, and apparently are abandoning that mode of operation.

MR. SIESS: They couldn't fix it.

MR. MICHELSON: Because they didn't know how to fix them. But yet GESSAR II, for instance, proposes such a system.

MR. ETHERINGTON: Yet GE has never admitted a problem there.

MR. MICHELSON: I understand that may or may not be the case officially --

MR. ETHERINGTON: The question was raised years ago and nothing was done about it.

MR. SIESS: I guess the conclusion is a research effort, say of the magnitude of the source term research wouldn't solve a water hammer problem. That you couldn't martial enough national labs and computer codes to be able to design for water hammers.

MR. O'BRIEN: If you are thinking of water hammer by itself, it is hard to envision a core melt or any serious radioactive release, because it is a kind of local event. It is isolated to one piping.

The real concern is water hammer with something that is not local like an earthquake. Or, lots of water hammers going on simultaneously, due to a common source.

MR. SIESS: If I have got to combine water hammer and earthquake to get in trouble, I am going to put it back on the shelf a ways. But you said, you know, that you couldn't do it analytically. You didn't know how to design for water

hammer. And my question was, if you want to spend enough money, could you learn how, or do you just think it is not worth spending the money?

MR. O'BRIEN: You are going to see, we have a recommendation for research on water hammer in a few minutes.

MR. SIESS: But not at the level of severe accident research?

MR. O'BRIEN: No.

MR. BUSH: Chet, one problem here is that the energy that a water hammer typically generates, the type we are talking about, is usually a very, very small fraction, perhaps one percent or less than ten percent of the theoretical.

If you start analyzing on the basis of the theoretical water hammer, then you know you are in trouble because things pretty much tear apart in a hurry.

In fossil plants, they occur, I would say with reasonable frequency, and it is a rather dramatic event, if you see what a water hammer will do, say, to a cast iron valve. If you want to see how shrapnel is generated in short order, that is one way to find out, because you can generate it in a hurry.

The big problem -- and this has been looked at off and on for about thirty years -- is how do you handle the probability that you can have energies -- you get into that 90 percent theoretical r vibration loads.

The first bullet there is really an attempt to account for gaps in piping vibration loads. Usually small amplitude, high frequency. Those that are transmitted to piping. Presently they are analyzed by assuming linear analysis. But, you can find out that usually pipe support gaps are not even closed, and the pipe doesn't even move when the vibration is going on.

This bullet will allow a less conservative way of dealing with pipe vibration loads.

(Slide)

And then we have some vibration loads.

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This bullet will allow a less conservative way of dealing with pipe vibration loads.

(Slide)

And then we have some recommendations here. The first bullet here is really consistent with present NRC policy. and this ANSI/ASME standard is just a convenient document for us to cite for the industry to follow.

-- That bullet is consistent with the way we are doing business now.

MR. MICHELSON: Excuse me, on that bullet, does that particular document require that the flow rates be varied so that you have particular rates at which the vibration peaks out and so forth?

MR. O'BRIEN: I don't know.

MR. MICHELSON: I don't either. Maybe Dr.Bush knows?

MR. BUSH: I don't recall it as there. But, I confess -- is Guy still here?

Guy, you probably looked at this OM-3. But, as far as I know, a significant factor with this one is that the code really hasn't discussed it. In other words, it isn't incorporated in either 11 or 3. And, as a result, it is kind of sitting in limbo. Nobody is using it because there is no force to use it.

MR. MICHELSON: I have witnessed the operation of systems which worked fine at full flow. You throttle down a little bit and they will shake apart.

I wondered if they had to run the range looking for vibration. So, it is not the kind of an answer --

MR. SIESS: Bob's got something to say. Maybe it is an answer.

MR. BOSNAK: I'm not sure that it speaks to flow.

What the Staff had been using before the advent of this document was the vibration amplitude at 10 to the 6th cycles. We have taken 50 percent of that.

This goes on and goes up into the higher frequency. But I don't know that it contains anything with respect to flow conditions.

MR. MICHELSON: But it is supposed to address fluid-induced vibration?

MR. BOSNAK: Fluid-induced vibration. Probably assumes that it is operating in its usual operating mode. And, if there is a mode which is worse, then that would be considered. But they really don't know.

MR. SIESS: Carl is talking low-cycle fatigue, and you are talking high cycle.

MR. BOSNAK: Exactly.

MR. MICHELSON: Low-cycle fatigue is the concern on fluid-induced vibration. You can see it at certain flow rates.

MR. BOSNAK: But this is a high-cycle fatigue standard.

MR. BUSH: Yes.

MR. O'BRIEN: The middle bullet on this slide is just polishing up the Standard Review Plan to make explicit reference to reciprocating eroding rotating equipment which is not explicitly referred to. It is just a clarification --

The last bullet is really a push to depend more on testing because analysis, we know, tend to overstate the situation with regard to arbitrary loads. And this is born from tests we have done at Koshane.

So, the recommendation -- the interpretation of this last bullet is if you depend on testing, you will get some release, because the analyses is very conservative.

MR. SHEWMON: John, before you leave that, at least three or four years ago, the code apparently quite at 10 to the 6th cycles on its fatigue curve and didn't go on. Yet, things were failing at 10 to the 7th. They were allowed to take the same level on out.

I remember a Japanese engineer asked me what we were doing about that.

Do you know if there is data on what is to be used beyond 10 to the 6th cycles?

MR. BOSNAK: Austenitic materials go beyond 10 to the 6th cycles now. It goes 10 to the 11th.

MR. SHEWMON The curve does.

MR. BOSNAK: The curve does.

MR. SHEWMON: That's an improvement over three or four years ago.

MR. BOSNAK: That's correct.

MR. SHAO: Anything more than 10 to the 6th or 7th is. Some people use endurance limits.

MR. SHEWMON: There is no endurance limit in austenitic material.

MR. SIESS: John, going back to the previous one, the last bullet says "loads transmitted by supporting structure."

Is that seismic?

MR. O'BRIEN: No. This bullet is under piping vibration loads, and it really means SRV discharge.

MR. SIESS: Oh, okay.

MR. O'BRIEN: This task group doesn't deal directly with seismic.

MR. BUSH: Paul, I would indicate this was an NRC decision. Or at least it was a part of an NRC task force in ferritic materials, where a requirement was established that you would have to operate to 10 to the 7th cycles. This happened to be a diesel generator. But, you know the analogy is so extrapolatable on the basis that at 10 to the 7th, if you examined after the fact and found no indication of cracking, et cetera, you had reasonable confidence that you would be off the fatigue limit.

Whereas, at 10 to the 6th, you are still in the never-never land, because you can look at data and find that at that juncture point, the fatigue limit has a plus or minus range of about 500 KSI.

MR. SHEWMON: But the austenitics would not have an

--

MR. BUSH: No, no, I said ferritics. The austenitics is a different animal. The curve keeps sliding down, sliding down.

MR. SHEWMON: I was talking about austenitics.

MR. ETHERINGTON: Isn't it also true that ferritics deals in a mildly corrosive environment that has no endurance limit?

MR. BUSH: Any time that you get cracking of any nature on there, then the ballgame is over, because you now pass the initiation phase and then the propagation. If you have corrosion, then you can get that --

MR. ETHERINGTON: What I am suggesting really, is even in the PWRs there might be no endurance limit in water.

MR. BENDER: I'm not sure I would know how to respond to the second bullet up there. If it really turned out that you wanted to --

MR. O'BRIEN: How would we respond?

MR. SIESS: Let him go through the list, Mike.

(Slide)

MR. BENDER: Okay.

MR. SIESS: You are anticipating a little bit.

MR. BENDER: I'll wait.

MR. SIESS: Start at the top.

MR. O'BRIEN: The first bullet says, see if you can

apply LOCA plus SSE decoupling for other than CE and Westinghouse. And since Volume 4 was published, we finished work on B&W and it does fit in. We have not finished our work on GE yet.

That takes us down to the next bullet. This is a very large program under Chuck Serpan regarding testing of degraded piping, ductile piping.

Now his program deals a lot with static tests, but there is dynamic loads like earthquake and water hammer that are planned. It is not the whole program, but some of his programs deals with dynamic loads like seismic. When Jack Strosnider was here and doing it, that's what it was.Milt is doing it now.

But there is a seismic aspect to that degraded piping program which will tell us what is the capacity of degraded piping, piping with cracks in it, to withstand water hammers, which would be very important. I mean, we don't even have an allowable for water hammer. How can we design for them. We don't know how good it is.

MR. SIESS: John, I don't understand the caveat in parentheses at the top of the slide. That says "not sorted by issues."

MR. O'BRIEN: Oh, because I have event combinations, water hammer -- see, we had --

MR. SIESS: Oh, okay. Each one is separate, but

they are not categorized in those.

MR. O'BRIEN: I didn't say that this deals with event combinations, this deals with water hammer.

MR. EBERSOLE: John, may I ask you a question.

Some of these hydraulic systems involving vessels, pressurizers or boilers or whatever, they suffer transients in which they depressurize due to say stuck safeties?

They depressurize, and they have high volumetric flows that depressurize the system. The makeup water comes in at prodigious rates and it doesn't stop. It keeps on coming until it gets to the orifice which is discharging vapor up to that time in all it wants.

That orifice is confronted with a solid stream of water.

Does that produce a shock on the system that is significant?

MR. O'BRIEN: Sure.

MR. EBERSOLE: Do you routinely look at that?

MR. O'BRIEN: No.

MR. EBERSOLE: How do you know that it isn't damaging?

MR. O'BRIEN: Our experience, I guess.

MR. BUSH: I think what you have to do there, Jesse is, there are some rather definitive criteria on testing of safety valves, and what you have to do, et cetera. And I

think -- safety relief valves.

MR. EBERSOLE: Do they test them in this mode?

MR. BUSH: There is a sequence of testing that -- for rates, et cetera. Usually -- you are really talking the slug effect in there.

MR. EBERSOLE: Yes.

MR. BUSH: Now you want to realize that these have a fairly good aperture when they are open.

MR. EBERSOLE: I know. I know the physics of the problem. I am just asking what is the extent of the shock produced by this sudden choking of the orifice with solid liquid when you have input flow rates that are prodigious.

MR. BUSH: Well, one of the things that can happen is, you can blow the whole valve off.

MR. EBERSOLE: Well, what about the vessel itself. Or, other points in the system that are weaker than the valve.

MR. BUSH: Oh, okay. You are talking of a different thing. You are really talking of a reflective wave that comes back in there and goes back up the pipe --

MR. EBERSOLE: It is the whole system.

MR. BUSH: Okay. I was thinking of it in the context of the valve per se. You are really talking of the reflective --

MR. EBERSOLE: I know it would dependent on the length of pipe and the velocity of fluids in it that is

feeding this system.

I am just asking in a systematic context, is this looked at.

MR. SIESS: Volume of the tank.

MR. EBERSOLE: Or, should it be?

MR. O'BRIEN: Has it ever happened?

MR. BUSH: Yes.

MR. EBERSOLE: I don't know. You wouldn't know if nothing happened.

MR. BUSH: The answer is it has happened. There have been two cases, at least, where we blew the whole bank of valves. One of them was at Robinson and the other was at Turkey Point.

MR. SIESS: Those weren't slugs, those events. One of them was just a lateral force.

MR. BUSH: You have got the shock load and the rotational.

MR. SIESS: That was Robinson.

MR. EBERSOLE: It sounds like a phenomenon that ought to be routinely examined, especially if we have got long feeder lines. That is the old, ancient RAM, is a good example.

MR. BUSH: The business of reflective waves has been looked at. But I don't know if it has been looked at in this specific context you are talking about. That one is looked

at, but for other reasons, I think.

I suspect the answer is, in the context you are raising the question it probably isn't.

MR. SIESS: He has raised it for the vessel upstream.

MR. BUSH: It is not just the vessel, it is also the piping.

MR. EBERSOLE: The whole thing.

MR. SIESS: Won't the wave be worse than the water hammer itself, as far as the piping is concerned?

MR. O'BRIEN: We have not looked at it. Nobodv has raised it but you.

MR. BUSH: It is the water hammer. Really, what you are doing is getting the reflected wave.

MR. SIESS: You are addressing waves originally in connection with the vessel.

MR. EBERSOLE: It is analoqous to the ancient RAM that used to pump water.

MR. SIESS: Well, water hammers will break pipe. We know that.

Okay, John.

MR. O'BRIEN: The next bullet is onlv for people who really love analvsis, and deals with things that if you are not into analysis don't make a lot of sense. But, they are in the multiple support recommendations that were developed.

They hinge on phase correlations -- and we have not extensively looked at it. And we will look at it in the Office of Research.

There is another problem which the analyst has to deal with on closely spaced modes. And we are also going to do some more work along those lines.

(Slide)

My final slide is -- number three on the top there isn't so important because as I said, pipe frequency modes just -- the use of algebraic summations for high frequency modes only lends greater realism, and doesn't necessarily have a very large impact. It could affect it conservatively or unconservatively. But we thought that we should do a little more work to show the realism to the extent we can.

The last bullet is an attempt to make the piping damping values adopted for seismic loads by the PRV to see if we could use the same dampings for SRV discharge in other environments, because right now those damping curves are restricted to seismic.

This is a curious thing, because Reg Guide 161, which says seismic damping is applied to every loading situation, but when the PVRC came out they said only seismic. So, we are going to do some testing with high frequency inputs on piping.

That's my presentation. The report is a best seller

in the sense that we are ordering 300 new copies. We have 60 unfilled orders right now.

(Laughter)

MR. SIESS: What was that last statement?

MR. O'BRIEN: See, we sell these things for $8.50 each. And we have exhausted our stocks and we are producing 300 more. But, we don't get any royalties.

MR. SIESS: That must be why I haven't gotten two sets like I get of everything else.

MR. SHEWMON: I've gotten three.

(Laughter)

MR. SIESS: John, I don't really mind all these people that are enthusiastic about analyses going through this stuff. It just bothers me when they start believing the results.

(Laughter)

I'm amazed at how little recommendation for research came out of this. These last two slides, and your recommendation for research. I thought they were rather minimal.

MR. O'BRIEN: What we suggest in addition to --

MR. SIESS: No, I am just wondering whether this was before or after the budget cut.

(Laughter)

MR. BUSH: I could comment on his last bullet up

there.

Gerry Bitner has picked up quite a few more points out in the ranges of interest from 33 to 100 hertz. He is just about ready to decide to change it, from what I would call an interim position to a final position, because even though theoretically we don't understand why there should be a change, all of the data we get -- and we have been getting quite a bit -- show exactly the same thing, that the damping values are high. At zero to 10 hertz they begin to drop off, and they stay at a lower value.

MR. SIESS: They stay fairly constant from 33 on?

MR. BUSH: Well, obviously the population of the data points is not so great there. We have a great number earlier. But he has been adding points. And the last time I talked to him, which was only about two weeks ago, he had just about decided he is going to put the document out. It won't be out as a WRC bulletin, it will go out as a PVRC technical report.

He has just about conceded to make the change from interim to final because he doesn't -- hasn't found any data to change his direction.

MR. SHEWMON: How much of that damping is in the pipe and how much of it is in the supports?

MR. BUSH: The tests have covered a very wide spectrum of support spans and so forth. So I would think a

great deal of it is in the piping.

Obviously, some of it is in the supports. So, I don't think I could answer your question exactly.

MR. SHEWMON: Is this dependent on ferritic or austenitic?

MR. BUSH: We see no obvious difference at all. Of course, it is still in the elastic range. If you got in the inelastic, then you might see something different in that respect.

MR. SHEWMON: I just wondered if there is a frequency dependence to the elastic damping.

MR. BUSH: That, I just don't know.

I will say there is one other aspect. That is, if you put insulation on the piping, that has a tremendous impact. You are now talking of damping values, it is 30, 40, 50 percent as contrasted to 5 percent.

MR. SHEWMON: But it is used both ferritic and austenitic?

MR. BUSH: Yes.

MR. MICHELSON: Chet, I think there may be a comment back here.

MR. VAGINS: Bill Vagins, Research, Staff.

Mr. Ebersole's question I think was a very valid one, and I think needs some clarification.

Several years ago, ten years ago, we started a

program called "Plenum Fill Experiments," which was partially to address the exact problem of what happens when you have a loss of coolant and you have massive injection.

You can consider the condition where you have a massive loss of coolant, depressurization of the system. And then you finally get down to firing your LPSI, your low-pressure injection system. At this point you have your whole system deadheaded, at 700 psi. And that fires when they reach that level, and you do get an injection, a very large flow of injection into a steam system, a two-phased system.

At this point, for instance the Combustion at Westinghouse will will be injecting into the cold leg. Babcock and Wilcox probably directly into the vessel. There is no problem with the vessel. There is enough volume and enough space to ensure there is no shock whatsoever.

However, into the cold leg and into the ECCS lines, you will be getting water hammer, steam acceleration or water slugging, or any of the three combined.

And the only reason I bring this up is that this is the one design condition where water hammers should be considered. We don't want to fire the LPSI and then rip out our system at the same time.

MR. EBERSOLE: Yes.

MR. VAGINS: So that when we look at removal of constraints, I think one of the things to seriously consider

is the maintenance of such restraints on the ECCS lines, ECCS system.

MR. EBERSOLE: Water can occur at frequencies higher than having a LOCA because you can get a stuck safety, or --

MR. VAGINS: Well, those would be beyond a design basis. But even in design, to fire your low pressure system you will be firing from a deadheaded position. An instantaneously -- almost instantaneously opening system. And that is inherently a water hammer design.

MR. EBERSOLE: Right.

MR. MICHELSON: How about the case of the reactor vessel overfill, or steam generator overfill into the piping? That also has the potential for serious water hammers.

MR. VAGINS: If you are talking about PWRs, you are talking about water injection into a single phase system.

MR. MICHELSON: Steam generator now.

MR. VAGINS: Secondary side, steam generator side, yes.

MR. EBERSOLE: He's talking about overfill, which is suddenly terminated by hydraulic filling of the secondary side.

MR. VAGINS: No question. We have had water hammer on the secondary side. Which is the case where we had a cracked pipe.

MR. BUSH: Indian Point 2. Back in the feedwater

line.

MR. MICHELSON: That was the feedwater side of the situation, not the steam side.

MR. BUSH: Also Maine Yankee.

MR. MICHELSON: That was also feedwater side.

MR. BUSH: Feedwater.

MR. SIESS: Okay, Larry?

MR. SHAO: (Slide)

Volume 5 is a summary of the volumes 1 and 4.

The way we work is, all the scope and objectives were set up by the NRC Piping Review Committee. But the actual draft report was written by a task group.

After the task report was written, it was submitted to the NRC Piping Review Committee for review and comments. And, after our review and comments, it was then sent to other major offices such as NRR, Research, I&E, and also the Region office for review and comments.

After we incorporated all their comments, then the report was published.

When we started writing volume 5, we found there were so many recommendations, there is no way the NRC can work on all the recommendations. So, we decided to categorize them into A, B and C.

The A category, of course, are the most important areas, and we feel NRC should work on them right away. But, B

and C are important, too, but of course, not as important as category A.

In general, we feel -- the Piping Review Committee has suggested many changes, and we feel some of the changes are very substantial. These changes, if they are made, should have a positive effect on overall licensing process. It will increase overall safety and reliability.

It may require changes to rules, Reg Guides and standard review plans. And also it may require change to the ASME code.

(Slide)

I was only prepared to talk about all these A categories. But now I find all the A categories have been covered yesterday and today.

MR. SHEWMON: Don't feel you have to talk for an hour to explain it.

(Laughter)

MR. SHAO: So, I don't want to talk unless you want me to talk.

MR. MICHELSON: I have a question on an A category item, which is item 5, which is the decoupling of the seismic and LOCA events.

What I wanted to ask you is in the case of boiling water reactors and systems such as reactor water cleanup, that system sees normally high full reactor pressure, full reactor

temperature in its operation. And yet it is nonsafety related, it is in many cases non-QA. In some cases it is even nonseismic.

Now, in a case like reactor water cleanup, are you going to still decouple the LOCA and the seismic event? It is a LOCA when the pipe breaks.

MR. O'BRIEN: The answer to that is -- unfortunately, A part says "where leak before break is applicable." That's wrong. It should have said "when justified," which Larry is going to tell you about. And right now the decoupling is not applicable to anything other than primary loops of the systems' three PWR vendors, and we are looking at GE.

So, what you did was you homed in on a mistake that went forward. It shouldn't be "where leak before break is applicable" but it should say "when justified."

MR. SHAO: They key word is "when justified."

It doesn't mean that we automatically decouple.

MR. MICHELSON: So I guess you don't know the answer yet until somebody asks -- well, nobody is going to ask. But the facts of life are it is designed this way already, and I guess nobody is going to ask to make it a leak before break system, I suppose.

MR. SHAO: If they ask they have it justified.

MR. EBERSOLE: I might comment that Carl is homing

in on one of the most devastating accidents you can have, which is continued primary discharge into machinery space because of valve unreliabilities to close and with little or no information on the dynamic competence of valves to close against a full discharge flow.

And the end result of that is it is regressive in that it destroys the mitigating equipment.

MR. MICHELSON: The real problem here of course is that my concern is should the valves be designed to close off the leak before break, or should they be designed to close off the break, keeping in mind they are nonseismic, non-QA in some utility cases.

I just wondered if you had a position or even a thought on it, and how I was to read this. But as I understand it, it would not even apply at this time. The committee didn't look at that particular kind of situation.

MR. SHAO: No.

MR. SIESS: I was looking at the B and C category recommendations, and I was just wondering, your A-2 is to modify the seismic damping values. And I go all the way down to C-1 to see spectral shift.

Why is --

MR. SHAO: Spectral shift is only about 10 percent --

MR. SIESS: I know, but it is just as easy to do as

modify the damping the values.

MR. SHAO: It can be easily --

MR. SIESS: Were these based on importance?

MR. SHAO: Based on importance and of consequence.

MR. SIESS: Because, if you are going to modify the Reg Guide 161 --

MR. SHAO: It can be easily done. As a matter of fact the ASME code is already put in the code case, and already Bob Bosnak has been used in many cases.

The only reason we didn't put it in A, it doesn't have major impact.

MR. SIESS: Let me go back to your first slide a minute.

What kind of changes did you make in your recommendations as a result of the comments received from the NRC offices?

And, to what extent were they related to the level of knowledge and to the problems of application and implementation?

MR. SHAO: To tell you the truth, all the experts -- there has already been dispute. People from the major offices already participated in the NRC Piping and Review Committee.

MR. SIESS: So the things like John talked about on water hammer came out of the original group?

MR. SHAO: Mainly because as you know, Alec Sirkus

who worked on A-1 is also on John O'Brien's group.

MR. SIESS: Did you have any differing professional opinions?

MR. SHAO: I think Spence Bush has a little bit.

MR. SIESS: You didn't allow for any additional remarks.

MR. SHAO: Finally, I think they compromised.

MR. SIESS: Reached a consensus.

MR. SHAO: Reached a consensus.

MR. SIESS: I expected that.

MR. EBERSOLE: May I ask in A-6, where are you going to modify leak detection equipment?

MR. SHAO: Let me give you a Vugraph.

MR. EBERSOLE: You have got it down there now. A-6. This leakage comes off of hot pipes that are cracked, I guess, don't you think?

MR. SHAO: That's a recommendation. Mainly we want to change from BWR piping, instead of 5 gallons per minute, change it to 3 gallons per minute. Instead of a surveillance period of 24 hours change it to 4 hours.

MR. EBERSOLE: This vapor will come off and will appear as condensate on the drains from the air coolers and the containments, is this correct?

So you are going to accumulate in some common receptacle the drains from the air coolant condensation

process?

MR. SIESS: Are you talking about how they detect leaks, Jesse?

MR. EBERSOLE: Yes. How are they going to find that 3 gpm when it comes out as steam into the general environment?

MR. BUSH: Of course one method that is used routinely, is the activated products technique which certainly works well with steam, and it can be calibrated to a degree, at least. It certainly is an early warning device.

And since most of these cracks we are talking about here are in the .0002 -- 1 or 2 gpm range, they do give you an early warning on damping.

I admit when you get down to the 3 gpm, you probably are ending up more with the sumps as much as anything else, which means that you have had condensation and rundown which, of course, may take a matter of hours or sometimes days.

MR. EBERSOLE: Where are you going to draw the line that you have got to shut down and have a look?

MR. SIESS: 3 gallons per minute.

MR. EBERSOLE: 3 gallons a minute.

MR. MICHELSON: Is that undetectable leakage of 3 gallons a minute, or --

MR. BUSH: That is nondetectable leakage, not detectable. Because the detectable is supposedly already taken care of --

MR. MICHELSON: But the detectable leakage is also an estimate, though, isn't it? You know where it is coming from, in other words, but --

MR. SIESS: Did I hear somebody say undetectable?

MR. ETHERINGTON: Identifiable.

MR. SHAO: Unidentifiable.

MR. MICHELSON: Unidentifiable.

MR. SIESS: For undetectable we don't worry about it.

MR. MICHELSON: Unidentifiable leakage has the problem of the identifiable leakage, which is really also an estimate. You think you know where it is coming from, you think you know how much it is, and therefore it is detected.

If I have a valve stem that has been leaking for the last two or three weeks, and I know it is 5 gallons a minute, then if I see it go up to 8 gallons a minute, I don't know whether that is coming from the valve stem, or whether it is coming from a breakdown in a pipe.

MR. BUSH: Unless you are using a bleedoff technique, where you are actually segregating the leakage from the valve stem or from the seals, which is often done, too.

MR. SIESS: In the case you are talking about, you would shut down and go find out.

MR. MICHELSON: But you now do this at 3 gallons a minute?

MR. SIESS: That's what it says.

MR. BUSH: This was volume 1, and this was discussed at considerable length. And the general feeling was at the 24-hour period which was used by some utilities, was excessive and that generally the value of 5 gpms which has been bandied around tended to be more on the basis of, well, it was hard, difficult.

But we also checked and found that several plants were operating at the lower levels and in a shorter time interval. So it can be done. It isn't an impossibility.

MR. EBERSOLE: Spence, in a practical sense, these shutdowns may cost a million dollars if you shut down and go in.

MR. BUSH: I agree.

MR. EBERSOLE: I was going to say, how does this 3 gpm relate to whether you can get in there and go find out where it is without shutting down?

MR. SHAO: All I can say is there are several plants that indeed are operating in their tech specs in this four hour or less business, and at essentially the 3 gpm rate, semi-voluntarily. I would say they might have had their arm twisted a little bit.

And I am unaware that -- certainly we didn't get any negative feedback during the meeting that this had represented an excessive burden. Now that doesn't say it doesn't. I just

say that we didn't get any negative feedback.

I don't think we have the right people here to answer. The people who looked at it were people like Bill Shack and others.

MR. EBERSOLE: Well, as a general rule when you go in a PWR you open purge valves, don't you, and blow the containment.

MR. BUSH: Oh, there is no doubt about it. In a case like this you would be entering into the drywell, and to enter the drywell you are going to have to shut down and go into the system. And that takes time.

MR. EBERSOLE: You don't have to shut down every time you go into the drywell -- into a PWR I'm talking about, a dry containment.

MR. SIESS: These are BWRs.

MR. BUSH: That is strictly a BWR requirement. PWR is one gpm.

MR. SIESS: This is a BWR requirement because of this intergranular stress corrosion factor.

MR. BUSH: That's right.

MR. SHAO: Also leak before break.

MR. SIESS: This is what they care going to pay for leak before break. And even if they go in and replace all their piping with NG, this is the price they have got to pay for leak before break to get rid of the restraints.

MR. SHAO: Right.

MR. SIESS: Now, if they want to continue to assume leak before break, will you let them and not impose this?

MR. BUSH: You mean if they want to assume the double-ended break? Is that what you are talking about?

MR. SIESS: Yes.

MR. BUSH: If they want to assume the double-ended break, then I presume they wouldn't try to apply this then.

MR. SIESS: So, if I have got an operating BWR, I can leave it as it is, if it is designed as a current process.

Or, if I want to go in and remove pipe restraints -- and I think some of them have these honeycombed to keep from busting the drywell stuff -- if I want to remove that stuff to facilitate inspection and meet ALARA -- did you look at ALARA?

MR. SHAO: For this package it says, normally the postulated break, you also have to remove the cracked piping. They have to replace with the good material.

If they don't postulate the break, they don't have to use this.

MR. SIESS: Okay. But they should replace the material anyway?

MR. SHAO: Replace the material for leak before break.

MR. SIESS: Replace the material, and at this leak rate they don't have to put the restraints in?

MR. SHAO: Right.

MR. SIESS: But if they replace the material and what to put the restraints back in, they have to go back to the old leak-rate requirements.

MR. BUSH: As a first step. I was thinking of other things. There are things beyond that they would have to do, if they want to go beyond that.

MR. MICHELSON: Boilers aren't doing any of this yet, though, are they? Because your whole review was only for the three brands of PWRs.

MR. BUSH: No. Four or five of them have replaced their piping, their recirc piping with NG at this stage. That is the most obvious thing I can think of.

MR. MICHELSON: The rulemaking doesn't cover this yet?

MR. BUSH: No. For leak before break you are talking about?

MR. MICHELSON: Yes.

MR. SIESS: It is only PWRs.

MR. BUSH: However, you may recall when Ray made his presentation, there was a caveat there that said if you have a resistant material in a BWR, at least it was open to consideration for that. That is as far as it went.

MR. MICHELSON: Have BWRs actually now removed their restraints?

MR. BUSH: No.

MR. SIESS: Not that I'm aware of.

MR. MICHELSON: I wasn't aware.

MR. SHAO: No. If they come with good material, if they want to remove --

MR. MICHELSON: This is for the future?

MR. SHAO: Right.

MR. SIESS: What would be likely to happen is, if they are going in to review that material, they could remove the restraints at the same time, impose this leak rate, and it would be all right.

MR. BOSNAK: One thing, some of the BWRs that have replaced their piping have reanalyzed their piping and have located restraints in accordance with today's standard review plan.

In the past they have located the restraints in a refitting or some other means. And they just brought it up to date to meet the current requirements. So, they got rid of a few restraints that they don't need to meet today's prescription. But, they didn't go into leak before break.

MR. SIESS: Now, Larry, the recommendations in the A, B and C categories are essentially an order of priority, and, of course, of time?

You recommend they implement the A items, and then go on?

MR. SHAO: Yes.

MR. SIESS: So it is mainly a question, you would like to see all of them implemented in this order?

MR. SHAO: Yes, in this order, because always the NRC cannot work on all at once.

(Slide)

These are the so-called A category on proposed research. A lot of them are ongoing research. We feel these are the most important areas. In case of any budget cut, these areas should not be cut.

A-1, I think John just talked about. That is the degraded piping program under Chuck Serpan.

Also, John covered A-4. Actually we already finished B&W. The only thing that is left is GE.

On A-3 we talked at great length yesterday. That is the program that EPRI, NRC and ENCO are working on. The purpose of the program, to verify the seismic margin, and also to identify the failure modes. And we feel that program is very important.

Under A-2, mainly it is to try to develop advance technique to detect and size cracks so that they can be incorporated into the Section 11.

Another area we feel is very important is they have been using weld overlay. We don't know how to inspect pipes that are repaired by weld overlay. So far we only call for

two cycles. There may be cases they want to use more than two cycles, so we would like to be able to develop an inspection technique to look at the pipes that are repaired by the weld overlay process.

The last item is, because everybody feels that leak detection is so important, we should have a program, a method to predict leak rate and validate the reliability of the leak detection systems.

MR. SIESS: All of these are ongoing?

MR. SHAO: We have all programs in this area. Let me show you a Vugraph.

MR. SIESS: All of these are in the FY1985 project?

MR. SHAO: Yes.

MR. SIESS: Now the Bs and Cs, did any of those get into 1986 and 1987?

(Slide)

MR. SHAO: We have programs in B and C, too.

MR. SIESS: You have some ongoing now?

MR. SHAO: Yes.

MR. SIESS: My question, to put it in context, are we looking at the 1987 budget now? I don't know that we have identified the Piping Review Committee recommendations in that. I am just wondering which ones of these are in 1987.

MR. SHAO: I can't answer your question right now.

MR. SIESS: Can you answer it two weeks from now

when we do the research committee.

MR. SHAO: Sure.

MR. SHEWMON: I would like to go back to the previous slide for a minute.

(Slide)

You have got two sets of recommendations.

MR. SHAO: One for research, one for regulatory actions.

MR. SHEWMON: Okay. I guess I am looking at A-2.

MR. SHAO: You want to look at which one? This one or the other one?

MR. SHEWMON: I want to look at that one. I look at the last line of A-2, and I wish it wasn't there because it sounds like you are only interested in inspecting weld overlays, and you don't care about the cast elbows and other things we were talking about.

MR. BUSH: I think you should realize that these are essentially taken right out of the reports. This one is taken out of one which dealt with stress corrosion cracking, which is not a problem in cast stainless.

The reason for this was the fact that we had put the caveat that you couldn't permit overlay clad for more than a certain period of time. But we were saying, see what you can do by inspecting through there.

I might comment that they now have a technique that

will inspect through the clad or the overlay.

So that is the reason, Paul. They are taken, essentially, close to verbatim. We didn't try to play games with the words on them. And so that would be the reason.

MR. SHEWMON: Good enough.

MR. MICHELSON: You are aware of the pipe locks, of course. Are they going to be used anywhere?

And if so, how does their usage fit into this plan, scheme of things?

MR. SHAO: Ralph is going to talk about that.

MR. BOSNAK: I could mention there is activities among several of the utilities to utilize the pipe lock. It is a proprietary device on -- I am not sure which -- I think one of the Commonwealth Edison plants.

Also, there is a move to look at a mechanical lock device in lieu of IHSI. In other words, this would provide the compressive stresses on the inside of the pipe. And in fact, as I have heard, provide compressive stresses more through the whole regime than IHSI would do.

So, that is another device that is being looked at. And these would come in on a kind of case-by-case basis to see how they are going to use them.

Pipe lock, if you are going to use pipe lock, you would have to reanalyze the whole system for the application of the pipe lock device.

MR. MICHELSON: Would it be possible if I use a pipe lock to say that I no longer have a break at that location? And, would I have to put in a detection system and so forth?

MR. BOSNAK: The pipe lock device has been tested with a break in that location. In other words, the whole --

MR. MICHELSON: Double-ended rupture is what I was referring to as a break.

MR. BOSNAK: We are not trying to mix pipe locks and breaks together. But the pipe lock device, the claim has been made for it that even though the flaw goes all the way through, that device will stay in place.

MR. MICHELSON: Therefore there would be no break there. There would be a leak, but not a break.

MR. BOSNAK: Well, it is not being proposed for that purpose.

MR. MICHELSON: I am puzzled about it.

MR. BOSNAK: It is being proposed in lieu of weld overlays.

MR. SIESS: But not in lieu of replacement.

MR. MICHELSON: I thought it was. I thought people were considering that a lifetime device.

MR. BOSNAK: Well they would like to, but the Staff is not yet ready. In other words, we are still looking at the applications and we still are looking at it as a limited application device. We may change our mind in the future.

MR. SHEWMON: It depends on whether the problem is Bill McDonald or Tom Bosniak.

MR. SIESS: But recommendation A-4 says replace.

Now that is the Piping Review Committee's recommendation, right?

MR. SHAO: Actually we should say the preferred action is to replace. The preferred action is to replace.

MR. BUSH: We only recommend.

MR. SIESS: I said recommendation.

MR. SHAO: If you read the letter to Dircks, we clarified this. I say the preferred action is to replace if you look at the Dircks letter on item A-4.

MR. SIESS: Okay, the preferred action is to replace. If you want to do anything else, convince me.

MR. SHAO: Another possibility, somebody will say I want to change to hydrogen water, also do IHSI in lieu of replacing. That is also acceptable.

MR. SIESS: Okay.

Now at some point, and I don't know whether this is it, we need to know what you expect of us in terms of comments on the major recommendations, at least, those that we expect to implement. And to do that, of course, we need to know the implementation approach.

Obviously, if it is a rule, we comment; if it is a Reg Guide, we comment; if it's a standard review plan, we now

have no formal mechanism for reviewing standard review plan, so we could comment on recommendations.

Do you want comments from the ACRS on the recommendations of the Piping Review Committee, or do you want comments on the various stages of implementation as they come along?

MR. SHAO: I think right now I would suggest to have comments on some of the major recommendations.

MR. SIESS: As recommendations of the Piping Review Committee?

MR. SHAO: Yes. Category A items.

MR. MICHELSON: Just in category A, I gather?

MR. SIESS: Yes.

Now the category A items did not include the schedule or exemption rule, which we may -- we will probably comment on as a rule.

MR. SHAO: No. Purely technical recommendation.

MR. SIESS: But it does include the broad-based rule and some Req Guide changes.

Now, could you refresh my memory as to what GDC 30, 31 and 32 are?

MR. SHAO: I think GDC 30 relates to the quality of primary coolant components on fracture mechanics and inspection.

MR. SIESS: 31 is --

MR. SHAO: Is on related inspection of primary coolant components.

MR. SIESS: 32?

MR. SHAO: 32 is on inspection, one is on quality, general quality, one is on inspection, and I forgot the other one.

MR. SIESS: Now, do you have to change those for the broad-based rule? It only addresses GDC 4. Do these others have to be changed?

MR. SHAO:

MR. SHEWMON: I think GDC 30, 31 and 32 are a matter of statements. I don't think you change.

MR. SIESS: They are in a column saying documents requiring change.

MR. SHAO: We say possibly. They are a general statement; you have to have a good primary coolant component, you have to inspect the primary coolant component, and so on.

MR. SIESS: Okay. Any other questions for Larry?

(No response)

We are down to Item III on the agenda.

Is there anything you want to bring up on tnat, Paul? This is 1.46, 1.48 Reg Guide issue?

Well apparently, you didn't put it on either.

Let me say something, maybe we can get it straight. We got information that was part of the implementation, Reg

Guides 1.46 and 1.48 were to be withdrawn and replaced by modified revisions to the standard review plan.

The question was raised in the ACRS about this procedure. In addition, we learned that this now was a new policy. To the extent possible, Reg Guides were to be replaced by standard review plans, which we hadn't heard of. Maybe it is not true.

But, it has been the practice of the ACRS to review Reg Guides. This was a practice implemented by the Staff. And our review has also provided an opportunity for public comments, but not limited to industry comments.

We have no methodology of procedure for reviewing standard review plans or branch technical positions. And I haven't found any strong sentiment towards that, since we still have enough other things to keep us busy. But, if our workload got down we might want to get into that. That would take care of a lot of time.

But, I had scheduled some discussion of the procedural, philosophical, whatever, idea of replacing Reg Guides by standard review plans for the next meeting of the Regulatory Activities Committee, which I think is June 4th.

I think the Staff at some level was going to come in and talk about that.

It is not so much these particular guides, as the general idea.

MR. BYRNES: This is Jack Byrnes from the NRC Research Staff.

As far as 1.46 and 1.48 is concerned, these were not being looked at as a change in policy, not presenting changes -- incorporating changes from the guides into the standard review plan and not bringing them to the ACRS. It is not the policy, but it is somewhat of an isolated case.

I think what has happened here is we were interpreting the memo between the Staff and the ACRS in June of 1983, which was referring to the coordination, about facts and so forth, how to go about these.

And this was indicating there that the primary areas of discussion would be related back to rules and the major policy matters.

And these two particular guides, there was no policy matter that we could see was involved from a technical sense, from a licensing sense. I think this is why we basically did not come to the ACRS on this.

MR. SIESS: Well, I think the memo is not very helpful. We were reviewing Regulatory Guides long before we had the Memorandum of Understanding which was mainly relating to rules. At some time after TMI they thought we ought to review rules. That is when we became the Regulatory Activities Committee, rather than the Reg Guides Committee.

The question that came up was, if there was going

to be a general practice of moving stuff from Reg Guides into standard review plan, then there would be a change in the review process. We would not be reviewing standard review plan items -- we haven't in the past. Industry would not -- publicly industry would not have a chance to comment on them. We thought we would like to sort of explore why this was being done, what regulatory purpose it served and so forth.

MR. BYRNES: There again, it is as far as I can see, no standard practice going to come about. Actually for the guides that came out, I guess it was in December of 1981, or something, the NRR had approached us and said, hey, these guys are not being used by the industry, by ourselves. The information that is contained in that has been incorporated in the standard review plan. In fact, even expanded on those, which made the standard review plans more active than the guides themselves.

So therefore, they suggested that we just drop the guides.

MR. SIESS: But the guide -- when something is in a guide, an Applicant can put in his FSAR that he will comply with Regulatory Guide 1.46, and that then is an accepted commitment.

Now, what does he do now? Say he complies with standard review plan section 4.3.2.6.8(i)?

MR. BOSNAK: In the case of the Regulatory Guide

1.46, that dealt with pipe breaks inside containment only, only for Class I and I believe Class II systems.

The standard review plan 3.61 and 3.62 came out in the mid-1970s and they expanded it. In other words, they cover all high energy lines, not only Class I, Class II, Class III and non-ASME class lines.

So now the Applicants come in and say they are going to comply with all aspects of those two standard review plans.

MR. SIESS: They are referring to standard review plans for compliance?

MR. BOSNAK: That's correct.

You mentioned something about industry commenting on standard review plans. These, when they are changed under the current processes, go out for industry comment. So I would expect that the committee could comment on them as well at the same time.

MR. SIESS: I'm not sure we want to.

MR. BOSNAK: If you want to.

MR. MICHELSON: If they are being used as the controlling document for review purposes, then it is just as important for seeing that as seeing Regulatory Guides.

MR. SIESS: Any time the ACRS wants to review standard review plans, I think they are willing to, but they can go find another chairman of the Reg Guide Activities

Committee when that happens. Because the standard review plan I've got is in two volumes, and we haven't even reviewed branch technical positions, which is another type --

MR. BOSNAK: They are part of the standard review plan. They are an annex to the standard review plan.

MR. SIESS: Now the standard review plan and branch technical positions are reviewed by CRGR. And since Reg Guides have been reviewed by CRGR, we have seen a lot fewer to review.

I don't know whether that means that the budget has been down to write new Reg Guides, or they are just not getting through CRGR.

MR. MICHELSON: Or they are replacing it with the standard review plan.

MR. SIESS: Yes.

Jack, correct me -- you said I was wrong, but let me just repeat it again. I heard that the Office of Nuclear Regulatory Research had decided, I guess was the word, to limit activity on Reg Guides and try to get the same thing accomplished through standard review plan changes. You said that is not true, there is no policy involved?

MR. BYRNES: I don't know of any such policy myself.

MR. SIESS: Okay, if you don't know about it it means it is not a policy, I guess.

But, rather than bring 1.46 up to date to cover greater territory, just in the standard review plan --

MR. BOSNAK: The same thing happened with 1.48. 1.48 was written in about 1973 or 1972, and since then the code was changed to apply different levels of allowable stress for Class II and III components.

In the earlier version when the Reg Guide was written, that was not the case. So as these things became available for industry use, there had to be some policy on how to deal with it.

At that time, standard review plans -- this goes back to about 1976 or 1977 -- 3.93 was written to cover the various events, events in combination and load combinations. So that, in effect, superceded what was in Reg Guide 1.48. It no longer was appropriate.

MR. SIESS: Now, let's take damping values, Reg Guide 1.61. Why would it not be equally logical to simply include that for standard review plan rather than a separate Reg Guide?

Or, is it in the standard review plan.

MR. BOSNAK: The Reg Guide was available. So it is referenced in the standard review plan currently.

MR. SIESS: But now, as you said, when 1.42 was available, but you added to it, so you put it in the standard review plan and didn't use it any more --

MR. SHAO: There's a difference. 1.61 not only includes damping value of piping, but also damping value of structure and other things. All the other things didn't change, only the damping value of piping has changed.

MR. SIESS: Suppose we changed the damping value for everything, would you then put it in the standard review plan rather than revised Reg Guide?

MR. SHAO: That would be a different story. But we are only changing damping value on piping.

MR. SIESS: I'm not on the Piping Review Committee now, I am on the question of Reg Guides versus standard review plans.

Would it be the policy in the future, rather than revising the Reg Guide, to simply put the revised version in the standard review plan?

MR. BYRNES: I don't see where that would particularly be a policy in any regard, even though it might be strictly related to one specific area.

I think something like the 1.61, with damping values applying to structures and mechanical systems, you would have to go back to a large number of standard review plans to modify it to include this in. It would probably be more appropriate and no effort to leave this thing in 1.61.

MR. SIESS: So the thinking is there is not that much difference between a Reg Guide and standard review

plan. They are comparable level documents. In one case, if you can reference one -- if you can reference the Reg Guide in the standard review plan, then that is convenient. So, it is an adjunct to the standard review plan much the same way a branch technical position is.

MR. ETHERINGTON: Do Applicants use and reference the standard review plan?

MR. SIESS: He said they could.

MR. BOSNAK: Yes, they do.

MR. BUSH: Extensively.

MR. BOSNAK: Both provide guidance to Applicants. They always have the alternative to come in with a different alternative, a different way of doing things.

MR. SIESS: If it is early enough in the process, they do.

MR. BOSNAK: That's correct.

MR. SIESS: The last six months it is not very likely.

MR. MICHELSON: If there are conflicts between the documents, standard review plan versus Regulatory Guide, which one takes precedent with the Staff?

MR. BYRNES: That's a good question.

MR. SIESS: There was no conflict between 1.42 and the standard review plan, just a difference in scope?

MR. BOSNAK: Just the scope is much larger. The

same thing is true of 1.48.

MR. MICHELSON: And 1.46

MR. BOSNAK: 1.46, not 1.42.

MR. SIESS: You said 1.48.

MR. BYRNES: 1.46 and 1.48 --

MR. BOSNAK: Both Reg Guides.

MR. SIESS: I'm sorry, you said 1.42 and meant 1.46?

MR. BOSNAK: Yes.

MR. BYRNES: I might comment that no where are we getting out of the Reg Guide business. We have several modifications to the guides going on right now.

MR. SIESS: I'm trying to get out of the Reg Guide business.

(Laughter)

Okay, but what I said you agree with? You think of it simply as a comparable level, comparable in all respects?

if it is convenient to write a Reg Guide and reference it in two or three places in the standard review plan, you expect to continue that way.

And, if it is more convenient to put it in one section of the standard review guide, you withdraw the Reg Guide?

MR. BOSNAK: That seems to be correct.

MR. SIESS: Okay. I will think about it a little

bit.

Does it bother anybody?

(No response)

Who started the idea of the ACRS reviewing Reg Guides?

MR. BUSH: I guess I did.

MR. ARLOTTO: I wrote the letter.

MR. SIESS: Spence was the first chairman of the Reg Guide Committee. I have been the other one.

How does it sound to you, Spence, all right?

MR. BUSH: Yes.

MR. SIESS: We don't have to meet every month now you know.

MR. BUSH: That's better than it used to be.

Incidentally, I looked at the standard review plan. I also looked at FSARs, where there has been reference citations.

Certainly, as Bob says, they do use that as a mechanism for indicating a degree of compliance in some areas, which is what was the intent, of course.

MR. SIESS: Paul, we are down to the last item.

I gathered from Larry that they would like to have comments on at least the category A recommendations of the Piping Review Committee. I guess it would have to be on the basis, we still reserve the right to comment on the actual

implementation when it comes along, whether it is a rule or Reg Guide change. Or, perhaps we could say even a standard review plan change.

And in order to get comments on this, it seems to me that we can't write a committee letter without having some presentation of this to the full committee. That has usually been the procedure, Paul.

I mean, there are exceptions. We have had subcommittees write letters of comment, which were then transmitted by the full committee. But I would not recommend that in this instance at all.

MR. SHEWMON: Now parts of this we have written on before. There is this June 14 letter on leak before break.

Have we written on the seismic/LOCA decoupling before?

MR. BOSNAK: I think some of that was in the June 14th letter as well.

MR. SHEWMON: I don't find it.

MR. SIESS: We don't with A-2 in that letter. No, we did, LOCA/seismic.

MR. SHEWMON: Okay. Fine

MR. SIESS: And we had a caveat that any relaxation of requirements to cope with double-ended guillotine breaks would be preceded by rigorous reexamination of the integrity of heavy component supports under all design conditions.

— I'm not sure what that means.

Do you know what that means?

MR. SHAO: I think it essentially says heavy support components should be maintained.

MR. BOSNAK: I tried to cover that a little bit this morning. I would hope that it could be interpreted broadly that if we got into things like trying to improve the reliability of the heavy component supports, particularly that have snubbers in their path, that the committee did intend that something like this could be included.

Basically we have in mind that we are not changing the margin of the supports. But if we can improve the reliability of the support system, we hoped that would be included.

MR. SHEWMON: That was the sentence that we added at Dave Okrent's advice or insistence. It wasn't in my original draft.

Part of the concern there, I am sure, was what we were grandfathering. That is, it is fine for newer current designs. What have we got that was designed 20 years ago that is out there? Have we looked at that? And, are we changing things?

It is not really what Carl brought up. In a sense it is what other sorts of things were there.

So, I think my off-the-cuff and personal opinion is

if you can show that you weren't reducing margins, and indeed, nothing had come as the toughness issue or other things, that made you feel that the margin here wasn't adequate -- we are more sensitive to this, mostly because of the Livermore study.

MR. SHAO: I will give you some background. I think the Livermore study said the pipe rupture came from two causes. One was direct cause, one was indirect cause.

MR. SHEWMON: We have read the report. Don't try to tell us why we wrote the letter.

MR. SHAO: Heavy components were indirect cause.

MR. SHEWMON: Yes.

MR. SIESS: I'm sure that all the work they did on the indirect causes, was not presented to us at that meeting. That was two years ago, and they have just finished up that work.

I just got a report the last few months looking at steam generators falling over and stuff.

MR. SHAO: I think it was presented to the subcommittee.

MR. SIESS: Which subcommittee? Metal Components? This one?

MR. SHAO: If I remember it was --

MR. SIESS: Okay, the full committee hasn't heard that. Although it is mentioned in the letter that the greatest

risk was from the indirect causes. They looked at that, more.

But, A-2 and A-5 have been looked at and there could be a follow up.

A-4 and A-6 are BWRs.

MR. SHEWMON: I don't think there is any argument with A-4s, certainly on the 3.16 and the 3.04 NG. That is generally accepted. And the 3.47, I've got on my notes the jury is still out on it.

MR. SIESS: And A-6 goes right along with it.

MR. SHEWMON: Yes.

Now A-5 you figure has been taken care of, since we have that in the letter of report?

MR. SIESS: No. It will come up again. It will have to be covered.

MR. SHAO: Mr. Chairman, on A-5 I would like to change the wording a little bit. Instead of saying seismic and LOCA events in systems where LBB is applicable, it should say decouple seismic and LOCA events when specified.

MR. MICHELSON: That's what it says already.

MR. SIESS: Not on page 37.

MR. SHAO: In my slide, but in Volume 5, the wording is different. In my Vugraph it is okay.

MR. MICHELSON: I agree with what is on page 37. I don't agree with what is on your slide.

MR. SIESS: What does the slide say?

MR. MICHELSON: Well, the slide leaves out those systems where leak before break is applicable.

MR. SHAO: When leak before break is applicable, automatically you don't need to decouple it.

If somebody can prove the probably is very small to have seismic and LOCA together, they can also be covered.

MR. SHEWMON: What is the benefit of trying to do this in two stages? It seems to me if you are going to look at comment on the limited rule of the leak before break, or with the damping when the modified Reg Guide is there, you can look at it.

It seems to me you are going to have some trouble in full committee buying a pig in a poke. Whereas, if you have got the Reg Guide or something definite, then you know what it is you are buying, and the discussion will be easier.

MR. SIESS: We can easily take care of A-1, which is -- that is the broad-based rule, right?

MR. SHEWMON: It is limited. Well, I would say it is the limited rule.

MR. SIESS: I don't see PWR in there.

MR. SHEWMON: You are right.

MR. SIESS: A-1 is the broad-based rule, right?

MR. SHAO: Right.

MR. SIESS: And we can take care of that in two steps. We can comment on them, do it as a comment on the

broad-based rule.

MR. SHEWMON: Broad-based rule isn't even written yet, is it?

MR. MICHELSON: Yes, it is.

MR. SIESS: That has gone to the Commission?

MR. ARLOTTO: No.

MR. SIESS: It hasn't. So, if we want to do it by steps, as Paul says, the broad-based rule as one item, we decide when you want to comment on it -- that's your committee. Modified seismic damping values we can treat just as a change to the Reg Guide in the usual manner, or referring to Okrent's Committee on Environmental as a Reg Guide change.

The decoupling OBE and SSE is not ready, and that is going to be a rule change. When the time comes, we will look at it.

A-4, Paul says how can you be against it.

MR. SHEWMON: I don't think anybody here is going to vote against it.

MR. SIESS: And A-5 and A-6. Maybe what we need to do is just prepare a letter saying how we will comment on this, and which ones we have no further need to comment on, which would probably be A-4, A-5 and A-6.

MR. MICHELSON: Certainly there is a problem. If A-5 is worded as it was in the Volume 5, I don't have a problem. But, if he does put down "when justified," --

MR. SIESS: Where did you see the "when justified"?

MR. MICHELSON: On the slide. And he says that is the way it really should have been written in Volume 5. Now we will comment on Volume 5 as it stands, and I won't have a comment.

If it is strictly when leak before break is applicable, fine because reactor water cleanup will not be applicable at all as I would see it.

So, which one are we comment on, Volume 5 or his slide?

MR. SIESS: Do you get the distinction he made? Does it apply to the primary system or --

MR. SHAO: Actually, there are cases in leak before break where you can justify decoupling seismic and LOCA.

MR. MICHELSON: I'm sure there are.

MR. SHAO: "Justify," we are not accepting a blank check. The Applicant has to give us a reason why they should do it.

MR. MICHELSON: The ACRS is giving you a blank check and saying, okay, go ahead until we have some further comment.

MR. SHAO: We have to go through a lot of study to make sure you can justify to decouple.

MR. SIESS: At this point what do you think is justified?

MR. SHAO: If the probability is something similar to what they do in Livermore.

MR. SIESS: At this point, for what systems has this been justified?

MR. SHAO: At this point right now on Westinghouse primary system we can decouple.

MR. MICHELSON: That's all.

MR. SHAO: And also the CE.

MR. BOSNAK: Right now we have completed the Westinghouse, the CE and the B&W loop, and that is it on the probabilistic work done at Livermore.

MR. SIESS: Now Carl is willing to accept it for the Westinghouse, because you have read the documentation, or because you trust the Staff?

MR. MICHELSON: Because I read the documentation.

(Laughter)

MR. SIESS: So we would be willing to say it is justified for Westinghouse for what we have looked at, and if similar results can be obtained for other plants --

MR. MICHELSON: On a similar basis.

MR. SIESS: We can say that, right?

MR. MICHELSON: Yes.

MR. SIESS: It seems to me that the Staff deserves some kind of a letter on the Piping Review Committee work. For one thing, although the ACRS never does it, I think they

ought to be complimented on the job they have done, and the reports they have gotten out. I think these are some of the best reports I have read, some of the easiest reports to read because the important stuff is up front, and you can really get it.

MR. SHAO: Thank you.

MR. SIESS: We could say in a letter, those parts that we have previously looked at are satisfied, and how we would look at the implementation.

We could agree with the recommendations with certain minor caveats, and point out how we will look at the implementation where the implementation involves more things.

For example, the broad-based rule, the language is important for the Reg Guide. It is easy to look at with the subcommittee that wants to go through that. I am sure they will, rather than coming into the full committee with it.

So, I like that approach, Paul. That is what you suggested.

Now, should the full committee hear anything of this, an overview which can't be done in less than a few hours?

MR. MICHELSON: I really think you would have to if you want them to get a letter out in any reasonable fashion. You will have to.

MR. SIESS: Do you think we could do something in

about four hours?

MR. MICHELSON: Hopefully it wouldn't take that long.

MR. SHEWMON: What parts would you have -- what parts would you bring before them?

MR. SIESS: Something like the introduction, background and sort of a summary, and something like Bosnak gave us on the implementation, just so people understand some of this.

MR. MICHELSON: All members didn't receive all volumes either, I assume. I would assume --

MR. IGNE: No, not yet.

MR. MICHELSON: I would assume Volume 5 is all they would need to see and use that as a basis for the presentation.

MR. SIESS: Have we got any time for the next meeting? I gave Ray back three hours that were scheduled for San Onofre.

MR. SHEWMON: If he hasn't spent it, you have got enough there.

MR. IGNE: We have nothing on the schedule now.

MR. SIESS: San Onofre is off. I think we have got three hours.

MR. SHEWMON: So, it would be the ramifications of leak before break, a little bit on -- you want to aim it

primarily on the recommendations that will be in the letter, or do you want to try to go over the summary of all five volumes?

MR. SIESS: I think they ought to go through the five major recommendations and how they are to be implemented, so that the committee will have the background for what the letter says about how we will review.

There should be some background on what we have already looked at in the June 1983 letter. Discussion. A little bit of the schedule on exemption, which followed form the A-2 which we talked about, what the broad-based does. And that is in the future aways.

Set the stage for a letter that says in general we think the Piping Review Committee has done a good job.

And these recommendations we previously looked at and agreed to. This we will look at under the rules and so forth.

MR. SHEWMON: So LBB for primary systems we will go over, and a little bit perhaps on the non-primary system part, the damping could be briefly done. Decoupling, OBE and SSE, what would you want on that?

MR. SIESS: John can give us something. We have John on that, John or Shao. I don't know which one had that?

MR. SHEWMON: It seems to me I would skip 3.04 and

take it by questions, if anybody has, so we could talk about what the tests are. But, decoupling, let's say we will take that on questions.

A-5, is that covered enough, or do you want background? This is seismic/LOCA decoupling.

MR. SIESS: That was the thing we discussed. We need some background on what we went through.

MR. SHEWMON: What is justified and what is applicable.

MR. MICHELSON: What the scope of this is going to be and where they are going to draw the lines, how they are going to handle the situation.

MR. SHEWMON: So A-5 we get then.

What about A-6? A-5 was decouple seismic/LOCA.

MR. SIESS: They need to start off with the June letter and bring them a little up to date on the incorrect clauses.

MR. SHEWMON: Leak detection requirements.

MR. MICHELSON: You need some discussion of that, just so they realize that is a part of the fix.

MR. SHEWMON: That probably should be grouped with the leak before break, shouldn't it?

MR. MICHELSON: Yes, that is where it logically, I would think, belongs.

MR. SIESS: That's the way it was presented

yesterday.

We really need to separate the PWR/BWR. There is a different set of caveats on the PWR. I think it makes it easier to think about.

MR. SHEWMON: Do you have that all so we can lay it out now?

MR. IGNE: Yes. We give the full ACRS Volume 5, a background document; we start off with the June 1983 letter; then we go leak before break with the leak detection; then we discuss damping; the OBE/SSE; 3.04; 3.16. We answer that by question.

MR. SHEWMON: You may want to break damping down.

MR. SIESS: Put the damping and the decoupling together at the end. They are different categories. Neither of those involves fracture mechanics -- I'm sorry, the decoupling does. The damping is a separate item, it doesn't involve the fracture mechanics study and the decoupling does.

MR. SHEWMON: So you have got the LBB leak detection as one significant component; and the other one is the decoupling damping.

MR. SIESS: LBB for a boiler involves everything that the PWR involved, but also involves the replacement of the leak detection, right?

MR. SHEWMON: It is not clear what LBB on the boiler -- that there is even anything about LBB on the boiler.

MR. SIESS: Broad-based rule includes everything?

MR. SHEWMON: No, it doesn't. It explicitly excludes things like the boiler that has stress corrosion cracking.

MR. MICHELSON: Unfortunately, it does not. We never got into all the detail. The words don't seem to exclude it anywhere.

MR. SHEWMON: They certainly do. If you turn to page 28 --

MR. MICHELSON: The recommendation of the committee does. I thought you were talking about the rulemaking document. In the rulemaking document, I don't find, for instance, that caveat.

MR. SHEWMON: Then we get back to the short rule which is PWRs only.

MR. MICHELSON: Yes.

MR. SHEWMON: And the report which says they clearly want to exempt boilers. And I think that is again the problem with trying to cope with the general rule at this time.

MR. MICHELSON: It is not supported by any of these five volumes that deal with it.

MR. SIESS: What I said is, if we inspect and review the broad-based rule later. What we need as a presentation, is enough for the full committee to know why we want to review it later.

MR. SHAO: For the BWR, suppose they place new material, suppose they put in water chemistry. Now they say they want to have leak before break. In that case, the boiler will be also applicable.

MR. SIESS: That's what I thought.

MR. MICHELSON: It is not supported though by the review committee.

MR. SHAO: When justified.

MR. MICHELSON: That's where we get into a problem, because you are extrapolating beyond what this Piping Review Committee seemed to be telling me.

MR. SHEWMON: No, it is not. It says if it is not sensitive to stress -- if it is stress sensitive, then LBB doesn't work. And he is saying, okay, if you take the other side of that same coin, if it is no longer sensitive, then it does.

MR. MICHELSON: If it is no longer sensitive.

MR. SIESS: That's what I was trying to say for the boiler, A-4 and A-6 are requirements for leak before break. Right?

MR. SHAO: Yes.

MR. BUSH: I think though -- this is a hypothetical one -- it would seem to me since there is a review on this, looking at it in a probabilistic fracture mechanics point of view, that probably one would want, you might say, the jury to

come back in before you make any such decision.

Hypothetically you could do it.

MR. SHEWMON: You mean we are sending LBL another X million dollars to do fatigue growth curve on stainless steel now?

MR. BUSH: Stress corrosion effect. Correct. That report is in draft form right now. The work has been pretty much done. It is not new work.

MR. SHEWMON: They are going to play merry heck finding out how fast a 3.16 nuclear grade would go, although I guess they could find some data on it.

MR. BUSH: No comment at this stage of the game.

MR. SIESS: Getting back to leak before break, the interim rule of the schedule exemption says for PWR primary loops, the Staff has gone ahead on the basis of our 1983 letter proposing to go ahead and eliminate leak before break for PWRs primary loop.

The Staff is working on another rule which does two things; it would extend leak before break to boiling water reactors if they have replaced the piping and if they have more stringent leak testing requirements.

The broader rule would also extend leak before break to other than primary systems. Right?

MR. SHAO: If they are justified.

MR. SIESS: If it can be justified on a basis

similar to that, and considering systems, et cetera, et cetera.

And that rule requires a lot more looking at when it is extended to other systems, and it may require more looking at when it is extended to boilers. I say may.

Now to me, that approach covers A-1, A-4, A-6 fairly straightforward.

Now A-5 you can toss in next, because that was addressed in the previous letter. We have had reports on it. The subcommittee has heard the indirect cause stuff.

Then modified seismic damping is a completely separate thing not involving fracture mechanic studies.

And the decoupling OBE/SSE is something that is so far down the line. It will certainly be looked at by other subcommittees.

I would take them about like that. And then we can write a letter saying essentially what we are going to do with it.

Okay, does that sound reasonable?

MR. SHAO: Yes.

MR. SIESS: Now, does it sound reasonable to adjourn?

(Whereupon, at 12:30 p.m., the hearing was adjourned.)

CERTIFICATE OF OFFICIAL REPORTER

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of: Advisory Committee on Reactor Safeguards

Name of Proceeding: Combined Meeting of ACRS Subcommittees on Metal Components and Structural Engineering

Docket No.:

Place: Washington, D. C.

Date: Friday, May 24, 1985

were held as herein appears and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission.

(Signature) Mimie Meltzer

(Typed Name of Reporter) Mimie Meltzer

Ann Riley & Associates, Ltd.

ACRS 5/24/85 RJBOSNAK NRR/DE

PRC TECHNICAL RECOMMENDATIONS

STATUS IN LICENSING REVIEWS

- o WRC BULLETIN 300-DAMPING AND SPECTRA PEAK SHIFTING
- o DECOUPLING SSE & LOCA CE A-2 PLANTS
- o GDC 4 LIMITED EXEMPTION - PWR LOOP
  - . EQUIPMENT QUALIFICATION
  - . HEAVY COMPONENT SUPPORT INTEGRITY ACRS LETTER 6/14/83
  - . STRUCTURAL DESIGN
- o ARBITRARY INTERMEDIATE BREAKS

  ENVIRONMENTAL QUALIFICATION FOR NON DYNAMIC EFFECTS OF NON-MECHANISTIC BREAK WITH GREATEST CONSEQUENCES

June 9 1983

Presented to ACRS 6/9/83.

ACRS APPROVAL OF STAFF PROPOSAL

- REVISED POSITION POSTULATED PIPE BREAKS (I)
  - PROPOSED INITIAL APPLICATION TO PWR PRIMARY LOOPS
  - LATER EXTENSION TO OTHER SYSTEMS

- REPLACEMENT CRITERIA (I)
  - LEAK BEFORE BREAK - DETERMINISTIC FRACTURE MECHANICS
  - LEAKAGE DETECTION
  - QUALITY ASSURANCE
  - ENVIRONMENTAL QUALIFICATION
  - SUPPORT DESIGN OF MAJOR LOOP COMPONENTS

- EVENT DECOUPLING - LOCA/SSE INITIALLY TO PWR PRIMARY LOOPS (II)

- IMPLEMENTATION (I AND II)
  - PLANT SPECIFIC EXEMPTIONS
  - LATER REVISIONS OF SRP AND GDC 2 AND 4

- ELIMINATE INTERMEDIATE BREAKS IN ALL SYSTEMS NOT SUSCEPTABLE TO CONDITIONS OF THERMAL FATIGUE, CORROSION, WATER/STEAM HAMMER (III)

- REPLACEMENT CRITERIA (III)
  - EITHER LEAK BEFORE BREAK - (I ABOVE)
  - OR
  - CONTAINED EQUIPMENT ENVIRONMENTALLY QUALIFIED

June 7 198

Presented TO ACRS 6/9/83

REPLACEMENT CRITERIA

- LEAK BEFORE BREAK – FRACTURE MECHANICS EVALUATION
- LEAKAGE DETECTION SYSTEM – POSTULATED LEAKAGE CRACK SIZE LARGE ENOUGH SO DETECTION ASSURED
- CRITICAL CRACK SIZE ≫ LEAKAGE CRACK
- DESIGN FOR FULL ENVIRONMENTAL EFFECTS FROM LEAKAGE CRACKS – (CRACK SIZE UNDER REVIEW)
  PRESENT SIZE – $\frac{\text{"D"}}{2} \times \frac{\text{"T"}}{2}$
- DESIGN OF SUPPORTS FOR MAJOR LOOP COMPONENTS – INTRODUCE MARGIN FOR SUPPORT SYSTEM RELIABILITY (UNDER REVIEW)
- QUALITY ASSURANCE – DESIGN/CONSTRUCTION

PRESENTATION OUTLINE

TASK GROUP ON OTHER DYNAMIC LOADS AND LOAD COMBINATIONS

0 ISSUES TREATED

0 PERSONNEL INVOLVED

0 RECOMMENDED REGULATORY CHANGES

0 RECOMMENDATIONS FOR RESEARCH

ISSUES TREATED

- 0 EVENT COMBINATIONS

  POTENTIAL SIMULTANEOUS OCCURRENCE OF EARTHQUAKES WITH PIPE RUPTURES AND OTHER DYNAMIC LOADS SUCH AS WATER HAMMER, SAFETY RELIEF VALVE DISCHARGE, TURBINE TRIP AND VIBRATORY LOADS.

  RESPONSE COMBINATIONS

  METHODS FOR EVALUATING THE PERFORMANCE OF MULTIPLY SUPPORTED PIPING WITH INDEPENDENT INPUTS.

- 0 STRESS LIMITS AND DYNAMIC ALLOWABLES

  INELASTIC ALLOWABLES AND STRAIN RATE EFFECTS.

- 0 WATER HAMMER LOADING

  CODE AND DESIGN SPECIFICATIONS FOR WATER HAMMER.

- 0 PIPING VIBRATION LOADS

  EVALUATION PROCEDURES FOR ESTIMATING OTHER THAN SEISMIC VIBRATORY LOADS.

PERSONNEL INVOLVED

NRC STAFF IN TASK GROUP

- 0 GOUTAM BAGCHI, NRR
- 0 JOHN FAIR, IE
- 0 MARK HARTZMAN, NRR
- 0 JOHN O'BRIEN, RES
- 0 AL SERKIZ, NRR

CONSULTANTS

- 0 BOB GUENZLER, INEL
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- 0 EVERETT RODABAUGH, E. C. RODABAUGH ASSOC.
- 0 AL SERKIZ, NRC
- 0 JOHN STEVENSON, J. D. STEVENSON & ASSOC.

INDUSTRY COORDINATORS

- 0 SID BERNSEN, BECHTEL
- 0 DON LANDERS, TELEDYNE

RECOMMENDED REGULATORY CHANGES

1. EVENT COMBINATIONS

   - O FOR MECHANICAL DESIGN, DECOUPLE EARTHQUAKE (SSE AND OBE) AND PRIMARY SYSTEM DOUBLE-ENDED PIPE BREAK FOR WESTINGHOUSE AND COMBUSTION ENGINEERING (BABCOCK AND WILCOX ADDED SUBSEQUENT TO THE PUBLICATION OF NUREG-1061, VOL. 4) . DECOUPLE EARTHQUAKE (SSE AND OBE) AND PIPE BREAK IN ANY OTHER PIPING SYSTEM WHEN ADEQUATE TECHNICAL EVIDENCE IS PRESENTED.

   - O ANTICIPATED DYNAMIC LOADS SUCH AS WATER HAMMER, SAFETY RELIEF VALVE DISCHARGE, TURBINE TRIPS, AND VIBRATORY LOADS SHOULD BE COMBINED WITH EARTHQUAKES (SSE AND OBE).

2. RESPONSE COMBINATIONS

   - O THE INDEPENDENT SUPPORT MOTION RESPONSE SPECTRUM METHOD SHOULD BE ALLOWED AS AN OPTION TO THE PRESENT UNIFORM SUPPORT MOTION PROCEDURES. THE METHOD ADOPTED BY THE

STAFF ALLOWS SRSS COMBINATIONS BETWEEN DYNAMIC AND PSEUDOSTATIC COMPONENTS OF RESPONSE, WHICH RELAXES THE PRESENT REQUIREMENTS OF ABSOLUTE SUMMATION. MOREOVER, A LESS CONSERVATIVE RULE IS USED FOR COMPUTING THE PSEUDOSTATIC RESPONSES. ALSO, A NEW RULE FOR COMBINING HIGH FREQUENCY MODES IS INTRODUCED WHICH REFLECTS GREATER REALISM.

3. STRESS LIMITS AND DYNAMIC ALLOWABLES

- A MAJOR SHIFT TO INELASTIC ANALYSIS OF PIPING SYSTEMS USING STRAIN LIMITS FOR PIPING ANALYSIS IS NOT JUSTIFIED AT THIS TIME. NO CHANGE IS RECOMMENDED IN THE PRESENT SRP PROCEDURE, WHICH ALLOWS INELASTIC PIPING ANALYSIS ON A CASE-BY-CASE BASIS.

- THE SRP SHOULD ALLOW INCREASES IN DESIGN YIELD STRENGTH GREATER THAN 10 PERCENT DUE TO STRAIN RATE EFFECTS FOR PIPE WHIP RESTRAINT DESIGN WHEN SUPPORTED BY TECHNICAL EVIDENCE.

4. WATER HAMMER LOADING

- O EFFORTS TO REDUCE OR MINIMIZE THE INCIDENCE OF ACCIDENTAL WATER HAMMER (WITH EMPHASIS ON OPERATOR TRAINING) SHOULD CONTINUE.

- O DEVELOPMENT OF DESIGN STANDARDS FOR WATER HAMMER SHOULD REST WITH THE PLANT OWNER OR APPLICANT AND HIS DESIGNER, AND NOT WITH THE NRC.

- O WHILE STANDARD CHECKLISTS COULD BE USEFUL, THE WIDE VARIETY OF PLANT DESIGNS AND OPERATIONS WORKS AGAINST DEVELOPMENT OF SUCH CHECKLISTS AND THE NRC SHOULD NOT BE CALLED UPON TO DEVELOP CHECKLISTS AT THIS TIME.

5. PIPING VIBRATION LOADS

- O FOR VIBRATORY LOADS OTHER THAN SEISMIC AND WITH SIGNIFICANT LOADING IN THE FREQUENCY RANGE FROM 33 TO 100 HERTZ, IT IS ACCEPTABLE TO PERFORM NONLINEAR ANALYSIS TO ACCOUNT FOR GAPS BETWEEN PIPES AND PIPE SUPPORTS.

RECOMMENDED REGULATORY CHANGES (CONTINUED)

- O THE SRP SHOULD ALLOW AND ACCEPT THE CONDUCT OF VIBRATION TEST PROGRAMS IN ACCORDANCE WITH ANSI/ASME OM3, "REQUIREMENTS FOR PREOPERATIONAL AND INITIAL START-UP VIBRATION TESTING OF NUCLEAR POWER PLANT PIPING SYSTEMS."

- O EXPLICIT REFERENCE TO VIBRATIONAL LOADS FROM RECIPROCATING AND ROTATING EQUIPMENT SHOULD BE MADE IN THE SRP.

- O THE SRP SHOULD INDICATE THAT IT IS ACCEPTABLE TO PERFORM THE EVALUATION OF VIBRATORY LOADS TRANSMITTED BY SUPPORTING STRUCTURE TO PIPING BY ANALYSIS, TESTING, OR A COMBINATION OF ANALYSIS AND TESTING.

RECOMMENDATIONS FOR RESEARCH
(NOT SORTED BY ISSUES)

- COMPLETE WORK ON BABCOCK AND WILCOX (COMPLETED SINCE PUBLICATION OF NUREG-1061, VOL. 4) AND GENERAL ELECTRIC REACTOR COOLANT SYSTEMS TO LEARN IF IT IS POSSIBLE TO DECOUPLE EARTHQUAKE (SSE AND OBE) AND RCL PIPE RUPTURES FOR THESE VENDORS.

- UNDERTAKE TESTS OF FLAWED (DEGRADED) DUCTILE PIPING SUBJECTED TO SIMULATED SEISMIC AND OTHER DYNAMIC LOADS, SUCH AS WATER HAMMER AND FLOW INDUCED LOADS, IN ORDER TO ESTIMATE DESIGN MARGINS.

- ADDITIONAL ANALYTICAL STUDIES SHOULD BE PERFORMED TO:

  1. CLARIFY THE IMPACT OF PHASE CORRELATIONS BETWEEN SUPPORT GROUPS ON THE RECOMMENDATIONS FOR THE INDEPENDENT SUPPORT MOTION METHOD,

  2. EVALUATE METHODS FOR CALCULATING THE EFFECT OF CLOSELY SPACED MODES, AND

RECOMMENDATIONS FOR RESEARCH (CONTINUED)
(NOT SORTED BY ISSUES)

3. ESTABLISH THE TRANSITION FREQUENCY BETWEEN HIGH AND LOW FREQUENCY WHEN IMPLEMENTING THE ALGEBRAIC SUMMATION RULE FOR HIGH-FREQUENCY MODAL COMBINATIONS.

0 IT SHOULD BE DETERMINED WHETHER THE RECENTLY APPROVED PVRC PIPE DAMPING VALUES FOR SEISMIC LOADS CAN BE EXTENDED TO HIGHER FREQUENCY (33 TO 100 HERTZ) VIBRATORY LOADS.

VOLUME 5

SUMMARY - NRC PIPING REVIEW COMMITTEE

CONCLUSIONS AND RECOMMENDATIONS

MAY 24, 1985

VOLUME 5 SUMMARY - PIPING REVIEW COMMITTEE CONCLUSIONS AND RECOMMENDATIONS

- PRC REVIEWED TASK GROUP REPORTS
- REVIEWED COMMENTS RECEIVED ON TASK GROUP REPORTS FROM NRC MAJOR OFFICES
- SUMMARIZED MAJOR ISSUES
- PREPARED SET OF RECOMMENDATIONS FOR REVISING NRC REQUIREMENTS - CATEGORIZED BY PRIORITY AND RANK
- PREPARED SET OF RECOMMENDATIONS FOR RESEARCH CATEGORIZED BY PRIORITY AND RANK

CONCLUDED

- SUGGESTED CHANGES SUBSTANTIAL
- SHOULD HAVE POSITIVE EFFECT ON LICENSING PROCESS, SAFETY, AND RELIABILITY
- MAY REQUIRE CHANGES TO RULES, REG GUIDES, AND STANDARD REVIEW PLANS
- MAJOR CHANGE IN ASME CODES

SUMMARY OF RECOMMENDATIONS

Category & Rank Order	Recommendation	Documents Requiring Change
A-1 (Vol.3)	Use leak before break (LBB) rather than the DEGB so that terminal and intermediate breaks would be eliminated when certain acceptance criteria are met. It would lead to exclusion of dynamic effects such as pipe whip, jet impingement, and subcompartment pressurization. The major impact would be on General Design Criterion 4 - Environmental and Missile Design Bases. The requirement to postulate arbitrary intermediate breaks should be eliminated.	10 CFR Part 50 (Appendix A, GDC-4, -30, -31, -32) SRP 3.6.2 R.G. 1.46
A-2 (Vol.2)	Modify seismic damping values currently used in seismic design. The suggested values have been incorporated into ASME-III and accepted by NRR on a case-by-case basis. This modification could lead to changes in support design and spacing and consideration of nozzle loads as well as reducing the number of snubbers.	R.G. 1.61 SRP 3.9.2
A-3 (Vol.2)	Decouple OBE from SSE.	10 CFR Part 100 (Appendix A)
A-4 (Vol.1)	Replace 316SS or 304SS in BWR recirculation piping with alloys resistant to IGSCC to eliminate this mode of pipe cracking. Possible types are 316NG, 304NG, 347NG.	10 CFR Part 50 (Appendix A, GDC-30 (possibly)) NUREG-0313 R.G. 1.44
A-5 (Vol.4)	Decouple seismic and LOCA events when justified.	SRP 3.9.3
A-6 (Vols.1,3)	Modify leak-detection requirements. This issue impacts BWR-IGSCC as well as Recommendation A-1.	NUREG-0313 Tech. Specs. R.G. 1.45

SUMMARY OF RECOMMENDATIONS FOR RESEARCH

Category & Rank Order	Recommendation
A-1 (Vols.1,3)	The full-scale pipe fracture experiments of the NRC Degraded Piping Program should be completed. Of primary interest is the development and/or validation of fracture mechanics analysis techniques for ductile piping. Experimental variables should include flaw geometries, material toughness, axial-to-bending load ratios, and static/dynamic loads.
A-2 (Vol.1)	Development of advanced techniques and procedures for crack detection and depth sizing should continue for incorporation into Code requirements. Included should be analysis of the human factor, equipment qualification and certification, and inspection techniques for detecting and dimensioning flaws in pipes repaired by the weld overlay process.
A-3 (Vols.2,3)	Test programs (e.g., EPRI's piping capacity tests) for verifying seismic design margins and identifying failure modes for typical piping systems should be supported. Test results should be evaluated and recommendations provided for criteria changes (e.g., reclassification of seismic inertial stresses as "secondary"), as appropriate. Both cracked and uncracked piping systems should be tested.
A-4 (Vol.4)	Work under way at the Lawrence Livermore National Laboratory on Babcock and Wilcox and General Electric reactor coolant loop piping should be completed to learn whether earthquake in combination with reactor coolant loop double-ended guillotine break may be excluded for these designs.
A-5 (Vol.3)	Work should be performed to determine the reliability of methods to predict leak rate and validate the reliability of leak-detection systems.