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UNITED STATES NUCLEAR REGULATORY COMMISSION'S
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

DATE: Thursday, December 7, 1989

The contents of this transcript of the proceedings of the United States Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards, (date) Thursday, December 7, 1989, as reported herein, are a record of the discussions recorded at the meeting held on the above date.

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Meeting of the Thermal Hydraulic

Phenomena Subcommittee

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7920 Norfolk Avenue

Room P-100

Bethesda, Maryland

Thursday, December 7, 1989

The above-entitled proceedings commenced at 8:30 o'clock a.m., pursuant to notice, Ivan Catton, Subcommittee Chairman, presiding.

PRESENT FOR THE ACRS SUBCOMMITTEE:

I. Catton

W. Kerr

D. Ward

P. Davis

V. Schrock

P. Boehnert, Cognizant ACRS Staff Member

STAFF AND PRESENTERS:

R. Barrett
S. Diab
G. Burdick
E. Throm
D. Bessette
G. Wilson
R. Lee
M. Ortiz

AUDIENCE SPEAKERS:

T. Scarbrough
O. Rothberg
K. Campe
J. Isom
J. O'Brien
B. Jones
L. Shotkin

PROCEEDINGS

[8:30 a.m.]

MR. CATTON: The meeting will now come to order.

This is a meeting of the Advisory Committee on Reactor Safeguards Subcommittee on Thermal Hydraulic Phenomena.

I am Ivan Catton, Subcommittee Chairman.

The ACRS members in attendance are Bill Kerr and Dave Ward.

We also have ACRS consultants Pete Davis and Virgil Schrock.

The purpose of this meeting is to discuss (1) the proposed NRR and RES programs for resolution of the interfacing systems LOCA issue; (2) the status of the NRC-RES Technical Program Group's efforts to apply the Code Scaling, Applicability, and Uncertainty methodology to calculation of the effects of the small-break LOCA; and (3) the status of the development of the Westinghouse best-estimate ECCS/LOCA model.

A portion of the meeting will be closed to the public in order to protect information deemed proprietary by the Westinghouse Electric Company.

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

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on November 28th, 1989.

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

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

If anybody has any comments --

[No response.]

MR. CATTON: -- I see none -- we'll proceed with the meeting.

I call upon Mr. Rich Barrett of NRR to begin.

MR. BARRETT: Thank you, Mr. Chairman.

I am Richard Barrett. I am Chief of the Risk Applications Branch in NRR.

This morning I would like to talk to you about an issue which we have known about for at least 15 years but which we have recently become more concerned about and we are placing more emphasis on, namely the interfacing systems LOCA.

Now as I am sure most of you know, an interfacing systems LOCA is a break in the piping or seals, gaskets, in the low-pressure systems which are connected to the reactor coolant system -- for instance, the residual heat removal systems in a PWR.

These kinds of breaks can be caused when the low-pressure systems are exposed to the reactor coolant system pressure due to the failure of the pressure isolation valves either through mechanical, electrical or, as we are learning more recently, through human errors.

[Slide.]

MR. BARRETT: We are concerned about this type of an accident because the break occurs outside of the containment or can occur outside of the containment and therefore what you have is a loss of two out of your three fission product barriers, namely the reactor coolant boundary and the containment.

We are concerned because there is a possibility for core damage very early in the accident either because the nature of the accident results in a loss of the injection capability or because even if you do have injection, the injected water will not make its way to the sump or not necessarily make its way to the sump and therefore you could lose recirculation to the core.

There is a possibility of early, perhaps lethal doses off-site and also because of the timing of the accident there can be limited opportunity for protective actions off-site, such as evacuation.

Now we recognize that there is a wide spectrum of possible scenarios associated with an interfacing systems LOCA. You can have interfacing systems LOCAs which proceed very slowly. You can have interfacing systems LOCAs which have much less than lethal doses off-site but the project that I want to talk to you about today is concerned about the high consequence type of interfacing systems LOCAs, the ones I described for you just a moment ago.

[Slide.]

MR. BARRETT: As I mentioned, we have known about this accident since WASH-1400. WASH-1400 included in the analysis an analysis of the so-called Event V, where Event V was a failure in a particular type of pressure isolation line. It was a failure of a configuration where you have two check valves as the pressure isolation boundary.

What they found was that you can get a fairly high frequency for this type of an accident if you have that kind of a configuration because, depending on how you test those lines, you can have an undetected failure of one of the check valves and so all that is required to create the accident is the failure of the other check valve.

What they concluded was that you can greatly reduce the probability of this type of accident if you can independently leak test both check valves in lines of this type so you won't have that undetected fault.

As a result, in the 1980-1981 time frame there were some -- a number of orders were sent out to PWR plants, mostly to PWR plants, there were a couple of BWR's also -- which had this kind of configuration, either two check valves or two check valves and an open MOV, requiring them to independently leak test both check valves.

Those orders went to I believe 34 PWR's and 2 BWR's.

MR. CATTON: But you need more than a leak, don't you, to get into trouble?

MR. BARRETT: Well, the point was not so much that you -- yes. To get into this kind of a high consequence situation, yes, you do.

MR. CATTON: You almost need a catastrophic failure of the check valve.

MR. BARRETT: Yes, but if you are not independently checking them, if you are only leak testing the two as a pair, you could have a catastrophic failure that is undetected.

MR. CATTON: Somehow I am missing something. I missed it when they reduced the probability of this failure 15 years ago by the testing.

How does the leak tell me about impending catastrophic failure?

MR. BARRETT: That's an excellent point and a little bit later in the presentation I would like to get into that.

MR. CATTON: Somebody will, good.

MR. BARRETT: It does not tell you about impending failure. The purpose of the testing is not -- we call it leak testing but it's really testing to see if the valve has failed.

If you are just testing the two as a pair, one of them could be completely failed and you would not detect it, but you are absolutely right. Leak testing does not tell you about impending failure and there is an awful lot of activity that is going on right now to try to go beyond leak testing.

We won't get into that in detail today but I will mention it a little later on.

MR. CATTON: The bottom line is two orders of magnitude as a result of leak testing, so I think it is kind of important.

MR. BARRETT: Oh, yes, but bear in mind that that was simply because independent leak testing would eliminate that undetected, totally failed valve.

MR. CATTON: Okay.

MR. BARRETT: Okay. At the time we put out the orders we also changed the standard review plan so that in the future all plants that were licensed after that time there was a requirement for independent leak testing of all pressure isolation valves, not just the ones that were in Event V type configurations and there was a decision that was made that we would try to backfit that requirement, namely that all pressure isolation valves would have to be independently tested but that would be backfitted through the IST process. As part of the SERs for the IST program that requirement would be implemented.

MR. KERR: I know a lot of these acronyms, but what is -- remind me what IST is?

MR. BARRETT: Oh, yes, okay. That's the integrated -- I'm sorry, the In-Service Testing program, the in-service testing that's required for all valves and pumps.

It's the in-service testing of all valves and test in-service inspection -- ISI and IST, In-Service Inspection of the integrity of piping and such.

However, in 1985 it was decided by the Committee for the Review of Generic Requirements that the decision that I just talked about was really a backfit and that as a backfit we would have to do a backfit analysis. We would have to show that a decision to require the independent leak testing of all pressure isolation valves was cost beneficial, and so Generic Issue 105 was instituted to do that.

To this date we have not yet been successful in demonstrating that leak testing of all pressure isolation valves is cost beneficial.

Now as Dr. Catton pointed out, leak testing a valve does not necessarily detect an impending failure of that valve.

A valve can have a completely failed hinge pin and yet it will be held nicely in place by the differential pressure until you have some sort of a transient and it falls off and I simply want to mention that more recently now there has been a great deal of effort to -- and discussion about being more proactive about check valves, about the maintenance of check valves, about removal of check valves, inspection and testing for possible undetected faults.

MR. KERR: What specifically has been done?

MR. BARRETT: Well, I will mention two efforts.

One very important one is the INPO-SOER 86-3.

That effort along with some EPRI work that has been done in terms of giving guidance on how to maintain and inspect check valves, essentially it's not a requirement on the industry but it essentially tells the industry that these -- that these valves should be removed and inspected after they have been in service for a certain amount of time.

Also, there's been guidance given on how to maintain these valves, how often to test them and that sort of thing.

MR. KERR: This is an industry initiative.

MR. BARRETT: That's an industry initiative. I'd also like to mention one NRC initiative that's recent, and that's Bulletin 89-02. That was a followup to some problems that were observed in Anchor-Darling valves, check valves where there was, I believe, some stress corrosion cracking of the hinge pins, where the hinge pin mounting and some valves were failing because of that.

89-02 placed a requirement on the utilities to dismantle and inspect valves of this make or of similar make and to report to the NRC as to what they found in terms of the inspection of these valves, what their physical condition was.

So we're moving away from just leak testing of valves and becoming more proactive about maintenance and testing and inspection of valves. There's a whole major effort on check valves, and I really don't want to get into it in detail today, but the NRC NRR has a whole check valve initiative. It has a whole plan for motor operated valves and we're trying to work very closely with the people in the mechanical engineering branch who are spearheading this whole effort.

I think if you want to know about that, it might be useful to have a separate briefing.

MR. KERR: I am aware of the motor valve, some of the initiatives. I was really referring to check valves where you said that we had become much more proactive and I was curious as to what you had had in mind.

MR. SCARBROUGH: I'm Tom Scarborough with the Mechanical Engineering Branch. As Rich said, we do have programs that we're initiating on check valves and motor operated valves. We gave a briefing to Mr. Michelson's subcommittee on October 3rd, I believe. I think maybe some of you were here, but --

MR. KERR: I didn't necessarily want all the details of the programs. I do appreciate the information. I was curious as to what he meant when he said "we are becoming more proactive." I think I have an idea now of what it is that he is referring to.

MR. SCARBROUGH: Very good.

MR. KERR: Thank you.

MR. BARRETT: Thank you, Tom.

MR. CATTON: You didn't mention the industry program, NIC, which is probably the best of the lot.

MR. BARRETT: Exactly, yes. I was about to mention NIC. It's Nuclear Industry Check valve Program and it's -- again, we are working closely with them, right, Tom?

MR. SCARBROUGH: Right.

[Slide.]

MR. BARRETT: Now, the situation, if you will pull out a modern PRA and you look for the ISLOCA, what you'll generally find is that the interfacing systems LOCA is still treated as a check valve failure problem. There's not a lot of treatment of human errors, and there's also not a lot of treatment of accident management to mitigate an interfacing systems LOCA once it has started.

The assumption is generally made that once an interfacing systems LOCA, especially a large interfacing systems LOCA has occurred, that that means core melt. Generally, you will also find that what you calculate is very low core damage frequencies in the vicinity of ten to the minus 6 per reactor year.

But even at those low frequencies, you'll find that interfacing systems LOCA is a major, if not dominant contributor to early fatalities because of the bypass of containment.

MR. DAVIS: Excuse me, Rich. I think it's useful to point out that those conclusions apply only to PWRs, and I don't know if that's all you're going to talk about or not, but the items on the slide that you just showed are only for PWRs, as I understand it.

MR. BARRETT: Yes. I will point out that we are concentrating on PWRs at this time in this program, yes. Thanks, Pete.

[Slide.]

MR. BARRETT: We have seen a lot of recent operational experience which indicates that interfacing systems LOCA may not be just a check valve failure problem. It may not be a mechanical problem. It may actually, in fact, be dominated by human errors. Recent operational experience in this country and abroad has demonstrated a wide variety of possible human actions to bypass the various safegaurds against the loss of the pressure isolation boundary.

If you want, we can give you a little bit more detail about that later, but these -- this experience indicates that the human error may, indeed, dominate the ISLOCA problem.

MR. KERR: When you say, "may, indeed," what does that statement mean?

MR. BARRETT: Well, we've seen a lot of different kinds of problems of human error, but we haven't taken those problems and evaluated them in an integrated way within the context of a PRA.

MR. KERR: Well, but this program that you're anticipating apparently depends on your evaluation of some major new perspective on risk. When all I hear is that something may, indeed, contribute to risk, I'm curious as to what that means.

MR. BARRETT: Well, a major part of this program is to make that evaluation. We're not at the --

MR. KERR: You haven't yet made it, then?

MR. BARRETT: No, we have not.

MR. KERR: In spite of these two rather formidable documents from BNL?

MR. BARRETT: The two documents from BNL are the main technical products from Generic Issue 105 and they concentrate primarily on the questions of the testing and the checking of check valves.

MR. KERR: Okay.

MR. BARRETT: What's new about this particular project I'm going to talk about is the human error component of it.

[Slide.]

MR. BARRETT: Okay, as a result of this recent experience, primarily with human errors, Dr. Murley has initiated a special project with the idea in mind of getting an early answer as to what is the severity of ISLOCA in light of all of this new experience that we're seeing.

The decision was made not to wait for the results of the IPE program, the Individual Plant Examinations, the PRAs that will be done by all plants in response to the Severe Accident Policy Statement, partly because the schedule for the IPEs is more protracted than we would like.

We would like to have an answer to this question earlier than we would expect to see the IPEs, but also partly because we're not confident that, given the current way in which PRAs are done, that the human element will be addressed in the way we would like to have it addressed.

MR. KERR: Are you confident that it can be addressed in the way you would like to have it addressed?

MR. BARRETT: We're confident -- yes, we're confident that we can do a better job, in general, than what is done now.

MR. KERR: That's an answer to a different question.

MR. BARRETT: Well, I recognize that human reliability analysis is a difficult area of study, and we're going into this to do the very best job we can with it.

MR. KERR: Is there some reason though, that you think you can do a much better job than is being done at present so that you will be able to answer this question?

MR. BARRETT: Well, yes.

MR. KERR: What evidence do you have that you're going to affect these improvements in existing methodology?

MR. BARRETT: Well, basically, we're going to take the existing state-of-the-art human reliability analysis methods and apply them to this interfacing systems LOCA and we're also going to take into account, the existing information about the types of failure modes that we've seen in the operational experience.

It's a package of putting together all of these things in a way that has not generally been done, or has not -- I think I can say it has not been done. So, it's not a matter that it could not have been done.

It's just that, in general in PRAs, it is not done. So, we're trying to do a special study to take the operational experience, the human reliability methodology; put it into a PRA type of analysis and come up with a one-time answer as to how severe this human element is in the ISLOCA.

MR. DAVIS: I can appreciate your desire to get this finished faster than the IPEs might produce a reasonable answer, but I'm not so sure that I understand why you don't think the IPE will give you the type of answer you want on this question.

Wouldn't it be possible for the NRC to provide the utilities with guidance on this issue for including in the IPES that would ensure that you would get the right kind of analysis.

MR. BARRETT: Yes, I think that's very possible. In fact, I think that's one of the possible outcomes of this study. At the moment, I wouldn't know what guidance to give them.

MR. DAVIS: The only concern I have is that this issue, like many issues, is extremely plant-specific. I think that was illustrated amply by the Brookhaven studies. That's why it seems to me that an attempt an a generic resolution is going to have a problem in trying to capture all the different designs, which to me means that an IPE approach might be a little more appropriate.

MR. BARRETT: I think that's a good comment, Pete, and I -- that is one of the things that -- we're keeping that as an option that when we complete this study and we have the insight that we get from the study, it could be that the way to resolve this problem is to put those insights out to the industry and ask them to address them in the IPE, or for those plants that have completed their IPEs, to update their IPEs with these new insights.

MR. CATTON: In the human factors --

MR. WARD: You're not willing to commit to that approach or plan on that approach at this stage; is that right?

MR. BARRETT: I don't think we know enough yet, Mr. Ward. I think it's possible that we'll find a generic problem.

It's possible we'll find no problem, and we may find a generic solution. We may find some limited set of applicable solutions, but this is definitely a possibility. I think it's too early to tell.

MR. CATTON: In the human factors area, we had sort of a tutorial here a few months ago and it showed that there -- at least it was discussed that the range was of almost two orders of magnitude on the errors of commission. This was a result of an ISPRA study.

What are you going to do with that?

MR. BARRETT: That's a difficult point. We recognize that human reliability analysis is even more uncertain than the rest of PRA analysis.

MR. CATTON: A comment was also made that the method that's used by NRC -- I don't remember what you call it, but it gave the lowest value for the errors.

MR. BARRETT: It was --

MR. CATTON: Consistently.

MR. BARRETT: -- the most accurate or the least accurate?

MR. CATTON: Well, I mean the most -- with the least conservatism --

MR. BARRETT: Oh, I see.

MR. CATTON: Of all of the different approaches that were looked at.

MR. BARRETT: Okay, I wasn't -- I'm not sure which method you're talking about.

MR. CATTON: I'm not in the human factors business. I just remember the range and where the NRC approach fell with respect to the band.

MR. BARRETT: We're going to be very careful about the human reliability analysis. It would be nice if the human reliability analysis would give us a hard and fast answer that we could just point to and say these numbers lead you to these conclusions.

What I think we may find is that the numbers will -- that the human reliability analysis will point us to the areas where risk is most sensitive to variations in performance and so that may -- we may have to settle for that kind of an answer. We may find, for instance, that the risk is most sensitive to the procedures which will be in place to deal with an ISLOCA.

On the other hand, we may find that the risk is most sensitive to the quality of maintenance work, people are working on MOVs and check valves. That may be all we learn from this thing, but that will at least point us to where we should concentrate any effort in trying to solve the problem.

We recognize the uncertainties in human reliability analysis.

MR. CATTON: In the area of the valves, in some of the sequences, isolation was important. What numbers did they use for the probability that they would get it done? Did they use the 1150 numbers, or the more recent ones in the Brookhaven report?

MR. BARRETT: I don't know that. I'm not sure.

MR. CATTON: There's a factor of 20 difference.

MR. BARRETT: In whether or not you can isolate once you've lost the pressure isolation boundary?

MR. CATTON: Once you have to close against full flow?

MR. BARRETT: I don't recall what was used in those reports, what value was used. I believe the value --

MR. CATTON: I got the feeling in reading through the Brookhaven reports that if it was supposed to close, it was assumed to close.

MR. BARRETT: If I recall, the isolation for the very largest lines was given no credit at all in the Brookhaven report for PWRs for the RHR lines.

MR. KERR: There must be somebody here who knows an answer to the question.

MR. BARRETT: Is there anyone here who can speak to that? I believe that for the smaller lines, there was credit given, and it was -- this is Owen Rothberg Office of Research, the sponsor of the Brookhaven work.

MR. ROTHBERG: We did a study of the NUREG CR5140 that talked about the closing of motor-operated valves, and we predicted a failure rate of eight percent.

MR. CATTON: That's what I'm referring to.

MR. ROTHBERG: Yes. Right. I don't believe that the current studies reflect that at all. The Brookhaven studies that you have don't reflect that.

MR. CATTON: It sounds to me like they ought to be redone, then, if that's important. There's also the testing that --

MR. KERR: Well, that depends on how much confidence he has in the data to which he referred.

MR. CATTON: Well, I think the eight percent is real. There are the tests that were just recently done in Germany that show that the manufacturer's recommended torque settings are not sufficient to get some of these valves closed. That ought to be incorporated into it, as well.

MR. ROTHBERG: We just had a pour block failure at Palisades.

MR. KERR: I'm sorry, you just had what?

MR. ROTHBERG: Poor block valve failure at Palisades and a failure to close against flow.

MR. CATTON: Go ahead.

MR. BARRETT: All right. Thank you.

Let me simply point out that in addition, at the outset, we're going to concentrate on pressurized water reactors. We have not yet decided what we will do about the questions related to BWRs, but we have decided to concentrate first on the PWRs.

[Slide.]

MR. BARRETT: The goal of the program is to assure ourselves that we have high confidence that the high consequence type of ISLOCA that I described will not occur for the current generation of plants, and in order to --

MR. KERR: Excuse me. I gather, from reading some of the material, that that means that that likelihood will be less than ten to the minus six per reactor year?

MR. BARRETT: Yes. When we talk about a numerical goal, that's the goal.

MR. KERR: That's the likelihood. Now, what sort of confidence do you want to have in that likelihood?

MR. BARRETT: Well, I don't think that we want to say that there's a mean value of ten to the minus six, and we have a confidence level -- or rather that -- I think what we're saying is that a mean value of ten to the minus six would be fine.

MR. KERR: But that, by itself, doesn't have a lot of significance, particularly at that low likelihood, unless you are going to say something about -- and indeed, you're -- that's why it says "high confidence."

MR. BARRETT: Yes. We feel that if you say that you want to have high confidence that an accident of this type will not occur for the current generation of plants, then you might say that, well, there are about 2500 years of operation left in the current generation of plants. That would say that if you thought you might have one of these, that would give you a--

MR. KERR: I'm not asking for illustrations of what one might say. I mean, if you're going to get to some point and say, "Well, I have achieved my goal," it seems to me you're going to have to have some measure of what the goal is, and I'm just trying to find out what that is.

MR. BARRETT: Well, the goal --

MR. KERR: How will you know when you've gotten there?

MR. BARRETT: If we can calculate a ten to the minus six of core melt, and with reasonable errors of -- you know, typical errors in PRAs are a factor of three or so, with the human error being so important here, I think that we probably have to settle for an uncertainty of more like an order of magnitude or more. I still think that that would say --

MR. KERR: I'm not trying to disagree with what your criteria are going to be; I just want to know what they are.

MR. BARRETT: Well, we would like to have a calculated core damage frequency of about ten to the minus six, mean value, and I'm not sure --

MR. KERR: Well, that doesn't have anything to do with the "high confidence" which I see at the top of that slide.

MR. BARRETT: Well, the way I interpret "high confidence" is if you go up one or two sigmas along the uncertainty curve, that you're still meeting the goal that you've set for yourself, that you're not going to have one for this generation of plants.

MR. KERR: Okay. What is one or two sigmas for this curve?

MR. BARRETT: If you're taking log normal distributions, we'd be talking about sigma in a logarithmic sense --

MR. KERR: Excuse me. Are you going to assume this is log normal with the human error contribution that will be there?

MR. BARRETT: I didn't mean to get into a discussion of the exact type of distribution. What I meant was that the uncertainties in PRAs tend to be more logarithmic than arithmetic. They tend to be a factor of too high, or a factor of too low, a factor of ten high, a factor of ten low, rather than plus or minus a fraction.

MR. KERR: Okay.

MR. BARRETT: What I meant was that even if we calculated ten to the minus six and the error factor is a factor of ten, so that you might reasonably expect that the number could be ten to the minus five, I still think that meets the criteria.

MR. DIAB: May I comment?

MR. BARRETT: Yes. Go ahead, Sammy.

MR. DIAB: This is Sammy Diab. Our objective, first of all, is to try to have an assessment, a realistic assessment, of the level of risk out there on the plants. The second step would be to take that realistic assessment that we think is presently occurring and to go from that into a goal of how to improve the level of vulnerability of those plants, and that's where the goal would come in.

MR. KERR: I recognize that the goal could come in there, I just still don't know what it is. Mr. Barrett has told me that achieving a ten to the minus six -- with some likelihood that it might be as high as ten to the minus five -- is a possible goal, but it's not necessarily the one that you've selected at this point.

MR. DIAB: It is a possible goal, and the reason that we are not exactly certain at this point is because it depends really on the quality of the PRA analysis that you do, and it depends on the level --

MR. KERR: I'm sorry. Your goal doesn't depend on the PRA.

MR. DIAB: The numerical goal does, sir, to some extent, because, you know, at ten to the minus six of value of core damage frequency, if you have not included all the relevant assumptions into the analysis, a ten to the minus six may be not adequate enough. On the other hand, if you include all the relevant factors that you can possibly include, ten to the minus five may be adequate.

MR. KERR: Okay. Would it be fair to say that at this point, you don't know what your goal is going to be?

MR. BARRETT: No. I think it would be more fair to say that we would like to demonstrate a ten to the minus six mean value with an error factor that is like an order of magnitude, but we recognize that we're in a region of numerical space here that's highly uncertain, and we're using methods of human reliability which are even more --

MR. KERR: Look, I'm not trying to be critical of the situation; I'm trying to find out how you are going to determine that you have or have not achieved your goal. Unless you know what you're goal is, I don't see how you're going to know whether you've achieved it.

MR. BARRETT: Well, what I mean is if w can do a PRA analysis that we feel we have confidence in, as I think Sammy was saying, if we feel that we have included everything that's important, and that we have confidence in that analysis, and it says ten to the minus six with an error factor of ten, we'll be satisfied that we will have met a numerical goal.

What we're concerned about is that because of the very low number that we're shooting for, and because of the uncertainties and limitations of the method, we may have to fall back to a qualitative type of goal.

MR. KERR: If what you're telling me is that you will do this until you feel good about it, that's a goal that is easy to define, and that apparently is about all you can say at this point, that you want to do enough analysis that when you get through, you feel good about the results.

MR. BARRETT: Well, that would be our fallback position, yes.

MR. KERR: Okay.

MR. WARD: Rich, if you do use a number of ten to the minus six, how does that square with the part of the safety goal policy which suggests a goal of ten to the minus six for accidents that involve a major off-site release?

MR. KERR: That's a suggested part of the safety goal.

MR. WARD: No, that one actually is part of the policy. That's in the policy.

MR. KERR: Sorry. The policy statement asks the staff to examine that as a possible addendum. I think it's real important that the distinction be made.

MR. WARD: That's correct. The question remains: How would you square this with that? The emphasis here on ISLOCAs is on scenarios where the containment is not intact, and that, in fact, is the reason for the interest in it. So if your project goal is a number of ten to the minus six, is that for a set of events of which the ones that have containment open are just a subset, or how do you square it with that number?

MR. BARRETT: That is a goal that we have for the high consequence type of event that we're talking about that I described earlier, one in which you have a rather large break; you have relatively unsuccessful attempts to mitigate the event or to delay the event; not much reduction in the source term, and so there are large doses offsite early.

MR. WARD: Okay. Well, then I have a problem with the safety goal in that if this same number is adopted as part of the safety goal policy, there isn't anything left over for any other events.

MR. BARRETT: Okay. I understand that. You know, we could say that we want to have a goal of five times ten to the minus seven, and that would leave something left over for other events, but I'm not sure -- when we're in that area of PRA analysis, I'm not sure that that would make much sense to me.

I don't want to get into a situation where I'm trying to add .5 and .5 times ten to the minus six to get to a proposed safety goal.

MR. WARD: I would agree that the numbers are difficult but conceptually are you saying that this event is pretty much the total risk from the operation of PWR's or that it represents half the risk?

MR. BARRETT: No. I'm not saying that, no. I do know in past PRAs it quite often dominates the risk of early fatalities. You may say early fatalities somehow define what is a large release so in many past PRA's it has been a major part of the most severe accidents, which I think is what that part of the safety goal is trying to address.

I wouldn't want to say that by solving this problem to 10 to the -6 we have met that part of the safety goal.

MR. KERR: And the probability of 10 to the minus 6 is synonymous with "will not occur," is that what that first bullet implies?

MR. BARRETT: Yes.

MR. DAVIS: Before we leave this numbers game, in NUREG 1150 for Surrey at least the V sequence did dominate the risk and the probability of an interfacing systems LOCA in that analysis was about 4 times 10 to the minus 6, which would be above the objective here.

However, the off-site risks were extremely low, well below the safety goal and my concern is we're starting to develop a whole bunch of different kinds of criteria that aren't consistent for these problems.

I am wondering if that is really the way to approach it. Do you have any thoughts on that, Rich?

MR. BARRETT: If I am not mistaken, the NUREG-1150 analysis of bypass events included steam generator tube ruptures that -- in the 4 times 10 to the minus 6 but I think the answer to your question about numerical criteria is our real concern with this particular project is really a safety concern in the sense that we are worried about a particular issue and the issue is are there accidents that are possible or even likely at our reactors in which there will be no -- little or no time for off-site response.

The question that comes up because of the recent operational experience is, well, is ISLOCA one of them, and we really want to see if this is a problem that we should be losing sleep over or if this is a problem that is down in the probability range that we are used to seeing in PRA's.

I think that is really the question we are trying to get at, whether a particular PRA calculates 4 time 10 to the minus 6 for a particular plant or another plant gets 3 times 10 to the minus 7, there are a lot of variation in the methods.

MR. KERR: At this point it is your view that the answer to that will depend a great deal on the way in which human error is evaluated --

MR. BARRETT: Absolutely.

MR. KERR: -- and in which there's at this point still a very large amount of uncertainty.

MR. BARRETT: Yes, sir.

MR. KERR: So any calculations that you get are going to be plagued with considerable uncertainties so you are going to have to have a method of decision-making that takes into account large uncertainties.

MR. BARRETT: Yes, sir. Exactly.

MR. WARD: Rich, let's -- are you -- you know, in developing this program are you -- I mean do you look to the safety goal policy as guidance at all in what you are going to do here? Perhaps, you know, I guess you're in the information developing stage now, and I can understand that --

MR. BARRETT: Yes.

MR. WARD: -- but once you satisfy yourself that you have enough information to lead to some sort of a decision, some sort of a program, do you think that the safety goal policy will be an influence on that decision or that program?

MR. BARRETT: I think so. I think that the part of the safety goal that you mentioned, the one about 10 to the minus 6 of a large release would be that the controlling part for this particular type of accident, because it is a low likelihood an accident --

MR. KERR: Please, let's not refer to that as part of the safety goal policy. It is not. It was a request to the Staff to examine that as a possible one. I don't want to get it built in to safety goal policy when it isn't yet. At least I don't think it is.

MR. BARRETT: No, I don't believe it is yet part of the safety goal policy.

MR. KERR: Okay.

MR. BARRETT: With regard to the actual quantitative safety goals for individuals, I don't believe that the interfacing systems LOCA challenges either the early fatality risk to an individual or the latent fatality risk to an individual and it would have to go up quite a bit in frequency before it began to challenge the core melt, the implicit goals regarding core melt frequency, so it's really the -- I believe the quantitative design criterion that was referred to, that was suggested to the Staff for evaluation that would be the controlling factor.

MR. WARD: One other point I'd like, could you, I guess I don't quite yet have a very good feel for why this particular issue has been singled out for attention.

Certainly there are some troublesome things about the sort of scenario that you have described but I think I could make some of those same, almost some of the same series of statements about the issue or group of issues that were involved in Generic Issue 99.

There is a chance that there is an event in which the containment is open -- Generic Issue 99 is concerned with that. There have been a lot of precursor events that have been troublesome, probably even many more for 99. Rough estimate risk analyses indicate it may be a major contributor to core melt and perhaps to off-site risk. Human contribution may be very important. There are all kinds of subtleties, difficulties in the operation under shutdown conditions where they are not as tightly controlled.

Although for most of the situations where you are concerned with GI-99, the decay power may be lower, that's more than compensated for in a lot of scenarios by the fact that the water levels can be down, but yet GI-99 has not been given the high profile treatment and the formal treatment that this has.

I think maybe that's better but I am just wondering why this one has been singled out in comparison with GI-99 and probably half a dozen others that one could name.

MR. BARRETT: I think I share your concern about accidents at shutdown. I don't know that I would say there are a half a dozen others but I do agree with you that accidents at shutdown are becoming more and more of a concern as, again, being brought forward by the operational experience.

I guess I really can't answer the question as to why this is being treated in one way and Generic Issue 99 is being treated in a different way. I don't know.

I'd simply like to point out that in trying to meet the goal we are gong to not only look at the likelihood of the initiating event, the loss of the pressure isolation valves, but we are also going to be looking at the likelihood of a break in the most likely break locations and also the effectiveness of accident management both to prevent core melt and to mitigate the off-site consequences.

[Slide.]

MR. BARRETT: Let me just briefly show you a very simplified schematic chart of how the program is structured.

Sammy Diab will give you a little more information about what these various project elements mean, but I simply want to point out that this is a very strongly interactive type of a project, heavy involvement on the part of NRR and the Office of Research and also some involvement on the part of AEOD and we have been getting a fair bit of help from the regions in the inspection program.

I simply want to point out here that the heart, the key to this program is that element right in the middle there, it's the analysis, the PRA, human reliability, structural, thermal hydraulic analysis that's being sponsored by the Office of Research and a lot of the other projects that we are doing are designed to bring information to that analysis effort, namely the selected plant audits and the analysis we've been doing of operational experience.

Now just a note with regard to the schedule.

We hope that by late in 1990 we would like to have our technical conclusions about the severity of the IS LOCA in light of the new experience, also have some answers as to whether or not any additional regulatory action is needed and what, if any, are the most effective types of regulatory action that we might want to recommend.

MR. CATTON: What role do the Brookhaven reports play in this? It seems to me they are finished.

MR. BARRETT: The Brookhaven reports are an important source of information for this audit. We also have participation in the program by one of the principal authors of the Brookhaven report and so we are starting from the Brookhaven reports and moving onward to bring the human element into the analyses, so it is a jump-off point.

MR. KERR: So the Brookhaven reports do not take account of the human element?

MR. BARRETT: Not in the detail that we would like to, no.

MR. CATTON: They did put together a model and you would just be going back into that model and changing things?

MR. BARRETT: I am not exactly sure if we are going back into the very same model. Maybe Gary Burdick from the Office of Research can tell me about that.

MR. CATTON: I see he's on the Agenda. Maybe he can tell us about it when he has his turn.

MR. BARRETT: Fine.

[Slide.]

MR. BARRETT: I would like to finish up here so we can get on with some of the more, some more detail. I simply want to talk for a second here about our interactions with the ACRS.

As you may recall, Dr. Murley was here in April to describe why he wanted to have this project. Today what we wanted to describe for you simply is the goals of the project and the way we have structured it and how we are going about it.

We hope to have some very preliminary results that we could come back in the Spring and describe to this Subcommittee, if you are interested, and we will schedule any future briefings that seem appropriate. We would like to keep you fully informed and we are very interested in what your comments are.

I would like to also point out that we have told the Commission about this. We gave them a very brief presentation back in October about describing this as one of five emerging technical issues that NRR is looking at.

Are there any further questions before I turn this over to Sammy Diab?

MR. KERR: Yes. Has the existing Commission abrogated its severe accident policy statement?

MR. BARRETT: Have they abrogated it?

MR. KERR: Yes.

MR. BARRETT: I don't believe so. I believe that --

MR. KERR: Well, the reason I ask is because as I remember that the Commission concluded presumably with the approval of the Staff at that time that existing reactors were in, taken in the main, appropriately safe but that since PRA's in some cases had identified outliers that a program was going to be put together to try to identify outliers.

Now it seems to me that the program is in place, it is underway and if there are outliers, either that program should identify them or else it's probably an inappropriate program and yet here is something which the Staff has concluded won't be looked at rapidly enough by the IPE program or won't be looked at appropriately by the IPE program, which says to me that either that policy has been discarded or else somebody has concluded that indeed operating reactors aren't safe enough unless they get a very quick look at this particular problem.

I could mention two or three other programs that have been undertaken in a similar way and this leads me to wonder if the IPE program as a method of locating outliers has been deserted?

MR. BARRETT: I think that's anything but the case. First of all, I don't know of anybody who believes that the current generation of plants is not safe enough. I have never heard that statement made and I --

MR. KERR: Well, this is a fairly large-scale program aimed at something or other. It is not aimed just at new plants, is it?

MR. BARRETT: No. No, it's not. It's aimed at the existing plants.

I think that with regard to the IPE, I think that that is a program that is proceeding along the lines of the policy and along the lines of 88-147 and I believe that given the fact that every single plant is going to do a PRA in response to the IPE. I believe that the vast majority of any vulnerabilities out there, severe accident vulnerabilities, have a good chance of being identified --

MR. KERR: Well, as Mr. Davis --

MR. BARRETT: -- and I don't think that should stop us from --

MR. KERR: -- Davis has pointed out, and certainly as NUREG 1150 points or at least says, this issue is likely to be very plant-specific and it's going to be I think strange if one can draw generic conclusions, particularly in light of the fact that the people who did 1150 have concluded that you probably can generic conclusions about plants from individual PRA's.

This seems like a natural to fit into the IPE program. I can't understand this rather large-scale effort apparently outside the IPE program, when it seems to me that this is one of the more logical issues to go into that.

MR. BARRETT: I think it could very well be that this will end up in the IPE program once we have a sense of whether or not -- we have a suspicion here based on the operational experience that there may be a bigger problem than we have seen in past PRA's. We have to either confirm or deny that suspicion --

MR. KERR: But you can't confirm or deny it until you look at every plant.

MR. BARRETT: Well, we are going to look at a few representative plants --

MR. KERR: Representative of what?

MR. BARRETT: Yes.

MR. KERR: 1150 says -- and maybe it's wrong; I rather think it may be -- but 1150 claims that you can't draw conclusions about plant safety by looking at a small population of plants. And that population is going to be bigger than yours.

MR. BARRETT: Yes, I understand that, Dr. Kerr. But I believe that by looking at a few plants and doing a full analysis of those plants, we can tell what types of issues are likely to be important, are likely to be unimportant, in any given plant.

If we can take those insights, and the results of this analysis, and this is just one option, if we find out that ISLOCA truly is a big problem, we can give those out as guidance for furtherance of the IPE.

But I would say right now there are plants out there that are starting their PRAs in response to the IPEs. And I don't feel that, I don't know that anybody has confidence that what we have learned from the operational experience recently would be included in those analyses. I don't think too many PRA analyses would say that.

So what we are trying to do here is a learning exercise as to how you can improve what we do about this particular action.

MR. KERR: So particularly, does not give you the insights that you need to deal with this issue.

MR. BARRETT: I don't think there is any PRA out there that does it. I may be mistaken, but this may end up in the IPE process, but by and large, I think the answer to your question is I think the Commission is steady going ahead with the severe accident policy.

MR. KERR: Okay. And you are confident that the IPE procedure now being described is incapable of providing the insights that you talk about?

MR. BARRETT: I believe that there may be some PRAs that are done under the IPE that will address this in some varying degrees of quality. There will be other PRAs that don't address it at all. I think you will see a whole spectrum.

MR. CATTON: So this is an example of what you expect in an IPE?

MR. BARRETT: I'm not sure I understand the question, Dr. Catton.

MR. CATTON: Well, if this winds up being a part of the IPE, what you are doing is an example of what you would expect to find.

MR. BARRETT: Oh, yes. Well, we are probably doing more analysis of this particular issue than you would want to have in an IPE, because it is more of a learning process. We are re-learning what the ISLOCA is about. Whereas in an IPE, you are not going and reinventing the wheel with regard to every accident sequence. So I would not expect that every IPE would spend this level of effort.

MR. KERR: I'm sorry. The IPE is inventing the wheel in the sense that it is looking at a specific plant.

MR. BARRETT: Yes, sir.

MR. KERR: And it seems to me in order to get a solution to this issue, if it is an important issue, you have got to look at the specific plant.

MR. BARRETT: You're right. And I believe that is what will happen. It could very well be that the mechanism for doing that will be through the IPE, through guidance to the IPE. The mechanism may be through some sort of a generic question, generic communication requesting information from the licensees. I don't know at this point. But you are absolutely right. The early indication we have is that it is very plant specific. But the procedures that are applicable are quite different from vendor to vendor and from plant to plant. The configurations vary by a great amount. And there are many other factors that vary.

MR. DAVIS: Rich, I think what you are saying, and I agree with it, is that there are some generic elements of this problem that are very troublesome. One of them is how to handle the human reliability question.

MR. BARRETT: Yes.

MR. DAVIS: And another one is what is the reliability of valves under the conditions of the LOCA, and so forth. So it seems to me that the research will be directed at trying to resolve some of those issues before you request that it be put in the IPE so that you get some consistency back in the analysis that is done as part of the IPE. Is that sort of what you are trying to do here?

MR. BARRETT: Exactly.

MR. DAVIS: Okay.

MR. BARRETT: Exactly.

MR. KERR: In terms of future plants, is any thought being given to an investigation or trying to reach a conclusion as to whether check valves, for examples, should be used in future plants? Maybe they shouldn't be used.

MR. BARRETT: That suggestion has been made, I believe, by EPRI among others, that check valves should not be used as a pressure isolation boundary. I'm not familiar myself with the details of that conclusion. But I know that that suggestion has been made. I don't know what the status of that question is with regard to the events, the light water reactors that are being proposed now.

MR. KERR: Well, if it would fit into this effort in some fashion, it strikes me as something that could be fairly important to future plants. And if it turns out that there is a major decrease in risk that can be associated with that, we ought to know it as soon as feasible.

MR. BARRETT: There are many design features in the future plants that try to take into account the interfacing systems LOCA. More robust piping, in the case of the PWRs, having a lot of the RHR system and RWST inside of the containment. So there are design features. But that is a good question, you are right.

MR. CATTON: Are you finished?

MR. BARRETT: Yes, I am.

MR. CATTON: The next speaker is Sammy Diab.

[Slide.]

MR. DIAB: Good morning. My name is Sammy Diab. And just to follow up to what the previous discussion urged, the goal is, in a qualitative sense, is that we would like not to have an ISLOCA event occur in the current generation of plants. That may be 10 to the minus 6. It may be even less than that.

However, the precursors that we have been seeing, the operating experience that we have been seeing, are too numerous for comfort.

In other words, we have been seeing like maybe one a month or maybe two a month that could fit into a pattern where it suggested that an ISLOCA could have happened if you add one or more of these precursors.

MR. KERR: What number would you be comfortable with?

MR. DIAB: I'm sorry. I really don't want to discuss numbers.

MR. KERR: If you're seeing numbers that you are uncomfortable with, what number would you be comfortable with?

MR. DIAB: We are simply trying to assess the situation and see if that is indicative of a problem.

MR. KERR: I know you are, Mr. Diab. And I'm trying to understand how you reached the conclusion that the number you are seeing is too great.

MR. DIAB: Well, when you begin to see heat exchanger seal ruptures and when you begin to see like tens of thousands of gallons dumped from the primary system, either in the auxiliary system, the auxiliary building or maybe in the containment building, inadvertently, and when you see this happening like month after month, it is really not a very comforting thought, especially when all of these things are designed at the plant.

MR. KERR: Look, we all know that it would be ideal to never have any accidents. What I'm trying to determine is what number do you expect is likely to occur in spite of anything we can do, and what number brings you to a conclusion that a fairly large program is necessary?

MR. DIAB: If you are speaking of precursors, which I mentioned, the numbers I mentioned --

MR. KERR: Yes.

MR. DAVIS: -- I would like to see none. I would like to see no precursors.

MR. KERR: Excuse me. I'm not talking about what you would like to see. I'm talking about what you expect as something that is reasonable. We aren't going to get to a situation where you never have failures in these plants. I mean, we can't possibly.

MR. DIAB: I really don't want to suggest a number here, but if we have 100 plants in the course of a year, we shouldn't be seeing more than 1 or 2 or something like that. With these type precursors, that's just an ISLOCA.

MR. KERR: Okay. And you are seeing now about how many?

MR. DIAB: I think we are seeing much more than that. Just look at the events that come in every other week.

MR. KERR: So you are seeing about 25 per year, or 26? That would be every other week.

MR. DIAB: We're seeing about that many. Some of them are more significant than others. But the ones that make it to the list of significant precursors are less than that per year.

MR. KERR: Are less than that?

MR. DIAB: Yes, are less than that per year. And we are, you know, talking about significant ISLOCA-related precursors.

MR. KERR: Thank you.

MR. CATTON: Is there a compilation of these somewhere?

MR. DIAB: Yes, there is a compilation. We have a list of events that we could probably provide to you.

MR. CATTON: And you will provide it to us?

MR. DIAB: Yes, we will. The one that we have compiled is really not a complete list. But we could --

MR. CATTON: The ones that led you to take the position you are taking.

MR. DAVIS: The Brookhaven report lists the more significant ones.

MR. CATTON: When I went through the Brookhaven report, I didn't see anything like 26 per year. Matter of fact there's a much less number, and some of the ones that they thought were significant, I didn't really think they were all that significant. That could be an erroneous conclusion on my part. But I would like to see your basis.

MR. DIAB: Dr. Catton, I didn't say 26 per year. Dr. Kerr said.

MR. CATTON: You said --

MR. KERR: Well, you said every other week.

MR. CATTON: You said two a month and then another time you said every other week. And either way that comes out to 24 to 26.

MR. DIAB: When you look at the events, that is correct. If you look at the events, you will see every other week something. But then when you analyze it, you boil it down, it doesn't boil down to one per week or one per every two weeks.

But anyway, let me get on with --

MR. WARD: But whatever that number is, you want to get it down to about one a year.

MR. DIAB: Okay. I can see that you want to hear a number from me.

MR. KERR: Well, we want to hear a number, if you are using numbers to make your decision. And you said you were seeing to many.

to me, that means the number is too big.

MR. DIAB: That's correct.

MR. KERR: I don't know what else it could mean.

MR. DIAB: That's correct. I would like to see none.

MR. WARD: Well, Sammy, that's our problem.

You are uncomfortable, or you don't want to talk about probabilities here. But the probabilities are there. And I guess I would maintain that zero is an inappropriate goal for you.

MR. DIAB: That is correct.

MR. WARD: That --

MR. DIAB: It may be a goal that may not be achievable. But this is really semantics, right now.

MR. WARD: No, I don't think it is. I think it is fairly important philosophy.

If you insist that nuclear power plants do everything they can to drive this particular number down to zero, you are probably going to continue what has been happening, that of putting so many constraints on the operation of a plant in a particular area that it either gets too expensive to run the plant or that you are devoting all your resources to one issue, and then neglecting other things.

And that is why we are not just arbitrarily picking at this, but we think it is an important, you know, technical, philosophical, engineering concept, that you are really dealing with probabilities, and asking for zero doesn't wash. That's not good engineering. You're concerned about a lack of balance.

MR. DIAB: Mr. Ward, remember, when Dr. Murley came here and addressed the committee, he didn't really come down with the number. He said I've been seeing 20 per year, I would like to see less than one per year. He said that he was not comfortable with the rate of ISLOCA-type precursors that have been occurring.

And we only want to be sure, because of the seriousness of the consequences, potential consequences. We want to be sure and we want to make an assessment as realistic as possible and from that, maybe come back to the conclusions, as maybe, you know, that we have looked at these events or the chances of such an event occurring, and it's not as serious -- you know, it's not too serious to -- you know, as compared to its already established value in the literature, or some other conclusion.

So we are checking the status basically.

MR. SCHROCK: I guess it's also puzzling to me that you've got in the BNL report, largely events that are six, seven years or more ago. Many of them are back in the 70's, and there are none in the list since 1985.

MR. DIAB: Yes, there is. There are several events. You're looking at a somewhat older list.

MR. SCHROCK: Well, I mean, it's a 1989 report.

MR. DIAB: That's correct, but I think their information had been -- I think we used information up to a certain point, but we'll provide you with a list that we have compiled in-house and it's really not complete, but we will be glad to provide you with that list.

MR. CATTON: I hope that this will be more than just a list; that you will give the basis for coming to the conclusion that you have.

MR. DIAB: Well, we -- you know, if you so request, we could probably expand it somewhat description-wise, but it's like an abstract, a list of abstracts. One could go back to the individual events and analyze it some more and see exactly what happened and why it happened.

Moving right along here now, I'd like to discuss with you this morning the project overview. In order to be able to assess the level of risk associated with such an event, the project has been structured basically to have three main elements that complement one another.

The operating experience, search -- and this is again to look into the literature for the ISLOCA type precursor data and the combinations of failures that collectively would lead to an ISLOCA.

Another element, a second element is an audit program. The audit program, again, it's intended for a few selected plants that will help give us a snapshot, so to speak, of the vulnerabilities, ISLOCA vulnerabilities for these particular plants.

It would also provide us with --

MR. KERR: Excuse me. What is a vulnerability?

MR. DIAB: A vulnerability could be a design feature. It could be a layout feature, the way a valve, say, is installed, the access to such a valve. Say you have a valve, a pressure boundary valve that is located in such a place where it cannot be reached in case of an emergency.

Another vulnerability could be the operating staff, for instance -- deficiencies in the procedures, deficiencies in the training and the like; certainly that sort.

The audit program would also provide us with the -- it's an excellent vehicle for collecting and gathering an in-depth information that we could use on a plant-specific basis here in the analysis of the project. The audit program would also enable us to have a qualitative assessment of the perceived risk at a plant, at such a plant.

It, again, wold also provide the necessary input for the analytical quantitative risk. Of course the third element is the analysis.

MR. KERR: Excuse me. In dealing with the human factors, do you anticipate a generic treatment eventually of human performance? Are you going to try to make that plant-specific?

MR. DIAB: No, it's generic as far as audit program?

MR. KERR: As far as whatever it is you're going to do about human performance.

MR. DIAB: Right, well, in this program, we are approaching the human performance area -- I really don't want to use the words, "generic basis" here, but we're approaching it uniformly. You know, whatever we apply to plant A will apply to plant B, and some things will fall out as significant and some things will prove needless in some plants.

I'm really not sure if I'm answering your question.

MR. KERR: I would use the term, "generic" to describe that, but I won't try to insist that you use it.

MR. DIAB: Have I answered your question?

MR. KERR: Yes, thank you.

MR. DIAB: The analysis element of the project; again, it's structured to provide a focused human reliability analysis and a PRA analysis. It will also involve thermohydraulic and stress analyses of the particular plant features.

[Slide.]

MR. DIAB: Now, I'd like to refer you back to the project plan that Richard has shown you earlier. In particular, I would like to discuss the two elements on the lefthand side.

The first is the operating experience. The compilation of operating data and failure data has been done by the Office of AEOD. The output of that search is being provided to NRR and to the Office of Research, and this is on a continuous basis.

So, as events do occur, they are being communicated to both offices.

MR. CATTON: Will there be an AEOD report on this?

MR. DIAB: No, I don't believe so, but the data is transmitted through appropriate channels to the Office of Research and to the NRR.

MR. CATTON: I would have thought that with something like this, it wold have been appropriate for them to write a report, if the problem is as important as you imply.

MR. DIAB: Well, what the AEOD are doing -- researchers are doing; it's really that they are compiling the data. they are searching the data for things that look like an ISLOCA that will either individually or collectively provide an ISLOCA.

They are also providing descriptions of the significant events.

MR. KERR: These are precursors? When you say, "it looks like an ISLOCA," do you mean something that could have been?

MR. DIAB: Yes, something that could have developed into an ISLOCA.

MR. KERR: What does -- how close does it have to have been to one in order that it be considered a precursor, or is that a matter of judgment?

MR. DIAB: No, it's really a matter of judgment and the -- you know, there are certain definitions for a precursor and I'm really not going by those. I'm going by the -- if a failure -- say you have a two-valve system, a pressure isolation valve. I think Rich mentioned this example earlier about the WASH-1400.

If a valve -- a check valve and the seat was off or the disk was off the seat, either rusted or with a foreign object or whatever, all you need is a failure of the other valve. If a failure of one of the two valves is reported, I think that's a significant piece of --

MR. KERR: That's considered a precursor?

MR. DIAB: That is considered a precursor, yes. Of course, they vary in degree.

MR. KERR: That's interesting because I thought the reason you put two valves in is because you expect that one of them may fail and that the other one of them may take care of the situation.

MR. DIAB: You put the two valves because of the defense-in-depth. YOu know, if one fails, you'd like to rest on the other one.

So this compilation of data will, again, be as an input to provide an insight to the NRR run of the program and it also provides the input to the research. We have identified, in order to assist the AEOD to do their research;

we have identified about a dozen low pressure systems.

They would then go and look at the high pressure/low pressure interfaces and search any such interface for previous periods.

MR. KERR: Excuse me. They're going to look at LERs or what?

MR. DIAB: LERs, basically.

MR. KERR: Thank you.

MR. DAVIS: Are you comfortable that the reporting requirements that currently exist will capture all of these important precursors?

MR. DIAB: I think the reporting requirements that are in existence ever since January of 1984 would make the reporting consistent. I think the staff here feels comfortable that it will.

MR. DAVIS: Thank you.

MR. DIAB: This again will provide the basic ingredients for the PRA.

Next, I would like to discuss the plant audit program. Again, this is intended for --

MR. KERR: Excuse me.

When you look at the precursors -- let's take, for example, two check valves in series -- you will find that there will be some failures, I assume. Now, is somebody going to compare an observed failure rate that you see with the failure rate that is used in existing PRAs? Existing PRAs certainly don't assume that check valves always work.

I'm trying to understand what a precursor is.

MR. DIAB: I'm using the term "precursor" somewhat loosely. In my opinion, a precursor is -- you're going to have to go by this -- a failure in a system or a component of a system that, given other failures, could have resulted in a particular event.

MR. KERR: But that sort of thing is certainly not something that is neglected in PRAs, because their failure is given. It seems to me that what you'd get from the search of LERs, if it is significant, is some failure rate that has been observed, that is significantly different from the failure rate that is typically used in PRAs. I mean, the fact that you get failures is, in itself, not going to be very significant.

MR. DIAB: Here we're trying to assume that -- We're really going to look at this problem as it has existed in the past. We're trying to make an assessment of this perceived problem, to see if it really justifies our concern.

MR. KERR: But you aren't doing it in a vacuum. The problem has been treated in existing PRAs.

MR. DIAB: That's correct.

MR. KERR: It's just that, apparently, you think, it's been treated incorrectly.

Now, what was said earlier led me to believe that it was not mechanical performance that you thought had been treated incorrectly, but human performance. I don't think you're going to get much human performance information from the LERs. Are you?

MR. DIAB: There are some root-cause analyses that are present in the LERs, and also, this data, this information that we're obtaining, will also be analyzed further by the Office of Research, in search of any possible root causes. Keep in mind that the people who are going to be using this data are PRA specialists, and they are not going to operate in a vacuum.

MR. BURDICK: This is Gary Burdick from the Office of Research.

We are taking a fresh look, in the Research program, at both hardware reliability numbers and human reliability. We are not relying on numbers that have been used in past PRAs at all. That includes the Brookhaven report. We're taking a fresh look across the board at this problem, hardware- and human-wise. I'll be covering this when I make my presentation.

Sammy's not involved in the calculational aspects here at all.

MR. KERR: And he doesn't understand what you're doing?

MR. BURDICK: Yes, but it's my job to answer questions concerning the Research program. Sammy Diab is in the Office of NRR.

MR. KERR: Okay. So when he is stumped, he can feel free to ask you to back him up.

MR. BURDICK: Certainly.

MR. KERR: Okay.

MR. DIAB: I believe Gary will be able to answer some of these questions.

MR. KERR: Okay.

MR. CAMPE: Excuse me. Kas Campe from NRR, Risk Applications Branch.

I'd just like to comment on an earlier question you had in reference to LERs, and whether or not they contained information that would be related to human errors, human factors. I believe it's fair to say that a fair number of these LERs -- at least the ones that I have seen personally -- do call out things like poor or incorrect or misinterpreted operating procedures, operator errors, and things of this nature, bad maintenance practices. All of these are flags of one sort of another that say that there is, perhaps, here something worthwhile to look into from the human factors point of view.

So the LERs can contain some information that is related to human factors and human errors.

MR. KERR: Well, I think they can if, number one, they are properly interpreted, and if, number two, the people who wrote the LER understood what the human factor contributed, and there's some question about both of those, I would think. But my point was that if you report a failure of a valve, or whatever, even though human performance may be contributed to it, what you see is a failure. In the PRAs, what you see is a failure, and it seems to me one ought to compare the two failure rates to see if existing PRAs have significantly missed -- I mean, what we are ultimately looking for is some sort of failure, and since we haven't have very many interfacing-system LOCAs, I guess we have to introduce human performance. We have had, however, failures of valves, and those are failures, whether human performance contributed to it or not. Since these same failures appear in PRAs, it would make sense, it seems to me, to compare what you see with your fresh look to what has been used.

MR. CAMPE: That's a valid observation. I was just commenting on whether or not LERs can be interpreted, perhaps, in human error type information. There's a lot of room for interpretation, admittedly. It's not an all-or-nothing kind of situation.

MR. DIAB: Dr. Kerr, also, this type of information that's being provided by AEOD, when it goes to the Office of Research, they also manipulate the information some more and look into it some more, in order to be able to understand whatever they can understand from the description of the events.

MR. CATTON: I thought part of AEOD's charter was to search for precursors. Why is it that they haven't found what you find? They just weren't interested in it, or something?

MR. BURDICK: This is Gary Burdick from the Office of Research.

There is a definition of a precursor that is used within the context of the precursor program. Although I haven't been involved with that program for a number of years, I believe it still has to do with the event's causing the failures of multiple trains in the same system, or causing failures in at least two safety systems.

MR. CATTON: So the definition is what led them to miss this.

MR. BURDICK: We're looking for more information on failures than you would find simply from the precursor program itself.

MR. DAVIS: But, Gary, I thought AEOD sponsored an accident precursor program at Oak Ridge in which --

MR. BURDICK: That's the program I'm talking about.

MR. DAVIS: Yes, but they didn't use that definition, as I recall.

MR. BURDICK: They did. That program began in the Office of Research. I was the branch chief that had it at the time. We transferred the program some years ago over to AEOD.

MR. DAVIS: But they took these events and put them through event trees and actually calculated probabilities that these specific events would end up in a core-damage situation.

MR. BURDICK: That's true, but in order to be considered a precursor, it had to satisfy the definition I just gave.

MR. DAVIS: Okay. Thank you.

MR. CATTON: Maybe it should be redefined, then.

MR. KERR: So there had to be multiple failures.

MR. BURDICK: That's right.

Well, the failure of multiple trains in the same system, or precipitating failures in at least two safety systems.

MR. KERR: So what you're looking for is not so much precursors, but you're really trying to look for better data on failures of components.

MR. BURDICK: That's it, and get a handle on the human aspect, also.

MR. KERR: So that's not really a precursor study; it's really a data analysis of failures.

MR. BURDICK: That's right.

MR. KERR: Okay.

MR. DIAB: The next element I'd like to discuss with you is the plant audits activities. This has been primarily run by the Office of NRR with assistance from the regions. The team we have is made up of eight multidisciplinary experts and a team leader, and the areas of expertise really cut across all the plant features that are relevant, like instrumentation and control, maintenance, procedures, and human reliability.

The blocks of time that the team use basically fall into three categories:

A preparation period before visiting the plant site. In that period, they study the material we obtained from the plant beforehand, system descriptions, procedures, maintenance records, et cetera. They also chart strategy for inspecting or auditing the plant once on site. They decide on systems of interest, and they find that, of course, from the system description and the plant layout. They also decide on significant scenarios that they would like to address once on site.

When they go to the plant -- which is the second phase -- they basically spend two weeks there, and they verify their initial strategy. Are the systems the correct systems to look at? Are the scenarios the significant ones? Et cetera.

They then come back and write their report, subsequent to this.

In order to streamline the audit process --

MR. KERR: How many of these audits do you plan to make? How many plants?

MR. DIAB: So far, we have done two.

MR. KERR: No, I said, how many do you plan to make, total?

MR. DIAB: Three or four, all together. I can discuss this a little bit later.

MR. KERR: Do the plants that are audited have to pay fees to the NRC for being audited?

MR. DIAB: I really don't know the answer to that.

MR. BARRETT: We've conducted two so far. The first was conducted as an audit, and I think, as such, the licensee did not have to pay fees. The second one was conducted as a formal inspection, and I believe they did have to pay fees.

I believe our team leader for the second inspection is here. Maybe he could clear that up.

MR. ISOM: Jim Isom with the Special Inspections Branch.

I don't know the answer to that question. All I know is that the second inspection was done as an inspection, rather than an audit.

MR. KERR: It would seem to me that you really ought to pay the clients, because I'm sure this takes a lot of effort on the part of the client's staff. Since, by Congress, the clients pay you guys when you go in because they've done something or other, it would seem only fair that they get paid for the staff time that has to be expended on this sort of thing. Have you considered asking your management for this authority?

MR. BARRETT: No, we haven't considered asking our management for this authority. We routinely go to the licensees with --

MR. KERR: Look, Rich, I know you routinely go to the licensees. This is what bothers me. We are seeing more and more programs where you go the licensees, and these guys have to spend a lot of resources on this. These are resources that could be used for something else.

MR. BARRETT: You're absolutely right. There's a major effort going on right now -- you may or may not be familiar with it -- in which NRR and the regions are trying to assess this very question, what kind of impact are we having on the licenses.

MR. KERR: And I can predict what the result is going to be.

MR. BARRETT: Well, I can't.

[Laughter.]

MR. BARRETT: But not only through the inspection and audit process, but also through generic communications. So it could very well be that what you're suggesting may change in the near future.

[Slide.]

MR. DIAB: Let me move on to the next viewgraph here. In order to streamline the audit process, we have structured the audit activities in general to fall along the same lines as the defense-in-depth concept, basically three layers of inspection or audit.

Number one: How can things go wrong? How can an ISLOCA event take place? Number two: How can it be discovered and rectified or recovered in a timely fashion. The third layer, of course, given that the above two have taken place, is to minimize offsite consequences.

The idea here is to look for plant features that either limit the chances or likelihood of occurrence in the first place, number one. Number two, if an ISLOCA has already taken place, how or what types of features or actions can be taken to either delay or prevent core damage?

MR. KERR: Now, is the NUMARC program that is being carried on in accident management not looking at this for ISLOCAs?

MR. DIAB: I can't answer that.

MR. BARRETT: The NUMARC program is not specifically looking at ISLOCAs.

MR. KERR: No, I didn't ask if it was not specifically looking. I mean is it neglecting -- maybe I should have said -- ISLOCAs?

MR. BARRETT: No, it's not neglecting ISLOCAs in the sense that the guidance that will be given to the utilities by NUMARC will be very much based on the IPE process, so whatever comes out of the IPE process, whatever comes out of generic PRAs in the past will be input to this. But to the extent that we're going beyond the IPE, then you would say that --

MR. KERR: Why should it go beyond the IPE, I mean if accident management is accident management?

MR. BARRETT: Well, I don't believe it's planning to go beyond the IPE except insofar as they would like to also take into account generic PRA results rather than just plan-specific PRA results. But given the fact that it's based on current PRAs and PRAs in the IPEs, it will not go as far as this unless --

MR. KERR: I don't see how one can establish an accident management structure at a plant, and then have a separate accident management structure for ISLOCAs.

MR. BARRETT: I don't believe this slide is meant to mean that there would be a separate structure for accident management.

MR. KERR: Well, it appears to me that the NRC is doing accident management for this issue, and I'm in favor of accident management, but including the rather major program the NUMARC already has, I'm puzzled that NRC is undertaking another one for this issue.

MR. BARRETT: Right now, this is simply a study to find out, given the current procedures and the current status of training and what have you, what is the likelihood that accident management in this particular area would be effective for the types of scenarios that we're looking at? Remember, this is just a study. We're not trying to get the utilities to do anything different here. It's a snapshot of the current situation given the current --

MR. KERR: At some point, if you don't try to get the utilities to do anything different, either it's not a problem, or else the study is worthless.

MR. BARRETT: Well, that's the point. I think once we've decided what the current situation is, and we've put that through the PRA models, we'll know whether or not ISLOCA is truly a bigger problem than we thought. Once we know that, and we've done a complete study from front to back, we'll have a sense of where improvements are needed, if they are needed, and some of them may be accident management improvements.

MR. KERR: No, but -- well, I guess I'm not getting through.

MR. WARD: I think what's bothering us is both with regard to IPE and accident management. If you said that the staff has a particular concern about ISLOCA, and you're going to develop some information on it, and you're going to take this information and use that as part of the total body of information you have to make some judgments when you're reviewing IPEs, or make some judgments when you're reviewing accident management procedures, or even better, if you make that information available to the people who are doing IPEs and developing accident management, I think we wouldn't have any -- I mean, that seems like a good program. But that doesn't seem to be your purpose. Your purpose seems to be to do something in addition, in parallel, in place of, ahead of the IPEs and the accident management programs. That's the problem, I think, that we're having. At least that's the one I'm having.

MR. BARRETT: Okay. Then let me answer the question. We don't plan to do anything in terms of changing plant programs, changing procedures, training, hardware, or anything at the plants at this time. What we're trying to do right now is a study to better understand the ISLOCA program, or a problem, event.

It could very well be that the right way, eventually, once we figure out this problem, is to take what we've learned and give it to the utilities as some sort of an add-on to the IPE generic letters, and ask them to go and do -- you know, augment their plant-specific evaluation. Pete suggested that. I think it's a good suggestion.

We're not talking about doing anything with the licensees or to the licensees at this point. We're not talking about anything of that type until we understand the problem better. What we're describing today is what we plan to do over the next nine to twelve months to better understand this problem. Your suggestions about how to implement what we learned is an excellent one.

MR. KERR: Well, then I misunderstood, because I thought what I heard was that you were in the process of developing an accident management strategy as part of your audit.

MR. BARRETT: No. No, sir.

MR. KERR: What did I hear?

MR. BARRETT: Well, to understand the risk of this accident, one component is the ability, for instance, to isolate the break once it has occurred, and you could call that part of an accident management, or that's an action to manage the accident.nt.

There are other things that go beyond that. Suppose you had melted the core. There are certain actions you might take to mitigate the magnitude of the release. Those are accident management type actions.

The audit is an attempt to go and look at some PWRs as they stand right now and make an assessment of whether or not, in an ISLOCA, actions of that type would be successful, would be likely to succeed or not likely to succeed, and, if not, how important is that? If it is important, and it's not likely to succeed, what could we do to improve it? Is it training? Is it better procedures? Is it something that we could perhaps add to the accident management program of NUMARC? Right now, this is an open question.

MR. DIAB: Precisely. This is basically a study to assess the ISLOCA situation out there, to basically see if it is a problem or if it's not a problem, and if it is a problem, what kind of problems do we see? Then in order to implement some of these recommendations, this will be a second phase that will have to interact with other programs that are underway.

MR. WARD: Sammy, when you say whether it is a problem or is not a problem, in your first item up there, you've got the likelihood.

MR. DIAB: Uh-huh.

MR. WARD: So that means you're recognizing that this is a problem, if I could use the term, in probabilistic space, and that your earlier statement about wanting to reduce the number of precursors, or the number of events to zero, is not really a, you know, technically sound goal for a problem that exists in probabilistic space. I'm not trying to be abstract, but it's important philosophy here, I think.

MR. DIAB: You're right. I mean a likelihood of zero occurrence, it probably is technically --

MR. WARD: Is zero. Yes.

MR. DIAB: -- unsound. It may not be achievable. But you're asking me what would you like to see? I'd like to see none of that. But the point is, the likelihood -- of course, it varies from plant to plant, from an operating crew to an operating crew, from a shift to shift, also from a certain plant configuration to another plant configuration. It depends on a multitude of factors, and the audit program, together with the research program, the audit program is trying to get some of this information, and the research program is geared to analyze this information into a numerical sense.

MR. DAVIS: I hope the likelihood in that first bullet is not going to be zero. I think that likelihood you'd like to be one, wouldn't it, the likelihood that an ISLOCA will not occur?

MR. DIAB: That's correct. That's correct. I'm talking about the likelihood of ISLOCA occurring; you're talking about of it not occurring.

MR. SCHROCK: It seems to me that the information you get from your audit program will depend on what you've chosen to audit, and I wonder what criteria you had in making a decision on which plants to audit.

MR. DIAB: A very good question. The structure of the audit activities really, like I mentioned earlier, went really basically over three layers: initiation, and then mitigation and control, and the third one would be if none of the above has worked, then what can be done to limit off-site consequences?

I think this covers just about any possibility of having an ISLOCA that progresses into a bad event, that progresses into a core damaging and fission products offsite.

MR. SCHROCK: I don't understand that answer. That guided you in deciding which plants to audit?

MR. DIAB: No. This is areas of review, or areas of audit.

MR. SCHROCK: Yes. My question was motivated by the recognition that you think it's very plant specific.

MR. BURDICK: I'm going to deal with that in my presentation.

MR. SCHROCK: All right.

MR. BURDICK: I'll tell you why we selected the plants we did, and I'll deal with the plant specific nature of the problem.

MR. CATTON: Sammy, we're running about 45 minutes behind. Could you maybe pick up the pace a little?

MR. DIAB: I am, I think, fairly close to finishing here.

[Slide.]

MR. DIAB: The next three viewgraphs --

MR. CATTON: I understand it's not your fault.

[Laughter.]

MR. DIAB: I appreciate it. The next three viewgraphs get into a little bit more detail, Professor Schrock, about what exactly is being looked at, and this is really not an exhaustive conclusive list. This just lists a few examples. For the sake of speed here, these are pretty much self-explanatory. I'm fairly done, unless you have other questions.

MR. CATTON: Are you finished?

MR. DIAB: I'm finished.

MR. CATTON: That was quick. I appreciate that.

Next, we're going to hear from Mr. Burdick from Research. I think, in deference to my colleagues, we'll take a break.

[Recess.]

MR. CATTON: Let's get started.

[Slide.]

MR. BURDICK: I'm Gary Burdick from the Office of Research, and I am going to be talking about the research program on the ISLOCA for the near term, and this is dealing with an assessment of the problem for the ISLOCAs that bypass containment and could lead, as Rich was saying, to an ISLOCA of major concern, more so than the ones that would occur inside containment. This is also supporting the development of the resolution of the Generic Issue 105, when encompasses both those ISLOCAs outside and inside containment.

[Slide.]

MR. BURDICK: The research program got started in response to a user request from Tom Murley to Eric Beckjord, and that asked, in effect, for a reassessment of this problem if the ISLOCA is outside containment. I was at the April 6th

ACRS full committee meeting, where Tom Murley expressed his concerns to the Committee. I understand, from that meeting and from his user-request memo, that there would be an evaluation of -- what was needed was an evaluation of both hardware and the human actions, a reevaluation, because past PRAs, past studies had been weighed in the balance and were found wanting in both these respects.

So, in devising this ISLOCA research program, we identified a number of objectives that we had to achieve in order to perform this reevaluation. So, we had to get farther into the low-pressure systems, because past PRAs, past analyses did not get very far beyond the pressure isolation valves.

We had to take a look at the fragilities of the components in those systems -- there was a suspicion that failure rates in use were, perhaps, too low -- again, take a look at the human actions and the performance shaping factors that affected those human actions, try to identify those that were important to ISLOCA.

There was a possibility that if the human was contributing more to the ISLOCA problem, we might identify simple ways to reduce the importance of the human element -- perhaps, additional training, sensitizing people to plant, perhaps.

We had to determine ISLOCA sequence timing, flow rates, and if necessary, accident-management strategies -- that is, if the problem was important enough -- timing, because we had to determine how long people had to act; flow rates, how long it would take compartments to fill up.

We had to look at effects on other equipment. There could be common-cause failures. The effluent could wipe out equipment that you might be relying upon to get water back into the primary, and we had to do this all in a PRA framework in order to assess these contributions.

The PRA framework would be useful if we had to go through backfit analyses a la the backfit rules, 50.109, and we had to carry these analyses out to estimate the consequences in order to factor those into the cost-benefit analyses of potential fixes, and we had to conduct this program, devise a program that would provide for a spectrum of possible fixes to the problem, if there was one.

We do not, a priori -- we do not know that this is a serious problem. We do not yet fully understand the nature of the problem, but we had to have a program that would cover, like I said, a spectrum of possible bases.

[Slide.]

MR. CATTON: What do the Brookhaven reports do for you?

MR. BURDICK: The Brookhaven reports are being examined by Idaho -- the Idaho National Engineering Laboratory -- along with other past PRAs, other sources of information, to take out of them what is useful and use it. The Brookhaven reports had a focus on the cost-benefit of valve testing. The modeling that was done in the Brookhaven reports was not to the depth -- it was not, in other PRAs, past PRAs, to the depth required to go into the analysis of the human contributions to the problem.

MR. CATTON: Well, the human factors part was weak, but the reports certainly are thick enough.

MR. BURDICK: Well, if that's how you judge the utility of reports -- we are using whatever is useful out of them.

MR. KERR: Mr. Burdick, I was waiting for this slide, because there were some things that were not on the previous slide that, it appears to me, should have been.

Number one, you say you aren't quite sure how bad the problem is, and you're doing a study to determine how bad it is, and presumably, this is going to be done in PRA space.

How are you going, when you have finished the study, to determine whether things are bad enough to do something?

Then, once you have determined, maybe, that things are bad enough to do something, how are you going to determine how much one has to do? Presumably, that will be on a cost-benefit analysis basis, because Mr. Barrett has said that this is not being done because existing plants are unsafe, but rather, because there is some feeling that they could be made safer.

Third -- and then, I'll stop -- has anybody tried to estimate whether this problem can really be solved using PRA space?

MR. BURDICK: We're not only looking at the problem quantitatively; we're looking at it qualitatively, as well.

We don't know the nature of the problem at this point. It could be that there are a lot of qualitative factors, a lot of things that you might do at a plant that could effectively handle this problem, and I mentioned a couple of them that I consider kind of qualitative -- training, sensitization of people that certain things might be important, that if they do not keep an eye on certain situations that their plant could deteriorate with respect to this problem.

MR. KERR: Excuse me. You're ahead of me. I thought you first were going to, after you had made the study, decide whether you had a problem or not. You've already passed that point, and you're sure you have a problem.

MR. MR. BURDICK: No. I'm saying we have not convinced ourselves, at this point, that this is a serious problem.

MR. KERR: Okay. What I am trying to understand is how you're going to decide, once you have done the study, that here is or is not a problem? What criteria are going to be used? What's the decisionmaking process going to be? Are you going to get six experts in a room and, as a result of their vote, it is or is not a problem or what?

MR. MR. BURDICK: We're going to use the PRA portion, certainly, to get estimates of frequency and consequences. We are going to look at the constituents of the problem and, in a cost-benefit context, see if there is something that might be worthwhile --

MR. KERR: Now, you're telling me what you are going to do if you decide there's a problem. I'm still back at deciding whether there is a problem or not. How do you decide that?

MR. BARRETT: Gary, let me take a shot at that. I think we may be discussing what we talked about earlier, and that is what's our criterion for what's an acceptable level of risk.

MR. KERR: Well, if you are going to use risk as the criterion, I am not sure what it is that's going to be used in the decisionmaking process that says we do or we do not have a problem.

MR. BARRETT: I think, as we discussed earlier, we see a lot of PRAs out there that say the core-melt frequency from this accident is 10 to the minus 6, and what we want to do is put the human factors, the human reliability area in there, do a little more careful analysis of the whole thing, including accident management, and see if that conclusion of 10 to the minus 6 still holds up, and if that's the case, then I think we'll be very satisfied, and if we had total confidence in the PRA process at the 10 to the minus 6 level, we would probably state that as a hard-and-fast goal, that 10 to the minus 6 is our goal, but we're keeping in mind that we may not -- when we finish this study, we may not have such a hard-and-fast PRA answer.

MR. KERR: See, the reason I ask this is because I would have great difficulty in a situation in which you find yourself setting up criteria, and I wonder if, since Murley and others -- maybe yourself -- are convinced this is a serious problem, maybe you should forget about PRA and say here are some things we can do to make the risk less, because I'm not sure but what you are going to go through this study and the results are going to be very inconclusive in terms of numbers, because there is going to be a big uncertainty, and you still won't be in any better position to make a decision than you are right now.

MR. BARRETT: Well, that could be the case, but --

MR. KERR: Is there something that leads you to believe that you will be in a better position?

MR. BARRETT: Well, I think we have to be, because right now, if I thought that I had a fix in mind that I could impose upon the industry that would somehow fix this perceived problem, the first thing I would have to do would be convince myself, my management, and you that there was a reasonable risk benefit to it, and I can't do that today.

MR. KERR: What leads you to believe that you might be able to do it a year from now?

MR. BARRETT: Well, the fact that we have structured a study that uses the best available information and methods that will include in the analysis of ISLOCA for the first time in an integrated way, this total treatment of human reliability, along with the other types of failure modes.

MR. KERR: But you don't have any idea of what the uncertainty is if you start trying to calculate uncertainty at this point, do you?

MR. BARRETT: No.

MR. BURDICK: If we decide that there is a significant problem here, the only way that we are going to be able to sell any fix to that problem, I think, is within a PRA context. If you have some other tool that we an use, I'd be happy to --

MR. KERR: All you have to do is to say that existing plants are not safe enough and you don't have to worry about cost/benefit analysis.

MR. BARRETT: I don't know what basis I would have for making that statement.

MR. KERR: Well, you are going to have to use the same basis for making that statement that you're going to have to use for making this decision, which is that things are worse than existing PRAs had led one to believe.

MR. BARRETT: But they could be worse by epsilon, or they could be worse by a factor of ten; we don't know yet.

MR. KERR: That's my question; how much worse are they going to have to be before you decide something needs to be done?

MR. BARRETT: I think that unless they're qualitatively the same level of risk that we currently perceive, I think we're going to take a hard look at whether something needs to be done.

MR. KERR: That's because you will have concluded that existing plants are not safe enough. I don't see how else you can convince yourself that something needs to be done.

MR. BARRETT: Yes, I suppose so.

MR. BURDICK: I think that if you look at the SECY paper on the closure of severe accident issues, you will see a cartoon in there which includes a number of activities, IPEs, containment work, accident management and along the top, there is a continuing line that goes clear across the page. That's called Operational Reliability.

When you do these things like IPEs, you do a PRA; these things are snapshots in time of the safety of that plant. It doesn't mean that you walk away and think everything is hunky-dory for all time. Eternal vigilance is the price of safety as well, I think, as of liberty.

You have to continually look at the situation. Things can be all right at a plant at a certain time. Due to management changes and other factors, the plant can vary in its safety profile.

At the April 6th ACRS meeting, I recall Tom Murley saying that this should be one of those elements of the operational reliability. What we are doing now is going out and being responsible as regulators and assessing a situation that Tom Murley, at least, has considered to not quite jive with what past assessments have indicated.

MR. KERR: Mr. Burdick --

MR. BURDICK: We are doing the best we can with the tools we've got, and when you say "when are we going to decide there's a problem," what exactly do you mean by a problem? Problems have a lot of different natures, and what is considered a problem, you know, could be a small item like maybe additional sensitivity of the people at the plant to this problem, maybe additional training.

The fix could be then maybe a bulletin, a Generic Letter, maybe not a backfit. But before we can make those kinds of judgments, we have to make an honest assessment of the problem with the tools we have; try to get its nature and get our hands around the constituents, and that's what we're trying to do here.

MR. KERR: Mr. Burdick, I want to go on record as applauding eternal vigilance in safety and a number of other areas. Let the record be clear.

What I am trying to understand -- and it's unfortunate that I have to try to understand this -- but if we're going to advise the Commission, we need to understand what you're doing. I'm trying to understand how you are going to decide, through whatever means, that there is or is not a problem.

At this point, I don't understand how you are going to make the decision after you have carried out this study. I won't pursue it any further. I just want to explain to you why I'm asking these questions.

I'm trying to understand the decision process. At some point, you're going to have to make a decision. The impression that I get is that nobody on the Staff at this point knows how the decision is going to be made. You have faith that having developed all this new information, the decision will sort of maybe rear its ugly head automatically.

I think somebody ought to be giving serious thought to how you are going to make the decision, because I don't think it's going to be easy.

MR. BARRETT: Dr. Kerr, I apologize for interrupting again, but I think that we have a way in mind of how to make the decision. We have criteria in mind as to what's acceptable and what's unacceptable for this accident. I think that realistically speaking, when we're finished with the study, we're going to have to exercise a certain amount of judgment.

I don't believe that the numerical results are going to dictate a conclusion as to whether or not this is acceptable. We have a general idea in mind of what's an acceptable level of risk for this sequence, but as I said, we're going to have to exercise a certain amount of judgment.

I would like to say one further thing though. I don't believe that to make an improvement to any plant, that we have to first conclude that the plant is not safe enough. I think that's an important point.

I think that the plants are safe enough. They meet our rules and our regulatory guidance and they're safe enough. What we have to conclude, according to our backfit rule, is that any improvement that we plan to implement is a substantial improvement in safety and meets the test of cost/benefit.

We can do that, even if we still believe the plants are safe enough.

MR. KERR: I know you can under existing rules, but it seems to me that if you do it for only that reason, it is somewhat capricious. You're saying that on the one hand, they're safe enough to protect the public, and yet you are spending public money to improve them.

I mean public money in the sense that the rate payers and others pay for this. So, I think as a responsible regulator, you have to decide before you start applying cost/benefit analysis, that something needs to be done because the public really ought to be protected better than it is now being protected.

It was in that sense that I was using the term, not in the legalistic sense in which current regulations can be interpreted.

MR. BARRETT: I understand.

MR. BURDICK: I think it is true to say that we do not at this point have any reason to say that they are not safe enough. Let me get into the program here. Let me start with the configuration review, because here it is that we try to cover as many plants as we could in the following manner:

We looked at the systems involved in interfacing systems LOCAs, and identified as well as we could, a set of systems that were representative, as representative as possible of those existing in the family of operating plants. The intent was then to analyze these systems in the context of a half a dozen specific plant studies, a half a dozen plants which, in fact, had these systems.

The output then of these systems analyses could be used -- with a little modification -- if necessary; if the problem indicated that this should be done; to go to plants that contained those systems, and with a little extra effort, walk through looking for common cause failures and those kinds of things.

You might then be able to deal with the plant-specific nature of the problem. I'll get into a more detailed discussion of each task --

MR. CATTON: If there is more detail, how much time do you plan to use?

MR. BURDICK: Thirty minutes is what I had allotted. How many have I taken?

MR. CATTON: Well, I'm going to cut this off at 11:15, so you guys have 20 minutes more.

MR. BURDICK: All right, we also have an engineering analysis test to look at fragilities. Thermohydraulic analyses will probably be taken off from existing results from other studies. I think we can do that. We may have to do some core physics analysis, depending upon whether or not there are sources of unborated water that would have to be used.

Accident management analysis initially is restricted to the normal recovery analysis in the PRA unless it indicates that there is some additional activity warranted because the problem has popped up in the PRA analysis.

Of course, we have a large human factor effort which is initially looking at operating experience to develop an initial shot at developing performance shaping factors. We are going to the plants with NRR on these audits, gathering additional information which can be used to refine the performance shaping factors.

MR. SCHROCK: You said you were going to answer the question that I raised about the criteria for which plants to chose for audit.

MR. BURDICK: Oh, well, I thought --

MR. SCHROCK: You'd thought you'd done that?

MR. BURDICK: Yes, I thought I had done that, but in the six plants that came out of the configuration review, the six plants that embodied the representative systems, these are the ones that we would use in the plant audits.

MR. CATTON: Would that be the same six plants that Brookhaven looked at?

MR. BURDICK: No, it would not.

MR. CATTON: Any reason? Their criteria for selecting them sounded the same as the one you just gave.

MR. BURDICK: No, I did not. They -- I'm looking at the systems and trying to cover as many operating plants as I can with these representative systems. Brookhaven did not do that.

MR. CATTON: They said they did, but that's beside the point, I guess.

MR. DIAB: Dr. Catton, if I may comment on this? The two or more most important or significant criteria for selection besides the systems are the vendors, the type of vendor and again, the human factors or opportunity for human failures.

As far as the vendors go, we have planned to cover all three PWR vendors. As far as the human reliability, it really is more generic. You know, the human failures means the failures are not plant-specific, so for any plant you have the same hardware --

MR. BURDICK: You're taking up my time, Sammy.

MR. CATTON: That's right.

[Slide.]

MR. MR. BURDICK: Again, this configuration review identified these representative systems for analysis in these six plants. And the audit plants are selected on this basis.

There was a data analysis task, to review the operating history for these events, to get information on reliability, down to the component level; to estimate PRA parameters; to identify the important human actions also for input to the PRA but also in a qualitative sense, also.

There was an engineering analysis task to calculate the component fragilities with respect to pressure and temperature and the low pressure system or systems.

Under this task we are going to estimate the likelihoods of failures at specific systems locations like flanges, valve packing, et cetera. And again, estimate the flow rates and timings, so that we know how long the humans have to act.

[Slide.]

MR. BURDICK: Under the human factors task, we are going to, as I said, analyze the human actions from the data analysis to get the preliminary identification of performance shaping factors; go through the plant audits and collect additional human factors information. We're going to try to improve these audits as we go through them and then we'll perform this review, recommend audit procedure revisions, and the final task here to develop the final performance shaping factors for estimating the human error contribution.

We had to do some methods development. The past PRAs had not put all these elements together in the depth that we are doing in this program. We needed to take a fresh look at how to do that.

[Slide.]

MR. BURDICK: The sixth task is to apply the method to the six plants identified in Task 1. There is, of course, a program management task that is the glue that holds all these elements together.

Now, the way we intend to package these results, in the achievement of these objectives, is in a library of system models that can be used in ISLOCA evaluations. And we want to provide guidelines for the assessment of designs and procedures, things that we have determined are important to the

ISLOCA problem.

You may, if we decide it is desirable to do so, use these models in going to specific plants and assessing the seriousness of the situation at that specific plant. And there would be the list of other items here that should be looked at in an ISLOCA context also, things like if it is important that a certain valve be turned or activated to alleviate perhaps an ISLOCA situation, is that valve even accessible to operators at a certain plant. That kind of thing.

so we are dealing with, we are covering these bases, the plant specific nature of the problem we are trying to deal with, if it becomes necessary that we do this.

[Slide.]

MR. BURDICK: This program has been underway since just July 24. We've completed our first plant. A letter report will be forthcoming around the third week in January. We are going to sit down with the contractor and go through his analysis and make a determination of a number of things. One thing we are going to be looking at very closely is how the human element, how human factors were dealt with.

Now, the configuration review, that has been completed. The data analysis has been completed. The engineering analysis on Davis-Besse, that is currently underway but will be finished in time to get the results in the letter report. Human factors work of course is underway.

The first plant here is going ahead before the analysis methods have been completed. We're using the first plant as a pilot kind of plant in this study. We may have to come back and modify some things after the final method has been completed.

We have now, as I said, completed the application on Davis-Besse. The audit program, by the way, is a super way to get information needed in this kind of activity.

The program management of course has been underway. And we are working on the evaluation guide and systems analyses with delivery in late Fiscal Year 1990.

Are there any questions?

MR. SCHROCK: You are doing this for PWRs at the present time. What is the plan on BWRs, now? Will that begin when this one ends, or is it not going to be done, or what?

MR. BURDICK: We have boilers on the list to do at the end of the program.

We are going to, however, be assessing the situation along the way, not only in January, late January, after the completion of Davis-Besse, but also after the next plant, we are going to again assess what we have learned to date and what is this program producing and is it necessary in fact to go ahead with the rest of these plants, or have we now learned enough at that point to make some decisions.

MR. SCHROCK: Does that imply that you will have a decision about BWRs based on the information you are gathering on PWRs?

MR. BURDICK: It may be. But we would have to be very careful about that. There may be aspects to the boiler situation that still bear some looking into.

MR. DAVIS: I have quick question, Mr. Chairman.

It would seem to me, Gary, that one of the more important parameters in this assessment is one which PRAs usually ignore. And that is aging of the components and how that might affect the valve performance.

I didn't hear you mention anything about that. Is that going to be looked at as part of this assessment or don't you agree that it is even an important parameter?

MR. BURDICK: That's included in the program, but that is a little out of my area of expertise.

John?

MR. O'BRIEN: My name is John O'Brien, the Office of Research.

With respect to the fragilities of components, aging is explicitly considered. And I'm talking about structural analysis.

But in the case of valves, I think it is embedded in the failure rates. You know, you just take whatever failure rates we get from in-service experience base, and that includes age experience as well as new experience.

So I think it is just in the data base.

MR. DAVIS: Well, you have to be a little bit careful. You can do some trending analysis to predict a future failure rate.

Is that what you have in mind? If you just take the raw data, I don't think you'll get the aging effect, because that tends to smear the --

MR. O'BRIEN: I don't believe it is the intent of this program to give probability of ISLOCA as a function of the age of the plant, but to give an average over the life of the plant. I believe that is our intent right now.

I would like Owen Rothberg to respond to that. But that's my view. This is not to give ISLOCA as a function of the age of the plant. That's my view.

MR. DAVIS: Well, I thought I saw that you were going to use the existing lifetime of the plant, 25 reactor years, as part of the basis for coming to a conclusion.

It could be that the aging effect is very important, and that towards the end of the lifetime this --

MR. O'BRIEN: That's true.

MR. DAVIS: -- effect could be much more probable.

MR. O'BRIEN: And in selecting the six units, one of the criteria is that they would look at new units and old units, Westinghouse units and CE units and so on. So aging would be reflected in the specific unit being studied.

MR. DAVIS: Thank you.

MR. O'BRIEN: Degradation is included, however, in the data going in in general.

MR. DAVIS: Thank you.

MR. CATTON: We are going to have now what, about a one-minute wrapup?

MR. BARRETT: Yes. I'll give you a one-minute wrapup. And to do so, I won't even go to the podium.

I would just like to reiterate that we believe that recent operational experience warrants a closer look at the interfacing systems LOCA, not so much because of the number of events that we've seen or the severity, even so much the severity, but because of the types of events that we're seeing. These are types of events which we don't feel are currently modeled in PRAs.

I think the strongest message that we've gotten from you today is that we need to take into account, be cognizant of the plant specificity of the interfacing systems LOCA, particularly in terms of the hardware, the interfacing systems LOCA hardware.

I think I heard a strong recommendation that we should structure this program in such a way that we develop information that hopefully can be used in the context of the existing IPE program, and the accident-management program of NUMARC. And we will certainly try to do that, if it is appropriate, to the extent that it is appropriate.

We also heard a request from the Chairman concerning more information about the events that we've seen, the actual events that we've seen, and what we think is important about those events and why those events have motivated this program. And we will provide that as soon as we can.

And also I would like to, I heard a couple of good questions here that I don't think we dealt with very well. I think we need to, we are still in the process, we really haven't dealt yet with the question of what we are going to do about BWRs. We have really concentrated so far on the PWR question. And we will be thinking about how to handle BWRs.

And I think that with regard to the question on aging, I think that we could probably give some more thought about that, too, in terms of how specifically, how well we are indeed addressing it with what we have come up with so far.

And finally, I would like to say that we intend to keep you fully informed of this program. As Gary mentioned, we hope to have some preliminary results from our contractors by mid-January. Giving us time to digest that, we would plan perhaps sometime in the Spring to come down and give you some idea of what is preliminarily coming out of the study, if that is satisfactory with you.

MR. CATTON: Sounds good to me.

If there are no further comments, we will move on.

Thank you.

MR. BARRETT: Thank you, Mr. Chairman.

MR. CATTON: Next on the agenda is the Small-Break LOCA Technical Program Group Activities, and I believe Dave Bessette is going to give it to somebody else.

[Slide.]

MR. LEE: Instead of David, I will be doing the presentation. I will give you a very brief introduction to this CSAU for small-break LOCA for the PWR.

MR. CATTON: What does "CSAU" stand for?

MR. LEE: It's code scaling applicability and uncertainty, and the objective is that we like to use the RELAP5/MOD3 code and apply the CSAU method to the small-break LOCA.

MR. CATTON: One of the first steps in the CSAU method is the documentation.

MR. LEE: Right.

MR. CATTON: Is the documentation complete?

MR. LEE: The MOD3 code is scheduled for release in the early part of January, and the documentation, the draft of that, will be coming out within a few months after that.

MR. CATTON: So, that would make it March, right? How can you initiate the process now?

MR. LEE: We will respond to that question later.

In terms of the program structure, it is similar to the large-break LOCA CSAU effort, and we formed a TPG group, the Technical Program Group, similar to the one for the large-break LOCA, and the members of that is shown on the next vu-graph.

[Slide.]

MR. LEE: I do the monitoring of this program for NRC, as of today, and INEL, there are two persons. Marcos and Gary Wilson are the two key people at INEL that coordinate this effort for us.

The TPG members consist of two of us from NRC, Brent Boyack from Los Alamos, Professor Griffith from MIT, Professor Hsu from UM, Professor Ishii from Purdue, and Gary Lellouche from Saul Levy, and of course, the two key persons from INEL.

You can see that some of these people here -- for example, Hsu and Ishii, those people are very familiar with the type of experiment data that we will be using for this purpose, and then, from ACRS, Professor Schrock will be attending all our meetings, starting with the second meeting we had just 2 days ago.

[Slide.]

MR. LEE: We initiated this effort back in June of this year. We are expecting to complete it by the end of fiscal year '91. We have had two meetings since then, and those are the dates shown here.

So, Gary is going to give you the summary from the first meeting, as well as what we have done in the last meeting.

MR. CATTON: Gary, there are two things I'd like you to address, maybe. One is the fact that the MOD3 is not a mature code, and part of the process, really, depends on some maturation. The second is try to help me understand how you are going to do it without documentation over the next 3 or 4 months.

MR. WILSON: All right, Ivan, I'll address both of those.

[Slide.]

MR. WILSON: Of course, I'm Gary Wilson from INEL. I'm program manager on this particular program. I'm going to give you a brief overview, and then, Dr. Ortiz, who is the principle investigator on the program, will show you results.

I'd like to add a cautionary note to the things that Marcos and I are going to say to you this morning. We are approximately 4 months into an 18-month program. So, I believe most of the things that we'll show you this morning, in terms of a product and of results to date, are valid. However, this is a status report. The work is ongoing. There can be certain things that we show you this morning that will change as we proceed. So, please keep that in mind.

[Slide.]

MR. WILSON: These are the major topics that I am going to address. I'm going to give you just a quick overview of the CSAU methodology, and Ivan, I'll try to cover the two questions you asked, at least in summary form, at that point in time. Then, Dr. Ortiz is going to show you results of work to date, and then, I will conclude the presentation with the future activities.

[Slide.]

MR. WILSON: Now, the CSAU methodology consists of three elements, and they're shown here -- the requirements and code capabilities element, the assessment and ranging of parameters, and them, of course, the sensitivity calculations and the uncertainty analysis that's involved.

As Richard alluded to, we are using the same process that we used on the large-break LOCA. Now, when I say "process", that's the real operational word. We're using the same process.

There are items that are specific to the application. CSAU small-break will differ in application, in some specifics, from the large-break LOCA, but the process will be the same.

MR. CATTON: If the process is going to be the same, Gary, what are you doing about steps 4 and 5? Step 4 says you select a frozen code. "Frozen code" usually implies that part of the -- at least, the code development assessment process has been completed, and you can't have done that with MOD3 yet. MOD3 is a new code.

MR. WILSON: If you will hold just a little minute, I'll come to that in about two slides. Is that satisfactory?

MR. CATTON: I'm just trying to get you ready.

[Slide.]

MR. WILSON: I understand. Okay. I understand the thrust of your concerns, and I will address that.

I put this up just to show you the methodology as a process. I know you can't read it. It is in your handouts.

MR. CATTON: It's almost as illegible in our handout as it is on the board.

MR. WILSON: Okay. We can take care of that. We can get you copies of it. I believe nearly everyone on this Committee has seen this particular overhead repeatedly, but I can get you better copies, if that's desired.

MR. KERR: I want to commend you, because I think almost every slide show should have at least one illegible slide included, and I think that is an appropriate one.

MR. WILSON: Okay.

MR. SCHROCK: It is legible on the next page, though.

[Slide.]

MR. WILSON: The steps in the first element compare the modeling requirements with basic code capabilities.

Now, in those particular six steps that are associated with that first element, amongst other things, we identify the plausible phenomena and processes that can take place in the plant in the scenario that was selected.

We then determined the dominant phenomena in the processes. We evaluate the codes in the context of that important phenomena, and then we define a basic code applicability, and this comes to the heart of the questions that Ivan was just asking. How can we do part of this if the code documentation does not exist?

[Slide.]

MR. WILSON: This overhead is just a flow diagram form of what I just said. You can see that "select a frozen code" up here is prominent in this particular element. I'll come back to that in just a minute. I'd like to take these in sequence.

We have specified the scenario. It's a small-break LOCA. We have specified the plant or the NPP, the nuclear power plant. We are going to look at a B&W power plant, and the specific plant is the Oconee-3 plant.

Now, in scenario specification, I would say, in my view, that, at this point in time, the scenario is specified to about the 90-percent level. There are some details that are still developing, as we go through this process, but basically, we know what the scenario is going to look like.

I will now turn to "select a frozen code". RELAP5/MOD3 has been the code that was selected. The motivation for doing that was to move to a second systems code that's available in the NRC stable of codes.

RELAP5/MOD3, in a pre-released version, was put out last summer. It has undergone and is undergoing developmental assessment. Part of that assessment is being done in the international community, under the auspices of the NRC ICAP program. More independent assessment is also in progress and will continue.

We believe that the frozen version of the code will be released in January. The documentation that goes with that frozen version is partially complete. There is much of it that is identical to RELAP5/MOD2, from which MOD3 came. They are also in the process of writing the documentation that applies to the new features of the code.

MR. CATTON: My recollection is that the RELAP5/MOD2 documentation was not adequately done.

MR. WILSON: Ivan, I guess I would disagree in the sense that I think the documentation both for RELAP5/MOD2 and for RELAP5/MOD3, as it develops in its schedule and our schedule, will be sufficient for this TPG to do its job.

MR. CATTON: I don't know what to say to that. I haven't seen the documentation. I did see the MOD2 documentation. The MOD2 documentation was incomplete.

MR. WILSON: The formal documentation for RELAP5/MOD3 I believe will be released along in the February time frame.

Fortunately, on this particular program, that code resides at my laboratory. And Marcos and I and RTPG, on the small-break LOCA program, have access not only to the existing draft documentation and the final documentation that is developed, we have access to the people that are doing the job.

Now, I agree, this would not be a way to conduct another program, outside of the particular laboratory. But in our case, I will again state, and I believe that TPG and the small-break LOCA team will have access at the proper time to the documentation that we need to do our job.

MR. CATTON: So you are going to skip part of Chapter 5?

MR. WILSON: No. We are not going to skip anything. We are going to go right down the line, and wherever we need to know something about the code, we will develop that. We will have access to that information.

MR. CATTON: So you are not going to follow the procedure that was followed before, which was that these things are available before?

MR. WILSON: You are correct in the sense that we are going to lead the procedure by a couple of months probably, because we don't want to slow down the small-break LOCA program.

Now, ultimately, in the end, all of the schedules will come together and catch up with each other.

MR. CATTON: Gary, as you well know, one of the big problems in this whole code development business has been using the kind of excuse that you just used, that we will have it when we are ready; it can always been delayed; well, documentation, gee, I can talk to the guy who did it.

And the result is at any given point, you don't have what you need. I don't think you are following the CSAU. That's just my opinion.

MR. WILSON: Well, I guess in my opinion, we are following the CSAU procedure in some cases by a couple of months. We may be leading it over the most optimum way you would apply the procedure.

MR. CATTON: One of the key elements to what was done previously was getting that documentation in hand straightaway. And you recall that yourself.

MR. WILSON: Well, as I recall, we did a number of things in advance before we did get that documentation.

MR. CATTON: And then you redid some, anyway. Why don't you continue?

MR. WILSON: All right.

In any case, what I've done is, I've outlined in red where we are in this particular process.

Essentially, the items that are in solid red, we believe are complete or 99 percent complete. You will notice I did not outline this one in red. At two months or so I probably can't.

We are in the process right now of doing this identification and ranking of phenomena. That is where we are in the process.

Marcos is going to show you some typical results of that process. Now, again, as in the case of the large-break LOCA, we are using two independent teams to do this. And we have been even more strident in this program than we were in the large-break LOCA program, for me to be able to stand up here and tell you that the two teams are truly independent.

At the point in time both of those teams complete the PIRT proc[illegible] we will bring their results together and compare them and [illegible]ve differences.

[illegible]lide.]

MR. WILSON: Continuing with a brief description of the process, just to set things up for what the results of Marcus is going to show you, the steps in Element 2 establish the key code parameters and their variability. The work is based on a defined assessment matrix. We will again plan to use standard nodalization which removes it as an uncertainty source. And then the individual parameter variabilities will be stated in terms of probability -- that's the preferred method -- or in terms of a bounding bias. And those ranges will, as previously done, be traced to experimental data and whatever studies might be appropriate.

[Slide.]

MR. CATTON: One of the key things in RELAP5/MOD3 that perplexes me, or one of many, maybe, is this business of how you deal with the multidimensional flow using the piping networks.

About 15 years ago that was shown to be inadequate. What have you done in the interim period to show that this is an appropriate way? How are you going to deal with this in the CSAU? Are you just going to take a penalty for it, or what?

MR. WILSON: I guess I can't give you the answer now. I can tell you how we are going to approach that.

MR. CATTON: I understand mathematically it is incorrect, and you can show that it doesn't compare well with experiment. And you can write down why.

MR. WILSON: Let me reiterate the approach. And then we can make comments on that.

What we will first do is establish where we definitely, where multidimensional behavior is critical to this particular event. And I'm not sure that that is going to be a very significant portion of the analytical space.

If we do establish that that is the case for certain selected items, we will then look at how the code handles that.

If we believe that we can on a technical basis argue that the code does a reasonable representation, then, hey, we will probably cast uncertainty in terms of probability if we can, bias if we can't.

If there is reason to believe that the code does not handle that behavior correctly, then I believe we will probably do a bounding bias and we will take a penalty.

[Slide.]

MR. WILSON: Continuing on, this is the element 2 in the flow diagram. You establish the assessment matrix, you define the nodalization, and again, as I mentioned earlier, we are going to use a standard nodalization.

You then start into the process of determining code and experimental accuracy, determine effects of scale, and so on through the process.

What we have here is a double path. All that, what that really denotes is that if you can cast your variabilities and your uncertainties in terms of probabilistic characterization, you go down through one path.

If you have to take biases based on a bounding basis, you can go down through another path.

The same process that we used in the large-break.

[Slide.]

MR. WILSON: The last element in the methodology, and really the ultimate goal to quantify uncertainty is accomplished in Element 3.

You perform sensitivity analyses to convert the variability in the individual contributors to uncertainty, into their individual reflections in the safety criteria. And

Marcus will review for you the safety criteria that are appropriate to small-break LOCA.

And then you combine those individual reflections in the primary safety criteria into a singular statement about code uncertainty.

[Slide.]

MR. WILSON: And just to cap it off, there is Element 3 in terms of a flow diagram.

Now, that is what I had intended to say in the context of an introduction.

Dr. Ortiz will come up now and show you examples of what we have accomplished in the last approximately four months.

[Slide.]

MR. ORTIZ: I am first going to show you an overview of what I will be talking about and that's the different steps, as Gary mentioned them.

We went through a plant scenario selection and made a selection and then we had two independent panels handling the issue of the PIRT, the different steps of the panel -- of the process were followed in parallel by the two panels. The final step, the future step, is the resolution of the differences between the two resulting phenomena rankings.

We used the analytical hierarchy process to define the ranking of these phenomena.

MR. WARD: Can you remind us what PIRT stands for?

MR. ORTIZ: Phenomena Identification and Ranking Table.

[Slide.]

MR. ORTIZ: So this scenario, as Gary mentioned, the scenario we chose was Oconee and we also chose -- that was the plant we chose the scenario was a small break in the worst break configuration and we have yet to define that specifically. We decided based on the information that we had that the worst break configuration would be in the cold leg at the discharge of the pump but we still are deciding whether it is in the top, the side, or the bottom of the pipe.

MR. KERR: Excuse me, how do you decide? By doing calculations for breaks at various spots?

MR. ORTIZ: We may have to do that.

MR. KERR: What have you done up to now?

MR. ORTIZ: Up to now we have just looked into the documentation like PRA's and they consulted with the utilities and the vendors and came up with -- according to their analysis this is the worst place.

MR. KERR: Thank you.

MR. ORTIZ: Then we are going to examine the most likely power shape for the accident and we are assuming that since we chose a plant that is somewhat sensitive to operator action we will not model the operator. We will assume that the operator in principle does everything that he is supposed to do according to the emergency operating procedures.

The scenario we're choosing is the one that will display the maximum number of phenomena to the extent that these phenomena are supported by experiments.

[Slide.]

MR. ORTIZ: So let me show you a viewgraph of -- that's what the plant looks like and this being the hea exchanger, the steam generator and here is the core.

MR. DAVIS: Where would the break be?

MR. ORTIZ: The break would be -- this is the pump out here -- somewhere in this pipe between the pump and the vessel.

MR. CATTON: Why is that the worst location?

MR. ORTIZ: Well, according to the vendors, the documentation and the utility itself, they have done analysis to determine what would be the worst location --

MR. CATTON: But they don't have a best estimate code. They just use Appendix K and the reason you are doing this is to get away from that.

MR. ORTIZ: They have done calculations to see what would happen if you have a break there.

MR. CATTON: But that is Appendix K calculations. What vendor is doing best estimate calculations?

MR. BESSETTE: This is David Bessette from the NRC

Research Office.

What we'll try to do is choose the break location that gives the maximum loss of inventory, that being the break that stays in liquid break flow for the longest period of time before transitioning to two phase or steam flow, so it means a low location.

MR. CATTON: Well, that sounds sensible, but to say that you got that information from the vendors is kind of next to silly.

MR. BESSETTE: Yes, we'll just take -- we have an idea just based on past analyses.

MR. JONES: This is Bob Jones from NRR.

The specific choice of the break, I wasn't involved in the decision process but the reason it is likely to be the worst location is that the high pressure injection system injects in that piping, and if you put the break downstream of the injection point you lose a portion of the injection flow that's coming in, and that's why historically the vendor calculation predicts that to be the worst case, not just because of the model itself, the EM nature but the location of the break relative to the injection point.

MR. CATTON: So actually it's based on somebody's judgment and then an Appendix K calculation is what it sounds like.

MR. JONES: Right. I think it was also looked at and missed. Some of the locations certainly in the cold leg was looked at in MIST.

MR. CATTON: You're right -- but again in MIST you'd have a very small pipe.

Where do you put it in the pipe? Elevation in the pipe?

MR. ORTIZ: We haven't decided that yet.

MR. BESSETTE: It will probably be the bottom.

MR. CATTON: The bottom? Why not the top? You are looking for something that tests phenomena.

MR. BESSETTE: We could --

MR. CATTON: If you put it in the bottom the break flow won't get into any difficulties until the pipe's practically empty I guess.

MR. BESSETTE: I think that's just -- the bottom will stay in liquid flow longer than the top.

MR. CATTON: But don't you want to test the phenomena?

MR. BESSETTE: Varying the location from the bottom to the top will vary the, will just vary the quality.

MR. CATTON: The pipe's half full of -- that's right. The physics are tougher if it is in the top than in the bottom, I think.

Anyway, why don't you continue?

MR. WARD: What he said is that the definition of the worst break is the one that gets the inventory down fastest.

MR. CATTON: But then selecting it so that it always sees just the liquid side is not testing the code and part of what they are supposedly trying to do is to select something that forces the code to exercise the most.

Now stratified flow is going to be important and I am not sure how well the code deals with it.

MR. ORTIZ: It will see vapor flow even if we look just at the bottom. At some point the inventory will come to the point where we'll see vapor coming out of the break.

MR. CATTON: I think you are still missing the point. If the pipe is half full of water and the break is in the top or in the bottom, which exercises the code the most?

MR. ORTIZ: I guess in that case we went in the worst break location given the criteria and that would be the bottom.

MR. SCHROCK: I think you have to ask what is the code model and the geometries and I raise some objection to what has been chosen now for RELAP 5, MOD3 in our last Subcommittee meeting and I still plan to pursue that but the fact is that you need to look at whether there is or is not a branch line that is broken that represents the small break.

You can't just put a small break anywhere at all and expect that you're representing something that is realistic. It is going to be a pipe that's broken that creates this small break. Now if you are talking about tears in a large pipe, 28 inch diameter pipe with a small tear in it, now you have a geometry that is not in the code -- so the only kind of geometry that the code attempts to address is the broken branch line.

MR. CATTON: So? What did you select?

MR. ORTIZ: We haven't yet.

MR. CATTON: Okay.

[Slide.]

MR. ORTIZ: Of the primary safety criteria that we selected, the first safety criteria was the liquid inventory in the core the technical group would uncover for this particular plant. It was unlikely that the core would uncover and then the peak clad temperature would experience some excursion, but that is why we put it as the second primary safety criteria. So these are the two safety criteria that we chose.

Now, up to this point, it is common for both panels. The panels have never heard of each other's results and these are the same ground rules for both of them and now I am going to present as an example, what the INEL panel has done.

[Slide.]

MR. ORTIZ: The first step in the PIRI after selecting the safety criteria was to divide the transient or partition the transient into phases that will better handle the situation. There are different stages of the transient that have different characteristics, so we break it down into stages or phases, and this is the case of the INEL panel.

They have a total of ten phases. The first phase occurs when we had the break and there is a rapid depressurization of the system and they call that the subcooled blowdown. Then we have, because of flashing and boiling all over the reactor, the pressure tends to not drop so quickly and we have the intermediate blowdown phase. This graph is not to scale and is not meant to draw any conclusions from the numbers or the relative positions of phases, just to show the different phases.

Then we have the reactor trip. At that point, we continue depressurizing because now, once the reactor is tripped, there is not as much energy put into the system anymore. Then we have another region of pressure stabilization. At this point, the pumps have tripped, and we have natural circulation in the loop and at some point, the boiling on the upper part of the reactor will interrupt that natural circulation and that's Phase 5.

Then it will go into a boiling/condensing mode. We no longer have natural circulation around the loop. We have the core boiling water and the condenser condensing the steam and that is this stage 6. Then we have -- many things can occur depending on the size of the break. When they occur in time depends on the size of the break.

The next thing that would occur would be the refuel.

The HPI begins to refill the reactor and then we get to the point in which the leak flow is equal to the injection flow and things begin to stabilize.

Then we can go to two different modes. In the one case, the natural circulation has been reestablished. That is, we have flow around the loop, or we can have an intermittent situation which we have and then we don't; then we have it and then we don't, and that is 9-B, called feed-and-bleed.

So, the way the process works is that we chose the phases and then I'm going to show you a slide of the process to apply AHP. For each -- here are the steps.

[Slide.]

MR. ORTIZ: For each phase, we are going to partition the system into components, physical components. They don't necessarily have one single apparatus involved. It could be a whole chunk of the system, depending on the nature of that phase, so we partitioned the system into components and then we ranked those components in a pair-wise basis.

Since the ranking is subjective, we want to make sure that we have it as accurate as we can, and it is easier to rank component A versus component B only and get a number, than to rank component A versus B through Z. So the AHP process works on pair-wise comparisons.

After we rank all these components, then we have a weigh-in factor for that component on a systemwide basis. Then the next step is; for each phase and for each component, we identify the phenomena that are important or that are relevant to that component in the context of the primary safety criteria.

Then we rank the phenomena for that one component, also on a pair-wide basis. At the end, we rank the phenomena on a system basis for each phase, using the weigh-in factor that the component had. This is a pictorial way of showing it.

For each phase we have different components -- Component N, Component N+1, and for each component we have different phenomena.

[Slide.]

MR. ORTIZ: I will show you one of the many phases. As I said, ten phases were chosen, so for instance, for Phase No. 1, the Subcooled Blowdown, the panel of experts chose to break down the system into these six components.

Then they decided that this phenomena were important in that phase. The next step, or step that you saw before, is this component is associated with that phenomenon. This component has more phenomena associated with it.

Last, we will do the pair-wise comparison for this component with this phenomenon. Now, just to show you the volume of -- this is half the story. These are the phenomena and these are the phases, 1 through 9-A and B, and these indicate where this phenomenon is important.

MR. CATTON: Why don't I see stratified flow?

MR. ORTIZ: I said that this is half the story. We have a total of 58 phenomena and I believe stratified flow is there.

MR. CATTON: It is?

MR. ORTIZ: I remember seeing it. It was not in that list?

MR. CATTON: I don't see it anywhere.

MR. ORTIZ: Oh, yes, it is here. Steam break flow -- what name they give to the phenomena may include several things and that is part of the problem -- or that is part of the process at the end of reconciling the results of both panels. Sometimes they call a phenomenon by a different name and the phenomenon that they use contains several things.

I'm sure that we discussed the stratified flow as a part of the problem in both panels. It might not be called by name, although I doubt it.

MR. CATTON: So you're going to generate new descriptions for the physical phenomena to suit your needs?

MR. ORTIZ: There will be a description -- not to suit my needs.

MR. CATTON: Is this to keep those of us who are not following you --

MR. ORTIZ: Excuse me.

MR. CATTON: Never mind.

[Slide.]

MR. ORTIZ: Anyway, this is an example of the pair-wise ranking and this is for Phase 1 that I showed you before. We have these components and we rank the components and this panel chose to rank from 1 through 3. If we use a 1, that means that the components are of equal importance.

If we use a 2, it means that this component is slightly more important than that component in the experts' opinion. If we use a 3, it means that this component is much more important than that component.

If it is the other way, we use the fractions. This 1 over 2 means that this component is slightly more important than this one. This 1 over 3 means that this component is much more important than this one.

Then we apply the AHP methodology and we come up with the rankings. The AHP methodology generates rankings on a scale from zero to 1, but that implies an accuracy that is not really there, so what we do is that we normalize those or we scale those from a scale from 1 to 9 and that's the result.

Nine is very important, and one is of very little importance. Yes?

MR. CATTON: The reason I asked you about stratified flow is that I don't believe the early RELAP-5/MOD codes nor TRAC or any of them handled it well. For the small break LOCA, it's important.

If you don't call it out, you're going to miss it. I'm really disappointed that I don't see it.

MR. BESSETTE: I saw it under the two phase flow in the hot leg. They didn't call it stratified flow.

MR. CATTON: But two-phase flow in the hot leg is treated in a particular way in these codes and for the small break and the possibility of stratified flow, you're going to miss it because --

MR. SCHROCK: It could be the two-phase flow in the hot leg without stratification, but --

MR. CATTON: Well, look how TRAC treated it for years. They had counter-current stratified flow treated as some sort of mixture of steam going through the water in one direction and the water going in the other and we all know that physically that's nonsense.

MR. ORTIZ: What I am showing you is the result of one panel. I know that the other panel called it by name.

MR. WILSON: Gary Wilson, INEL. The code does have stratified flow models in it. Both panels definitely understand the criticality of stratified flow. Although it may not be named explicitly -- at this point in time, explicitly i the tables that Marco is showing you, stratified flow in the appropriate areas, under the appropriate phase conditions, are being addressed and evaluated.

Now, you have a very valid question about how well the codo handles that. Stratified flow, in my opinion, will come out as one of the phenomena that at least in one or more phases has to be addressed by the code to calculate these transients.

We will then range the variability in the stratified flow or in the key parameter that represents stratified code in the flow and we will do sensitivity calculations. If the code does not simulate the phenomena well, that should come out as a part of the process and that's exactly what we're trying to do.

I assure you, Ivan, stratified flow and its importance is recognized by both panels. It is being considered by both. It is recognized by the code because the code has stratified models in it.

[Slide.]

MR. BARRETT: Going back to the original slide, what I just showed you is that, for one panel and one particular phase, at this point the TPG group has completed the phenomena ranking. We did that yesterday in our second meeting, and we still have to process that to get the final system ranking.

The INEL group is in the process of doing the phenomena ranking, and once we have those two together, we'll proceed to the next step, which is the resolution of any differences that there may be. That's the status of the results today.

Now Gary will show you the future.

[Slide.]

MR. WILSON: I have only one slide that I'm going to conclude with. You will have copies before we leave here.

The future work scope and the schedule include the following milestones for this program:

As you can see, the first item is the one just referred to by Marcus. We will take the PIRT results, the phenomena identification results, from the TPG and from INEL, and we will compare them. There will be a certain amount of work to get them on a one-to-one basis so that we can make those comparisons. This is roughly the third time that we've applied this process, and our past experience indicates to us there's a strong likelihood there will be some major differences between the two panels. In fact, that's the reason you use two independent panels: to be assured that you haven't forgotten anything.

We will resolve those differences on the basis of technical arguments. We will consult both panels. We will argue the way through it. If there are differences because of procedural errors or, for example, one panel called something one thing and another panel called it another thing, we'll resolve those. The non-significant ones, like procedural errors, fall out automatically. There may be some real differences of opinions. We will resolve those on technical arguments.

If we are unable to get a resolution -- i.e., a consensus between the two panels -- then we will take the highest-ranking that exists between the two panels, and we will factor that into how that particular phenomena is considered.

We are in the process of looking at the assessment matrix. We intend to complete that process in February, at least in draft form. We will have a draft assessment matrix out at that time. Now, that assessment matrix is likely to change as we go on, but we'll certainly have the basis for it in February.

The next TPG meeting is scheduled for the last part of February. INEL is in the process of setting key code parameters and doing the initial of those parameters. That information will be provided to the TPG in January. They'll have a chance to take a look at that, and then, in February, we will sit down and come to a consensus among the TPG of what the key code parameters that we have to address are, and the ranges that we have to vary those over.

We intend to get the first statements of code applicability out in March.

Also in March we expect to conduct what for lack of better words we've called a small-break LOCA CSAU workshop. The intent for this workshop -- it's probably a two-day workshop -- is to take the NRC's program and its results, invite in industry, vendors and utilities, bring those parties together who have some common interest, and exchange information in some sense. Industry can probably act as a reviewer of what we are doing. We will get their feedback. In the same general sense, I believe that what we are doing we will be able to pass on to industry so that they may benefit from that. So that item, the small-break LOCA CSAU workshop, that's what is intended. We'll conduct that in March, we believe.

The final results for the PIRT will be out in April. That's more than likely going to be a letter report.

All of this will be formally documented in the NUREG at the end of the program, but we will have several levels of formality of documentation as we go through the process.

Our schedule is to complete the sensitivity calculations that are involved in the process in October of next year. We will be doing documentation that will fit into the NUREG CR all through the program, but in October of next year we will turn and really get serious about documenting the NUREG, and that sort of thing. We have scheduled to put out the draft report or the draft NUREG in March of 1991, and then to issue the NUREG CR for the total program in June of 1991. That's our current schedules, the milestones.

MR. CATTON: When are you going to get the documentation?

MR. WILSON: Step 5.

Oh, When will we get the documentation for the codes, so that we can go through the process, is that the question?

MR. CATTON: That's correct. Because somewhere you have to do the usual accuracy and convergence kind of studies. Where are they?

MR. WILSON: With respect to the TPG, to our activity --

MR. CATTON: No, no. These should be done before you start. Where are they?

MR. WILSON: The code assessment of RELAP 5, MOD3.

MR. CATTON: I'll ask it again.

One of the big criticisms of the earlier CSAU effort was the lack of certain information regarding the code characteristics. These dealt with things like the accuracy, time step, nodalization one should be using The studies that form the basis for that, that should precede the process you're going through, where are these?

MR. WILSON: Okay. I understand the question now.

To the extent that the RELAP 5, MOD2, work as the predecessor of the code we're using is applicable, those results are already available.

MR. CATTON: I'm talking about MOD3.

MR. WILSON: I understand, but what I'm trying to hint to you, Ivan, is that RELAP 5, MOD2, what was done on it has certain applicabilities, because it was a predecessor code.

You have to understand the RELAP 5, MOD3, is not a totally new code. It is changes in the prior code, RELAP 5, MOD2.

Now, with respect to RELAP 5, MOD3, the developmental assessment being done for that code, parts of it are available already. I would say the majority of it is, at least in draft form.

MR. CATTON: Do you have a new set of rules for the CSAU?

MR. WILSON: I do not perceive that we do.

MR. CATTON: Well, from my vantage point, it certainly looks like that.

MR. WILSON: I think you and I are debating time here. I believe that, with respect to the optimum way you would do the process, we are probably leading the optimum way by about two months. I do not see that as a significant problem, because the code happens to reside at the laboratory that I work at, and I have access that other people might not have.

MR. CATTON: Well, Gary, I'd like to see the code accuracy and convergence studies.

MR. WILSON: Would you say that again, please.

MR. CATTON: I would like to see them. Certainly you must have them.

MR. WILSON: The code information.

MR. CATTON: That's correct.

MR. WILSON: All right. We will take that as an action item: to provide you with documentation of the code that is available.

MR. CATTON: And also the basis for the nodalization, and how you transfer from MOD2 to MOD3.

MR. WILSON: Okay, but we have not done that process. At the time we do that process, we will provide that to you.

MR. CATTON: But usually that -- But how could you assess the code then? Now I don't understand.

We're not getting anywhere with this conversation.

I don't have any more questions.

MR. WARD: I wonder if I could ask Gary a question about the CSAU process more generally.

The end product of a CSAU analysis is a quantity which purports to be an estimate of the uncertainty in, let's say, PCT, based on three variables, a particular code, a particular plant, and a particular transient. Back when ACRS first commented on this program, in 1987, we were concerned that there might be a fourth variable, and that is the code user: The competence or the style or something of the code user might introduce a fourth variable. Is that a realistic concern, or is it being dealt with, or where do you stand on that?

MR. WILSON: Now, what I'm about to say it my own personal opinion. I don't believe it's totally out to lunch, but I've got to admit that that's my own personal opinion.

In principle, I believe that uncertainly induced by the user could be looked at in the same way that you looked at nodalization. You could characterize that uncertainty, if you chose to do so. I'm not sure how I would go about characterizing user uncertainty in that regard.

In my view, past use of this process and the process as we're going to use it in this thing will treat user uncertainty somewhat in the same sense that we're going to treat nodalization -- i.e., we're probably going to remove it as a source of uncertainty. Now, I think I have some confidence in that, because I think a large part of what we call user uncertainty is associated with nodalization. We are going to establish a standard nodalization that represents the best or the optimum way to calculate this transient.

There is a small part of user uncertainty that is induced by other factors. Of course, one of them could be, "Does he screw up and just put in the wrong numbers?" You handle that by quality control.

There is a small part fo that that's induced by how the user approaches certain things that he may input to the code. For example, friction factors, flow multipliers, those sorts of things, are user input. I believe we are going to assume that we are using a mature code user. I don't know anybody in industry that makes safety decisions that doesn't use mature code users. There are certain practices that mature code users go through to establish quality. Some of those are formalized. It was a part of the ICAP program. All of the codes have and are continuing to in the code documentation insert sections that say, "These are the good things you do. Do this. Don't do that."

In summary, I think we're going to treat potential uncertainty in the same sense that we treated nodalization: We're going to kind of standardize it. We're going to assume that we're using a mature code user. And, therefore, we'll probably take that out as a real source.

MR. CATTON: But isn't that supposed to be in your user's manual, the instructions for the use of the code? You demanded that of TRAC.

MR. WILSON: That's just what I alluded to. The NRC documentation has in the past -- and it is more and more so for the codes in the user's manual -- specified user guidelines. In fact, I think, for RELAP 5, MOD3, there's a separate report along those lines.

MR. WARD: I have another question of the staff, but I see NRR isn't here.

Again, a couple of years ago, when we were addressing the use of CSAU, we suggested that it was going to be more difficult for the staff to review an application that made use of a realistic estimate in a CSAU approach or something else for estimating uncertainty. It was going to take more skill, training, experience on the part of the staff reviewers than review of an Appendix K analysis, which was a little more of a recipe. Has the staff addressed that issue, and if so, how?

MR. WILSON: Dave, may I make one introductory remark to that? We heard that comment in the past, for example in the large break LOCA. We tried to assist NRR, perhaps, by, in the documentation, providing what we thought were successful keys to success or success criteria based on our experience, to give the NRR staff some idea of those things. So I think in part, we have tried to do that in the research programs.

MR. KERR: In that connection, you commented earlier that you did not know of any group that had made safety decisions without having available a mature code user. Does that include the NRC?

MR. WILSON: Was the question does that include the United States?

MR. KERR: No, the NRC, the US NRC.

MR. WILSON: I guess I would like NRR to comment to that.

MR. KERR: Well, you made the statement. You said that you didn't know of a single organization that made a--

MR. WILSON: Okay. I will answer it. The people that I know that are making decisions that I am personally familiar with I believe have the necessary degree of competency.

MR. KERR: They are mature code users?

MR. WILSON: If that is their function, to provide that kind of information, yes.

MR. KERR: I was just trying to understand whether, when you made that observation about organizations, that the NRC was included among the organizations to which you referred.

MR. WILSON: Yes.

MR. KERR: Okay.

MR. BESSETTE: I think Gary speaks only for the thermal hydraulics code.

MR. WILSON: That's true. You have to limit it. We're talking about a thermal hydraulics code, a systems code. That's my -- David's right in saying that that's my perception.

MR. SCHROCK: Gary, I have a lot of problem with this argument that you're making because I've seen many instances of what you would regard as mature users doing things that are absolutely unacceptable engineering practice. An example is the suggestion that to fix a code so it will replicate a single experiment, let's change the interfacial drag coefficient by orders of magnitude. That came from somebody that I think you would regard as a mature code user.

MR. WILSON: But was that in an assessment sense, or something like that, or was that in actual calculations that we used to make safety decisions?

MR. SCHROCK: That was in the sense of how we make this code do what it has to do.

MR. WILSON: But you've got to put it in the framework, are you talking about a case where safety decisions are being made. I may do any number of things in an assessment environment that I would not do where I'm trying to make a safety decision.

MR. KERR: What other decisions does the NRC make? I mean, presumably the decisions they make are made on the basis of establishing safety.

MR. SHOTKIN: I think the Chairman asked the representative of NRR a question. Gary tried to be helpful by answering the question. Maybe NRR would like to answer the question.

MR. JONES: This is Bob Jones. I was hoping I could duck it. I think, David, your question about the experience of the staff and the guidelines for review and best estimate calculations, I think we said at the time that we would end up using probably National Engineering Lab help in coming to those conclusions. As you'll hear later this afternoon, we are expecting a large break LOCA application from Westinghouse in the near future, and we will be seeking National Laboratory assistance, and probably INEL's assistance. So we will be tapping people with experience in the area to help us with those decisions, and that's how we intend to do it.

MR. CATTON: Well, I would hope that you wouldn't let Westinghouse respond to some of the questions the way that they've been responded to here in that, "Gee, we don't really need to worry too much about that because we're in the same room as those who developed the code."

If you recollect from the earlier process we went through, one of the keys to making this whole thing work well is that it's auditable, and this appeal to the guy in the next office for answers is not auditable. It's not traceable in the simplest sense.

MR. WILSON: I think I disagree. I think, Ivan, that you and I are again debating schedule. When we publish the final document in June of 1991, we will have the same auditability and traceability that we had in the large break LOCA, maybe even more.

MR. CATTON: I guess you also don't remember all the troubles we had with the people who knew the code during that process. They just didn't remember what was in it, and they would give answers. It was only when the documentation was in hand, and you could see it, that you knew what you were doing.

MR. BESSETTE: You know, we'll go to the same thing here. I mean, you'll recall that we had to wait for the documentation when we did the large break --

MR. CATTON: I also recall that the co-developers didn't want to supply the documentation on the schedule that was needed, and it took a -- it was very painful to get it. Maybe you can't get it when you do your TPG process in the same laboratory.

MR. BESSETTE: But we haven't come to that step, yet. We're still on the PIRT, and we can do PIRT independent of code.

MR. CATTON: That's certainly true.

MR. BESSETTE: But when we come to look at code in a -- you need the documentation when you look at code applicability because you have to see if the code has the models for the phenomena that you determine to be important. You also have to decide how you're going to arrange these bottles. Before we do that step, we'll have the documentation.

MR. CATTON: I hope so.

MR. BESSETTE: It's impossible to do that step without the documentation.

MR. CATTON: This is it?

MR. WILSON: That concludes our part of our address.

MR. CATTON: Okay. Are you going to say anything, Dave, or is that it?

MR. BESSETTE: That's it.

MR. CATTON: Okay. Virgil, if you could give me a few comments on what you've heard, I'd appreciate it.

MR. SCHROCK: Well, I don't know exactly what to say other than the comments I've already made. Your question about is the TPG looking at stratification, I would confirm that in the discussion yesterday, clearly in the PIRT process, that is an item which was looked at.

Something that was not discussed there that occurred to me this morning and came out of these discussions is that leaving until a later time to identify the location of the break seems now to me to be presuming that you can have small break occurring in a 28-inch pipe in some way.

The point that I made earlier today is, I think, important, and that is that there is no model in any of the codes for a tear in a pipe. All we have is a model for branch lines on the pipe. So if we're going to have a small break, it seems to me it has to be in a branch line; it's not going to be a small break in the big pipe. I don't know -- I'd like to hear the staff view about that, but it's something that was not discussed in the meeting that I attended of this TPG.

At a previous subcommittee meeting, I pointed out that I had raised objections a year ago to the fact that INEL was installing some program language that was provided by Keith Ardron in the International Code Assessment Program without questioning the basis for that. It's difficult for me because it involves my own work, and yet I can't help commenting on it.

What our experiments show is that when you do the experiment with air and water and with steam and water in the same apparatus, the height for incipient two-phase flow is different, and we attributed that difference to the different physical properties, surface tension and viscosity, and we provided a correlation for incipient pull-through on the basis of those data.

The KFK model, which is installed now in RELAP 5, MOD3, in fact, was simply air/water data, and so it couldn't see that.

There are arguments that came back from Keith Ardron that are a year old now that I had not seen until today which are erroneous. He points out that there is a pressure effect in the KFK correlation which is absent in our correlation. Simply untrue. I mean, the fact that we were able to correlate the data from INEL, which were at very high pressure, in contrast to all other experiments, and also for steam water, incidentally, is attributed to the fact that we took into account the dependence on viscosity and surface tension, both things that are temperature dependent, and therefore pressure dependent in a single component system.

So, I don't know, I have a lot of trouble with the next step in the code, which will be applicability. I see it inadequate either for the case of branch lines, and I have to point out that we simply don't have data for flow-through small breaks in a big pipe, which implies that what you have is some kind of a tear in the pipe. The geometry is not going to be well represented by data that we've obtained when we have measurement of critical flows through circular pipes that are branch lines. It's not the same.

MR. CATTON: Thanks, Virgil. Pete, do you have any comments on this morning's?

MR. DAVIS: Can I write them down for you?

MR. CATTON: I'd be delighted.

MR. DAVIS: Okay. I'll do it.

MR. CATTON: Thank you. And, Virgil, any comments you have on what was earlier this morning, if you could write them down, I'd appreciate it.

MR. SCHROCK: Okay.

MR. CATTON: Thank you. I think that's it for this morning. Why don't we break for lunch and come back at 1:30?

[Whereupon, at 12:30 p.m., the subcommittee recessed for lunch, and the open session adjourned, to reconvene in closed session at 1:30 p.m. this same day.]

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission

in the matter of:

NAME OF PROCEEDING: ACRS Thermal Hydraulic Phenomena

DOCKET NUMBER:

PLACE OF PROCEEDING: Bethesda, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Marilynn Nations

Marilynn Nations
Official Reporter
Ann Riley & Associates, Ltd.

Ansc17

SBLOCA CSAU

Status

Code Selected: RELAP5/MOD3

Plant & Scenario Selection:

Criteria and considerations.

Possible choices and final selection.

Primary safety criteria

PIRT:

TPG	INEL
Phases of the transient:	Phases of the transient
Plant Components	Plant Components
Components Ranking	Components Ranking
(AHP)	(AHP)
Phenomena Identification	Phenomena Identification
phenomena ranking	phenomena ranking

SCENARIO SELECTION

1. OCONEE
2. WORST BREAK CONFIGURATION
3. MOST LIKELY POWER SHAPE
4. INITIALLY ASSUME THAT THE OPERATOR PERFORMS AS DIRECTED BY EOP's
5. SCENARIO THAT DISPLAYS THE MAXIMUM NUMBER OF SBLOCA PHENOMENA TO THE EXTENT SUPPORTED BY EXPERIMENTAL DATA

Ansurt

SBLOCA CSAU

Status

Code Selected: RELAP5/MOD3

Plant & Scenario Selection:
Criteria and considerations.
Possible choices and final selection.
Primary safety criteria

PIRT:

TPG	INEL
Phases of the transient:	Phases of the transient
Plant Components	Plant Components
Components Ranking	Components Ranking
(AHP)	(AHP)
Phenomena Identification	Phenomena Identification
phenomena ranking	phenomena ranking

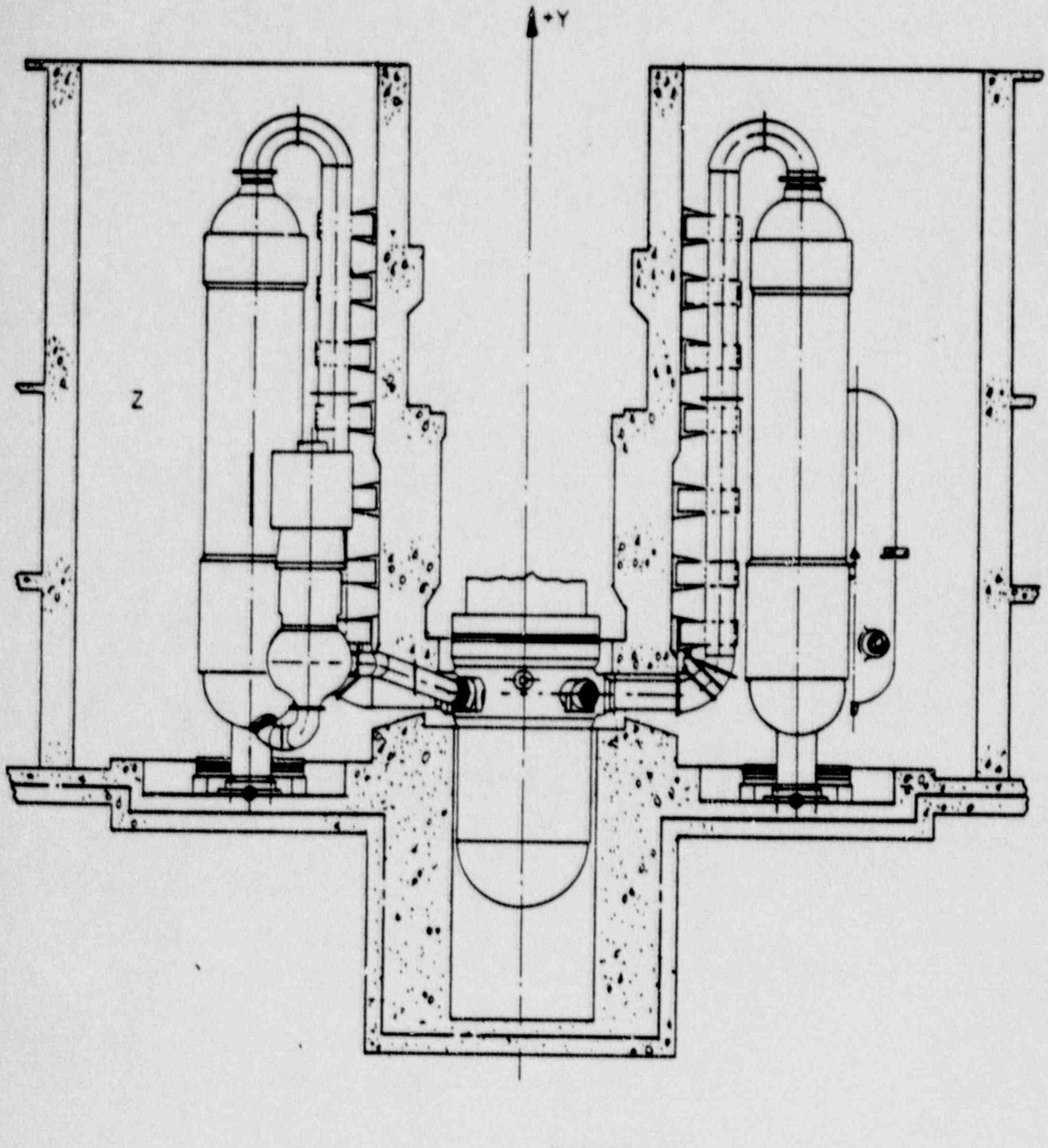
PRIMARY SAFETY CRITERIA

1. Liquid Inventory In The Core

2. PCT

SCENARIO SELECTION

1. OCONEE
2. WORST BREAK CONFIGURATION
3. MOST LIKELY POWER SHAPE
4. INITIALLY ASSUME THAT THE OPERATOR PERFORMS AS DIRECTED BY EOP's
5. SCENARIO THAT DISPLAYS THE MAXIMUM NUMBER OF SBLOCA PHENOMENA TO THE EXTENT SUPPORTED BY EXPERIMENTAL DATA



BABCOCK 241

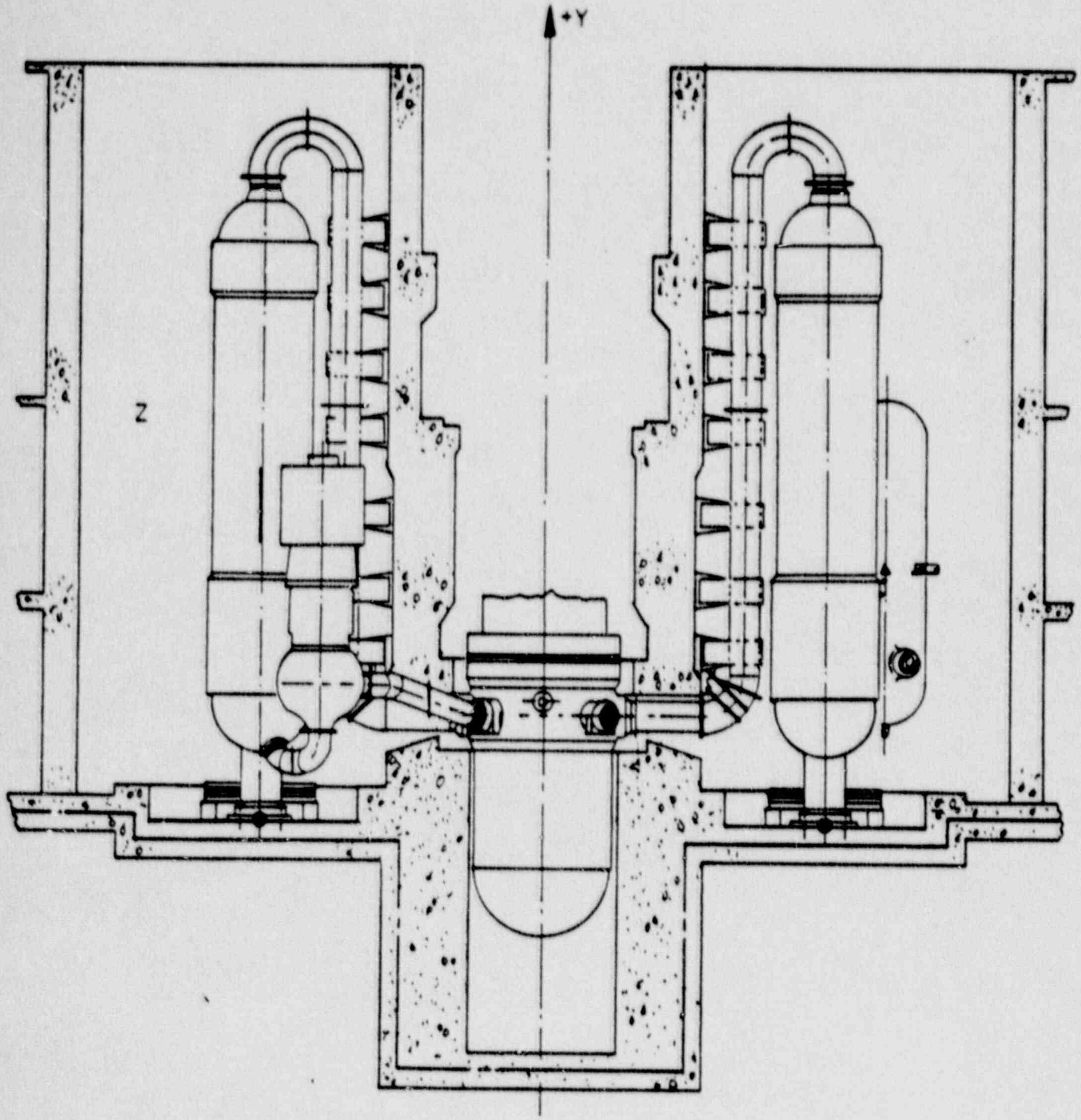
RCS SUPPORTS AND RESTRAINTS

ELEVATION VIEW

Figure 5.5-8

SCENARIO SELECTION

1. OCONEE
2. WORST BREAK CONFIGURATION
3. MOST LIKELY POWER SHAPE
4. INITIALLY ASSUME THAT THE OPERATOR PERFORMS AS DIRECTED BY EOP's
5. SCENARIO THAT DISPLAYS THE MAXIMUM NUMBER OF SBLOCA PHENOMENA TO THE EXTENT SUPPORTED BY EXPERIMENTAL DATA



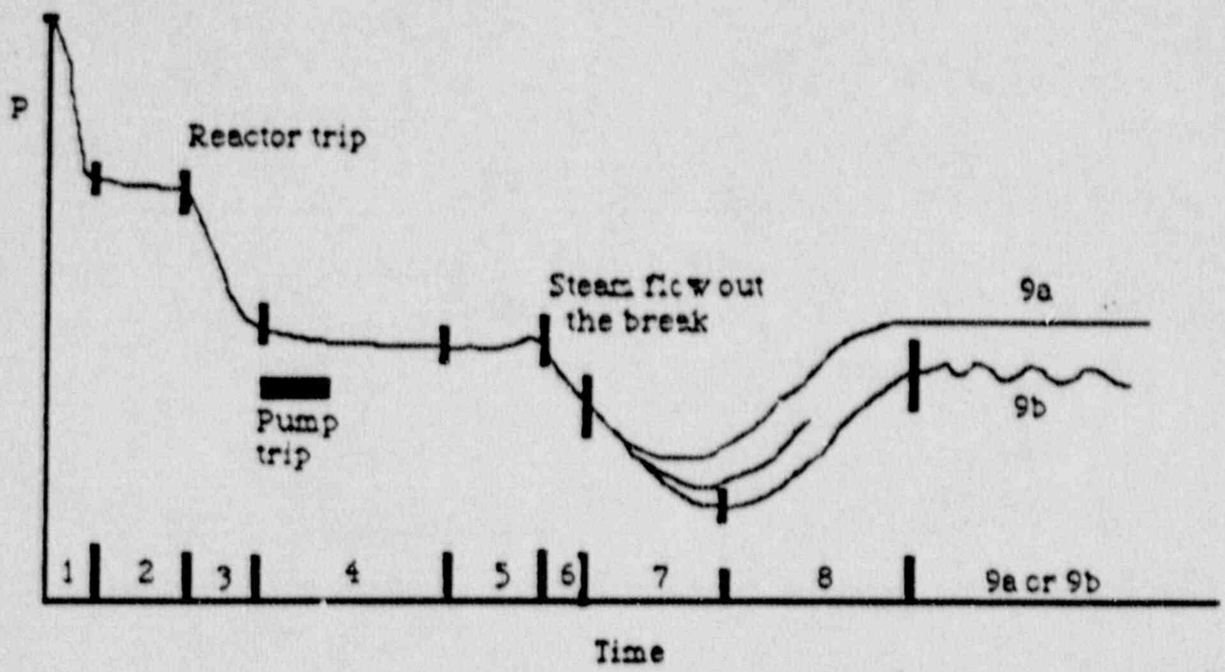
BABCOCK 241

RCS SUPPORTS AND RESTRAINTS

ELEVATION VIEW

Figure 5.5-8

SBLOCA PHASES ACCORDING TO INDEPENDENT (*INEL*) PANEL



PHASE 1. SUBCOOLED BLOWDOWN

PHASE 2. INTERMEDIATE BLOWDOWN

PHASE 3. REACTOR TRIP

PHASE 4. PRESSURE STABILIZATION

PHASE 5. LOSS OF NATURAL CIRCULATION

PHASE 6. BOILING-CONDENSING

PHASE 7. REFILL

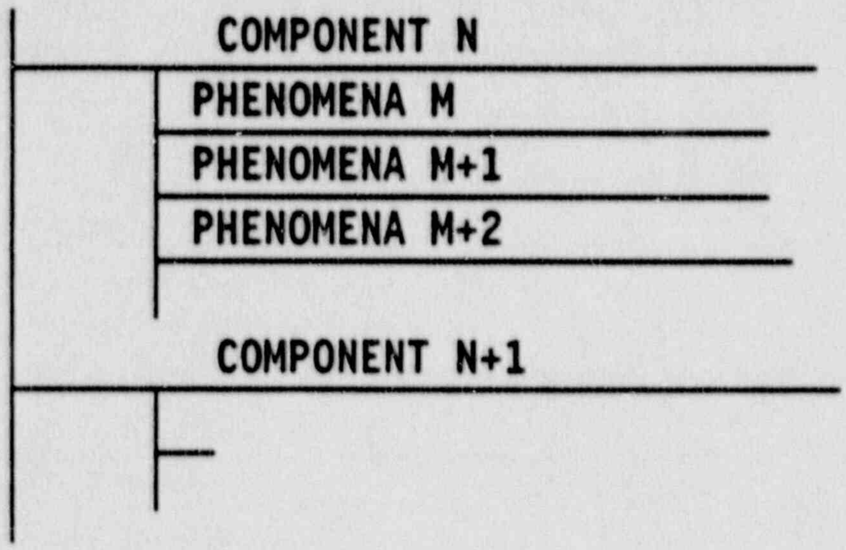
PHASE 8. LEAK FLOW = INJECTION FLOW

PHASE 9A. NC RE-ESTABLISHED

PHASE 9B. FEED AND BLEED

AHP GENERAL APPLICATION

PHASE M



Steps

1. Define Primary Safety Criteria
2. Partition Transient Into Phases

For Each Phase:

3. Partition System Into Components
4. Rank Components On Pair-Wise Basis
5. Rank Components On System Wide Basis

For Each Component:

6. Identify Phenomena
7. Rank Phenomena On Pair-Wise Basis

8. Rank Phenomena On System Wide Basis

PHENOMENA	1	2	3	4	5	6	7	8	9a	9b
Critical Break Flow	1	1	1		1	1	1	1	1	1
Break Nucleation		1	1							
Two-phase break flow				1						1
Steam break flow			1		1	1				
Flashing		1	1	1	1	1				
Subcooling Margin	1	1	1			1	1	1	1	1
Loss of Subcooling Margin			1	1	1					
Boron Concentration	1	1	1							
Cold Leg Temperature	1	1	1	1	1	1	1	1	1	1
Cold Leg Pressure	1	1	1	1	1	1	1	1	1	1
Sonic Velocity	1	1	1							
Pump Cavitation		1	1							
Two-phase pump degradation			1	1	1					
Pump coastdown				1	1	1				
Pressurizer Volume Expansion		1	1							
Pressurizer Emptying			1							
Pressurizer refill							1	1	1	1
Pressurizer pressure										1
Neutronics:										
Moderation (slow down theory)	1	1	1							
Kinetics	1	1	1							
Doppler	1	1	1							
Peak to Average Flux Ratio		1	1	1	1	1	1	1	1	1
Heat Transfer:										
Nucleate Boiling		1	1	1	1	1	1			
Departure from Nucleate Boiling		1	1	1	1	1	1	1		
Conduction		1	1					1	1	1
Forced Convection		1	1	1	1					
Void colapse condensation (inverse flashing)		1	1	1	1				1	1
Condensation heat transfer (void compression)						1	1	1	1	1
Wall to coolant heat transfer				1	1	1	1	1	1	1
ECCS spillage (out the break)			1	1	1	1	1	1	1	1
ECCS Mixing			1	1	1	1	1	1	1	1
Shrink or Swell			1					1		1

	PHENOMENA	1	2	3	4	5	6	7	8	9a	9b
	Instrumentation & Control:										
	Detector Response			1							
	Instrumentation Delay			1							
	Actuation			1							
	Promp Drop (rate of change of reactivity insertion)			1							
	Secondary Saturation Pressure			1	1	1	1	1	1	1	
	Primary-Secondary Heat Transfer			1	1	1	1	1	1	1	
	Turbine Trip			1							
	Main FeedWater Pump Runback			1							
	Secondary Level				1	1	1	1	1	1	
	two-phase flow in Hot Leg			1	1	1	1	1			
	Asymmetric Loop Flow			1							
	Decay Heat			1	1	1	1	1	1	1	1
	Upper Head Voiding			1							
	Turbine bypass Demand - Steaming			1	1		1	1	1	1	
	Rod Drop time			1							
	Upper plenum voiding				1	1	1				
	Core Inventory				1	1	1	1	1		
	Natural circulation transport time				1			1	1		
	Candy Cane Voiding				1	1					
	Internal Vessel Circulation				1	1	1	1	1	1	1
	Thermal Stratification					1	1	1	1	1	1
	Water Hammer					1					
	Upper head refill							1	1		
	Upper plenum refill							1	1		
	Hot path Refill							1	1		
	Upper head void									1	1

PHASE 1 SUBCOOLED BLOWDOWN

COMPONENTS

1. Break
2. Pumps
3. RCS Volume
4. Pressurizer
5. Core
6. CVCS

PHENOMENON

1. Critical Break Flow
2. Subcooling Margin
3. Boron Concentration
4. Cold Leg Temperature
5. Cold Leg Pressure
6. Sonic Velocity
7. Neutronics
   a. Moderation(slow down theory)
   b. Kinetics
   c. Doppler

PHASE 2 INTERMEDIATE BLOWDOWN

COMPONENTS

1. Break
2. Reactor Coolant Pumps
3. Upper Head
4. Pressurizer
5. Core
6. Hot Leg and Candy Cane
7. Reactor Shutdown System
8. Rest of System

PHENOMENON

1. Critical Break Flow
2. Break Nucleation
3. Flashing
4. Subcooling Margir
5. Boron Concentrat
6. Cold Leg Temperature
7. Cold Leg Pressure
8. Sonic Velocity
9. Pump Cavitation
10. Pressurizer Volume Expansion
11. Neutronics
    a. Moderation(slow down theory)
    b. Kinetics
    c. Doppler
    d. Peak to average flux ratio
12. Heat Transfer
    a. Nucleate Boiling
    b. Departure from Nucleate Boiling
    c. Conduction
    d. Forced convection
    e. Void Collapse Condensation (inverse flashing)

PHASE 3 POST REACTOR TRIP

COMPONENTS

1. Break
2. Emergency Core Cooling System
3. Core
4. Reactor Coolant System Volume
5. Reactor Coolant Pumps
6. Cold Leg
7. Steam Generator
8. Operator
9. Hot Path
10. Emergency Safeguards Features Actuation
11. Pressurizer
12. Balance of Plant
13. Integrated Control System
14. Chemical & Volume Control Systeml

PHENOMENON

1. Critical Break Flow
2. Break Nucleation
3. Steam Flow Through Break
4. Flashing
5. Subcooling Margin
6. Loss of Subcooling Margin
7. Boron Concentration
8. Cold Leg Temperature
9. Cold Leg Pressure
10. Sonic Velocity
11. Pump Cavitation
12. Two-Phase Pump Degradation
13. Pressurizer Volume Expansion
14. Pressurizer emptying
15. Neutronics
    a. Moderation(slow down theory)
    b. Kinetics
    c. Doppler
    d. Peak to Average Flux Ratio
16. Heat Transfer
    a. Nucleate Boiling
    b. Departure from Nucleate Boiling
    c. Conduction
    d. Forced Convection
    e. Void Collapse Condensation (inverse flashing)
17. ECCS spillage (out the break)
18. ECCS mixing
19. Shrink or Swell
20. Instrumentation & Control
    a. Detector Response
    b. Instrumentation Delay
    c. Actuation
    d. Prompt Drop (rate of change of reactivity insertion)
21. Secondary Saturation Pressure
22. Primary-Secondary Heat Transfer
23. Turbine Trip
24. Main Feedwater Pump Runback
25. Two-Phase Flow in Hot Leg
26. Asymmetric Loop Flow
27. Decay Heat
28. Upper Head Voiding
29. Turbine Bypass Demand/Steaming
30. Rod Drop Time

PHASE 4 PRESSURE STABILIZATION

COMPONENTS

1. Break
2. Emergency Core Cooling System
3. Core
4. Main & Aux. Feedwater
5. Reactor Coolant Pumps
6. Candy Cane
7. Steam Generator
8. Operator
9. Downcomer & Lower Plenum
10. Upper Plenum & Hot Leg
11. Balance of Plant
12. Integrated Control System

PHENOMENON

1. Two-phase Break Flow
2. Flashing
3. Loss of Subcooling Margin
4. Cold Leg Temperature
5. Cold Leg Pressure
6. Pump Coastdown
7. Two-Phase Pump Degradation
8. Neutronics
   a. Peak to Average Flux Ratio
9. Heat Transfer
   a. Nucleate Boiling
   b. Departure from Nucleate Boiling
   c. Forced Convection
   d. Void Collapse Condensation (inverse flashing)
   e. Wall to Coolant
10. ECCS spillage (out the break)
11. ECCS mixing
12. Secondary Saturation Pressure
13. Primary-Secondary Heat Transfer
14. Secondary Level
15. Two-Phase Flow in Hot Leg
16. Decay Heat
17. Turbine Bypass Demand / Steaming
18. Upper Plenum Void
19. Core Inventory
20. Natural Circulation Transport Time
21. Candy Cane Void
22. Internal Vessel Circulation

PHASE 5 LOSS OF NATURAL CIRCULATION

COMPONENTS

1. Break
2. Emergency Core Cooling System
3. Core
4. Main & Aux. Feedwater
5. Reactor Coolant Pumps
6. Candy Cane
7. Steam Generator
8. Operator
9. Downcomer & Lower Plenum
10. Upper Plenum & Hot Leg
11. Balance of Plant
12. Reactor Vessel Vent Valves
13. Pressurizer

PHENOMENON

1. Critical Break Flow
2. Steam Flow Through Break
3. Flashing
4. Loss of Subcooling Margin
5. Cold Leg Temperature
6. Cold Leg Pressure
7. Pump Coastdown
8. Two-Phase Pump Degradation
9. Neutronics
   a. Peak to Average Flux Ratio
10. Heat Transfer
    a. Nucleate Boiling
    b. Departure from Nucleate Boiling
    c. Forced Convection
    d. Void Collapse Condensation (inverse flashing)
    e. Wall to Coolant
11. ECCS spillage (out the break)
12. ECCS mixing
13. Secondary Saturation Pressure
14. Primary-Secondary Heat Transfer
15. Secondary Level
16. Two-Phase Flow in Hot Leg
17. Decay Heat
18. Upper Plenum Voiding
19. Core Inventory
20. Candy Cane Voiding
21. Internal Vessel Circulation
22. Water Hammer
23. Thermal Stratification

PHASE 6 REFLUX & BOILING CONDENSING

COMPONENTS

1. Break
2. Emergency Core Cooling System
3. Core
4. Main & Aux. Feedwater
5. Reactor Coolant Pumps
6. Candy Cane
7. Steam Generator
8. Operator
9. Downcomer & Lower Plenum
10. Upper Plenum & Hot Leg
11. Balance of Plant
12. Reactor Vessel Vent Valves
13. Pressurizer

PHENOMENON

1. Critical Break Flow
2. Steam Flow Through Break
3. Flashing
4. Subcooling Margin
5. Cold Leg Temperature
6. Cold Leg Pressure
7. Pump Coastdown
8. Neutronics
   a. Peak to Average Flux Ratio
9. Heat Transfer
   a. Nucleate Boiling
   b. Departure from Nucleate Boiling
   c. Condensation (void compression)
   e. Wall to Coolant
10. ECCS spillage (out the break)
11. ECCS mixing
12. Secondary Saturation Pressure
13. Primary-Secondary Heat Transfer
14. Secondary Level
15. Two-Phase Flow in Hot Leg
16. Decay Heat
17. Turbine Bypass Demand / Steaming
18. Upper Plenum Voiding
19. Core Inventory
20. Internal Vessel Circulation
21. Thermal Stratification

PHASE 7 REFILL / REPRESSURIZATION

COMPONENTS

1. Break
2. Emergency Core Cooling System
3. Core
4. Balance of Plant & Feedwater
5. Hot Path
6. Cold Path
7. Steam Generator
8. Operator & Reactor Coolant Pumps
9. Pressurizer

PHENOMENON

1. Critical Break Flow
2. Subcooling Margin
3. Cold Leg Pressure
4. Cold Leg Temperature
5. Pressurizer Refill
6. Neutronics
   a. Peak to Average Flux Ratio
7. Heat Transfer
   a. Nucleate Boiling
   b. Departure from Nucleate Boiling
   c. Condensation (void compression)
   d. Wall to Coolant
8. ECCS spillage (out the break)
9. ECCS mixing
10. Secondary Saturation Pressure
11. Primary-Secondary Heat Transfer
12. Secondary Level
13. Two-Phase Flow in Hot Leg
14. Decay Heat
15. Turbine Bypass Demand / Steaming
16. Core Inventory
17. Natural Circulation Transport Time
18. Internal Vessel Circulation
19. Thermal Stratification
20. Upper Head Refill
21. Upper Plenum Refill
22. Hot Path Refill

PHASE 8 LEAK FLOW = INJECTION FLOW

COMPONENTS

1. Break
2. Emergency Core Cooling System
3. Core
4. Balance of Plant & Feedwater
5. Hot Path
6. Cold Path
7. Steam Generator
8. Operator & Reactor Coolant Pumps
9. Pressurizer

PHENOMENON

1. Critical Break Flow
2. Subcooling Margin
3. Cold Leg Pressure
4. Cold Leg Temperature
5. Pressurizer Refill
6. Neutronics
   a. Peak to Average Flux Ratio
7. Heat Transfer
   a. Conduction
   b. Departure from Nucleate Boiling
   c. Condensation (void compression)
   d. Wall to Coolant
8. ECCS spillage (out the break)
9. ECCS mixing
10. Secondary Saturation Pressure
11. Primary-Secondary Heat Transfer
12. Secondary Level
13. Shrink or Swell
14. Decay Heat
15. Turbine Bypass Demand / Steaming
16. Core Inventory
17. Natural Circulation Transport Time
18. Internal Vessel Circulation
19. Thermal Stratification
20. Upper Head Refill
21. Upper Plenum Refill
22. Hot Path Refill

PHASE 9a NATURAL CIRCULATION REESTABLISHED

COMPONENTS

1. Break
2. Emergency Core Cooling System
3. Core
4. Balance of Plant & Feedwater
5. Hot Path
6. Cold Path
7. Steam Generator
8. Operator & Reactor Coolant Pumps
9. Pressurizer

PHENOMENON

1. Critical Break Flow
2. Subcooling Margin
3. Cold Leg Pressure
4. Cold Leg Temperature
5. Pressurizer Refill
6. Neutronics
   a. Peak to Average Flux Ratio
7. Heat Transfer
   a. Conduction
   b. Condensation (void compression)
   c. Void Collapse Condensation (inverse flashing)
   d. Wall to Coolant
8. ECCS spillage (out the break)
9. ECCS mixing
10. Secondary Saturation Pressure
11. Primary-Secondary Heat Transfer
12. Secondary Level
13. Decay Heat
14. Turbine Bypass Demand / Steaming
15. Internal Vessel Circulation
16. Thermal Stratification
17. Upper Head Void

PHASE 9b FEED AND BLEED

COMPONENTS

1. Break
2. Emergency Core Cooling System
3. Core
4. Balance of Plant & Feedwater
5. Hot Path
6. Cold Path
7. Steam Generator
8. Operator & Reactor Coolant Pumps
9. Pressurizer

PHENOMENON

1. Critical Break Flow
2. Two-Phase Break Flow
3. Subcooling Margin
4. Cold Leg Pressure
5. Cold Leg Temperature
6. Pressurizer Refill
7. Pressurizer Pressure
8. Neutronics
   a. Peak to Average Flux Ratio
9. Heat Transfer
   a. Conduction
   b. Condensation (void compression)
   c. Void Collapse Condensation (inverse flashing)
   d. Wall to Coolant
10. ECCS spillage (out the break)
11. ECCS mixing
12. Shrink or Swell
13. Decay Heat
14. Internal Vessel Circulation
15. Thermal Stratification
16. Upper Head Void

PHASE 1 COMPONENT RANK BY INEL

PAIR-WISE RANKS

	BRK	RCP	RCS	PZR	COR	CVC
BRK	1	3	3	2	3	3
RCP		1	1/2	1/3	1	1/2
RCS			1	1/2	1	1/2
PZR				1	2	1
COR					1	1/2
CVC						1

SYS RANK
9
1
2
4
1
4

NRR COMMENT ON
SCOPE AND SCHEDULE OF REVIEW OF
W BE ECCS/LOCA MODEL

PRESENTED TO:
ACRS T/H SUBCOMMITTEE
BETHESDA, MD
DECEMBER 7, 1989

PRESENTED BY:
Y. GENE HSII
NRR/DST/SRXB
492-0887

REVIEW SCOPE

- REVIEW WCOBRA/TRAC CODE QUALIFICATION DOCUMENT
  - CAPABILITY TO PREDICT IMPORTANT PHENOMENA IDENTIFIED BY CSAU
  - SCALING CAPABILITY
  - CODE ASSESSMENT
- REVIEW UNCERTAINTY QUANTIFICATION
  - CSAU ELEMENTS
  - PROPAGATION OF UNCERTAINTY BLOWDOWN PEAK TO REFLOOD PEAK
  - OVERALL UNCERTAINTY QUANTIFICATION
- REVIEW PLANT APPLICATION
  - PLANT MODEL
  - PLANT PARAMETERS

REVIEW SCHEDULE

- REVIEW TO BE COMPLETED APPROXIMATELY ONE YEAR AFTER SUBMITTAL

- PERIODIC MEETINGS WITH ACRS TO INFORM PROGRESS OF REVIEW

- WILL HAVE NATIONAL LABORATORY TO HELP REVIEW

IDAHO NATIONAL ENGINEERING LABORATORY

STATUS
SBLOCA CSAU

GARY E. WILSON
MARCOS G. ORTIZ

ACRS SUBCOMMITTEE ON
T/H PHENOMENA

DECEMBER 1989

EG&G Idaho, Inc.

THE MAJOR TOPICS WHICH WILL BE ADDRESSED IN THE PRESENTATION ARE:

- o CSAU METHODOLOGY OVERVIEW (WILSON)
- o RESULTS OF WORK-TO-DATE (ORTIZ)
- o FUTURE ACTIVITIES (WILSON)

THE CSAU METHODOLOGY CONSISTS OF THREE BASIC ELEMENTS

- REQUIREMENTS & CODE CAPABILITIES (STEPS 1–6)
- ASSESSMENT & RANGING OF PARAMETERS (STEPS 7–10)
- SENSITIVITY & UNCERTAINTY ANALYSIS (STEPS 11–14)

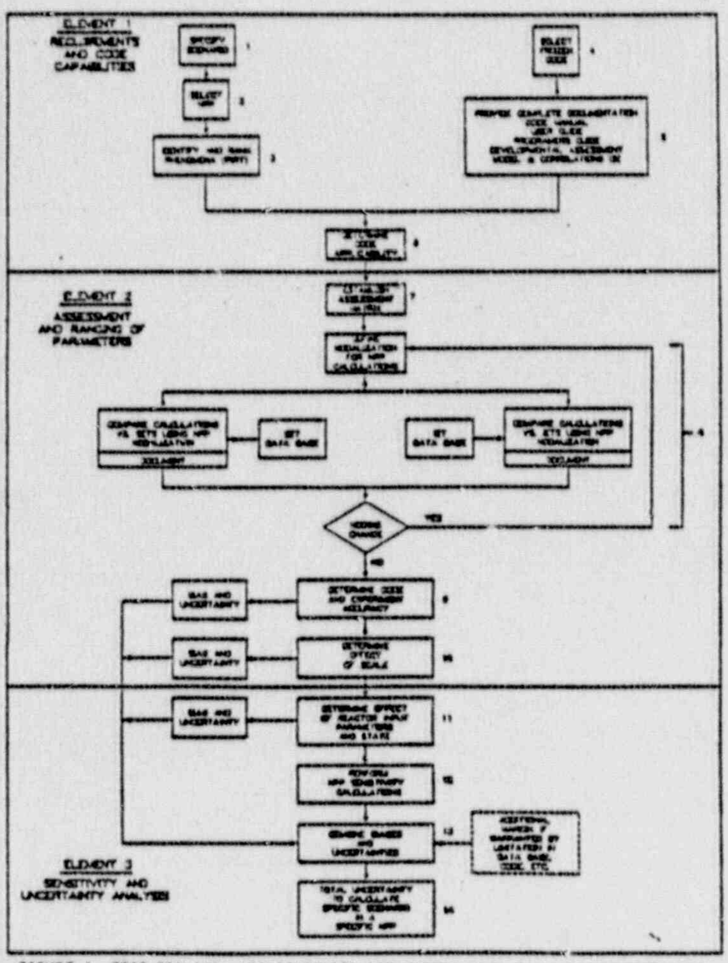
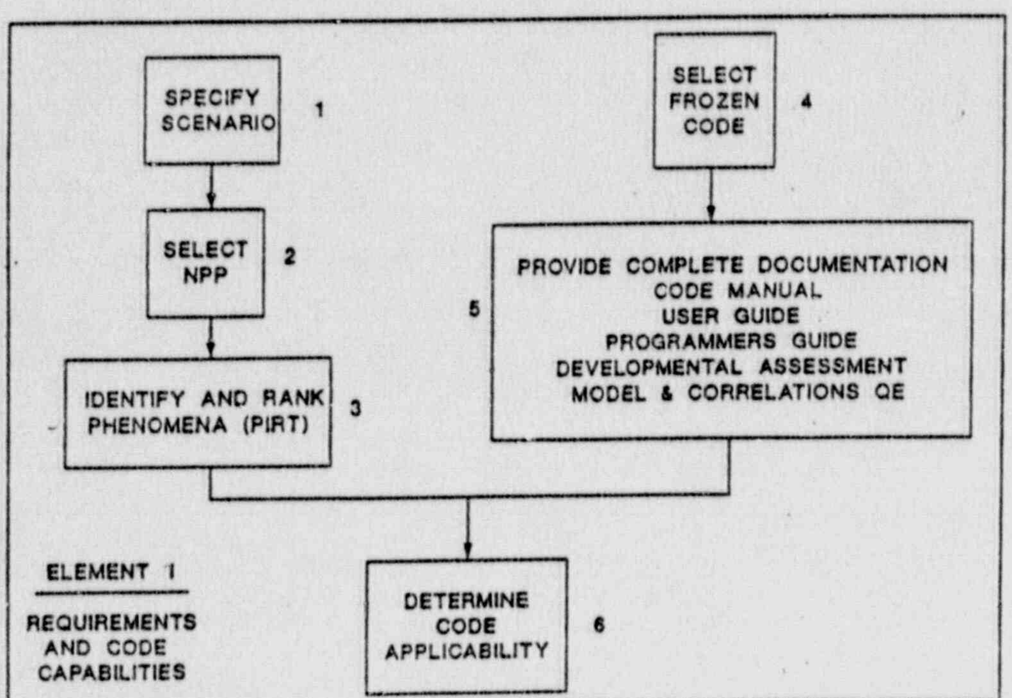


FIGURE 1 CODE SCALING, APPLICABILITY AND UNCERTAINTY EVALUATION METHODOLOGY

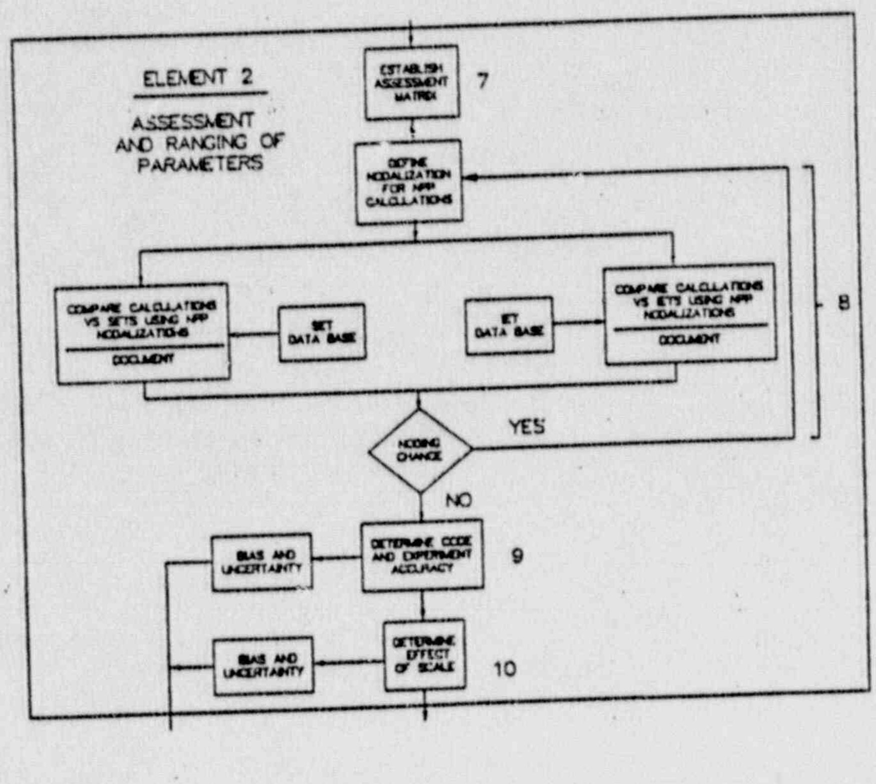
THE STEPS IN THE FIRST ELEMENT COMPARE THE MODELING REQUIREMENTS WITH THE BASIC CODE CAPABILITIES

- IDENTIFY PLAUSIBLE PHENOMENA/PROCESSES
- DETERMINE DOMINANT PHENOMENA/PROCESSES
- EVALUATE CODE MODELS IN CONTEXT OF IMPORTANT PHENOMENA
- DEFINE BASIC CODE APPLICABILITY



THE STEPS IN ELEMENT 2 ESTABLISH THE KEY CODE PARAMETERS, & THEIR VARIABILITY

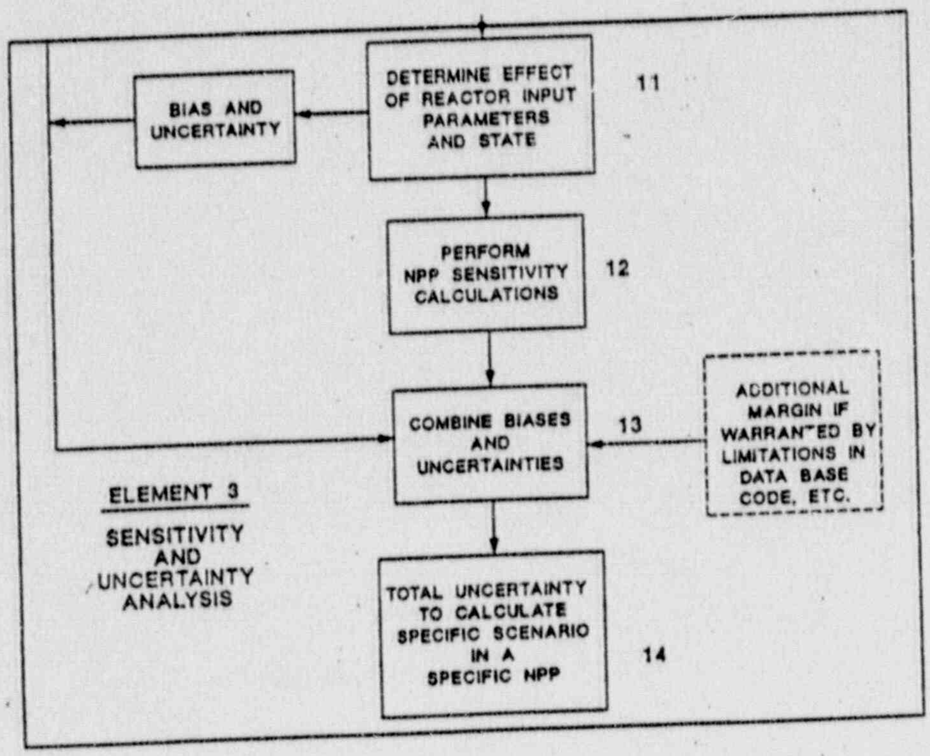
- WORK BASED ON DEFINED ASSESSMENT MATRIX
- STANDARD NODALIZATION REMOVES IT AS AN UNCERTAINTY SOURCE
- INDIVIDUAL PARAMETER VARIABILITY STATED IN TERMS OF PROBABILITY (PREFERRED), OR BOUNDING BIAS



JENOO8K

THE STEPS IN ELEMENT 3 QUANTIFY THE UNCERTAINTIES IN INDIVIDUAL IMPORTANT KEY PARAMETERS IN THE CONTEXT OF THE PRIMARY SAFETY CRITERIA, & THEIR COMBINED EFFECT

- SENSITIVITY ANALYSIS USED TO CONVERT VARIABILITY IN INDIVIDUAL KEY CODE PARAMETERS INTO THEIR INDIVIDUAL REFLECTIONS IN SAFETY CRITERIA
- INDIVIDUAL UNCERTAINTIES IN SAFETY CRITERIA ARE COMBINED TO DEFINE TOTAL CODE UNCERTAINTY



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CSAU for PWR SBLOCA

presented to the
Advisory Committee on Reactor Safeguards
T/H Phenomena Subcommittee
December 7, 1989
Bethesda, Maryland

by

Richard Lee
Reactor & Plant Systems Branch
Division of Systems Research
Office of Nuclear Regulatory Research

CSAU for PWR SBLOCA

Objective:

To determine the CSAU for RELAP5/MOD3 when applied to small break LOCA for PWR

Program Structure:

Similar to LBLOCA CSAU effort. A Technical Program Group (TPG) was organized to guide and coordinate the effort of INEL.

Program Structure (continued)

NRC: Richard Lee, Program Monitor

INEL: Integrating Contractor
Marcos Ortiz - Principal Investigator
Gary Wilson - Program Manager

TPG Members:
Richard Lee, David Bessette (NRC)
Brent Boyack (LANL)
Peter Griffith (MIT)
Y-Y Hsu (UM)
Mamoru Ishii (Purdue)
Gerald Lellouche (S. Levy, Inc.)
Gary Wilson, Marcos Ortiz (INEL)

ACRS Oversight:
V. Schrock (UCB)

Program Status:

* Initiated in June 89. Scheduled for completion in FY91.

* 1st TPG meeting:
  September 19-20, 1989.

* 2nd TPG meeting:
  December 5-6, 1989.

Insert

NRR STAFF PRESENTATION TO THE ACRS

SUBJECT: ISLOCA PROGRAM OVERVIEW

DATE: DECEMBER 7, 1989

PRESENTER: RICHARD J. BARRETT

PRESENTER'S TITLE/BRANCH/DIV: CHIEF, RISK APPLICATIONS BRANCH
DIVISION OF RADIATION PROTECTION
AND EMERGENCY PREPAREDNESS

PRESENTER'S NRC TEL. NO.: 492-1089

SUBCOMMITTEE: ACRS T/H

CONSEQUENCES OF AN ISLOCA

- o LOSS OF REACTOR PRESSURE BOUNDARY AND CONTAINMENT (Two out of three fission product barriers)
- o POTENTIAL FOR EARLY CORE DAMAGE
- o POTENTIAL FOR HIGH OFFSITE DOSES
- o LIMITED TIME FOR OFFSITE PROTECTIVE ACTIONS

PWR ISLOCA BACKGROUND

- o WASH-1400 (10/75)
- o EVENT V ORDERS (4/81)
- o GI-105
- o INPO SOER 86-3
- o BULLETIN 89-02

CURRENT PRA RESULTS

- ISLOCA ANALYZED AS A VALVE LEAKAGE/FAILURE PROBLEM
- RELATIVELY LITTLE ANALYSIS OF HUMAN ELEMENT
- LITTLE OR NO CREDIT FOR ACCIDENT MANAGEMENT
- CORE DAMAGE FREQUENCY ~1E-6
- ISLOCA A MAJOR CONTRIBUTOR TO EARLY FATALITIES

OPERATING EXPERIENCE

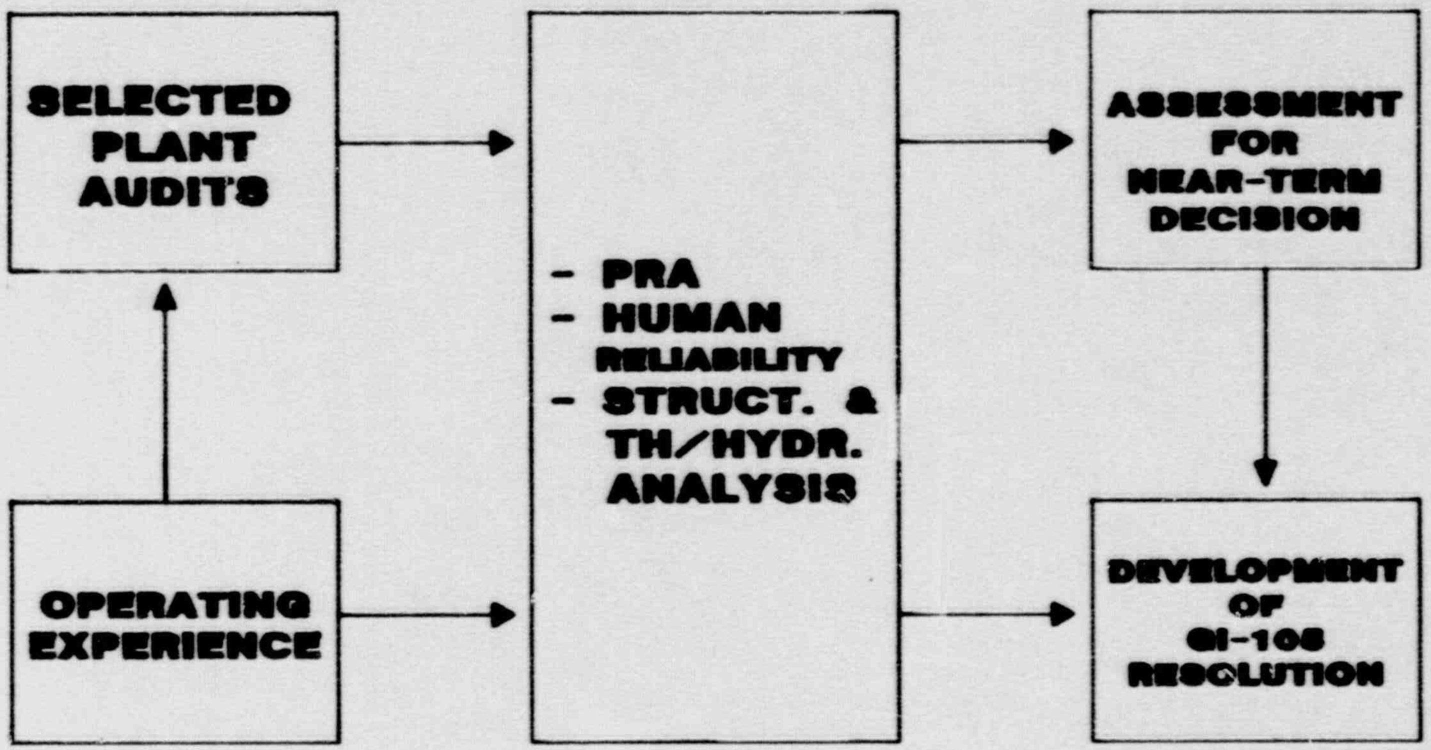
- o HUMAN ERRORS
- o VALVE FAILURES
- o UNANTICIPATED FAILURE PATHS (e.g., CCW)

ISLOCA PROJECT GOAL

- HIGH CONFIDENCE THAT A HIGH CONSEQUENCE ISLOCA WILL NOT OCCUR IN THE CURRENT GENERATION OF U.S. PLANTS

ISLOCA AREAS OF EXAMINATION

- LIKELIHOOD THAT AN ISLOCA WILL OCCUR
- IN THE EVENT OF AN ISLOCA, LIKELIHOOD THAT PROCEDURES AND EQUIPMENT ARE IN PLACE TO DELAY SIGNIFICANTLY OR PREVENT CORE DAMAGE
- EFFECTIVENESS OF EQUIPMENT AND PROCEDURES IN MINIMIZING OFFSITE RADIOLOGICAL CONSEQUENCES OF AN ISLOCA


SELECTED PLANT AUDITS
OPERATING EXPERIENCE
- PRA
- HUMAN RELIABILITY
- STRUCT. & TH/HYDR. ANALYSIS
ASSESSMENT FOR NEAR-TERM DECISION
DEVELOPMENT OF GI-106 RESOLUTION

ACRS BRIEFINGS ON ISLOCA

o APRIL 1989

Tom Murley informed Full Committee of existence of ISLOCA Project

o DECEMBER 1989

Staff briefing of Thermohydraulic Subcommittee regarding goals, structure and elements of project

o SPRING 1989

Subcommittee briefing on preliminary technical results

o FUTURE BRIEFINGS

At appropriate intervals

NRR STAFF PRESENTATION TO THE ACRS

SUBJECT: NRR COORDINATION OF ISLOCA RESOLUTION ISSUE

DATE: DECEMBER 7, 1989

PRESENTER: SAMMY S. DIAB

PRESENTER'S TITLE/BRANCH/DIV: RELIABILITY AND RISK ANALYST
RISK APPLICATIONS BRANCH
DIVISION OF RADIATION PROTECTION
AND EMERGENCY PREPAREDNESS

PRESENTER'S NRC TEL. NO.: 492-1075

SUBCOMMITTEE: ACRS T/H

PROJECT OVERVIEW

- o OPERATIONAL DATA ASSESSMENT

  SEARCH FOR PRECURSORS (ROOT CAUSES & FAILURE MECHANISMS).

- o INSPECTION PROGRAM

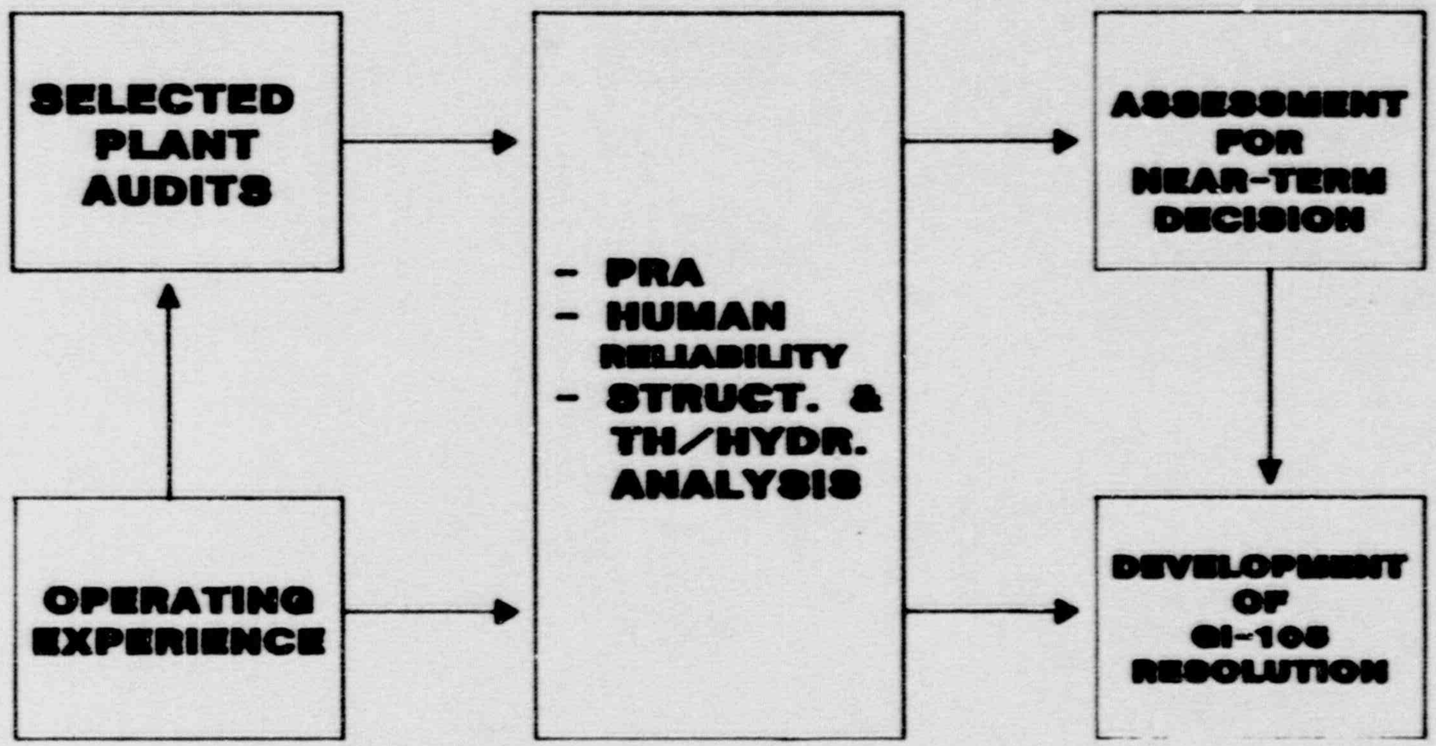
  AUDIT SELECTED PLANTS TO GAUGE CURRENT STATUS REGARDING PROJECT AREAS OF EXAMINATION

  - MAINTENANCE & OPERATOR ERRORS
  - VALVE TESTING/SURVEILLANCE
  - OPERATOR RESPONSE/ACCIDENT MANAGEMENT

- o ANALYSIS PROGRAM

  FOCUSED PRA EFFORT TO ASSESS POSSIBLE ISLOCA SCENARIOS.

  - HUMAN RELIABILITY
  - THERMOHYDRAULIC/STRESS ANALYSIS


SELECTED PLANT AUDITS
OPERATING EXPERIENCE
- PRA
- HUMAN RELIABILITY
- STRUCT. & TH/HYDR. ANALYSIS
ASSESSMENT FOR NEAR-TERM DECISION
DEVELOPMENT OF GI-105 RESOLUTION

AREAS OF EXAMINATION

- o LIKELIHOOD THAT AN ISLOCA WILL NOT OCCUR FOR THE CURRENT GENERATION OF REACTORS

- o IN THE EVENT OF AN ISLOCA, LIKELIHOOD THAT PROCEDURES AND EQUIPMENT ARE IN PLACE TO DELAY SIGNIFICANTLY OR PREVENT CORE DAMAGE

- o EFFECTIVENESS OF EQUIPMENT AND PROCEDURES IN MINIMIZING OFFSITE RADIOLOGICAL CONSEQUENCES OF AN ISLOCA

RELEVANT PLANT ATTRIBUTES

AREA 1: LIKELIHOOD THAT AN ISLOCA WILL OCCUR

- o VALVE INTEGRITY
  - TESTING/MAINTENANCE
  - INTERLOCKS
- o PIPE/SEAL INTEGRITY
  - TH/STRUCTURAL
- o HUMAN PERFORMANCE
  - PROCEDURES
  - TRAINING
  - MAN/MACHINE INTERFACE
  - PERFORMANCE SHAPING FACTORS
- o EARLY BREAK ISOLATION
  - PROCEDURES
  - DIAGNOSIS

RELEVANT PLANT ATTRIBUTES (Continued)

AREA 2: ASSURANCE FOR DELAY OR PREVENTION OF CORE DAMAGE

- o INSTRUMENTATION/DIAGNOSIS AND ISOLATION
- o ECCS (SHORT TERM)
  - INJECTION PATH
  - NPSH
  - SYSTEM INTERACTIONS (PROTECTION OF EQUIPMENT FROM FLOODING, STEAM, ETC.)
- o ECCS (LONG TERM)
  - RWST REFILL
  - CONSERVATION OF BORATED WATER
- o HUMAN PERFORMANCE
  - PROCEDURES
  - TRAINING
  - MAN/MACHINE INTERFACE
  - PERFORMANCE SHAPING FACTORS

RELEVANT PLANT ATTRIBUTES (Continued)

AREA 3: MINIMIZATION OF OFFSITE CONSEQUENCES

- o DELAY/MINIMIZE F.P. RELEASE
  - RCS DEPRESSURIZATION
  - FLOODING OF BREAK LOCATION
  - ACTIVATION OF FIRE SPRAYS
  - SECONDARY BUILDING CHARACTERISTICS

Insert

RES STAFF PRESENTATION TO THE

ACRS

SUBJECT: ISLOCA RESEARCH PROGRAM (NEAR-TERM)

DATE: DECEMBER 7, 1989

PRESENTER: GARY BURDICK

PRESENTER'S TITLE/BRANCH/DIV.:

SPECIAL ASSISTANT

DIVISION OF SYSTEMS RESEARCH

OFFICE OF NUCLEAR REGULATORY RESEARCH

PRESENTER'S NRC. TEL. NO.: 49-23509

ISLOCA RESEARCH PROGRAM NEAR-TERM OBJECTIVES

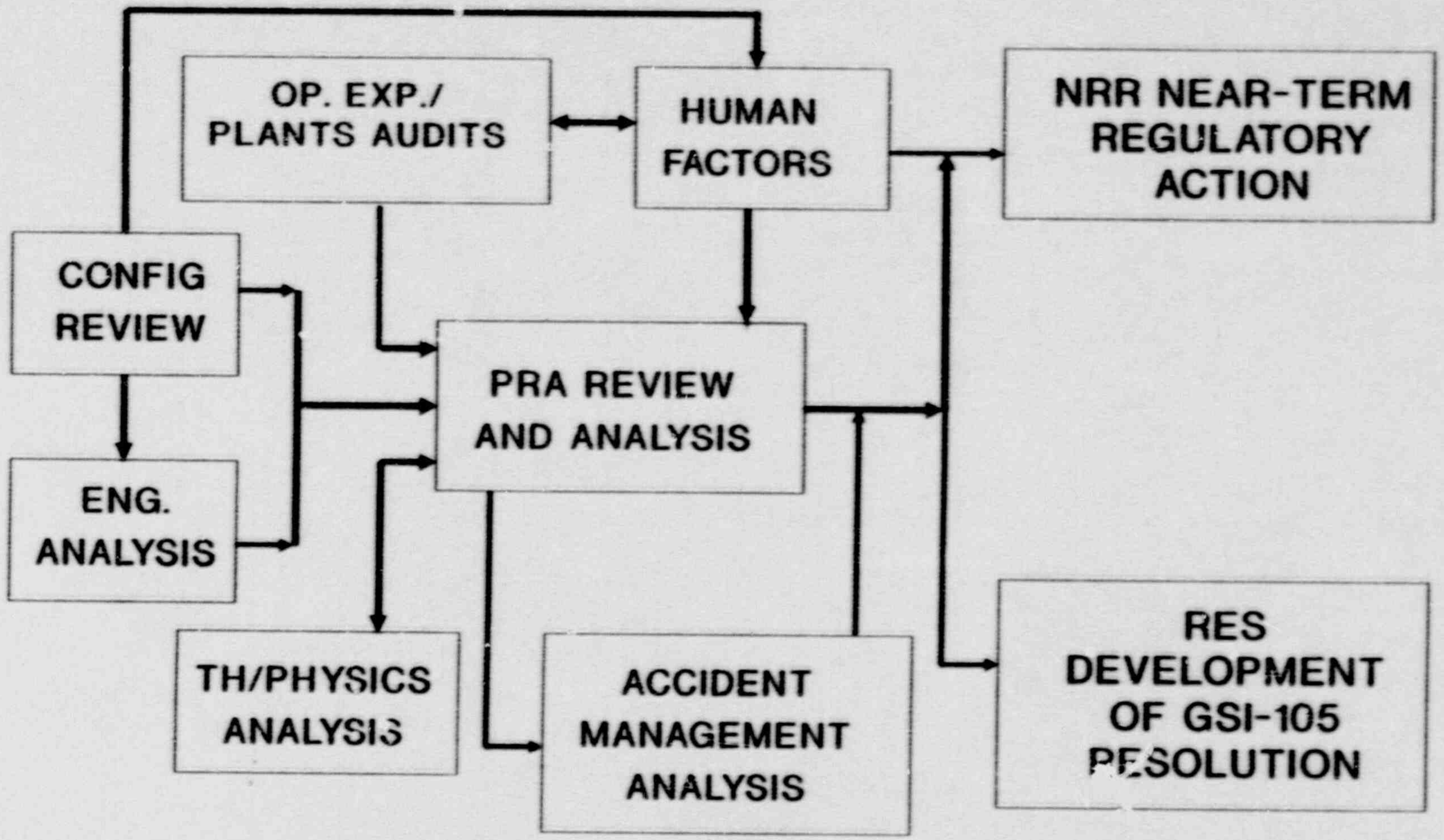
- EVALUATE LOW PRESSURE SYSTEMS FRAGILITIES UNDER HIGH PRESSURES/TEMPERATURES TO IDENTIFY LIKELY FAILURE LOCATIONS.

- IDENTIFY SPECIFIC HUMAN ACTIONS AND ROOT CAUSES IMPORTANT TO ISLOCA FOR RECOMMENDING RISK REDUCTION ACTIONS.

- DETERMINE ISLOCA SEQUENCE TIMING, FLOW RATES, ACCIDENT MANAGEMENT STRATEGIES, AND ISLOCA EFFECTS ON OTHER EQUIPMENT.

- DEVELOP A PRA FRAMEWORK TO EVALUATE HUMAN AND HARDWARE CONTRIBUTIONS TO ISLOCA.

- ESTIMATE ISLOCA CONSEQUENCES AND IMPORTANT FACTORS FOR CONSEQUENCE REDUCTION.



RES ISLOCA PROGRAM FLOW CHART

Brief Task Descriptions

1. Configuration Review

    - Identify "Representative" systems for analysis in six plants

2. Data Analysis

    - Review operating history for ISLOCA events
    - Estimate PRA parameters
    - Identify important human actions

3. Engineering Analysis

    For the systems identified in Task 1:

    - Calculate component fragilities w.r.t. pressure and temperature
    - Estimate likelihoods of failures at specific system locations
    - Estimate flow rates and timings

Brief Task Descriptions (cont'd)

4. Human Factors

    - Analyze human actions from Task 2 for performance shaping factors
    - Collect additional data from plants identified in Task 1
    - Retrospectively review audit procedures in light of current program results
    - Recommend audit procedure revisions
    - Develop final performance shaping factors for estimation of human error contribution to ISLOCA

5. Analysis Method Dev.

    - Develop procedures to integrate analyses and results (Tasks 1-4) into ISLOCA plant evaluation method

Brief Task Descriptions (cont'd)

6. Evaluation Method Application

   Apply procedures of Task 5 to systems and plants identified in Task 1.

7. Program Management

   - Identify critical path items
   - Ensure coordination among tasks

8. ISLOCA Evaluation Guide Development

   - Produce a library of system models for use in ISLOCA evaluations
   - Provide guidelines for assessment of designs, procedures, recovery actions, etc. to evaluate ISLOCA frequency and risk.

PROGRAM STATUS

TASK

1. CONFIGURATION REVIEW (COMPLETED)
2. DATA ANALYSIS (COMPLETED)
3. ENGINEERING ANALYSIS

   (DAVIS-BESSE UNDERWAY)
4. HUMAN FACTORS (UNDERWAY)
5. ANALYSIS METHOD DEV.

   (UNDERWAY)
6. METHOD APPLICATION (DAVIS-BESSE)
7. PROGRAM MANAGEMENT (UNDERWAY)
8. ISLOCA EVALUATION GUIDE AND SYSTEMS ANALYSES

   (DELIVERY IN LATE FY1990)

Draft

FUTURE WORKSCOPE AND SCHEDULE INCLUDE THE FOLLOWING MILESTONES

RESOLVE TPG & INEL PIRT DIFFERENCES . .	JAN 1990
COMPLETE ASSESSMENT MATRIX (DRAFT) . . .	FEB 1990
DETERMINE KEY CODE PARAMETERS & RANGE	FEB 1990
DETERMINE CODE APPLICABILITY (DRAFT) . .	MAR 1990
SBLOCA CASU WORKSHOP	MAR 1990
DOCUMENT PIRT (FINAL)	APR 1990
COMPLETE SENSITIVITY CALCULATIONS . . .	OCT 1990
DETERMINE CODE UNCERTAINTY (DRAFT RPT) .	MAR 1991
ISSUE NUREG/CR	JUN 1991