UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Title: MEETING WITH THE NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE - PUBLIC MEETING

Location: Rockville, Maryland

Date: Thursday, July 27, 1995

Pages: 1 - 62

ANN RILEY & ASSOCIATES, LTD.
1250 I St., N.W., Suite 300
Washington, D.C. 20005
(202) 842-0034

DISCLAIMER

This is an unofficial transcript of a meeting of the United States Nuclear Regulatory Commission held on July 27, 1995 in the Commission's office at One White Flint North, Rockville, Maryland. The meeting was open to public attendance and observation. This transcript has not been reviewed, corrected or edited, and it may contain inaccuracies.

The transcript is intended solely for general informational purposes. As provided by 10 CFR 9.103, it is not part of the formal or informal record of decision of the matters discussed. Expressions of opinion in this transcript do not necessarily reflect final determination or beliefs. No pleading or other paper may be filed with the Commission in any proceeding as the result of, or addressed to, any statement or argument contained herein, except as the Commission may authorize.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

MEETING WITH THE NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE - PUBLIC MEETING

Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland

Thursday, July 27, 1995

The Commission met in open session, pursuant to notice, at 2:02 p.m., Shirley A. Jackson, Chairman, presiding.

COMMISSIONERS PRESENT:

SHIRLEY A. JACKSON, Chairman of the Commission
KENNETH C. ROGERS, Commissioner

STAFF AND PRESENTERS SEATED AT THE COMMISSION TABLE:

JOHN HOYLE, Secretary of the Commission

MR. EDWIN KINTNER, NSRRC Chairman
Executive Vice President
GPU Nuclear Corporation (retired)

DR. ROBERT E. UHRIG,
Distinguished Professor of Engineering
Department of Nuclear Engineering
University of Tennessee

PROFESSOR MICHAEL W. GOLAY
Professor of Nuclear Engineering
Massachusetts Institute of Technology

DR. FRED MOLZ, III
Professor, Civil Engineering
Auburn University

DR. E. THOMAS BOULETTE
Sr. Vice-President, Nuclear Operations
and Station Director, Pilgrim Station
Boston Edison Company

P R O C E E D I N G S

[2:02 p.m.]

CHAIRMAN JACKSON: Good afternoon, ladies and gentlemen. I'm pleased to welcome the Nuclear Safety Research Review Committee to brief the Commission on the NRC research program plans and priorities. I particularly would like to welcome Dr. George Bankoff, who has recently joined the committee. And I understand that this may be the last meeting for Mr. Kintner with the full Commission and if so, I would like to thank you very much for what I understand has been a long and stellar service.

MR. KINTNER: Too long and too stellar.

[Laughter.]

CHAIRMAN JACKSON: As you know, our research programs must provide a technical basis to support the regulatory decision-making of the Commission, as well as anticipate the regulatory needs.

In this regard, the committee has and has had a valuable role to play in advising the Commission and its Office of Nuclear Regulatory Research on research and priorities, and that's particularly true today, in light of severe budget constraints.

And I understand that today's briefing will focus on research programs on instrumentation and controls and human factors, probabilistic risk assessment research, which

is a particular interest of mine, and waste disposal research. These topics obviously represent important areas in which the agency is devoting considerable attention and resources.

The Commission has received several letters from the committee's February meeting, as well as the staff's responses to those letters. We realize that you're about to complete your second day of meetings with the staff, and we're interested in any follow-up or progress on the resolution of issues identified during your February meeting, as well as new thoughts.

And I understand that copies of your viewgraphs, if there are any, are available. And before we begin, I'd like to ask Commissioner Rogers if he has any comments he'd like to make.

COMMISSIONER ROGERS: Nothing special at this time.

CHAIRMAN JACKSON: You may proceed, Mr. Kintner.

MR. KINTNER: First, let me talk for just a minute as to how this committee works. We have 12 members with varied technical backgrounds covering the whole spectrum of nuclear engineering safety matters.

We divide into five subcommittees to look at particular areas in safety. The subcommittees meet, write draft reports. Those are reviewed with the full committee

and the report is submitted to the director of research as a report of the full committee.

These committees are Accident Analysis, Materials and Engineering, Instrumentation and Control and Human Factors, PRA and Waste.

The committee is now seven years old. The original members are not here. We are limited to two three-year terms, and so there is no one here who was here from the beginning.

Several members of the committee have been here for six years and bring a considerable background of history and experience as to the development of the research program over that time.

We believe that the research program has a number of achievements to its credit. Very significant advances have been made in severe accidents, and one in particular, the source term. That took a long time to resolve but it's truly fundamental and I think maybe one of the most important single pieces of action that the Commission has taken in years. By the time the revised source term is understood and applied in regulatory space over a period of time, if there are ever any more reactor plants built in this country or elsewhere, that's going to be fundamental.

Another fundamental area is reactor vessel integrity and the whole idea of embrittlement and the weld

chemistry and so forth, which leads to considerations of reactor vessel failure has come a very long way.

Similarly, piping integrity has come a long way. The question of the supporting and the welding requirements and piping integrity -- these activities associated with the primary boundary are obviously fundamental to nuclear safety.

And then the secondary side of that is containment performance. A great deal has been done to understand and experiment on containment performance. So in the question of severe accidents and how to prevent them and mitigate them when they occur, a great deal has been accomplished.

Another area that's important to recognize is thermal-hydraulic codes. These are important not only to regulation, but they're used by the utilities for a number of ways of analyzing reactors and analyzing safety margins, in fuel loadings, and so forth. And those have been developed and refined and are continuing to be refined in a very important way.

Thermal-hydraulic activities have also led to the ECCS resolution, emergency core cooling system resolution, which has changed the safety aspects of power reactor operation in a significant way.

The third area is seismic research. That has been refined, after a long and sometimes bitter discussion, to a

point where anyone who wants to build another plant, design another plant, has a much better idea what is or what is not acceptable from the safety point of view and what is and what is not available and acceptable from a regulatory point of view.

So a great deal has been achieved. These sometimes get forgotten and lost in the general flow of business, and it seems to us important to recognize that the research activities of the Nuclear Regulatory Commission have not been just another expenditure at another national laboratory or university, with its own favorite research programs.

There are still problems remaining, which I think only research can resolve -- regulatory problems. One that's obvious is aging. The plants are going to get older. People are asking to run them for longer periods of time, and that is an area which, because there's no previous experience, no precedent, can only be addressed in a rational way on the basis of experimentation, extrapolation of where we are in terms of operating plants to what will be the circumstances when they age even further. That's an area which is far from completed.

A further area is instrumentation and control and human factors. Now, we have combined these because we think that whole area deserves to be looked at as a system, that

the operators are a part of the system and if you separate the two, you may be asking for trouble in a way that's happened in the aviation industry, and you need to always consider that this is a total system of control and operation of the reactors.

This is also an area which is new. It's about the only major technical change in the design and operation of reactors in the last decade or so. They're essentially fundamentally the same, except for instrumentation and control. Modern digital electronics is coming in in a large way. It has to be accepted in some respects because the replacement parts are not going to be available. It's being done sort of piecemeal in the sense that this system and this system is being replaced.

The integration of these things and understanding the totality of that introduction is one which is far from, in our view, a completed matter.

The digital equipment, in addition, is an area which is going to change rapidly. I mean, the field is changing so rapidly that what is today may not be there in a year or two. The research in that area is far from complete.

You were talking very seriously about risk-based regulation. That is a new subject. The supporting base, both from the standpoint of the theory and the data base,

which is required to do that and do it adequately, is not yet as available as you would like it to be, and that's going to take some additional research.

And obviously, the waste question, the final disposal question, is one which is far from complete from the standpoint of research. And that one is further complicated by the turbulence of what is really going to happen and when is it going to happen.

So there are these problems that still remain with regard to research. We believe -- we may be somewhat prejudiced in this way -- that no intelligent, logical, responsible regulation can occur without a base of data from which to make the decisions. And some of that data is already available and some of it still needs to be developed.

So the importance of research is hard to overestimate, even in a circumstance in which no more plants are going to be built.

There's a further aspect of that, which is a great deal of research is being done overseas -- Japan, Europe and so forth -- very good research, and the ability of the United States to work with, to make that available to us and to participate in the kind of research that's being done depends upon the strength of our own research program. We cannot expect and should not want to expect that these

results are going to be made available to us unless we have something to give in return.

So on the one hand, a very great deal has been accomplished. On the other hand, a great deal is yet to be done. And there is now, for some of us, a reason to feel very strongly -- we want to make this point as we leave, because the membership in the committee is going to change rapidly.

The first to leave, not here today, is Herb Isbin of the University of Wisconsin. You may remember Herb was, for many years, a very, very strong person in involvement in the severe accident area.

Dr. Uhrig is going to be leaving with this session. He is our only remaining really experienced person in instrumentation and control.

Sol Burstein, who is behind me here, brings with him a very long history within this committee and also within operational reactors at the practical level as one of the chief executive officers of one of the most successful nuclear utilities.

And I, myself, will be leaving. I don't know what I've brought to this, but whatever it was, I think it was an historic contact, back from the very beginning in Nautilus up through Shipping Port and TMI-II, which I would like to feel is going to be hard to replace that much age. You have

to find some very old people, and you won't nominate them to be on this committee.

So the old boys' club is disappearing. You've got a bunch of young, enthusiastic nuclear engineers from places like M.I.T. and Georgia Tech. and the University of Tennessee.

So with that, if you have any further questions about what I have said as a background, fine, but otherwise, we'll proceed with the subcommittee presentations.

CHAIRMAN JACKSON: Please do.

MR. KINTNER: I guess number one on our committee is Dr. Uhrig.

DR. UHRIG: Are the slides ready?

CHAIRMAN JACKSON: Do we have the slides?

[Pause.]

CHAIRMAN JACKSON: I think we're ready.

DR. UHRIG: Okay. Madam Chairman, Dr. Rogers, it's my pleasure today to give you a report of the Instrumentation and Control and Human Factor Subcommittee activities. We've had two meetings this year, one in January where we covered the instrumentation and control part of the program, and one in May when we covered the human factors program.

The committee is made up of four people: myself as chairman; Tony Baratta, Penn State; Michael Golay from

M.I.T.; and Charles Mayo from North Carolina State University.

Let me take about 60 seconds for background here. In a 1988 NRC-sponsored Oak Ridge survey of the nuclear industry, we found that the utilities were very interested in mass instrumentation and control. They saw the wondrous things that were happening with the space program and with the aircraft, and they were interested in the possibility of applying this to nuclear power plants.

However, they were not willing to act without NRC criteria and requirements so that the systems they put forth could be approved without having to go through a long profess.

Well, time caught up with the utilities. The replacement parts were not available and LERs kept coming in saying the biggest cause of trips were the I&C failures and therefore they proceeded to implement digital systems, some of which are listed in the next slide here -- the Foxborough system, the Connecticut Yankee, the Westinghouse, System 21 at Sequoyah, and the list goes on here, and there's a lot more that could have been added to this list, starting about five years ago.

At about that time, the NRC proposed a rule that all digital systems effectively constituted an unreviewed safety issue because of the problems of diversity in the

software. This obviously precipitated a lot of discussion. ACRS came into the picture with the discussions, and the result was that there was a recommended National Academy of Science/National Resource Council study that is now under way. And the Nuclear Safety Research Review Committee concurred with the initiation of that particular study.

Unfortunately, it was delayed in getting started until January of this year. The phase one report, which was due out in May or June, has now been delayed till September. We understand it's presently under review and that it should be out around September some time.

Now, the subcommittee has some concerns here. One is that NRC may be expecting too much from this report in terms of solving all their problems, and no report ever solves every problem that's coming along. And another one is that some needed and important decisions may be delayed until this report is in.

This is only phase one. Phase two may be at least a year away, and we don't want to see the I&C and human factors program in a holding circuit until such time as that report is in, such things as initiating research that may be needed in this area to satisfy the licensing needs of new systems coming in, as well as acquiring more in-house expertise, particularly in the digital instrumental and control field.

There are many activities in the instrumentation and control field and human factors areas that are viewed favorably by the NSRRC and our subcommittee, such things as the NRC-wide Human Factors Coordination Committee of the various offices within NRC. The allocation of program funds is about two-thirds instrumentation and control and one-third human factors, and we believe this is an appropriate division at this time.

The completion of Revision 1 of NUREG 0700, which is sort of the Bible of human factors that applied to plants after Three Mile Island, this Revision 1 now covers the transition to digital instrumentation systems, and we view this very favorably.

The research liaison with foreign regulatory agencies, particularly in Canada, France, Japan, and Germany, we think is good, and also the liaison with other human safety interfaces -- such things as rail, air and ship traffic control centers. All of them have much more modern instrumentation and control systems than are presently available in the nuclear power plants. So we think that this liaison is very good and there's much to be gained.

We view the Halden manned machine research program very favorably. The benefit is calculated to be about six times its cost and it may be more than that, particularly since almost all of these programs have a direct benefit to

the NRC and, just speaking personally here, I'm very pleased to see that it does involve artificial intelligence, as applied to nuclear power plants. That's one of the few places within the NRC where this is going on.

We recommend an aggressive participation with as much emphasis as possible on bringing programs out of that effort that are of special interest to the NRC.

COMMISSIONER ROGERS: Just before you leave that, how did you get to six times? I'm not questioning you; I'm just curious. How do you get this number?

DR. UHRIG: This was a number given to me, but let me tell you my understanding.

COMMISSIONER ROGERS: Rounded from 5.7.

DR. UHRIG: It was my understanding it would cost six times as much for the NRC to perform the research that was done that was of special interest to them.

COMMISSIONER ROGERS: Through shared costs?

DR. UHRIG: Yes, because of other participants in the program.

COMMISSIONER ROGERS: Yes.

DR. UHRIG: Okay. There are some concerns that the subcommittee has. Budgets are obviously one, but we're not going to go into that at this point.

One of the critical questions we're concerned about here is whether a hybrid of analogue and digital

components is less safe, as safe as or more safe than the old analogue system because when you put together systems that were not designed to go together, sometimes there are synergistic benefits and sometimes there are synergistic problems that arise out of this.

And the question that obviously arises is whether there's a basis for insisting on going to digital I&C. We're not answering that question. We simply raise it as an issue that needs to be addressed somewhere along the line.

CHAIRMAN JACKSON: Let me ask you a question. Relative to the various activities that you said the committee viewed favorably in this area, are those activities such that some of these critical questions are likely to be or could be addressed within the framework of those efforts? Or is this something that you're suggesting there needs to be some additional activity in order to --

DR. UHRIG: Well, when you take a look at the Canadian system of regulation, it is different than our system. They have different criteria. They have had digital instrumentation and control systems for 20, 30 years, in operation. And they have a big backlog of experience. And some of the questions that we are concerned about, they may have some answers for us, and we think there's much benefit to be gained with this liaison between the NRC and the Canadians on their experience with digital

systems.

One of our concerns here, and this is not just instrumentation and control; the whole area is the NRC contracting process seems to be extraordinarily complex, resulting in staff members spending a lot of time in administration. Sometimes technical people get frustrated when they get too involved in the administration of contracts.

Another issue is that it costs just about as much to administer a $50,000 contract as it does a $2 million contract. We're not sure what the answer is but again, we flag it as an issue that somewhere along the line needs to be addressed.

A couple of years ago, there was an Inspector General report of the Research Office that was critical, basically demanding strict accountability, saying that programs should not be initiated until there is a demonstrated need for it.

Now, that is a fundamental problem because when you have a need for something, you want an answer now, and research does not produce answers instantaneously. It may take a year; it may take five years.

One of the suggestions we have is that research work with the other NRC offices to attempt to identify these needs earlier, anticipate the needs and to begin the program

so that results would be available at the time that they are needed. And we understand this is being done on an informal basis, but perhaps something a little more formal would be appropriate here.

One of the real tough problems in digital systems is verification and validation of software. The Commission has a two-pronged effort here. For short-term programs, they are adapting many of the current methods, looking at what the options are and using the results of this work to review, on a case by case basis, the applications from the utilities to install software-based systems.

In the long term, they're looking at more rigorous, formal methods, very similar to what the Canadians are looking at, and these may or may not prove out to be better, but clearly it's an important issue that should be looked at because if we can have formal methods that assure us that software is the best we can have, then we're much better off.

Now, I alluded at the very beginning that the utilities were saying, "We need guidelines, we need criteria before we get into the digital/software systems." Such requirements are today being prepared within the NRC. This is a little late, but it's coming, and hopefully it will be available within the next year or two, at the most.

So the kind of requirements that industry was

looking for are being developed, many of them in conjunction with professional societies like the IEEE and ASME, this type of thing.

As a bottom line, however, the design must be fault-tolerant because nobody can write perfect software. There's typically -- one error per thousand lines of code that's commonly used. If you have a million-line code, you've got 1,000 errors, and it's awfully hard to get that down to less than 100. So the design has to be fault-tolerant.

Now, going to software modules is certainly one approach, and it's an area that we think NRC could very well put some effort into in an effort to try to address this problem.

The last slide I have here is called long-term concerns of the subcommittee. One of the issues we're concerned about is that the I&C and the human factors programs sort of go along in parallel, and they're not as integrated as we would like to see. And it's possible that because of this separation here, they could wind up being flawed. We're not saying that they are, but simply we're encouraging interactions between the programs, which we think is important.

One of the critical questions is the allocation of function between humans and machines. We're not advocating

going to an automated system. The Canadians are doing this. Some of the Europeans are doing this. We don't think we're to the point where we'd even consider this at all.

On the other hand, we've got a lot of technology out here, we've got magnificent computers, we've got outstanding information processing systems, and somehow we should be able to back-stop the operators so that there aren't errors being made in the operation of nuclear power plants.

This is my presentation. I'd be happy to answer any questions.

CHAIRMAN JACKSON: Thank you.

COMMISSIONER ROGERS: Well, you went very quickly over it and there's a lot of issues here that I think are very important. I'm very pleased to hear what your thoughts are and what your recommendations are.

I'm not sure whether I want to pick up on it just at the moment, but I think sometime before we totally wrap up this presentation, I would like your general comments, not only from the I&C area but from the other areas, as well, as to what you feel about the relationship between research and the other parts of the organization -- NRR and NMSS -- particularly with respect to the issue of who initiates work.

I think it's a very important question. You've

touched on it, Dr. Uhrig. I'd like to hear from the other parts of your committee and perhaps you, Mr. Kintner, at the end because I think it is an important management issue here at NRC that we have to grapple with. And without saying anything more about my own views on this at the moment, I would like to hear what your thoughts are.

I do see some things in each one of the individual reports that I've seen that somehow or other seem to me to be related to that issue. But I'd appreciate to have your candid thoughts on that matter.

I was particularly interested in your very strong support for the coupling of I&C and human factors work because I quite agree with you that they, together, do represent a system and an important system for nuclear power plants, but from a discipline point of view, the people who are experts in one tend not to ever even come in contact with the other, particularly in the university, unless there's a very strong effort to bring them together. I think that how we do that is very important, and yet it's very difficult.

My concern with human factors research at NRC over the past seven or eight years that I've been watching it is that it's been a roller coaster. At times we've been very interested in it. We think human factors is very important. We all know that human error is an important contributor to

plant safety. And management, organizational questions are very important. That isn't to say that NRC necessarily should get involved with that, but we know that they're important.

And yet, how much effort we put into supporting research in this general field has waxed and waned over the years, and I think what we need to try to do is to come to some level of effort that we think is a basic one to continue, without a lot of disturbances, some basic level at which we ought to make a commitment, if we can, within whatever budgets we have, that is important for the future, and also the extent to which I&C and human factors really have to be connected and what possible mechanisms you might envision to do that more effectively.

You've commented that you see these as both coupled together in actuality, in practice, but at NRC somewhat distinct, even though they're under the same organizational heading. I take it what you've said is you think that they really ought to be working more closely together.

DR. UHRIG: Let me just give you an example here. One of the things that came out of the human factors research was a project in which they observed operator retraining. And out of about 4,000, I believe was the number, opportunities for making a mistake, there were

actually about 40 some odd mistakes made, a 1 percent error rate.

This is a factor of 10 higher than anything that we've been thinking of. This is a very, very significant finding if it is verified at subsequent research.

The question is what can we do in the human factors side? What can we do in the instrumentation and control side? What can we do together to reduce this error rate? There's got to be some combination, and it may be related to the allocation of functions -- some functions ought to be automated, others be brought back under direct control of the operator. I'm not sure, but it's an issue that's very important when we have an error rate that's 10 times what we thought it was.

CHAIRMAN JACKSON: It's also true, though, is it not, that all errors don't have the same consequence?

DR. UHRIG: Fortunately.

CHAIRMAN JACKSON: And so at a certain level, the errors themselves have to be risk-loaded.

But I guess what comes through here is that you really have what's more of a three-body problem. I mean, you talked about hybrid analogue-digital systems, and that's kind of a two-body problem in terms of how those systems interact.

And then you put the human element into it. And

from the point of view of a physicist, three-body problems are not, in general, solvable.

And therefore, my question for you is do you feel that in other complex industries or industries that have complex human factors consideration -- you mentioned the airline industry -- are there lessons to be learned and is there enough in terms of those lessons that we can gain comfort in terms of the likelihood for success, in terms of a resource allocation consideration?

DR. UHRIG: Well, I would simply cite the example of the French Airbus, which is a very highly automated system. In most cases, it works very, very well. Unfortunately, there's been several crashes -- two, three, four, something of this sort -- that had some blame to this new modern system.

And it basically says that it may have been automated too soon. They still need to pilot in control. Somebody has to be making sure that the system is functioning in the way it's supposed to. And in the end, it had better be a human judgment than an automatic system. That's one lesson I believe comes out of the aircraft industry.

There may be a lot of others around that would be applicable here. This is the reason I mentioned we do not recommend a fully automated system, even though Canadians

and others may be going in that direction.

COMMISSIONER ROGERS: Just on that point, I was going to ask you -- it's really a little more technical than we want to get into too much here today -- what your thoughts on that question of human intervention, operator intervention are with respect to modern I&C control systems because more and more, other countries are going to designs in which they do not prevent the operator from intervening, but the operator is not expected to intervene for some rather long period of time -- 30 minutes or more in some cases -- to give the operator plenty of time to think through what he or she might want to do.

I wonder if you feel that we are looking at that aspect of the human factors I&C coupling in sufficient detail at NRC or in the U.S. in general.

DR. UHRIG: Well, just speaking personally, I think that approach is a good approach to give the operators time to think through. I think Three Mile Island is an example of where there may have been some precipitous action. In the long run, it may not have made any difference, but it certainly had some short-term effects.

It's an issue that I'm sure is one of those on the list to be studied. I don't know what the priorities are at this point. Perhaps one of the other committee members can answer that.

CHAIRMAN JACKSON: Before you do that, so that we make sure that we have the opportunity to go through all the subcommittee reports, perhaps we should go through those and then come back for our broader discussion.

MR. KINTNER: Well, it happens that Dr. Golay here is number two and he's going to talk about PRA, which touches on this to some degree.

DR. GOLAY: Thank you, Mr. Chairman. The PRA Subcommittee was formed about a year ago in recognition of the growing role of performance-based regulation within the NRC. It was formulated before the proposed PRA policy statement came out and the implementation plan which followed in the past year. So the timing was quite fortuitous, actually.

And what we have done during the past year is essentially to examine the activities under way within the agency and try to contrast them to what we feel is needed within the agency to support performance-based regulation gaining much greater acceptance, and with risk-based regulation being in the context of that.

So the first thing that I'll note that we see is that there have been many things under way before the most recent PRA policy statement; for example, using reliability standards for diesel generator performance, the maintenance rule experiment, which is being worked through, some

experiments in revisions and tech specs, and so on.

And what we have seen is that most of the current work still is a continuation of that previous work, which is sensible. I mean, that's where the momentum is. And the difficult problem is really figuring out what do you do in a more comprehensive strategic way to make a major change in the regulatory approach within the agency. How does research support that fundamentally?

And that's what I want to use most of my time to turn to, and I'll try to give a status report on sort of where things appear to stand with regard to that broader set of requirements.

Before I go further, however, one thing I should note is the composition of that committee. I didn't prepare a slide summarizing the membership, but they consist of Dr. Boulette on my left, the in-coming chairman of the overall committee, Sol Burstein, who is behind me, Dr. Yukara, who is not in attendance today, and Dr. Uhrig has been in attendance at all of the meetings. We've tended to meet with the Human Factors and I&C Committee.

If we turn to the first slide, I think that one of the important things to do is to make the distinction between performance-based regulation and risk-based regulation because the two terms are often used interchangeably. And while a consensus has not yet emerged

on exactly what performance-based regulation is, I've taken a shot at trying to summarize it.

The way I would describe it is a regulatory approach which is concerned with the outcomes that are desired in terms of safety performance, and that the important thing to recognize is that there are a variety of decision basis elements which play a role in there where, say, the maintenance rule experiment is a good example of things under way in the performance-based regulatory theme, and where tests and inspections actually play the most prominent role, where they can be applied.

So the way of viewing this is really to say that there are a variety of ways of basing regulatory decisions, in terms of acceptable design or performance, which make use of tests and inspections, deterministic analyses, which have historically been used within the NRC, PRA, which is a new element coming into it, and subjective judgment, which has always played a role, but perhaps more in the background.

And one of the things which I think emerges from the work of the Human Factors Subcommittee is that one thing the Commission might consider is trying to find more of a way to let subjective or qualitative judgment play a more explicit role in the portions of the problem where it fits best.

What I've tried to do is to give examples here of

places where each of these decision bases may be best suited to a portion of the safety problem.

So our subcommittee was formulated focussed on PRA, but within the context of performance-based regulation, feeling that this is an area where there's still a lot of research that's needed in order to get the capabilities that the agency needs to use this on a routine basis in the regulatory decision-making environment.

If we go to the second slide, what I've done here is to list important factors which show up in the use of PRA and give a status summary on what we have learned about where things are within the Commission. And we're looking at this always from the point of view of asking what do we need to bring capabilities within the Commission to the point that PRA can be used as routinely as deterministic analyses are used today.

And for that we'd say that one of the things which we need are standardized modeling treatments, so that the variability between analyses, which we now see coming up from one contractor to another, say, working for a licensee, that that kind of variability is reduced.

And the status is that the methods for creating this standardized approach is not in place, but there has been some thinking given to it.

Concerning data bases, this is always recognized

as one of the parts of the PRA that has to be gotten right. And again, there is existing work, but a recognition for substantial need for improvement, and we are told that there's going to be a major initiative started in this area in the future, perhaps in cooperation with INPO.

In terms of the status of the kinds of results that you can get from PRA, I've tried to summarize here the portions of the PRA in terms of where they're most useful, and I would say that for the agency today, that really the most important part is the level 1 or the core damage frequency estimation part. And the good news is that there's a lot of improvement in safety performance that can be obtained by extracting from available analyses and those yet to be generated results in that portion of the analysis. That is, the accuracy of what you can achieve there is good enough that you can actually make some decisions.

In the other parts, I think it's more questionable. I'm speaking on behalf of the committee, not just for myself, but I believe I represent their views.

One of the things which is very important for the agency is that the difficult part in PRA is not figuring out what to make of the results that you get from the analysis, but figuring out how you treat the uncertainty that's associated with it.

The important thing to recognize about that

uncertainty is that it's no different from the uncertainty that we live with without PRA. The only thing that PRA does is make that uncertainty somewhat more explicit, but it doesn't increase it. And when we go to using it in making decisions, what we're simply doing is encountering a situation where society hasn't quite worked out an agreement on how it will handle that uncertainty.

So I've listed here some of the important sources of uncertainty because they relate back to the future agenda for the Research Division of the agency. One that we always talk about is data variation, which the entry on the "Status" side says "Understood." That should only relate to data variation, so there's a typographical error there, but that's probably the least important part of the contributors to uncertainty.

Where we also have uncertainty arising is from errors of aggregation, basically arising in the treatment of complex or sensitive system behavior, where approximations have to be made. And most importantly is areas where we're simply ignorant of important phenomena, and I've listed a few examples there. And this is one area where clearly the Research Division has opportunities to make contributions. And human error, which we just spoke about, is one of those.

In terms of the limitations upon safety improvements that can be achieved within the agency, say

through better design, better standards and so on, there is sort of an irreducible limit in terms of what can be achieved, and these are reflected in the portions of a PRA which are hard to model. And I've listed here the three most important contributors, which are human error, external events, and internal common cause failures.

These are ones which are, I think, going to remain hard to model for a long time and where a long-term perspective within the research program is going to be required so that we can as good an understanding as we can, but we have to recognize that it's going to be somewhat like trench warfare in many cases.

And I would say that the programs that we've reviewed, especially in human error, tend to reflect this, where they're just tough problems. People are working, actually, pretty hard, but it's hard to come in with more useful results.

COMMISSIONER ROGERS: Just so in the future nobody looks at this slide and misunderstands what you're saying, I understood what you were saying. You were saying that these items -- human error, external events, and common cause failures -- it's very difficult to get a handle on those and improvements in understanding them are going to come with a lot of work.

DR. GOLAY: Right.

COMMISSIONER ROGERS: On the other hand, the general title of this, "Limitations upon safety improvements," I think you can make real safety improvements through PRA. I think there's no question about that. These particular ones are very troublesome to pin down.

DR. GOLAY: That's correct. There are some things that you can do, and Professor Uhrig alluded to them. For example, in human error, one of the important parts of what the NRC can do is to provide incentives for licensees to compensate for human errors through other technical fixes, like advanced I&C. This is an area, though, where leadership is required by the NRC to actually make it happen.

And similarly with common cause failures, doing things to make sure that, say, common manufacturing flaws don't creep into components is, again, an area where the agency can make contributions.

I'm just saying that these always emerge as sort of the evil three.

COMMISSIONER ROGERS: Oh, I agree.

DR. GOLAY: Then the last slide that I've prepared is concerned with activities that our subcommittee has recognized as being important for the NRC to undertake in advancing performance-based regulation and supporting the NRC in all of its areas.

These come from, first, setting out the overall strategy, which, in part, involves deciding which of these decision bases, which I listed on the first transparency, are appropriate to different parts of the safety problem, in effect, dividing up the turf and figuring out what serves best in different places.

This is probably the most immature effort of those which are listed here, which is not so surprising because people only got their marching orders about six months ago.

One of the things which is needed is to get some successful examples of performance-based regulatory experiments, such as the maintenance rule, and this kind of thing has been under way for some years, and good results are coming in, particularly in the revision of tech specs, using PRA as the basis for it.

This is important to get both buy-in from the constituencies and the overall nuclear power enterprise -- we're going to have to cooperate to make performance-based regulation work -- but also to gain the experience which will help you figure out what is the best way to meld these different treatments in the safety solution.

It's recognized that within the NRC that you need more PRA-trained staff, and there is an effort under way currently which appears to be well focussed for making that happen.

However, you also need, in addition to that, standardized decision rules and tools for the staff to use in their routine work. And what I'm really alluding to here is that PRA may serve best in the background, for example, supporting deterministic decision rules, rather than having a PC on the desk of every professional, who would then run one to support every particular decision that he might make. That's a subtle problem and it takes some iteration to come up with the right approach.

COMMISSIONER ROGERS: My impression is that the staff is really working on that.

DR. GOLAY: Okay. Well, it may not have been evident in the presentations that we received.

COMMISSIONER ROGERS: Well, it may not be through research.

DR. GOLAY: Conceivably.

COMMISSIONER ROGERS: But I think we've seen some evidence from the EDO that there is now an effort to try to provide some guidance for the use of PRA throughout the agency.

DR. GOLAY: And certainly, with the staff that we have talked with, they've recognized the need for this. So it's good news if it's further along than I had understood.

I spoke about the standardized PRA methods. Work on that is under way. Similarly, work is at a less mature

stage but has been undertaken to improve the status of data bases and, just as importantly, to create standard methods for refining those data bases as experience is accumulated.

And finally, there's a need for standardized methods for treating the PRA uncertainties, and I would say that this is in its early stages, as well, but the need is recognized.

COMMISSIONER ROGERS: I wonder if you could say anything on the standardized PRA methods. It seems to me that that's a very important, very important aspect of the use of PRA. If everybody has their own custom approach, done with the aid of different contractors, first, it makes it difficult for us, in looking at these things.

DR. GOLAY: Sure.

COMMISSIONER ROGERS: It also, I think, raises some questions about the validity of the results, when they start off from a different basis and one has a sort of uncomfortable feeling that if you did it a different way, you'd get a different number. Well, a little different is okay, but not very different, I would hope.

So the modeling, what are the mechanisms that one could envision that would help to standardize a modeling approach for initiation of a PRA study?

DR. GOLAY: Well, I think that we have some examples already from the way standardized formats, for

example, were specified for the SARs, in the way that standardized analytical methods were specified in the resolution of the emergency core cooling controversy during the '70s, where basically a road map was laid out to an applicant, saying, "If you will use this approach, we will accept what you have used. You're free, of course, to do it your way if you can come in with a good argument."

And so simply standardizing on format, on the structure of the systems divisions, on the data base to be used, these are good starts, I think, and from that, you penetrate further; for example, on modeling assumptions, again, with some guidance to analysts on what would be acceptable assumptions in treatment of, say, equipment reliability, human reliability.

COMMISSIONER ROGERS: But this is all being done -- I mean, what you're suggesting is sort of a regulatory initiative on this, and what I was thinking of is something that's broader than that that, for instance, has an international character to it so that someone who does a PRA on a French plant doesn't go and do that in a way that is so different from the way you might do it on an American plant or a Japanese plant, that you just simply take the number and nothing else.

I wonder if there's some way that we could help to encourage providing more of a clearinghouse for modeling, at

least in the nuclear plant area, that would start to regularize this process a little bit.

DR. GOLAY: Yes, I think you could, which would be to basically create the forum where the technical content of those treatments would be resolved, and within the standardized format.

The NRC is in a very good position to do this because first of all, if you look at PRAs done in industries worldwide, you find that the great bulk of them are done in nuclear applications. And then, if you look at different countries and look at how much this technique has been used, it's used more in the U.S. than it is elsewhere.

So the NRC is, in fact, perfectly positioned to play that leadership role, but to include people from other countries in the exercise because, as with, say, the propagation of the U.S. regulatory system to other countries, there will be an incentive for people elsewhere to understand and contribute to the way things are done if, if they're likely to be done elsewhere.

CHAIRMAN JACKSON: So you're essentially saying there could and should be a U.S.-led --

DR. GOLAY: Yes.

CHAIRMAN JACKSON: -- in this regard.

Let me ask you about a specific aspect of this, and it's really based on a comment that's in one of your

earlier reports having to do with IPEs. And you talked about the need for hastening the reviews of IPEs and that they could reveal there are vulnerabilities and inconsistencies and so on, and these inconsistencies that might, among IPEs done for similar plants, might help to refine the PRA tools.

And I note that the staff response was that there was no intention to do a comprehensive review of all IPEs, and that makes sense. Nonetheless, licensees have expended and hired contractors and put in a great deal of effort in this regard.

Do you think that there should be a plan on the part of the NRC, spearheaded from research, that should really be focussed on doing a really comprehensive and robust review, in a QA sense, anyway, of a subset of IPEs that are done in more depth than currently, that might begin to reveal certain vulnerabilities or differences in how modeling is done that might get at some of what Commissioner Rogers is talking about?

DR. GOLAY: I think that one obvious pay-off could be in using them as a source of insight regarding what would be the good way to set up standardized approaches, because you have a good set of examples of alternatives, and that's the best place to begin.

In terms of doing it in a formal way with QA and

so on, I tend to recoil because I think the formality is not really the issue here, but simply trying to understand what the analyses tell us.

CHAIRMAN JACKSON: Well, what I meant when I said QA, I meant taking a targeted subset to look at in greater detail, to try to understand what the input to those IPEs really is and how the modeling is done based on that input.

DR. GOLAY: My experience has been you either dig into them to that level or you don't bother because if you don't do it, you're really not going to learn enough to be sure that you understand what's in the document. So the real question is only the size of the sample.

CHAIRMAN JACKSON: That's right.

DR. GOLAY: Conceivably, a subset would be adequate. I think one has to try it and then see whether you feel that you're getting sufficiently defensible generalizations arising from that examination. Until you've tried a subset, I don't think you know whether you need to go to the entire set.

However, I think there's another argument for looking at the entire set, which is from the point of view of the licensee, if the behavior of the agency carries the implicit message that perhaps your contributions need not be of the highest quality because some of them may not even be examined, this may contribute to undermining the seriousness

with which they take that portion of their response to your requirements.

CHAIRMAN JACKSON: Okay. I think what we're talking about are two important issues. One has to do with given a look at whatever set of IPEs one wants to focus on, whether the issue is how are they examined and to what depth and what is one looking for, what can one expect to learn from them that has generic implications or broader based implications.

The second is the one that you just mentioned, which has to do with the fact that perhaps even looking at a subset, to whatever depth, is not enough, that one has to look at them all.

DR. GOLAY: Well, I'm saying I don't feel I know the answer to that latter question because until you've looked at a subset, you don't know whether you need to go further.

CHAIRMAN JACKSON: Right, and that's what I'm asking you. I'm saying is there some difference in how the IPEs that have been reviewed to date need to be reviewed? Because they do represent a subset, because it's an important issue in terms of focus of resources.

I mean, either we aren't looking at them in enough depth or we are, and either we look at a subset or we look at more. And since you're the advisory group to research,

I'm somewhat trying to pin you down on this.

DR. GOLAY: Oh, but I will wiggle out.

[Laughter.]

DR. GOLAY: The answer is that we haven't done the work with your staff on that question for us to be able to answer it. It's something which we could undertake in the immediate future because I understand it's very important, particularly in this last meeting was the first time we were told that all of the IPEs would not receive the same treatment. Before that, we simply assumed that they all would.

DR. BOULETTE: We have discussed, though, the importance to look at integrating the look at the IPEs and looking for inconsistencies from one to the other, and that's been expressed quite strongly, I think. So I believe I speak for the committee in saying that more work needs to be done in that area.

COMMISSIONER ROGERS: I think the Commission always understood that the staff would not look at every IPE in detail and that they'd look at some, but how they'd pick those some was never really defined in any systematic way. I mean, that would evolve during the course of their work.

So I think we always understood that the IPEs, in fact, didn't require a PRA. It's not a requirement. I think just about everybody has done it because it seems to

make good sense, but it was not an absolute requirement that an IPE had to involve a PRA. It had to involve an examination, but not necessarily risk analysis.

So at the time that we endorsed the requirement of an IPE, it was really quite an open question as to how many people would even do PRAs, and certainly we didn't know -- I think the staff essentially told us, at the time, that if everybody does a PRA, we will not have the resources to examine in depth every single PRA.

DR. GOLAY: You know, there are two points I'd like to make. I'm sensing my time is running out.

COMMISSIONER ROGERS: We're using it up on you.

DR. GOLAY: Well, no. And that is that one of the implications, though, of the IPE process is whether the utility use of PRA ends at that point or whether this is simply a step along the road of it becoming a living tool within their organization. You can find examples of licensees that approach it over that entire spectrum.

In the examples where they have taken it in as a living tool, I think you can cite a lot of performance benefits that they've obtained from it. And so implicit in this question of how deeply you go into the IPEs is also the question of what do you do to encourage licensees beyond that?

CHAIRMAN JACKSON: I think there's another way to

put it, also -- I mean, another factor. That is if it's a living tool for the licensees and it has benefit, then that's something we should encourage. But if there are actually regulatory decisions that are taken based on that, and the associated PRAs, then that puts it at a different level.

DR. GOLAY: Sure. That's right.

The second point I want to make relates to both subcommittees that have had presentations before you, and that is in both the human factors, advice I&C and PRA areas, these are places where the quality of the research program really depends on the degree to which the NRC wants to lead, to become active, as opposed to simply reacting to problems which are served up.

Others on the research agenda demand simply a reactive mode for sufficient performance, but I would say that in both committees, and I serve on both, there is some consensus that the NRC mission would be favored if an active posture were taken.

CHAIRMAN JACKSON: Okay. I think we can go on to waste disposal.

DR. MOLZ: My name is Fred Molz and it'll be my pleasure to deliver the report for the Waste Subcommittee. The members present are Robert Hatcher and Herb Isbin has dropped off the committee but has been a very active member

in the past. Ed Kintner is one of the members of our subcommittee, and Richard Vogel is the other member.

We seem to be at a time of change at the NRC, and that's probably even more true, from what I've heard today, regarding the nuclear waste program, in particular, the high level waste. So I thought, or the committee thought that it would be most effective if we were somewhat more philosophical in our discussion, as compared to some of the other subcommittees.

So what I'm going to talk about is really based mostly on meetings that the subcommittee held during the last year and a half to two years. Specifically, in '93 we had an in-depth review of the research program at the center in San Antonio. And then, in January of '95, we had a two-day field trip because we felt we wanted to get more familiar with the actual locations where the proposed repository would be and also where the research was being carried out. So we visited Yuca Mountain and the Apache Leap site in Arizona.

And then finally, this past May, we had another meeting, in Las Vegas, where we looked at some of the relationships between the on-going research program and what have been identified as key technical uncertainties with regard to high level waste disposal in particular.

So the committee has been around since the center

was established or shortly after that, and so we watched the development of the center. And in our previous reports we were very positive on the contributions that they were making to the basic problems that we need to understand to evaluate a high level waste disposal site.

We felt they were a valuable asset to the NRC and there probably are three main reasons for that. They were somewhat protected, so they focussed more on actual research problems and actually performed the research. They were independent of the problems that you face all the time in Washington. And I would say we could detect that in the way differences of opinion were aired at our meetings, between the various members of the research teams. And we felt that they provided an unbiased view on a lot of things.

If the committee had any major influence or any influence, it was probably in urging that the high level waste program become more field-oriented and move towards examining the processes in the actual geological settings that were thought to be important at Yuca Mountain.

And, to a large extent, this was done. And in particular, Apache Leap, we felt, was an excellent analogue for Yuca Mountain, and the University of Arizona was doing a very good job of studying fractured rock hydrology and identifying the intermittent processes that play an important role in fractured rock hydrology in arid climates.

And by that, I mean climatic events that might occur only once every 10 years or every 20 years can be the very important events in determining the way the system responds hydrologically. And so it takes a long-term program to identify those kinds of things and become aware of them.

And so in high level waste in particular, we think it's important to have continuity in a program. Even if Yuca Mountain ultimately is not judged to be the best site for a repository, and we're by no means saying that that is the case, we still need, as a nation, a long-term research effort in the high level area.

We don't think that the problem of high level waste is going to go away. We have all the waste from the utilities. Interim storage, by its very nature, is a transient solution, not a permanent solution.

We have a lot of enriched uranium fuel and plutonium becoming available from dismantling some of the bombs, both here and in Russia and surrounding states. And it's probably good to use that, rather than let it sit around. So that's a potential source of waste in the future.

So what we think should happen is that since we have the expertise and the capability, at the center in San Antonio, to study a generic high level waste type disposal

problem, that it ought to be continued in some way, so that we get the benefit of the work that went into establishing that group of people.

And probably, as I mentioned, the program might evolve towards a more generic mode, but in general, I think that cutting research activities and discretionary activities can be the easy way but sometimes short-sighted way of absorbing budget cuts.

So we would like to see or we would recommend that some very serious attention be given to maintaining the capability in some way that's been established at the center.

CHAIRMAN JACKSON: Well, I have two questions I was going to ask you, and I'm going to tell you what they were. Then I'm going to put them together into one question for you.

DR. MOLZ: Okay.

CHAIRMAN JACKSON: The questions were are there other areas or types of research in this area that should be pursued that are not currently being worked on or being pursued? And what impact would you see for research in this area if DOE is forced to slow the pace of their high level waste disposal program?

I could tell you the two answers that I got to those questions at a certain level from what you call

philosophical but it was an informative set of comments, and that is that you say that there should be more of a field orientation in the research that's done, and you spoke about Apache Leap in Arizona.

And then, in terms of if the DOE is forced to slow its program, you make the point that nonetheless, or whatever happens, whether it's a decision that Yuca Mountain is not it or something else happens, that continuity is important because the end game still is a repository.

So having claimed that those were the answers that I got to my questions out of what you said, I guess I would ask you, based on what you saw in your visit, is the skills mix such that a response to change in the repository approach, whether it's location or focus, is something that could occur on a time frame that would be useful to us from a regulatory point of view?

DR. MOLZ: Well, I would say that as far as the kinds of skills that are there, the answer to that question would be definitely yes. They seem to be a group that is not unduly influenced by politics, but they have a spectrum of abilities that cuts across the entire high level waste disposal problem area.

And it seems like, as a nation, we need some kind of an approach to high level waste disposal where we really make an unbiased evaluation of what we ought to do with our

high level waste and where it ought to go.

And I could see a smaller, low key program where this question is looked at over a period of years that could be tremendously beneficial in the long run because in Yuca Mountain, we didn't do that. It was mainly that we have three places where we can go and we chose this one. Most geologists will tell you that they could identify, off the top of their head, five or more better site than Yuca Mountain in the sense of being simpler, geologically simpler to analyze.

And so I guess that's what I mean by a generic research program. We ought to have some defensible viewpoints that are based not on any politics, but on just the basic science that would provide the information about possible locations for sites.

And as far as the impact of a DOE slowdown, well, it definitely would have an effect on their program because what they're doing now is largely oriented towards Yuca Mountain, both the work being done directly by the center, in that several of their projects are aimed at understanding the tectonics of the Yuca Mountain vicinity, making measurements of crustal movement from satellite data, things like that, developing the entire context, the geological context within which the repository sits, and the studies being performed by the University of Arizona and also the

analogue studies that are being done, meaning the studies of ancient deposits of radioactive material and how the material moved and spread around -- that has all been chosen, based on the characteristics of Yuca Mountain.

So that would certainly logically change. But they're a real capable group of scientists, and if there's a way to keep them together, even if they were moved into a different division of the government, I think it would be worth doing because we're going to need that expertise some time in the future and possibly the very near future.

And, of course, we may not lose it at all. It all depends on the outcome of a lot of things that are unknown at the present time.

CHAIRMAN JACKSON: I'll be visiting the center and Yuca Mountain next week. Commissioner Rogers?

COMMISSIONER ROGERS: Just on that, I think one has to keep in mind the reason that we created that center was to give us an independent, and that means independent of any interests of DOE, collection of experts that we could call on for regulatory purposes that would be untainted by any interest in DOE's problems, as such, only the scientific aspects of it, of course.

And, of course, moving this to someplace else might be the only way the group might be kept together. I hope it's not, but that might result in the loss of its

purity in a certain sense for regulatory purposes, and I think we have to keep that in mind, too.

That was the reason we created it, and we had great difficulty in finding people with adequate expertise that had not been involved with DOE programs. That was a very difficult task to bring about.

Do you think that there are any areas, with respect to low level waste, that merit a continuing research interest of NRC?

DR. MOLZ: Well, the problem of the movement of radionucleides in natural systems exists in low level, as well as high level wastes. And in many ways, they're the same type of problem except that the environment where we have low level waste is more variable and there's more than one location being considered.

I think all these things have to be watched, although one of my pet theories is that there's going to be somewhat of a discontinuous change and concern when we finally get cancer under control because I think a lot of fear stems from that, and I believe that all the indications are that we're on the verge of understanding that disease.

COMMISSIONER ROGERS: Well, I think I'm going to dodge the implications of that one with respect to our research programs.

DR. MOLZ: Yes, but it's going to come along.

COMMISSIONER ROGERS: Let me just turn to a couple of the points that were touched on. If I could come back to the thermal-hydraulic code subject, Mr. Kintner, you indicated that codes are very important tools for use by the utilities themselves, these codes.

I wonder if you could just give me a little bit more on that because our view, at least my personal view, has been, of the code development here at NRC, that it was really applicable to the review of reactor designs. And that was principally why we were carrying on its development and the use for the new reactor designs.

With the completion of reviews of those designs, the whole question of what do we do with TH codes, or about TH codes, is a big one for us. It could be a big expense to continue development of codes. Even the maintenance of these codes is an expensive proposition.

And I wondered if you could comment on how relevant the existing codes are for their use in the plants, the existing plants, because we know there's an on-going activity that we must be looking at as carefully as we can.

MR. KINTNER: Well, I think it's certainly true that the major use is looking at advanced designs and looking, by the regulatory activity, at what happens to advanced designs when you get proposals, for example, to increase power levels or change temperatures. That's, by

far, the major one.

But the utilities do use them also in terms of core management, for their own safety considerations, and so forth, and they're there and available and really important tools in doing that.

Tom, you may be much more able to talk to the specifics.

DR. GOLAY: I don't know if I can add much to what Ed just said. The industry does use them quite extensively, in particular, whenever they look at design changes or safety evaluations for changes in the vessel in the primary system.

COMMISSIONER ROGERS: Well, I guess what my question has to do with is to what extent do we need to continue a research effort in this direction, for those purposes, for use by the utilities?

MR. KINTNER: For use by the utilities?

COMMISSIONER ROGERS: Yes.

MR. KINTNER: I guess the answer is in my view, and you can say it another way, is not very much, if that's the objective. You've got purposes of your own which you need to satisfy, and the industry just uses what's available from that activity on your part.

Isn't that enough, Tom?

DR. BOULETTE: I think so.

CHAIRMAN JACKSON: As the work on the advanced reactor designs winds down to some level, is there a need to mount an effort to write new codes?

MR. KINTNER: Well, you've touched on a sore subject because --

CHAIRMAN JACKSON: I always do.

MR. KINTNER: -- because that's been a subject of considerable debate in the committee. And there is a sense, I think, if I try to put the consensus together, that the total activity associated with code maintenance has now reached a point where it should diminish, but that you cannot stop it altogether for two reasons.

One, there will be subjects come up that require your use, as well as the industry's use of codes; and second, additional data and refinement takes place all the time, so that these codes are brought more closely into reality. And that aspect of it should not stop.

But I think we all agree, after a lot of conversation, that some diminution of effort in thermal-hydraulic codes is due.

CHAIRMAN JACKSON: Is it an effort that should migrate more in-house?

MR. KINTNER: And now I'm being facetious; do you have people smart enough to do it? They've told us they weren't. On several occasions, we've asked them why they

don't do it and they keep saying, oh, they've really got to have the experts in the laboratories.

Mike, you could talk to this from personal experience.

DR. GOLAY: Yes, I was thinking about it as this was going on. My sense is that you need a keeper somewhere because, as Ed said, new things come up. It's not just someone to turn the crank, but new questions will arise. It's really a question of the level. You could easily, I would imagine, concentrate this at one lab, for example.

There are plenty of questions that one can work on that would maintain their skill so that when the time came, they were needed on some new things. As an example, in the severe accident area, there remain a host of thermal-hydraulic questions that one could investigate and maintain the capabilities that the NRC would wish to have in reserve, with five seconds to reflect on it.

DR. BOULETTE: Also whether the keepers should be within the NRC. My self would be no, I wouldn't think that would be an efficient way to do that. I think it takes a very high level of expertise and a cadre of supporting individuals that probably can only be found either at universities or laboratories.

DR. GOLAY: And universities are the wrong place for that, is my feeling. Universities are not good code

supporters. That's not what they're set up for. The labs are in a much better position to do that.

COMMISSIONER ROGERS: Now, one area that you didn't touch on in your report was the materials area, although in some of the documents that were prepared earlier, particularly in February, you did touch on some materials questions and aging, corrosion, cables, things of this sort.

I wonder if you could give us any of your thoughts with respect to what you think should be a focus of NRC's materials research, particularly for aging purposes.

MR. KINTNER: Sol, do you want to talk to that?

DR. BURSTEIN: No, you go ahead.

[Laughter.]

MR. KINTNER: Well, I mentioned it in the opening remarks to some degree.

COMMISSIONER ROGERS: Yes.

MR. KINTNER: Clearly, the absolute assurance that reactor pressure vessels are not going to fail is important. And we've heard from several different presentations that that research has not been completed. I think that's one form of aging, neutron embrittlement of the vessels, which you have to stay ahead of one way or another, and it overwhelms all others in one sense.

Another one is if you're looking to the really

long term, the licensee extension and so forth, is to somehow assure yourself that the cables, all instrumentation and control cables are going to perform their function. This is a hard thing to define because you can irradiate them to a certain degree, you can age them at certain temperatures for some years, and they're no longer what they were when they were put in place.

So there has to be some judgment made as to whether they're going to perform their function in the sense that you mean from a regulatory point of view. The most important example is if you're going to extend the licenses for 10 or 20 years. That research, to the best of our ability to understand, is not completed by any means yet.

Then there are, in fact, some questions which surprise me, that they are there but nevertheless are being talked about, which is the thermal aging over a period of time of stainless steels, the reactor vessel components and primary coolant systems, and I think that in that order, those are the important questions still involved in aging research.

And I ask again whether there are any other members of the committee that would like to add to that.

DR. BOULETTE: I think if you think about the recent performance at Maine Yankee in the steam generator, it's clear that there's a lot more to be done in that whole

area, and it's very significant work that has to be done. The price tags are very big. They threaten the industry in many respects.

COMMISSIONER ROGERS: Well, there, I've been uncomfortable with the state of detectors. The analytical tools that are being used there, it seems to me, could probably be improved upon considerably. The surprises that came at Maine Yankee should not have come about, it seems to me. It was only when they put in a little more sensitive or appropriately designed eddy current probe that they found the circumferential cracks, but they were really pushing that technology pretty hard, to see those things anyhow.

And I've been concerned that I don't see any efforts out there, other alternative methods of detecting incipient cracks, and I don't know where the incentive comes from to do that. To me it's strange that with the potential problems that can arise from steam generator tube failures or other piping failures, that there isn't more of an industry-supported effort to provide new tools for nondestructive examination.

CHAIRMAN JACKSON: It looks like that discussion brought another member to the table.

DR. BURSTEIN: If you'll forgive me, Madam Chairman and Commissioner Rogers, you've touched on --

CHAIRMAN JACKSON: Welcome.

DR. BURSTEIN: My name is Sol Burstein and I'm one of these shy, retiring guys.

MR. KINTNER: He's retiring, too. This is his last meeting.

DR. BURSTEIN: The subject of new technology, new method of giving us tools that we never had before, was discussed at some length by this committee and we should not pass it lightly, given the opportunity that you've provided, because it requires research, or at least someone within this agency to be alert to how do we respond to these developing technologies that come to us from external directions and from all directions?

For example, we've discussed with you this afternoon the digital instrument and control revolution that has occurred in our recent past. There's more of this coming, as you heard. That's entirely foreign to developments that originated within this industry or within this regulatory commission. It came to us from many other fields.

The area of materials, it seems to us, but particularly the areas of detection, nondestructive testing, nondestructive examination, are going to provide us with new tools to which we must be alert so that we can apply them to either improve our margins of safety or allow us more economical and certainly better designs and operating

characteristics.

I think the need to maintain the capability to do that is a pressing one that faces us and I think this committee would recommend your attention to assuring that that is preserved.

CHAIRMAN JACKSON: I appreciate that. I would not like to close off discussion. In fact, perhaps even with your retiring, we should put this on the agenda for a future meeting soon, even if it means inviting you back as a guest.

We've covered quite a bit of ground today and I want to thank you very much, every member here, for a very, very informative meeting. As you know, Commissioner Rogers and I like to ask lots of questions because we like to get to the heart of the matter.

And I would like to recognize those of you who I did not realize were retiring from the committee and to thank you, in addition, for your service. I look forward to working with those of you continuing, and the Commission appreciates your independent review of the research program.

It's going to be very important to us, as we go ahead, to try to make the right choices, and we look forward to receiving your next set of letters.

And my only final comment is I would really like to perhaps close the time gap between when we get your letters and when we can talk to you about them verbally.

Thank you very much.

[Whereupon, at 3:35 p.m., the meeting was adjourned.]

CERTIFICATE

This is to certify that the attached description of a meeting of the U.S. Nuclear Regulatory Commission entitled:

TITLE OF MEETING: MEETING WITH THE NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE - PUBLIC MEETING

PLACE OF MEETING: Rockville, Maryland

DATE OF MEETING: Thursday, July 27, 1995

was held as herein appears, is a true and accurate record of the meeting, and that this is the original transcript thereof taken stenographically by me, thereafter reduced to typewriting by me or under the direction of the court reporting company

Transcriber: Susan Harris

Reporter: Susan Harris

U.S. NUCLEAR REGULATORY COMMISSION NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE ON INSTRUMENTATION AND CONTROL AND HUMAN FACTORS

Robert Uhrig, Chairman
Anthony Baratta
Michael Golay
Charles Mayo

July 27, 1995

BACKGROUND

1988 - NRC SPONSORED ORNL SURVEY

- Utilities Interested in Advanced I&C
- Not Willing To Act Without NRC Criteria/ Requirements

TIME CAUGHT UP WITH UTILITIES

- Replacement Parts Not Available
- LERs Showed More Trips Caused By I&C Failures Than Any Other Cause

DIGITAL SYSTEMS INSTALLED

- Foxboro System At Conn Yankee
- W System 21 At Sequoyah
- GE NUMEC Line Of Digital Instruments
- Digital Feedwater Control System At Monticello
- Digital ATWS System - Diablo Canyon Etc.
- Some Installed Under 10 CFR 50.59 Approved By NRC

NRC PROPOSE A RULE THAT ALL DIGITAL SYSTEMS CONSTITUTED AN UNREVIEWED SAFETY ISSUE

- NRC Pre-Approval Required
- Diversity In Software Needed To Protect Against Common Mode Failure

ACRS BECAME INTERESTED IN ISSUES

- Recommended NAS/NRC Study
- NSRRC Concurred

NAS/NRC STUDY OF DIGITAL I&C SYSTEM

- Delayed In Getting Started
- Phase 1 Report Delayed
  - Delayed Until September 1995
  - NAS Reviewers Not Satisfied

SUBCOMMITTEE CONCERNS

- NRC May Be Expecting Too Much
- Important RES Decisions May Be Delayed
  - Initiating Needed Research
  - Acquiring More In-House Effort

MANY I&C AND HF ACTIVITIES VIEWED FAVORABLY BY NSRRC

- NRC-Wide Human Factors Coordination Committee
  - NRR, AEOD, RES, NMSS
- Allocation Of Program Funds
  - 2/3 Instrumentation and Control
  - 1/3 Human Factors
- Completion of Rev. 1 Of NUREG-0700
  - Covers Transition to Digital I&C
- RES Liaison With Foreign Regulatory Agencies
  - Canada, France, Japan, Germany
- RES Liaison On Human Safety Interfaces
  - Rail, Air & Ship Traffic Control Centers
  - All Have Modern Digital Systems

HALDEN MAN-MACHINE RESEARCH PROGRAM

- Benefit is 6 times Cost
- Strong NRC Participation
  - Many Projects Of Direct Benefit To NRC
  - Virtually Only Artificial Intelligence Program
- NSRRC/IC & HF Recommends Aggressive Participation
- Around ~1% of RES Budget

NSRRC/IC & HF SUBCOMMITTEE CONCERNS

- Budget Reductions - FY 1996
- Programs To Go Into "Maintenance Mode"
  - No Forced Reduction In Personnel
  - Contract Work To Be Brought In-House
  - Only Essential Contracts to be Retained
- Subcommittee Concerns
  - Availability Of Needed Expertise In Staff
  - Ability of Administrative Staff to Perform Research
- NSRRC Should Review Situation With RES Management

NRC CONTRACTING PROCEDURES TOO COMPLEX

- Consumes Too Much Staff Time In Administration
- Delays Projects
- May Not Be Able To Get Best Talent for Research
- Technical Personnel Become Frustrated
- Cost of Administering $50,000 Contract Almost The Same as $2,000,000 Contract
- Inspector General Report Was Critical
  - Demands Strict Accountability

FUNDAMENTAL PROBLEM:

- Initiating New Research Program
  - Must Have "Needs Letter" From Other NRC Office
  - Little Flexibility For RES To Initiate Research
- Subcommittee Recommendation
  - RES Should Work With Other NRC Offices To Identify Needs Earlier
  - Results More Likely To Be Available When Needed

LONG-TERM CONCERN OF SUBCOMMITTEE

- I&C and Human Factors Programs
  - Are Virtually Independent
- Results of Both Programs May Be Flawed
  - Interactions Necessitate Integration
- Allocation Of Function Between Humans and Machines Is Critical Issue
- Automation Should Not Be Current Goal
- Modern Data Processing Must Provide Operators With Information Needed For Safe Operation

VALIDATION AND VERIFICATION OF SOFTWARE

- Short-Term Programs
  - Adoption Of Current Methods
- Long-Term Program
  - Involves Rigorous "Formal" Methods
- NRC Requirements Being Prepared
  - Probably Not Available Until 1997
- Design Must Be Fault Tolerant
  - "Perfect" Software Is Impossible
  - Highly Tested Modules Improve Software

CRITICAL QUESTIONS

Is HyBrid Of Analog And Digital Components

- **Less Safe,**
- **As Safe As, Or**
- **More Safe Than Old Analog System?**
- **Is There A Basis For Insisting On Digital I&C?**

Will Digital I&C Systems Be Required For License Renewal?

FOUNDATION OF PERFORMANCE-BASED REGULATION

BASIS ELEMENT	AREAS OF BEST APPLICATION
Tests and inspections	Actual system or component reliability or capability
	Personnel capabilities
Deterministic analyses (sometimes with conservative bias)	Plant and system design
PRA (basis of risk-based regulation)	System reliability analysis System vulnerability analysis System improvement analysis
Subjective judgement	Very complex or poorly • Severe accidents • Personnel behavior

FACTORS OF PRA AND STATUS

FACTOR	STATUS
Standardized modeling treatments	Not in place but started
Data bases	Existing but needing substantial improvement
Status of Available Results	
• Core damage frequent	Most accurate
• Severe accidents and containment failure	Least accurate
• Offsite dose delivery	Adequate at order of magnitude level
Uncertainty	Understood
• Data variation	
• Complex or sensitive system behavior	
• Ignorance of phenomena (eg. external events, human error)	Needing improvements
Limitations upon safety improvements	Hard to improve
• Human error	
• External events (e.g., earthquakes)	
• Common cause failures (internal)	

NRC PERFORMANCE-BASED REGULATION AND PRA CAPABILITY NEEDS

NEED	STATUS
Assignment of the various decision bases to their appropriate portions of the safety problem	Beginning
Successful performance-based regulatory experiments	Underway
Sufficient PRA-trained staff	Underway
Standardized NRC staff decision rules and tools	Not started
Standardized PRA methods	Not started
Standardized PRA databases and methods for refinements	Beginning
Standardized methods for treating PRA uncertainties	Beginning

May 1, 1995

MEMORANDUM TO: The Chairman
Commissioner Rogers
Commissioner de Planque

FROM: James M. Taylor
Executive Director for Operations

SUBJECT: NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE MEETING OF FEBRUARY 6-7, 1995: THE COMMITTEE'S REPORTS AND STAFF RESPONSE

At its February 6-7, 1995 meeting, the NSRRC deliberated on the reports of its Accident Analysis Subcommittee, Materials and Engineering Subcommittee, Instrumentation and Control and Human Factors Subcommittee, and Subcommittee on Research Supporting Risk-Based Regulation ("PRA" Subcommittee). The Committee reported on these deliberations in a set of four separate reports, covering each of the four subcommittee areas. The four NSRRC reports are attached (Attachments 1 to 4), followed by the staff response, contained in two letters to the NSRRC Chairman (Attachments 5 and 6).

The Committee report on the Accident Analysis area covers an extensive update review of research programs addressing severe accidents, other accidents, thermal-hydraulics, and transients. The Committee notes for continuing attention the administrative burdens of project managers; research program criteria, processes and guidelines; long-range planning; and support and leadership of international programs. It recommends increase in the proportion of exploratory and readiness research. It counsels timely extension of direct containment heating results to all containment designs.

The Materials and Engineering report covers generic safety issues, seismic hazard methodology, seismic design of piping, containment issues, environmental qualification of cables, variations in reactor-vessel material properties and their bearing on embrittlement, and core shroud ring cracking in BWRs.

The Instrumentation and Control and Human Factors report expresses concern about recent research results that appear to suggest human error rates an order of magnitude greater than previously believed. It counsels a more rigorous, more quantitative approach to comparing the safety of hybrid analog-digital systems with the safety of the older analog systems that they would

CONTACT:
George Sege, RES
415-6593

replace. It questions whether foreign digital systems experience, where it is ahead of the U.S., has been adequately examined and factored into NRC research plans.

The PRA report offers recommendations regarding research in support of risk-based regulation, with recognition of theoretical and practical subtleties. It recommends expansion of NRC PRA capabilities, broadening and acceleration of IPE reviews, reexamination of human reliability programs, and development of improved communication with constituencies outside the NRC about PRA-based regulatory processes.

The staff responded to the Committee's comments regarding burdens on project managers in a letter dated April 3, 1995 (Attachment 5) and to the comments and recommendations regarding other issues in a letter dated April 27, 1995 (Attachment 6).

Attachments:
1. Letter, E. Kintner, NSRRC to E. Beckjord NRC, February 14, 1995 (Accident Analysis)
2. Letter, E. Kintner, NSRRC, to E. Beckjord, NRC March 1, 1995 (Materials and Engineering)
3. Letter, E. Kintner, NSRRC, to E. Beckjord, NRC February 13, 1995 (I&C and Human Factors)
4. Letter, E. Kintner, NSRRC, to E. Beckjord, NRC, March 14, 1995 (PRA)
5. Letter, E. Beckjord, NRC, to E. Kintner, NSRRC, April 3, 1995
6. Letter, E. Beckjord, NRC, to E. Kinter, NSRRC, April 27, 1995

cc: SECY
OGC
OCA
OPA

Distribution
See attached list

Offc:	RES	D:RES	EDO
Name:	GSege	DMorrison	JTaylor
Date:	4/28/95	4/ /95	5/ /95

OFFICIAL RECORD COPY RES-5C-5

February 14, 1995

Mr. Eric S. Beckjord, Director
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Beckjord:

The Nuclear Safety Research Review Committee (NSRRC) met on February 6, 1995 to consider the report of its Accident Analysis Subcommittee on the Subcommittee's meeting of November 9-10, 1994. The full Committee approved the Subcommittee's report with some modifications as indicated in bold type in the attached revised Subcommittee report. The Subcommittee report, as modified, is hereby forwarded to you with the concurrence of the NSRRC.

Sincerely,

Edwin Kintner

Edwin Kintner, Chairman
Nuclear Safety Research Review Committee

Attachment:
As stated

NSRRC REPORT

ACCIDENT ANALYSIS SUBCOMMITTEE

INTRODUCTION

THE ACCIDENT ANALYSIS SUBCOMMITTEE HELD ITS FIRST MEETING ON NOVEMBER 9 & 10, 1994. MEMBERS ARE H. ISBIN, CHAIRMAN, R. VOGEL, A. BARATTA AND C. MAYO. MOST OF THE ACTIVITIES OF THE PRIOR NSRRC SUBCOMMITTEES FOR SEVERE ACCIDENTS AND ADVANCED REACTORS HAVE BEEN COMBINED FOR THIS NEW SUBCOMMITTEE, AND THUS THE SUBCOMMITTEE FOLLOWED THROUGH ON TOPICS NOTED IN PAST NSRRC REPORTS. PREPARATIONS FOR THIS MEETING WERE CARRIED OUT WITH THE DIRECTOR OF SYSTEMS RESEARCH, OFFICE OF NUCLEAR REGULATORY RESEARCH, RESULTING IN THE RELEASE OF THE JULY 5, 1994, RESEARCH PLANS FOR THE NRC FOR THE FULL COMMITTEE. FOR THIS SUBCOMMITTEE MEETING, THE PERTINENT DOCUMENTS ARE

RESEARCH PLAN FOR STANDARD PLANT DESIGNS AND
OPERATING PLANT PERFORMANCE
RESEARCH PLAN FOR SEVERE ACCIDENT PHENOMENOLOGY,
CONTAINMENT PERFORMANCE & STRUCTURAL INTEGRITY

ALTHOUGH THESE DOCUMENTS ARE PRIMARILY BUDGET PLANS FOR THE NEXT THREE FISCAL YEARS, THE DOCUMENTATION INCLUDED PROVIDES THE NECESSARY BACKGROUND AND UPDATES FOR THE RESEARCH PROJECTS. WITH THIS APPROACH, RES WILL BE DOCUMENTING ANNUAL REVIEWS AND WILL BE PROVIDING THE NSRRC WITH CURRENT INFORMATION NEEDED FOR PLANNING ITS REVIEWS. THE PREPARATIONS FOR THIS SUBCOMMITTEE ALSO INCLUDED SEVERAL MEMOS PRESENTING THE NATURE OF THE REVIEW PLANNED ALONG WITH A NUMBER OF GENERAL COMMENTS AND QUESTIONS. THIS APPROACH WAS SUCCESSFUL IN SHAPING THE CONTENTS OF THE SUBCOMMITTEE'S AGENDA AND ASSISTED THE RES STAFF IN PREPARING AND FOCUSING ON THE TOPICS SELECTED BY THE SUBCOMMITTEE SINCE THE OVERALL ARRAY OF ADMINISTRATIVE AND TECHNICAL AREAS WAS VERY BROAD. THE RESPONSE BY THE RES STAFF WAS EXCELLENT IN THAT A WEALTH OF INFORMATION WAS PRESENTED IN ORAL AND WRITTEN HANDOUTS IN AN EFFICIENT AND EFFECTIVE MANNER. ALTHOUGH THE NEW ORGANIZATIONAL STRUCTURE FOR RES WAS NOT FULLY IMPLEMENTED, THE SUBCOMMITTEE MEMBERS WERE IMPRESSED WITH LEADERSHIP AND THE DIRECTIONS BEING TAKEN. THE AGENDA IS PRESENTED IN APPENDIX A, AND THIS SUBCOMMITTEE REPORT WILL HIGHLIGHT SOME GENERALIZATIONS AND SEVERAL SPECIFIC TOPICS. THROUGHOUT THE TECHNICAL DISCUSSIONS OF SPECIFIC RESEARCH PROJECTS, MENTION WAS MADE OF FORTHCOMING NUREG REPORTS.

TO ASSIST THE COMMITTEE MEMBERS IN KEEPING CURRENT ON RESEARCH ACTIVITIES, THE COMMITTEE REQUESTS THAT MEMBERS BE PROVIDED WITH A COPY OF THE QUARTERLY ABSTRACTS OF NRC PUBLICATIONS, THAT A REVIEW BE DONE BY RES OF PUBLICATIONS AND THOSE OF PARTICULAR INTEREST TO THE COMMITTEE BE FORWARDED TO MEMBERS, AND THAT COMMITTEE MEMBERS BE PROVIDED WITH ACCESS TO THE NUDOCS SYSTEM.

CRITERIA, PROCESSES AND GUIDELINES

IN REVIEWING RESEARCH EFFECTIVENESS AND EFFICIENCY, PAST NSRRC REPORTS COMMENTED ON THE PROCESSES USED BY RES IN THEIR DECISION MAKING AND THE NEED FOR IMPROVEMENTS. THUS CONSIDERABLE ATTENTION WAS GIVEN IN THIS SUBCOMMITTEE MEETING TO THE CRITERIA, PROCESSES AND GUIDELINES USED BY RES FOR IDENTIFYING, IMPLEMENTING, EVALUATING PROGRESS, AND TERMINATING PROJECTS. GUIDING DOCUMENTS WERE IDENTIFIED AS OFFICE LETTERS. THE SUBCOMMITTEE CONCLUDED THAT IN ITS AREA OF INTERESTS APPROPRIATE CRITERIA, PROCESSES AND GUIDELINES WERE IN OPERATION. THE SUBCOMMITTEE RECOMMENDS THAT FURTHER IMPROVEMENTS IN GUIDANCE FOR PEER REVIEWS IS NEEDED.

ADMINISTRATIVE BURDENS FOR PROJECT MANAGERS

THE SUBCOMMITTEE IS STILL CONCERNED WITH THE ADMINISTRATIVE BURDENS THAT THE PROJECT MANAGERS HAVE IN CONTRACTING RESEARCH AND IN FISCAL RESPONSIBILITIES, AND THE APPARENT DECREASE IN THE TECHNICAL ATTENTION NEEDED FOR EFFICIENT PROJECT MANAGEMENT. THE NEWLY IMPOSED DIRECTIVE 11.7, "NRC PROCEDURES FOR PLACEMENT AND MONITORING OF WORK WITH THE DEPARTMENT OF ENERGY", HAS LED TO AUGMENTED BURDENS. [THE BULK OF THE RESEARCH IS CONTRACTED THROUGH THE DOE NATIONAL LABORATORIES.] BUDGET APPROVAL REQUIREMENTS ARE SUCH THAT THE PAPER TRAIL MUST BE FULLY ESTABLISHED FOR THE VARIOUS STEPS. ADDITIONALLY, RES IS PERIODICALLY AUDITED BY THE OFFICE OF THE INSPECTOR GENERAL. [THE MARCH 8, 1993, OIG REPORT IS ENTITLED "PERFORMANCE CRITERIA AND BETTER MANAGEMENT OVERSIGHT NEEDED TO ENHANCE NRC'S RESEARCH PROGRAM CONTRIBUTIONS."]

THE COMMITTEE CONSIDERED THE SUBCOMMITTEE'S REQUEST THAT IT MEET WITH THE NRC EXECUTIVE DIRECTOR OF OPERATIONS TO DETERMINE HOW NRC ADMINISTRATIVE PROCEDURES CAN BE IMPROVED TO MEET LEGISLATIVE REQUIREMENTS WHILE MINIMIZING PAPERWORK AND LEADING TO MORE EFFECTIVE AND TIMELY OPERATIONS BY THE PROJECT MANAGERS. THE NSRRC REVISED AND BROADENED THIS SUBCOMMITTEE RECOMMENDATION TO REQUEST THAT THE DIRECTOR OF RES ARRANGE A MEETING WITH ONE OR MORE APPROPRIATE AND AUTHORITATIVE OFFICIALS IN THE NRC TO EXPRESS ITS NUMEROUS CONCERNS IN THE RESULTS OF ADMINISTRATIVE RESTRICTIONS WHICH THE COMMITTEE BELIEVES SIGNIFICANTLY REDUCES THE EFFECTIVENESS OF THE RESEARCH ACTIVITIES.

LONG RANGE PLANNING

RES INITIATED INTRODUCTORY DISCUSSIONS ON LONG RANGE PLANNING AND THE SUBCOMMITTEE STRONGLY ENCOURAGED THE RES STAFF TO CONTINUE IN ITS PURSUIT OF BROAD AND INNOVATIVE CONCEPTS, INCLUDING EXPLORATION OF ADVANCED METHODS FOR ANALYTICAL TOOLS, NEW STRUCTURES FOR CONTRACT RESEARCH RESULTING IN COST EFFECTIVE PROGRAMS, MAINTENANCE OF EXPERTISE AND APPROPRIATE FACILITIES, STAFF EXCHANGES OF VARIOUS TYPES, UNIVERSITY

INVOLVEMENTS INCLUDING STUDENT PARTICIPATION IN PROJECTS, AND USE OF MODEST RESOURCES TO STIMULATE PARTICIPATION FROM A VERY BROAD SPECTRUM OF OUR SCIENTIFIC COMMUNITY.

THE COMMITTEE NOTED THAT CURRENT FORECASTS AND FUTURE PROGRAMS AS PRESENTED TO THE COMMITTEE DO NOT ADEQUATELY ADDRESS LONG RANGE PLANNING. TO AID THE OFFICE OF RES IN IMPROVING ITS LONG RANGE PLAN, THE COMMITTEE ENCOURAGED THE DIRECTOR OF RES TO DEVELOP A STRATEGIC WORKING GROUP WITHIN RES, NRR, AND THE OTHER NRC OFFICES WHICH COULD DEFINE THROUGH VARIOUS MEANS A LONG-RANGE VISION FOR NRC RESEARCH. THIS PROCESS MIGHT ALSO INCLUDE WORKSHOPS AMONG INDUSTRY, EPRI, UNIVERSITIES AND LABORATORIES TO CONSIDER EXPLORATORY AND RESEARCH SUBJECTS WHICH MAY BECOME IMPORTANT FIVE TO TEN YEARS HENCE.

INTERNATIONAL RESEARCH PROGRAMS

THE SUBCOMMITTEE RECEIVED COPIES OF THE PRESENTATION MADE BY THE EDO AT THE WATER REACTOR SAFETY MEETING HIGHLIGHTING THE INVOLVEMENTS WITH INTERNATIONAL PROGRAMS. THE SUBCOMMITTEE REPORTED THAT THE NSRRC CONTINUES TO STRONGLY ENDORSE THESE ACTIVITIES, AND EMPHASIZES THE NEED FOR APPROPRIATE INTERNATIONAL TRAVEL TO MONITOR THE ALWR RESEARCH ACTIVITIES, OECD/CSNI/NEA ACTIVITIES, JOINT SPONSORSHIP OF SPECIAL FOREIGN FACILITIES AND ANALYTICAL PROGRAMS, AND THE FOREIGN TECHNICAL CONFERENCES. IN MANY CASES, RES HAS BEEN ABLE TO LEVERAGE ITS FINANCIAL INPUT. KEY FEATURES IN MAINTAINING WORLD CLASS EXPERTISE AND SUPPORT INCLUDE LEADERSHIP ROLES IN ORGANIZING COOPERATIVE RESEARCH PROGRAMS, AS WELL AS THE SPONSORSHIP OF THE CSARP MEETINGS, THE WRSM, CAMP, AND THE PUBLICATION OF NUCLEAR SAFETY.

THE COMMITTEE ENDORSES THE SUBCOMMITTEE'S REPORT ON THESE ACTIVITIES AND THE STRENGTHENING OF THE LEADERSHIP ROLES.

IMPROVED COMMUNICATIONS

PAST NSRRC REPORTS HAVE COMMENTED ON THE NEED FOR IMPROVED COMMUNICATIONS AMONG THE PARTICIPANTS IN THE ALWR RESEARCH PROGRAMS. THE SUBCOMMITTEE WAS SATISFIED WITH THE PROGRESS BEING MADE BY RES WITH ITS CONTRACTORS, INCLUDING THE INCREASED ATTENTION BEING GIVEN IN THE THERMAL HYDRAULICS AREA ON THESE MATTERS. THE COMMUNICATIONS WITH RES AND NRR APPEAR TO BE FUNCTIONING WELL, THOUGH DELAYS IN OBTAINING VENDOR TEST INFORMATION AND RESULTS HAVE OCCURRED. IN THE AREA OF SEVERE ACCIDENTS, IMPROVED COMMUNICATIONS WITH DOE WERE REPORTED AND SEVERAL EXAMPLES WILL BE NOTED IN THIS REPORT.

CODE SCALABILITY, APPLICABILITY AND UNCERTAINTY

CONSIDERABLE PROGRESS WAS REPORTED ON CODE SCALABILITY, APPLICABILITY, AND UNCERTAINTY [CSAU]. AS A RESULT OF EXTENSIVE WORK INCLUDING

ANALYTICAL AND TEST RESULTS INVOLVING ROSA AND SPES, RES REPORTED THAT THE RANGE OF ACCIDENT SCENARIOS WOULD BE ADEQUATELY ASSESSED BY ONLY ONE MODIFIED CSAU CASE FOR THE AP600 [THE WORST SBLOCA]. ONLY ONE SIMILAR CASE WOULD BE EXPECTED FOR THE SBWR. SINCE CORE UNCOVERY IS NOT ANTICIPATED FOR THE ACCIDENT ANALYSIS PROPOSED, THE CODE ASSESSMENTS WILL BE MADE USING APPROPRIATE EVALUATION CRITERIA IN ADDITION TO JUST WATER LEVEL. RES ALSO REPORTED THAT THE CSAU CASE WOULD ALSO APPLY TO PROPOSED BEYOND ACCIDENT BASIS EXPERIMENTS. IN GENERAL, RES BELIEVES THAT THE APPROPRIATE SCALING AND INSTRUMENTATION REQUIREMENTS HAVE BEEN MET BY THE TEST FACILITIES IN PLACE IN SUPPORT OF THE ALWR'S.

ALWR THERMAL-HYDRAULIC RESEARCH INTEGRATION

BECAUSE OF DELAYS IN RECEIVING TEST REPORTS FROM THE OPERATION OF THE VARIOUS TEST FACILITIES, THE ACCUMULATION OF DATA AS WELL AS SOME UNIQUE TECHNICAL ISSUES POSED UNUSUAL CHALLENGES TO THE RES STAFF. AS A CONSEQUENCE, RES INITIATED A NOVEL APPROACH IN ITS ATTEMPT TO OBTAIN COST EFFECTIVE METHODS FOR THE DATA EVALUATION, INTERPRETATION AND CODE ASSESSMENT. A LARGE POOL OF TECHNICAL CONSULTANTS HAS BEEN ASSEMBLED INTO WHAT IS CALLED ATRIG, ALWR THERMAL-HYDRAULIC RESEARCH INTEGRATION GROUP. THE MANAGEMENT PORTION OF ATRIG CONSISTS OF THE NRC COORDINATOR, TECHNICAL ASSISTANT (FROM INEL), AS WELL AS AN NRR CONTACT AND AN INEL COORDINATOR. UNIVERSITY PARTICIPANTS INCLUDE FACULTY FROM MIT, ILLINOIS, WISCONSIN, TEXAS A & M, DARTMOUTH, PURDUE, OREGON STATE, UCSB, RPI, AND PENN STATE. ONE INDEPENDENT CONSULTANT IS ALSO INCLUDED. INEL AND LANL REPRESENTATIVES ARE INCLUDED ALONG WITH ADDITIONAL RES AND NRR STAFF. ONE RES REPRESENTATIVE IS ON LEAVE FROM THE UNIVERSITY OF MARYLAND. ATRIG WILL ALSO USE RES PROJECT MANAGERS AND NATIONAL LABORATORY INVESTIGATORS AS NEEDED. IN THE DISCUSSIONS OF THE STRENGTHS AND POSSIBLE WEAKNESSES OF THIS APPROACH, THE SUBCOMMITTEE CONCLUDED THAT THE APPROACH IS WORKABLE.

THE COMMITTEE NOTES THAT APPROPRIATE MANAGEMENT ATTENTION IS REQUIRED, HOWEVER, TO ENSURE THE TIMELINESS AND EFFECTIVENESS OF THIS EFFORT IN VIEW OF THE VARIETY AND NUMBERS OF THE PARTICIPANTS. THE COMMITTEE ALSO SUGGESTS THAT SUCH INVOLVEMENTS WITH UNIVERSITY FACULTIES MIGHT ENLARGE THE CONTACTS WITH STUDENTS LEADING THEM TO CONSIDER CAREERS WITH THE NRC.

NRC ALWR CODES

THE SUBCOMMITTEE RECEIVED UPDATES ON THE PROGRESS OF THE IMPROVEMENTS IN MODELING FOR THE NRC ALWR CODES. RELAP5 IS USED FOR BOTH THE AP600 AND SBWR. TRAC/PF1/MOD 2 WILL BE AVAILABLE FOR THE LBLOCA FOR THE AP600. SBWR STABILITY WILL BE EVALUATED USING RAMONA, FOR WHICH A MUCH REDUCED ASSESSMENT PLAN WILL BE USED. RES HAS TAKEN MEASURES TO ASSURE THE "ROBUSTNESS" OF THE ALWR T/H CODE DEVELOPMENTS SO THAT CONTINUED USE OF THE CODES FOR OPERATING REACTORS WILL BE MAINTAINED. THE SUBCOMMITTEE WILL CONTINUE TO FOLLOW THE CODE DEVELOPMENTS AND

ASSESSMENTS.

COUPLING OF RELAP5 WITH CONTAIN

THE INITIAL PLANS TO COUPLE RELAP5 WITH CONTAIN HAVE MET WITH SOME DIFFICULTIES, AND THE PROGRAM AT BNL HAS BEEN TERMINATED. INTERIM PROCEDURES ARE AVAILABLE FOR DETERMINING THE SENSITIVITY OF BACK PRESSURE ON THE RELAP CALCULATIONS. RES BELIEVES THAT A UNIVERSITY CONTRACTOR MAY BE ABLE TO PROVIDE THE COUPLING DESIRED.

TEST FACILITIES FOR INDEPENDENT NRC RESEARCH

THE NSRRC HAS TAKEN A POSITION THAT IT SHOULD BE POSSIBLE TO USE FACILITIES OTHER THAN THOSE BUILT FOR THE NRC ONCE THE APPLICANT RELEASES THE FACILITY FOR THE INDEPENDENT NRC USE. RES HAS WORKED OUT AN ARRANGEMENT WITH DOE AND WESTINGHOUSE TO USE THE OSU FACILITY NOW THAT VENDOR TESTING HAS BEEN COMPLETED.

TRANSIENTS AND OTHER ACCIDENT ANALYSES

IN THE AREA OF TRANSIENTS AND OTHER ACCIDENT ANALYSES, THE SUBCOMMITTEE WAS UPDATED ON THE WORK THAT HAS BEEN DONE ON RISK ASSESSMENTS AT SHUTDOWN AND LOW POWER. RESULTS OF THE RESEARCH WILL BE USED IN PROPOSED RULES PLACING EMPHASIS ON PERFORMANCE AND RESTRICTIONS FOR TAKING EQUIPMENT OUT OF SERVICE. RES REPORTED THAT RECENT TESTS ON HIGH-BURNUP FUEL APPEARS TO INDICATE LOWER FAILURE THRESHOLDS ARISING FROM REACTIVITY INITIATED ACCIDENT TRANSIENTS. THE SUBCOMMITTEE CONCURRED WITH RES'S REACTIVITY INITIATED ACCIDENT PROGRAM PLANS, NOTING SEVERAL INTERNATIONAL INTERACTIONS. FUTURE SUBCOMMITTEE MEETINGS WILL FOLLOW THE PROGRESS BEING MADE ON THESE MATTERS AND MAY BE EXPANDED TO INCLUDE ISSUES INVOLVED WITH BORON DILUTION TRANSIENTS AND SBWR STABILITY WORK.

PROPORTION OF RESEARCH WHICH IS EXPLORATORY, PRAGMATIC OR READINESS

THE CONTRACT RESEARCH CARRIED OUT BY THE REACTOR AND PLANT SYSTEMS BRANCH [PRINCIPALLY THE THERMAL HYDRAULIC PROGRAM] IS BASED UPON USER NEEDS AND THUS IS TERMED CONFIRMATORY. THE PROGRAM INVOLVES 15 TECHNICAL STAFF AND ABOUT $12 MILLION FOR FY 95. THE ACCIDENT EVALUATION BRANCH INCLUDES ABOUT 5% OF THE RESEARCH AS RESEARCH INITIATED AND THE TOTAL CONTRACT PROGRAM INVOLVES 11 TECHNICAL STAFF AND ABOUT $11 MILLION FOR FY95. THE DIVISION OF SYSTEMS RESEARCH ALSO INCLUDES THE HUMAN FACTORS BRANCH AND THE TOTAL OF THESE FUNDINGS IS NOT INCLUDED IN THIS REPORT. OVERALL, ONLY ABOUT 10% OF THE SYSTEMS RESEARCH FUNDING WOULD BE TERMED EXPLORATORY, PRAGMATIC, OR READINESS.

THE NSRRC RECOMMENDS THAT THIS PROPORTION BE INCREASED.

SEVERE ACCIDENT RESEARCH PROGRAM

THE SUBCOMMITTEE REQUESTED AND RECEIVED AN INDEPTH ACCOUNTING OF THE RISK BASIS THAT HAD BEEN USED IN THE DEVELOPMENT OF THE SEVERE ACCIDENT RESEARCH PROGRAM [SARP] LEADING TO NUREG-1365, REV. 1 [1992]. APPENDIX B PRESENTS THE BUDGET ITEMS FOR THE ACCIDENT EVALUATION BRANCH. RISK PRIORITIES HAVE NOT BEEN ASSIGNED, AND THE CLASSIFICATION IS BY CATEGORIES DEFINED IN THE TABLE. THE NINE BUDGET CATEGORIES ARE ADVANCED REACTOR SUPPORT, DIRECT CONTAINMENT HEATING, HYDROGEN COMBUSTION RESEARCH, DEBRIS COOLABILITY, LATE PHASE CORE MELT PROGRESSION, LOWER HEAD INTEGRITY, FUEL COOLANT INTERACTIONS, SOURCE TERM, AND SEVERE ACCIDENT CODES [MELCOR, SCDAP/RELAP5, VICTORIA, AND IFCI]. THE JULY 5, 1994, "RESEARCH PLAN FOR NRC'S SEVERE ACCIDENT PHENOMENOLOGY, CONTAINMENT PERFORMANCE AND STRUCTURAL INTEGRITY", LISTS EIGHT ISSUES FOR SARP SINCE SARP DOES NOT INCLUDE THE CATEGORY OF ADVANCED REACTOR SUPPORT. ALSO LISTED IN THIS REPORT ARE TWO BUDGET CONTAINMENT INTEGRITY ITEMS, SPONSORED BY THE DIVISION OF ENGINEERING, OFFICE OF NUCLEAR REGULATORY RESEARCH. THE SUBCOMMITTEE ACCEPTED THE RATIONALE FOR THE CHANGES IN SARP.

COMMENTS ARE PROVIDED FOR THE FOLLOWING SARP ISSUES:

DIRECT CONTAINMENT HEATING

THE DIRECT CONTAINMENT HEATING [DCH] ISSUE HAS NOW BEEN RESOLVED FOR ZION AND THE REPORTS WERE MADE AVAILABLE TO THE COMMITTEE. SIMILAR REPORTS FOR RESOLVING THE SURRY CONTAINMENT ARE EXPECTED TO BE ISSUED SOON.

THE COMMITTEE AND RES RECOGNIZE THAT THERE HAVE BEEN DELAYS FOR THE DCH RESOLUTION. THE COMMITTEE RECOMMENDS THAT RES EXPEDITE THE PREPARATION OF A REPORT FOR DETERMINING THOSE ZION AND SURRY-LIKE CONTAINMENTS THAT MEET THE REQUIREMENTS OF DCH RESOLUTION. RES REPORTED THAT THEY HAVE THE METHODOLOGY IN PLACE TO RESOLVE DCH ISSUES WITH OTHER TYPES OF CONTAINMENT, INCLUDING THE ADDITIONAL RESEARCH NEEDED FOR COMBUSTION ENGINEERING CONTAINMENTS. THE COMMITTEE REQUESTS THAT IT BE KEPT INFORMED ON THE APPROACHES AND PROGRESS FOR REACHING DCH RESOLUTION ON ALL CONTAINMENTS.

CORE MELT PROGRESSION TESTS

IN THE PAST, THE NSRRC HAS COMMENTED ON THE CONTINUATION OF THE CORE MELT PROGRESSION TESTS. THE SUBCOMMITTEE QUESTIONED WHETHER THERE IS A NEED FOR IMPROVING THE UNDERSTANDING OF THE LATE PHASE MELT PHENOMENA SINCE RES HAS ALREADY DEMONSTRATED THAT THERE IS A METHODOLOGY FOR ENCOMPASSING CONSERVATIVELY THE DESCRIPTIONS OF THE INITIAL CONDITIONS FOR CORE MELTS CORRESPONDING TO POSTULATED SEVERE ACCIDENT SCENARIOS. PEER REVIEWS HAVE ACCEPTED THIS APPROACH AS DEMONSTRATED FOR RESOLUTION OF THE MARK I LINER ISSUE, AND THE DCH ISSUE.

RES REPORTED TO THE COMMITTEE THAT THE NUMBER OF PROPOSED

TESTS HAD BEEN REDUCED FROM FOUR TO ONE, THAT THEIR PARTICIPATION IN THIS INTERNATIONAL PROGRAM IS TO BE CONTINUED, AND THAT IF A CRITICAL HEATER TEST IS SUCCESSFUL THAT THE PROPOSED REMAINING TEST WOULD BE UNDERTAKEN.

LOWER HEAD INTEGRITY

RES PARTICIPATES IN THE OECD RASPLAV PROJECT AIMED AT CONFIRMING THAT THE THE REACTOR PRESSURE VESSEL CAN MAINTAIN ITS INTEGRITY FOLLOWING A CORE MELT RELOCATION TO THE LOWER HEAD. IN ADDITION TO SMALL SCALE CRITICAL FLUX TESTS UNDERWAY AT PENN STATE, RES STATED THAT IT IS FULLY AWARE OF DOE-SPONSORED PROGRAMS AND WILL TAKE THESE EXPERIMENTS AND ANALYSES INTO ACCOUNT.

AS A RESULT OF THE TMI-2 VESSEL INVESTIGATION PROJECT, RES DETERMINED THAT ITS CURRENT MODELING WOULD HAVE PREDICTED FAILURE OF THE LOWER HEAD, WHICH, OF COURSE, DID NOT OCCUR. RES HAS INITIATED A NEW SCALED STRUCTURAL EXPERIMENT AT SNL TO INVESTIGATE THE EFFECTS OF THERMAL AND PRESSURE LOADS. THE RESULTS OF THESE TESTS AND ANALYSES WOULD BE APPLICABLE TO OPERATING PWR'S AS WELL AS FOR THE AP600. ADDITIONALLY, RES HAS ISSUED A BROAD AGENCY ANNOUNCEMENT SEEKING PROPOSALS TO STUDY THE COOLING OF MOLTEN MATERIAL UNDER A WATER POOL.

SCDAP/RELAP5

CONSIDERABLE DETAIL WAS PRESENTED ON THE STATUS AND IMPROVEMENT OF THE SCDAP/RELAP5 CODE WHICH HAS ALREADY UNDERGONE A PEER REVIEW. RES HAS INSTITUTED A PROCEDURE FOR CONTROLLING THE ONGOING MODEL DEVELOPMENTS BY REQUIRING PRELIMINARY DESIGN REPORTS [PDR'S]. FOLLOWING PDR REVIEW AND APPROVAL, MODEL IMPLEMENTATION AND TESTING ARE STEPS TO BE FULFILLED. SCDAP/RELAP5 IS ASSESSED WITH SEPARATE EFFECTS TESTS AND INTEGRAL EXPERIMENTS, AND WILL BE COMPARED WITH MELCOR. THE SUBCOMMITTEE PLANS TO FOLLOW THE PROCESS AND PROGRESS FOR SEVERE ACCIDENT CODE ASSESSMENTS.

FUEL-COOLANT INTERACTION

IN THE DISCUSSIONS OF FUEL-COOLANT INTERACTIONS, THE SUBCOMMITTEE QUESTIONED THE PROGRESS BEING MADE WITH THE INTEGRAL FUEL-COOLANT INTERACTION [IFCI] CODE AND HOW WELL IFCI COMPARES WITH OTHER CODES DEVELOPED HERE AND ABROAD. RES STATED THAT THEY HAVE AN AGREEMENT WITH DOE AND UCSB TO OBTAIN THE UCSB DEVELOPMENTS AND WILL MAKE THE COMPARISONS.

A NEW EXPERIMENTAL PROGRAM INITIATED AT ANL WILL STUDY WHETHER THERE IS AN AUGMENTED CHEMICAL REACTION WITH MOLTEN ZIRCALOY AND WATER TO PRODUCE STEAM EXPLOSIONS.

CONTAINMENT INTEGRITY

THE ACCIDENT ANALYSIS SUBCOMMITTEE WAS INTRODUCED TO THE PROGRESS BEING

MADE IN THE COOPERATIVE TEST PROGRAM WITH MITI INVOLVING THE TESTING OF A 1/10TH SCALE STEEL BWR CONTAINMENT AND A 1/4TH SCALE PRESTRESSED CONCRETE PWR CONTAINMENT. THE PRE- AND POST-TEST PREDICTIONS OF THE CONTAINMENT BEHAVIOR UP TO FAILURE WILL INVOLVE AN ARRAY OF PARTICIPANTS. PROGRAM CLOSURE OF THE TESTS FOR THE BWR CONTAINMENT IS FY97, AND FY98 FOR THE PWR CONTAINMENT. A SECOND PROJECT INVOLVES CONTAINMENT DEGRADATION WITH THE EMPHASIS ON UNDERSTANDING THE MECHANISMS FOR CORROSION AND FOR MITIGATION METHODS. CLOSURE DATES ARE FY96 FOR DETERMINING THE EFFECTIVENESS OF INSERVICE INSPECTION TECHNIQUES, AND FY97 FOR THE ANALYTICAL DETERMINATION OF CAPACITY OF DEGRADED CONTAINMENTS. THE MATERIALS AND ENGINEERING SUBCOMMITTEE WILL HAVE OVERSIGHT ON THE CONTAINMENT INTEGRITY PROGRAMS.

LISTINGS FOR CONTRACT RESEARCH PROJECTS

RES PROVIDED THE SUBCOMMITTEE WITH TITLES AND FUNDING FOR THE CONTRACT RESEARCH.

RES INFORMED THE COMMITTEE THAT THE RESEARCH PLAN BUDGET DOCUMENTS ARE UNDERGOING UPDATING AND THE EXPECTED RELEASE DATE WILL BE MARCH 1995. THESE DOCUMENTS WILL PROVIDE THE COMMITTEE WITH THE GROUPING OF FINS INTO RESEARCH MISSIONS. THE COMMITTEE REQUESTS THAT PROJECT MANAGERS BE IDENTIFIED ALONG WITH SCHEDULES FOR ANTICIPATED CLOSURES OF PROJECTS.

CONCLUDING REMARKS

THE COMMITTEE HAS REVIEWED AND MODIFIED THE ACCIDENT ANALYSIS SUBCOMMITTEE'S REPORT COVERING RES'S PROGRAMS INVOLVING SEVERE ACCIDENTS, THERMAL-HYDRAULICS, TRANSIENTS AND OTHER ACCIDENT ANALYSES. THE COMMITTEE HAS NOTED ITEMS FOR CONTINUING ATTENTION SUCH AS THE ADMINISTRATIVE BURDENS FOR PROJECT MANAGERS; CRITERIA, PROCESSES AND GUIDELINES; LONG RANGE PLANNING; SUPPORT AND LEADERSHIP ROLES FOR INTERNATIONAL RESEARCH PROGRAMS AND ACTIVITIES; INCREASE IN EXPLORATORY, PRAGMATIC OR READINESS RESEARCH; USE OF FACILITIES FOR INDEPENDENT RESEARCH; AND THE NEED FOR RES TO KEEP THE COMMITTEE CURRENT ON RESEARCH ACTIVITIES. SEVERAL ISSUES REQUIRING FURTHER ATTENTION INCLUDE THE MANAGEMENT OF ATRIG, CODE ASSESSMENTS, IMPROVED TIMELINESS OF DCH RESOLUTIONS, AND CONCURRENT DOE RESULTS FOR LOWER HEAD INTEGRITY AND FUEL-COOLANT INTERACTIONS.

Submitted by

H. S. Isbin

H. S. Isbin, Chairman
Accident Analysis Subcommittee

APPENDIX I

AGENDA

ACCIDENT ANALYSIS SUBCOMMITTEE
NSRRC

NOVEMBER 9, 1994 THERMAL HYDRAULICS, TRANSIENTS & OTHER ACCIDENT ISSUES

8:30 AM INTRODUCTION — Herb Lohen

8:45 INTRODUCTION — Tom King.

CRITERIA, PROCESSES & GUIDELINES used by RES to define T/H needs, ~~including~~ evaluation of research programs, use of peer reviews and T/H consultants; and response to Subcommittee's questions and comments.

Update on July 5, 1994, RESEARCH PLAN FOR STANDARD PLANT DESIGNS and OPERATING PLANT PERFORMANCE, and response to Subcommittee's questions and comments

10:00 BREAK

10:15 OVERVIEW OF T/H RESEARCH — Farouk Eltawila

AP-600 & SBWR testing programs re adequacy of scaling and instrumentation, and sufficiency; communication effectiveness among participants; status of tests and findings.

Maintenance of suite of validated codes and expertise

12:00 LUNCH BREAK

1:00 PM CODE ASSESSMENTS — Norm Lauben and David Bessette

Response to Subcommittee's comments and questions regarding CODE SCALING, APPLICABILITY, and UNCERTAINTY — CSAU

2:00 PM High BURNUP FUEL issues — Ralph Meyer

OTHER ACCIDENT ACCIDENT ANALYSES — Mark Cunningham

including shutdown and low power accidents; use of research results in PRA's and Accident management

3:00 - 5PM SUBCOMMITTEE DISCUSSIONS + PREPARATION OF DRAFT REPORT

APPENDIX A

AGENDA

ACCIDENT ANALYSIS SUBCOMMITTEE
NSERC

NOVEMBER 10, 1994 SEVERE ACCIDENT RESEARCH PROGRAM (SARP)

8:30 AM INTRODUCTION — Herb Tabrin

8:45 CRITERIA, PROCESSES & GUIDELINES used by RES — Tom King
to define Severe Accident needs, planning, prioritization, evaluation of research progress, and closure. Illustrate use of the above principles to produce the July 5, 1994, RESEARCH PLAN FOR NRC SEVERE ACCIDENT PHENOMENOLOGY, CONTAINMENT PERFORMANCE & STRUCTURAL INTEGRITY.
Update on this document and response to Subcommittee's questions and comments. Present goals for SARP closures.
Use of peer reviews and response to NSERC comments.

10:15 BREAK

10:30 IN-VESSEL OVERVIEW OF SEVERE ACCIDENT ISSUES — Alan Rubin
Lower Head Integrity
Fuel Coolant Interaction including status of IFCI
Core Melt Progression including response to Subcommittee's questions and comments
SCDAP/RELAP5 and other codes including code assessments
Source Term

12:00 LUNCH BREAK

1:00 PM EX-VESSEL OVERVIEW OF SEVERE ACCIDENT ISSUES — Charles Tinkler
DCH
Debris coolability
MELCOR CONTAIN including code assessments and response to Subcommittee's questions and comments
H_2 Combustion including response to Subcommittee's questions and comments.

2:30 PM CONTAINMENT STRUCTURAL INTEGRITY — Larry Shao
Model tests
Degradation

3:00 – 5:00 SUBCOMMITTEE DISCUSSIONS & PREPARATION OF DRAFT REPORT

APPENDIX B

DSR FY95 FIN Categorization by Program Office Need

Categories

A = Being done in direct response to a program office user need request

B = Supported by program office as useful

C = RES initiative, international agreement, support to FSU*

FIN	Funding (K) A	B	C
Accident Evaluation Branch			
- Advanced Reactor Support:			
W6269 ALWR Commix code	400		
W6343 Hydrogen Distribution		350	
J6030 Critical Heat (CHF) Flux Phenomena	138		
L2290 ALWR-Contain Code Improvements	350		
L2443 H2 Behavior Program for ALWRs	200		
- Direct Containment Heating			
W6242 Natural Circulation During SA		250	
L1990 Phenomena of DCH (SET)		100	
J6027 DCH Issue Resolution		200	
W6162 DCH Testing for CE Plants		200	
- Hydrogen Combustion Research			
L1924 High Temp. Hydrogen Combustion			250
W6142 Hydrogen Combustion Research		190	
L2363 Hydrogen Research in Russia			250
- Debris Coolability			
W6364 Debris Coolability Experiment		600	
- Late Phase Core Melt Progression			
L1468 Ex-Reactor Experiments		500	
L2452 Melt Relocation & Blockage		200	
W6336 Late Phase Core Melt			450
- Lower Head Integrity			
W6091 Analysis of CORVIS & RASPLAV			200
W6199 RASPLAV International Project			550
W6350 Coolability of Continuous Debris		1,000	
- Fuel Coolant Interactions			
W6183 FCI Experiment & Analyses		135	
L1552 FARO FCI Experiment		300	
W6347 Zirc-Water Interaction		500	

*Former Soviet Union

	A	B	C
- Source Term			
L1838 Cash Contribution to PHEBUS			600
W6172 In-Kind Contribution to PHEBUS			500
A6893 Spent Fuel Storage Fee			38
A6345 Spent Fuel Disposal			350
- Severe Accident Codes			
A3281 MELCOR Benchmark		150	
L2587 MELCOR CAP		100	
W6203 MELCOR Code D&A		1,200	
W6095 SCDAP/RELAP5 Code D&A		500	
A1837 VICTORIA Code D&A		300	
W5265 IFCI Code D&A		250	
BRANCH TOTAL	1,088	7,025	3,138

ATTACHMENT 1

UNITED STATES
NUCLEAR REGULATORY COMMISSION
Nuclear Safety Research Review Committee
Washington, D.C. 20555

March 1, 1995

Mr. Eric S. Beckjord, Director
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Beckjord:

The Nuclear Safety Research Review Committee (NSRRC) met on February 6-7, 1995 to consider the report of its Materials and Engineering Subcommittee, which had met on January 24, 1995. The full Committee approved the Subcommittee's report with some modifications. The Subcommittee report, as modified, is hereby forwarded to you with the concurrence of the NSRRC.

Sincerely,

Edwin Kintner, Chairman
Nuclear Safety Research Review Committee

Enclosure: As stated

SOL BURSTEIN
7475 North Crossway Road
Milwaukee, Wisconsin 53217

Tel 414-351-0690
Fax 414-351-0664

February 11, 1995

Mr, Edwin Kintner, Chairman
Nuclear Safety Research Review Committee
Bradley Hill Road
PO Box 682
Norwich, VT 05055

NRC NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE (NSRRC)

Dear Ed,

Attached is the Final Report of the NSRRC Subcommittee on Materials and Engineering covering its meeting of January 24, 1995. This Report incorporates comments from a full NSRRC review and was endorsed by the NSRRC at its meeting on February 7, 1995.

Enclosure

Copy to George Sege

SOL BURSTEIN
7475 North Crossway Road
Milwaukee, Wisconsin 53217

Tel 414-351-0690
Fax 414-351-0664

February 11, 1995

Mr, Edwin Kintner, Chairman
Nuclear Safety Research Review Committee
Bradley Hill Road
PO Box 682
Norwich, VT 05055

NRC NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE (NSRRC)
SUBCOMMITTEE ON MATERIALS AND ENGINEERING

Dear Ed,

On January 24, 1995, the Subcommittee on Materials and Engineering of the NSRRC met in the offices of the Nuclear Regulatory Commission primarily to review five important issues of current concern to the Division of Engineering Technology of the Nuclear Regulatory Research Office. The meeting was held pursuant to Federal Register Notice of December 20, 1994.

All members of the Subcommittee, Messers. Boulette, Burstein, Uhrig and Yukawa, participated in the meeting. Professor Robert Hatcher, member of the NSRRC, had planned to attend the meeting because of his interest in seismic matters. Unfortunately, he was not able to do so.

The entire meeting was open to the public and one member of the public was present for a portion of the session. Members of the public were invited to make oral or written presentations to the Subcommittee. None was made. The meeting followed the attached agenda. RES Director Beckjord attended a major portion of the meeting and participated actively in the discussion on earthquake issues.

OVERVIEW

Lawrence C. Shao, Director of the Division of Engineering Technology, provided a brief description of the Division responsibilities for developing and managing safety research programs to support the NRC regulatory mission in areas of Materials, Structural/Civil, Seismic, Electrical and Mechanical Engineering. Matters of Instrumentation and Control, Computer Applications and Human Factors are not part of this Division's scope.

A reorganization of the Division in July of 1994 resulted in a structure comprising three principal branches as shown in the attached chart. All three Branch Chiefs made comprehensive presentations covering portions of their branch activities to the Subcommittee.

THE SUBCOMMITTEE NOTED THAT THE EXISTING ALLOCATION OF WORK LOAD RESTED UNEVENLY ON THE THREE BRANCHES. APPROXIMATE COMPARISONS OF LOAD WERE INDICATED BY ESTIMATED BUDGETS FOR THE BRANCHES AS FOLLOWS:

GENERIC SAFETY ISSUES	$1,000,000
STRUCTURAL AND GEOLOGICAL ENGRNG.	8,000,000
ELECTRICAL, MATERIALS AND MECHANICAL ENGINEERING	18,000.000

(The staff later corrected these estimates to $0.8, 6.8 and 18.5 million respectively.)

THE SUBCOMMITTEE UNDERSTOOD THAT THIS ORGANIZATIONAL ARRANGEMENT WAS RELATIVELY NEW AND APPEARED STILL TO BE IN TRANSITION. BASED ON ITS LIMITED REVIEW, THE SUBCOMMITTEE BELIEVES A MORE EQUITABLE DIVISION OF WORK BETWEEN THE THREE BRANCHES THAN IS INDICATED ABOVE WOULD UTILIZE AVAILABLE RESOURCES MORE EFFECTIVELY.

GENERIC ISSUES

Charles Z. Serpan, JR. Chief, Generic Issues Branch, provided the current plan for dealing with safety issues that apply to a class of reactors. He outlined the mechanisms, resources and schedules for dealing with these outstanding concerns, all of which are planned for resolution in 1995 except for some safety-relief valve issues and environmental qualification of electric cables. The latter was addressed in more detail later.

THE SUBCOMMITTEE ENDORSED THE APPROACH BEING TAKEN IN IDENTIFYING THESE GENERIC MATTERS, ASSIGNING RESOURCES TO THEIR RESOLUTIONS INCLUDING THE SELECTIVE USE OF CONTRACTOR ASSISTANCE AND THE TRACKING OF PROGRESS TOWARD SUCCESSFUL CLOSURE.

ONE MATTER OF CURRENT GENERIC CONCERN IS THE POTENTIAL FOR BLOCKAGE OF THE RECIRCULATION PUMP SUCTION STRAINERS IN BWR PLANTS THAT COULD RENDER THIS FEATURE OF THE ECCS INOPERABLE. THE SUBCOMMITTEE NOTED THAT THIS CONCERN WAS SIMILAR TO THAT FOR PWR CONTAINMENT SUMP DESIGNS THAT HAD APPARENTLY BEEN SUCCESSFULLY RESOLVED MANY YEARS AGO. THE SUBCOMMITTEE WISHES TO BE KEPT INFORMED ON THIS MATTER.

SEISMIC HAZARD METHODOLOGY

In an attempt to resolve the so-called "Charleston earthquake" issue raised by the USGS in 1982, the NRC through Lawrence Livermore National Laboratory (LLNL) and the nuclear industry through the Electric Power Research Institute (EPRI) each undertook the independent development of probabilistic methods for the analyses of seismic hazards applicable to nuclear plant sites east of the Rocky Mountains. Results obtained by both groups differed significantly and since 1989 attempts have continued to seek resolution of the differences. Over these years, the NSRRC has expressed concern with delays in resolving this issue.

Andrew J. Murphy, Chief, Structural and Geological Engineering Branch, began the discussion on seismic issues by reviewing this history. He acknowledged that the differences between the LLNL and EPRI results were primarily due to the way that expert elicitations were conducted and utilized.

Recent improvements (1993-94) in the LLNL methodology pursued primarily under NRR auspices narrowed these differences but it had not eliminated them. RES is now engaged in a joint activity with the DOE and EPRI to develop guidelines for the conduct of probabilistic seismic hazards analyses that would be acceptable to users, regulators and the scientific community at large.

A Seismic Hazards Analysis Committee was established in January 1993 to provide technical direction and to develop the guidelines. Technical and administrative support has been provided by contractors. Draft Guidelines were completed by the Committee in November, 1994. They are presently undergoing peer review by a panel of the National Academy Committee on Seismology. If this peer review is completed by the end of February 1995, a final report can issue in April. Verification of the guidelines would be accomplished by trial applications for selected sites.

The staff also provided a preliminary report of the recent Kobe earthquake.

THE SUBCOMMITTEE IS PLEASED TO NOTE THAT CLOSURE OF THIS LONG STANDING ISSUE APPEARS IN SIGHT, CERTAINLY WITHIN FY96. THE SUBCOMMITTEE TOOK NO POSITION AS TO WHETHER THE RES APPROACH TO CLOSURE WAS APPROPRIATE. THE STAFF DID CONFIRM, HOWEVER, THAT THE GUIDELINES ARE INTENDED TO BE USED IN NEW SITE-RELATED ACTIVITIES AND NOT FOR REANALYSES AND BACKFITTING OF EXISTING SITES. THE STAFF ALSO INDICATED ITS INTENT THAT THE GUIDELINES BE APPLICABLE TO WESTERN SITES AS WELL AS THOSE EAST OF THE ROCKY MOUNTAINS. THE SUBCOMMITTEE CAUTIONED THAT SUCH UNIVERSAL APPLICABILITY COULD REQUIRE SPECIAL APPROACHES THAT MAY NOT BE READILY APPARENT, MAY NOT BE TECHNICALLY SUPPORTABLE AND MAY NOT BE COST-EFFECTIVE.

THE SUBCOMMITTEE CALLED ATTENTION TO RECENT TECHNICAL REPORTS ON EFFECTS OF THE NORTHRIDGE EARTHQUAKE. THE SUBCOMMITTEE REQUESTED THAT IT BE KEPT INFORMED AS MORE ANALYSES OF THESE RECENT SEISMIC EVENTS BECOME AVAILABLE.

ASME CODE CRITERIA FOR SEISMIC DESIGN OF PIPING

Nilesh C. Chokshi of the RES Structural and Geological Engineering Branch advised the Subcommittee that the ASME has approved significant changes in the piping design criteria for nuclear plants that are not acceptable to NRC staff. The staff is concerned that proposed ASME Code changes could increase allowable piping design stress levels beyond yield strengths of the materials and could result in unacceptably low margins at SSE levels. A letter dated December 15, 1994 from RES and NRR to the Board on Nuclear Codes & Standards expressing the NRC concern is attached.

The NSRRC had received information on this matter at its meeting on January 14, 1993. RES continues to work with NRR and an external peer review group to complete evaluation of the Code changes and assessment of the resulting reduced margins. In November, 1994, the Peer Review Group met with the ASME Code Committee and some progress toward resolution of the NRR/RES concerns was made. Major differences, however, remain. The staff concludes that the proposed ASME Code approach would not permit of piping systems that contain any flaw.

THE STAFF DID NOT QUANTIFY THIS "UNACCEPTABLY LOW MARGIN" EXCEPT TO STATE THAT THE PIPING COULD YIELD AND HAVE LARGE DEFORMATIONS EVEN AT OBE LEVELS. IT WAS SAID THAT THE INCENTIVE FOR THE PROPOSED ASME CHANGE IS TO PERMIT REMOVAL OF SNUBBERS AND HANGERS IN SOME PORTIONS OF PIPING SYSTEMS TO FACILITATE IN-SERVICE INSPECTION.

THE SUBCOMMITTEE URGES THAT THE NRR/RES WORKING GROUP CONTINUE TO SEEK COMPLETION OF THE REVIEW OF THE PROPOSED CODE CHANGES AND ASSESSMENT OF THEIR EFFECTS (BY ETEC) SCHEDULED FOR JULY 1995. THE DIALOGUE WITH THE ASME CODE COMMITTEE SHOULD ALSO BE CONTINUED. DEVELOPMENT OF A REGULATORY POSITION SHOULD BE PURSUED ONLY AFTER FAILURE TO REACH AGREEMENT HAS BECOME IRREVOCABLE.

CONTAINMENT ISSUES

James F. Costello of the Structural and Geological Engineering Branch addressed RES concerns that are centered in areas of verifying safety margins in existing containment designs and establishing safety margins for degraded containments.

Because of budget restrictions, Dr. Costello said that RES had been unable to examine via experiment the failure margins of as-built BWR steel containments and PWR pre-stressed concrete containments. Experimental data was obtained for reinforced concrete containment designs. However, the ability to apply these data to verification of pre-stressed designs hinges on the ability to correlate analytical models for the two designs. The staff acknowledged this ability has not yet been established.

Further, several questions remain in the minds of NRC staff as to the ability to identify and analyze containments degraded by corrosion. Corrosion has been found in US as well as in French and German metal containments. There have been 28 such occurrences, the majority of which have been detected by other than licensee containment inspection programs.

The ability to detect and quantify corrosion degradation as well as the capability to predict performance of a degraded containment have prompted the NRC to seek experimental data from which these concerns might be resolved. A cooperative testing program has been forged with Japanese interests to provide test models for steel containments fabricated in Japan for testing at Sandia National Laboratory. Additional designs for a pre-stressed concrete containment model have been approved and construction of the test shell is expected to begin in July 1995, also at Sandia. Peer review of these test programs is being provided by an 11-member expert panel.

ALTHOUGH THERE IS EFFORT UNDERWAY TO SEEK ANALYTICAL METHODS TO IMPROVE THE DETECTION AND QUANTIFICATION OF CORROSION, THE SUBCOMMITTEE WAS GIVEN TO UNDERSTAND THAT THIS TASK WILL BE DIFFICULT. PRESENT SCHEDULES FOR CONCLUDING PROGRAMS TO VERIFY DESIGN MARGINS FOR BWR STEEL AND PWR PRE-STRESSED CONTAINMENTS ARE FY97 AND FY98 RESPECTIVELY. CLOSURE DATES FOR CONTAINMENT DEGRADATION PROGRAMS INCLUDING IMPROVED INSPECTION TECHNIQUES AND METHODS TO VERIFY CAPABILITY OF DEGRADED CONTAINMENTS ARE EXPECTED IN FY96-97.

THE COMMITTEE NOTED THAT NEW METHODS OF DETECTING METALLIC CORROSION ARE BEING DEVELOPED AND MIGHT USEFULLY BE INVESTIGATED BY RES. THESE INCLUDE NEUTRON TOMOGRAPHY AND ELECTRICAL PROPERTY MEASUREMENTS.

THE SUBCOMMITTEE RECALLED THAT THE NSRRC HAD OBSERVED SOME CONTAINMENT TEST MODELS DURING ONE OF ITS EARLIER VISITS TO SNL. AT THAT TIME, THE COMMITTEE SUGGESTED THAT SPECIAL CONSIDERATION NEEDED TO BE GIVEN TO SCALING EFFECTS. THE SUBCOMMITTEE RE-AFFIRMED THAT CAUTION (THE STEEL CONTAINMENT TEST IS 1/10TH SIZE AND THE PRE-STRESSED CONTAINMENT MODEL IS 1/4TH SIZE). THE SUBCOMMITTEE CONCERN IN THIS REGARD WAS PRIMARILY DIRECTED TOWARD ASSURING THAT THE TEST MODELS ARE STRUCTURALLY VALID REPRESENTATIONS. THE SUBCOMMITTEE ALSO SUGGESTS THAT A PLAN BE DEVELOPED AS TO WHAT RESULTS ARE EXPECTED FROM THE TEST AND ANALYTICAL PROGRAMS AND WHAT THE NRC PROPOSES THAT THE RESULTS WILL BE USED FOR.

THE COMMITTEE NOTED THAT UNDERSTANDING CONTAINMENT PERFORMANCE DURING ACCIDENTS INCLUDES POST LINER FAILURE BEHAVIOR. WITH REINFORCED CONCRETE CONTAINMENTS, FAILURE OCCURS WHEN THE LINER MEMBRANE BECOMES TORN. FOLLOWING LINER FAILURE, THE ABILITY OF THE CONTAINMENT TO RETAIN ITS CONTENTS APPEARS TO DEPEND ON WHETHER THE ATMOSPHERE CONTAINS STEAM. THE DEMONA TESTS IN GERMANY HAVE INDICATED THAT STEAM-LADEN ATMOSPHERES DEPRESSURIZE MORE SLOWLY THAN DRY ATMOSPHERES. PLUGGING OF CONCRETE CRACKS BY CONDENSED STEAM HAS BEEN POSTULATED AS THE EXPLANATION. THE COMMITTEE UNDERSTANDS THAT PAST NRC CONTAINMENT FAILURE TESTS AT SANDIA WERE PERFORMED USING DRY ATMOSPHERES.

THE COMMITTEE SUGGESTED THAT IT MAY BE WORTHWHILE FOR RES TO SUPPLEMENT THE TESTING PROGRAMS FOR CONCRETE STRUCTURES TO INCLUDE A SERIES INVOLVING STEAM-AIR MIXTURES. THE COMMITTEE BELIEVES THIS MAY PROVIDE A MORE REALISTIC BASIS FOR EVALUATING CONCRETE CONTAINMENT PERFORMANCE.

ENVIRONMENTAL QUALIFICATION

Michael E. Mayfield, Chief, Electrical, Materials and Mechanical Engineering Branch, provided a summary of issues related to degradation of electric cables. Stemming from license renewal activities and results from SNL tests, there is concern that previous environmental qualification techniques may have been inadequate to assure maintenance of accident performance capability. This appears to be particularly the case for certain artificially aged cable tests.

It is RES intent to "establish an EQ data base" from which program direction and scope can be developed. In addition, RES intends to obtain and test certain typical cables to evaluate the adequacy of prior qualification methods and condition monitoring techniques.

THE SUBCOMMITTEE IS AWARE THAT A MAJORITY OF OPERATING NUCLEAR PLANTS HAVE SAFETY SYSTEMS THAT RELY ON ELECTRIC CABLE SYSTEMS THAT WERE ENVIRONMENTALLY QUALIFIED TO STANDARDS THAT WERE IN EFFECT AT THE TIME OF THEIR CONSTRUCTION AND WERE "GRAND-FATHERED" SO AS NOT TO REQUIRE REQUALIFICATION TO PRESENT STANDARDS. ALSO THE SUBCOMMITTEE UNDERSTANDS THAT ABOUT 1/3 OF CABLES SUBJECT TO THE PRESENT EQ TESTING FAILED TO MEET SPECIFICATIONS. THE SUBCOMMITTEE IS NOT AWARE WHAT PORTION, IF ANY, OF THESE "FAILED" CABLES RETAINED THE CAPABILITY TO PERFORM THEIR REQUIRED FUNCTION IN AN ACCIDENT ENVIRONMENT. EXPERIENCE FROM OTHER INDUSTRIES AND OTHER COUNTRIES MAY BE HELPFUL TO THE NRC.

MATERIALS ISSUES - PALISADES

Mr. Mayfield described the materials issue at Palisades as another instance where reactor vessel material samples are not representative of beltline weld metal. In the Palisades case, the licensee sought to utilize weld materials from steam generators (SG) that were believed to be representative of the reactor vessel. The SG materials turned out to have higher copper content that assumed and higher transition temperature values than industry average for this particular class of welds. The results indicate that the Palisades vessel may reach Pressurized Thermal Shock screening limits within five years.

RES is undertaking a research program assisting NRR in seeking to resolve these materials issues for Palisades and also to address their generic implications. RES is providing independent assessment of data and methods of analysis for Palisades, evaluating effects of material chemistry and radiation exposures including the combination of aging effects. The program is expected to continue through FY97.

THE SUBCOMMITTEE LEARNED THAT PRIOR RESEARCH HAS NOT ADEQUATELY RESOLVED QUESTIONS OF VARIATIONS IN MATERIAL PROPERTIES AND THEIR BEARING ON EMBRITTLEMENT. THE CURRENT RESEARCH PLAN IS DESIGNED TO PROVIDE THE DATA AND METHODOLOGIES NEEDED TO DEAL EFFECTIVELY WITH THIS IMPORTANT, CONTINUING CONCERN.

BWR INTERNALS

NRC and industry have found that instances of core shroud ring cracking in BWRs can be correlated with water chemistry and the operating ages for various stainless steel materials employed. Of the 22 BWR operating units so categorized, staff has concluded that 11 or half have either exhibited cracking or have the potential for significant cracking. Up to now, no instances of 360 deg through wall cracks have been found, no operational difficulties have occurred and structural margins required in the design code have been maintained even in the presence of cracked rings.

A comprehensive research program is underway and is scheduled to continue through FY98. The program includes specimen tests at Halden, grain boundary chemistry investigations (the cracking is believed to be intergranular stress corrosion), flaw determination, crack acceptance criteria and development of mitigative procedures.

THE SUBCOMMITTEE WAS NOT MADE AWARE OF THE SIGNIFICANCE OF THESE CRACKING INCIDENTS. NO INSTANCE OF A SAFETY SYSTEM FAILURE RESULTING FROM CORE SHROUD RING CRACKING WAS REPORTED. THE SUBCOMMITTEE IS PLEASED THAT RES IS BEING ANTICIPATORY ("PROACTIVE") OF FUTURE PROBLEMS BUT URGES CAREFUL REVIEW OF THE DEVOTION OF SCARCE RESOURCES TO PROGRAMS WHOSE PRIORITY HAS NOT BEEN ESTABLISHED.

The Subcommittee has made several comments above that are of a programmatic and administrative nature. The Subcommittee has not had the benefit of a review of the entire Division program and budget. Such a review is planned for a subsequent meeting.

The Subcommittee expresses its appreciation to the RES and particularly to Division Director Shao and the entire Engineering Technology Division for their outstanding presentations to the Subcommittee at this January 24 meeting.

Subcommittee on Materials and Engineering

Chairman

Attachments

NUCLEAR REGULATORY COMMISSION
NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE
WASHINGTON DC 20555
February 13, 1995

Mr. Eric Beckjord, Director
Office of Nuclear Regulatory Research
Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Beckjord:

The Instrumentation, Control, and Human Factors (IC&HF) Subcommittee of the Nuclear Safety Research Review Committee (NSRRC),consisting of Anthony Baratta, Michael Golay, Charles Mayo, and Robert Uhrig (Chairman), met at the NRC Headquarters in Rockville, MD on January 12, 1995. The program was arranged by Frank Coffman, Manager of the Control, Instrumentation, and Human Factors Branch, to provide the subcommittee (especially the three new members who have only recently been appointed to the NSRRC) an overview of the IC&HF research program. Mr. Coffman and Wayne Hodges, Director of the Division of Systems Technology, attended the meeting and offered comments as appropriate during the presentations and discussions. A copy of the agenda is attached. This report of the Subcommittee was approved by the full NSRRC at its meeting on February 7, 1995.

The IC&HF research programs addressed many issues important to the NRC's regulatory responsibility. Most of the program (17 projects with an annual cost of about $3.7 million) is driven by "user needs" arising out of requests from other groups within NRC. Exceptions to this policy are the Halden program (0.8 million per year), the National Academy of Science study ($0.3 million this year), several "evaluation" projects, several SBIR (Small Business Innovative Research) grants to small businesses, and a limited number of smaller programs initiated by the staff. About two-thirds of this program is directed toward control and instrumentation, with the rest distributed about equally between personnel performance, reliability assessment, and performance of materials licensees.

The subcommittee generally concurs with the overall allocation of funds between the various areas. Indeed, there have been many accomplishments that are noteworthy. RESEARCH is to be congratulated on the completion of the revision of NUREG 0700 to include the on-going transition from analog to digital technologies in the years since it was originally published. This has been a monumental task that will fill a critical need within NRC and the nuclear power industry, and early formal issuance is encouraged.

The PRA related activities presented emphasized improving representation of human reliability. These activities, the efforts to improve PRAs, and the exploration of how PRA results can be adapted to make regulation more cost effective and realistic, are also very important to the NRC and the nuclear industry.

There are, however, a number of issues of concern that the committee wants to address. The order of presentation here is not a reflection of the priority of the issues.

1. The Subcommittee is very disturbed by recent research that suggests error rates by plant personnel may be an order of magnitude greater than the generally accepted error rates (about 1% vs. 0.1%) This discrepancy, if substantiated, could have a significant impact upon the validity of PRAs that use the lower value. Resolving this issue, including establishing a precise definition of error rate for personnel, should have a very high priority, and problems associated with getting the required data from the plants should not be allowed to slow or detour this task. The Subcommittee also wonders if there is an innovative way that I&C can be used to quantitatively assess and monitor human performance.

2. The replacement of analog components with "functionally identical" digital components is a current trend by industry. A more quantitative methodology for determining whether the resultant hybrid analog-digital system has the same risk level as the older analog systems is as safe as or safer than the replaced system, is a critical need of NRR. (This would be consistent with the current NRC increased use of Probabilistic Risk Assessments in regulatory activities.) Current *ad hoc* determinations of adequacy by NRR and by utilities under 10CFR50.59 need to be enhanced by a more rigorous objective (or quantitative) methodology.

3. The Verification and Validation (V&V) research program seems to have a reasonable balance between short term (adaptation of current V&V methodology) and long term ("rigorous" methods) approaches. The Subcommittee believes there are opportunities to secure results in a more timely manner through a more aggressive program in this area. Participation of NRC personnel in industry (IEEE, ANS, etc,) standards preparation, (with subsequent adaption of these standards in NRC regulations) is very beneficial. NRC still needs to clearly define to the utility industry its requirements for software V&V through the use of "acceptance criteria." The goal of the V&V research program needs to be directed towards this objective. The Subcommittee also encourages the continued investigation of CASE (Computer Assisted Software Engineering) tools in meeting the V&V requirements. The goal here is to utilize automation to the maximum extent possible in software preparation to correctly satisfy program performance requirements and to eliminate human programming errors.

4. The Subcommittee endorses continued participation in the Halden IC&HF project as a signatory member. Its representative should continue to push for projects that have direct benefit to NRC and to the U.S. nuclear utility industry. Furthermore, NRC should strive to have research reports prepared that can be distributed without restrictions to U. S. utilities.

5. The U. S. nuclear power industry does not exist in a vacuum, and neither does the regulation of nuclear power. French, Japanese, German, and especially Canadian licensing authorities have dealt with the regulatory aspects of digital systems well ahead of the U. S. Their experience does not appear to have been adequately examined and/or factored into current RESEARCH and NRR plans. Furthermore, other Federal agencies (FAA, DOD,

NASA, EPA, FDA, etc.) as well as industrial groups have long ago converted many systems from analog to digital systems. NRC has much to learn from such groups. A short visit by a contractor followed by a report is not adequate. NRC or contractor personnel need to spend enough time to really understand the approaches and methodologies of other organizations, and consider how they might be adapted the NRR's needs. Furthermore, the Subcommittee strongly encourages participation by RESEARCH personnel in both industry and professional society standards activities related to systems that can shift from analog to digital operation.

6. The Subcommittee views with concern the slow progress with the National Academy of Science (NAS) study. The May 1995 deadline for Phase I is probably unrealistic if results are to be meaningful. RESEARCH personnel should monitor the NAS study progress by attendance at open meetings and seek opportunities for additional input if they believe the objectives of the study are not being addressed adequately. Indeed, the Subcommittee strongly believes that NRC should present a comprehensive picture of the current NRR procedures used to evaluate digital systems submitted for review (e.g., the type of material briefly summarized by Joe Joyce at our meeting) and seek either approval of the process or guidance for changes or alternative approaches that the NAS can provide. (Notice that such approval or alternatives is being sought should be conveyed to the NAS Committee at its first meeting.) The Subcommittee encourages top management of RESEARCH and NRR to pre-review the NRC presentations to the NAS study with this objective in mind. A presentation that only describes the research program and its level of effort or gives a statistical picture of the program at RESEARCH and NRR would be of little value to either NAS or NRC. The focus must be on the process of evaluating proposed digital systems and establishing acceptance criteria.

7. Furthermore, this delay in the NAS Study should not be used as an excuse to delay a number of important decisions, such as the replacement of retiring personnel, the recruiting of needed expertise (especially in digital systems) and the initiation of research projects. Regardless of what the NAS Study recommends, the types of expertise needed within RESEARCH to deal with digital systems is clearly apparent. Recruiting the appropriate personnel (which appear to be in short supply) should be allowed to proceed in a timely manner, even if this means reductions in other areas of RESEARCH. The Subcommittee is especially concerned about the lack of expertise in areas such as reliability and safety analysis of hybrid I&C and digital system architecture, and will continue to monitor progress in staffing in this and related areas.

8. The RESEARCH program seems to have been slow to respond to changing technology. Part of this may be due to NRC's unreasonably complex contracting procedures, but the back log of seemingly high priority items raises the issue of how these priorities are established. Such items as the safety implications of hybrid analog-digital systems and large screen displays are just now being addressed, even though they have been in use for several years. The basis for establishing priorities should be reviewed.

9. Finally, the Subcommittee wants to express its concern regarding the timeliness of RESEARCH activities. (While this issue goes well beyond the aegis of the Subcommittee,

it is also pertinent to the activities we reviewed.) Several of the NRR users expressed the view that when they wanted answers to current regulatory issues, they utilized contractor personnel, and that assistance from RESEARCH was requested only on long-term issues. RESEARCH needs to review its activities with the user Divisions of NRC to assure that its priorities reflect NRC needs and that a proper balance is given to short-term and long-term activities, least its activities become irrelevant to the rest of NRC. Perhaps the use of "umbrella contracts" with experts and organizations would expedite the making of expertise available in a more timely manner.

10. The Subcommittee also reviewed certain aspects of the human factors research program, but a comprehensive review was deferred to a future meeting. However, the NSRRC reiterates its previous emphasis on the critical importance of an integrated systems approach for instrumentation and control, man-machine interface, and human factors.

Clearly, the Subcommittee has addressed only a few of the issues presented during its meeting. It is our hope that these comments will be useful. We want to express our appreciation to the members of RESEARCH and NRR that participated in the meeting and to those making presentations. We appreciate their willingness to address the various issues raised by the Subcommittee during the meeting.

Sincerely yours,

Edwin Kintner
Chairman

Attachment: Agenda for NSRRC Subcommittee Meeting, January 12, 1995
Advanced I&C and Human Factors

ATTACHMENT 2

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 14, 1995

Mr. Eric S. Beckjord, Director
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Beckjord:

The Nuclear Safety Research Review Committee (NSRRC) met on February 7, 1995 to consider the report of its Research Supporting Risk-Based Regulation Subcommittee on the Subcommittee's meeting of January 13, 1995. The full Committee approved the Subcommittee's report with some modifications, which are reflected in the attached revised Subcommittee report. The Subcommittee report, as modified, is hereby forwarded to you with the concurrence of the NSRRC.

Sincerely,

Edwin Kintner, Chairman
Nuclear Safety Research Review Committee

Attachment:
As stated

NUCLEAR REGULATORY COMMISSION
NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE
SUBCOMMITTEE ON RESEARCH SUPPORTING RISK-BASED REGULATION
WASHINGTON DC 20555

REPORT OF 13 January 1995 MEETING

Mr. Edwin Kintner, Chairman
Nuclear Safety Research Review Committee
Subcommittee on Research Supporting Risk-Based Regulation
Washington DC 20555

23 February 1995

Dear Mr. Kintner:

This report includes revisions to the Subcommittee report directed by the full Committee at its meeting of 6 - 7 February 1995.

The Subcommittee on Research Supporting Risk-Based Regulation of the NSRRC met on 13 January 1995 to review the program of the NRC Research Division (RES) in the area of Probabilistic Risk Assessment (PRA) as applied to Risk-Based Regulation. The presentations from the NRC staff were organized by Mr. M Cunningham, Chief of the Probabilistic Risk Assessment Branch of RES. The meeting agenda is attended. The subcommittee consists of Messers. T Boulette, S Burstein, M Golay (Chairman) and S Yukawa, (all were in attendance). Mr. R Uhrig, of the NSRRC, also attended.

The purpose of the meeting was to review the activities of RES in strengthening the use of PRA within the NRC, particularly in support of the Commission's 2 December 1994 Revision to the Proposed Probabilistic Risk Assessment Policy Statement. In that statement the intention to use PRA as the basis for attainment of the Safety Goals is presented, and with it the need for the NRC PRA capabilities and staff preparation to be greatly strengthened. When this is accomplished PRA is expected to join Deterministic Analyses, Defense in Depth and Expert Judgment in forming the foundation of NRC future safety regulation.

The staff presentations noted that current uses of PRA within the NRC pre-date the Revised Policy Statement. They include

- Passive system reliability assessment (mostly concerned with advanced reactor assessment, and post-Certification use of PRA)
- Performance of the Reactor Safety Study, creation of NUREG 1150, and requirement of the individual plant evaluations (IPEs) by nuclear power plant licensees
- PRA methods development and demonstration (mostly concerned with shutdown risk assessment, human reliability assessment, organizational performance and plant aging)
- NRC staff technical support and guidance development (mostly concerned with risk-based regulation, including data bases and model development; and staff guidance on PRA use).

Applications of PRA to concerns of NRC licensees other than nuclear power plants are almost non-existent to-date. This is a clearly required extension of current work. Notably, PRA has also been applied in the chemical process and transportation industries, but not nearly to the extent of the nuclear uses.

In addition RES has been and will continue to support NRR through review of the plant-specific Independent Plant Evaluations (IPEs). This activity appears to be more properly the mission of NRR; and quite time-consuming, thereby diverting the RES staff from the work of making the NRC fluent in the use of PRA.

It appeared to the Subcommittee that the RES program was striving hard to improve the understanding of human reliability (HRA), as reflected in errors of omission, commission and sensitivity to organizational factors. Also, in applying PRA to previously unappreciated safety concerns, such as low power and shutdown risks, the Division was providing needed leadership and new regulatory understandings.

Ms. A Ramey-Smith presented several research projects as examples of current work, including work to integrate improved HRA results more intimately in structuring PRA models and improving results, and studies of organizational effects upon safety outcomes.

The Subcommittee also received presentations from NRR (by J Schiffgens) and AEOD (by D Rasmuson). Briefly, RES has helped NRR in such areas as passive reactor and operating reactor design reviews, risk-based ranking of regulations under review (i.e., 10CFR50, Appendix B; containment leak rate testing; in-service testing & in-service inspection); and in formulation of the evolving "Maintenance Rule"). RES has also helped AEOD in improving data bases being used within the NRC. However, it was impossible from the presentations to determine the degree to which NRR has been genuinely relying upon RES, and that to which they bypass RES to utilize outside contractors. The point was made that often NRR needs a quicker response than RES can provide, but it is unclear whether this argument masks deeper divisions between the two groups. Regardless of the causes, such poor interaction appears to be happening to an undesirable degree. This question is important as it can affect whether RES will be permitted to play an important role in making risk-based regulation a successful innovation.

Part of why it is difficult to answer the preceding question is that NRR appears to have made little progress in framing its plans for risk-based regulation, and from that point to determine what help is needed from RES and AEOD. Among the currently-unaddressed questions which must be faced are

- How shall PRA-based decision rules be formulated for use by the NRR staff?
- Shall standardized data bases and modeling treatments be used in plant specific PRAs, and if so, how?
- How shall model uncertainties be treated, and PRA results meshed with those available from other methods (particularly recognizing that PRA, deterministic treatments and expert judgment each are the best tools in different portions of an overall safety assessment)?
- How shall accumulating nuclear power experience be integrated into PRAs?
- How shall PRA-based regulations address problems of licensee safety demonstrations and regulatory compliance?
- How should the PRA-based regulatory process and its results be explained to constituencies outside of the NRC?

Answering these questions likely will require several iterations between the

different NRC groups, for the mutual refinement of both the PRA tools and their methods of use.

As far as can be determined NRR has not formulated a program for answering such questions, and consequently RES has no mission to contribute to the needed answers. In the absence of such a program risk-based regulation may remain still-born, and an opportunity to improve safety substantially may be lost.

The Subcommittee had several observations following the presentations. They are summarized here.

In order to be useful PRA results must be sufficiently accurate and reproducible that different parties can agree upon what they mean. Doing this demands having a comprehensive, easily verified data base, with a means for its continual improvement. It also requires standardized modeling treatments for both the expected risks and associated uncertainties. Among the topics of model formulation is that of criteria for deciding which accident event scenarios should be included in a PRA. Currently no plan for accomplishing any of this is evident. Once the needed plan has been formulated its execution is a logical task for RES. RES can contribute to the plan's formulation, but the participation of other NRC Divisions is also required. These needs are recognized in "PROPOSED AGENCY-WIDE IMPLEMENTATION PLAN FOR PROBABILISTIC RISK ASSESSMENT(PRA)," SECY-94-219, but do not yet appear to have been translated into a plan of action.

The research being performed concerning human reliability appears to be formulated upon a too-narrow base. The relevant literature and experience of intellectual disciplines other than engineering and of other relevant industries and countries does not appear to have been integrated into current projects. Consequently, they appear to be at a greater risk of failure than is necessary. The need to be more inclusive was suggested to the staff but it is unclear whether the advice will be heeded. Also, coupling of the current work to regulatory needs of the agency appears to be weaker than necessary.

Several subcommittee members also questioned whether the understanding of organizational behavior was sufficiently mature to permit attempts at reliability modeling. Rather, it was suggested that expert judgment might be a more valuable tool than quantitative models, at this stage of development.

The use of RES resources in reviewing reactors unlikely to be built in the United States within the foreseeable future (i.e., CANDU and passive LWRs) was questioned by some subcommittee members. Many other topics, discussed elsewhere in this report, appeared to be of higher priority. In particular, preparing for risk-based regulation and completing the IPE reviews are proceeding at an inexplicably unconcerned pace. The IPE reviews are especially important because of what they may reveal about the existing plants, both in particular and in general. Ultimately their results are likely to be useful in structuring a risk-based regulatory framework.

RECOMMENDATIONS

The recommendations to RES are the following:

- Implementation of risk-based regulation involves many theoretical and practical subtleties. RES should provide leadership in formulating and contributing to experimental implementation projects concerning limited scope regulatory examples in order to identify the better ways to implement risk-based regulation. These projects should be undertaken with the greatest feasible collaboration with NRR, and, where feasible, should be coupled to the most urgent regulatory problems facing NRR. However, RES should not be held back in this work by any lack of participation by NRR.
- The PRA capabilities of the NRC should be greatly expanded, in terms of trained personnel, modeling capabilities and data bases. Concerning data bases, RES should formulate a plan for identifying the NRC's data needs and ensuring that they are satisfied.
- The reviews of the IPEs should be hastened and made more comprehensive. The results of the IPEs are likely to reveal vulnerabilities and strengths in individual plants and among sets of similar plants. However, they should also reveal inconsistencies among similar plants which can be helpful in refining the PRA tool. The current pace of review is inconsistent with the urgency for reaping the full safety benefits of the IPEs.
- The current program of human reliability research should be reexamined in order to determine how it could be structured to ensure that it will lead to results of practical regulatory value.
- Methods should be developed for effectively communicating PRA-based regulatory processes and results to constituencies outside of the NRC.

Respectfully submitted,

Michael W. Golay

Michael W. Golay
Subcommittee Chairman

ATTACHMENT 3

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 3, 1995

Mr. Edwin E. Kintner, Chairman
Nuclear Safety Research Review Committee
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Kintner:

I am replying to your letter of February 14, 1995, and specifically to the Report of the Accident Analysis Subcommittee in its commentary on the two paragraphs under the heading Administrative Burdens for Project Managers. The Subcommittee expresses concern about the added administrative burden on research project managers attributable to Directive 11.7, "NRC Procedures for Placement and Monitoring of Work with the Department of Energy." Directive 11.7 went into effect nearly a year ago in May 1994, after a study and revision of the provisions of the earlier Directive 1102 and Manual Chapter 1401, under which NRC offices procured research and other technical services from Department of Energy laboratories since the inception of NRC in 1974. Several important considerations triggered the effort of revision, including the Chief Financial Officers (CFO) Act, an outside audit of research procurement at DOE laboratories by an accounting firm several years ago, the findings of an investigation of the quality of the laboratory financial accounting practices by the DOE Office of the Inspector General, and an NRC internal review of project records of a number of projects then underway at the laboratories.

Directive 11.7 has been in effect for about a year now, and it has accomplished its basic purpose, although it does increase the paperwork and add to the lead time that was normally required to place work. Most project managers believe that some of the requirements for paperwork add more cost to the procurement process than benefits, and I believe that this was what the Subcommittee heard when discussing the subject with project managers last fall. From the project managers' point of view, additional time devoted to administrative procedures reduces time available to project managers for technical understanding and management of the work.

When Directive 11.7 was issued last May the NRC planned to revisit the experience with it, and to see if it is accomplishing its purposes in a cost effective way, and specifically to ascertain whether any changes and improvements are indicated. The plan was to revisit Directive 11.7 in about a year in a session that would involve not only NRC, but DOE headquarters, DOE field offices, and the national laboratories. The review will consider the 11.7 process within NRC, as well as within DOE field offices and the laboratories. This review is expected to begin soon.

I have put major attention since I came to NRC in establishing user need as a basis for planning and carrying out the NRC research program. This focus requires greater attention and effort on the part of project managers in two respects: (1) understanding the user need and (2) guiding the research so that it is most likely to answer the questions posed with technical credibility.

In carrying out research it is therefore necessary to achieve technical objectives, as well as to manage the resources required in a cost effective manner that meets the norms of administrative practice. Directive 11.7 was developed before the National Performance Review and reinventing government, with emphasis on eliminating unnecessary effort of all kinds and improving productivity in the government sector. I think it is appropriate now to review research procurement at laboratories to make any adjustments that are needed to strike the right balance between the technical and administrative requirements referred to above.

Given the scope of the comprehensive review of Directive 11.7, I suggest as an alternative to the NSRRC's request for a meeting with NRC management, that instead it meet with the 11.7 Review Group to discuss your views and concerns. This meeting could involve NSRRC as a Committee-of-the-whole, or a Subcommittee, or one or two Committee members who could then report back to the full NSRRC. I will advise you on the schedule of this activity as soon as it is established. It may be convenient to meet just before or after the July NSRRC meeting.

Sincerely,

/s/ Eric S. Beckjord

Eric S. Beckjord, Director
Office of Nuclear Regulatory Research

Distribution:
NSRRC File
JMilhoan
EHalman
PNorry
ESBeckjord
DLMorrison
TPSpeis
LJDonnelly
GSege

CF	(Y)	N
PDR	(Y)	N

TO RECEIVE A COPY OF THIS DOCUMENT, INDICATE IN THE BOX "C" COPY WITHOUT ATTACHMENT/ENCLOSURE; "E" COPY WITH ATTACHMENT/ENCLOSURE; "N" NO COPY

OFC	:RES:DIR								
NAME	:ESBeckjord:s/by								
DATE	:4/3/95								

OFFICIAL RECORD COPY

(RES File Code) RES-5C-5
(If more than one File Code) RES-

ATTACHMENT 5

April 27, 1995

Mr. Edwin Kintner, Chairman
Nuclear Safety Research Review Committee
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Kintner:

You reported on the Committee's deliberations at its February 6-7, 1995 meeting in four separate letters (dated February 13, February 14, March 1, and March 14, 1995), each addressing one of the four major research areas covered at the meeting. I have already responded to one of the Committee's comments, concerning administrative burdens of project managers, in my letter of April 3. Our responses to the rest of the Committee's recommendations and comments are attached.

Sincerely,

/s/

Eric S. Beckjord, Director
Office of Nuclear Regulatory Research

Attachment: Response to NSRRC
Comments

Distribution:
See attached list

Offc:	RES GS	D:RES R
Name:	GSege	EBeckjord
Date:	4/20/95	4/21/95

OFFICIAL RECORD COPY RES-5C-5

Attachment

RESPONSE TO NSRRC COMMENTS

(Letters, E. Kintner, NSRRC, to E. Beckjord, RES, dated 2/13, 2/14, 3/1, and 3/14/95)

CONTENTS:

A. ACCIDENT ANALYSIS

Responses to Recommendations and Comments in Letter, E. Kintner, NSRRC, to E. Beckjord, RES 2/14/95.

Page numbers for the Committee's comments cited refer to the Attachment to the above-cited letter.

A1. Helping the Committee Keep Current

Comment (p.1):

"To assist the Committee members in keeping current on research activities, the Committee requests that [a] members be provided with a copy of the quarterly abstracts of NRC publications, that [b] a review be done by RES of publications and those of particular interest to the Committee be forwarded to members, and that [c] Committee members be provided with access to the NUDOCS system."

Response:

a. We are sending the current issue of the quarterly abstracts to all Committee members and plan to provide the next issue when it comes out. [NUREG-0304, Vol. 19, No. 3, "Regulatory and Technical Reports (Abstract Index Journal), Compilation for Third Quarter 1994 July-September," dated December 1994; and the forthcoming Vol. 19, No. 4, for October-December 1994.] These quarterly compilations cover a large number of reports many of which are quite distant from the Committee's central interests. After providing these two issues, we will ask the Committee members whether they wish to continue to receive future issues, and limit further distribution to members who wish to continue.

b. We will be more ample than we have been in selection of significant reports to be sent to NSRRC members, keeping the increase moderate enough not to overburden Committee members. We will consult the Committee periodically, to determine whether we are sending too much or too little and any comments on our selection of the material sent, and adjust our practice in the light of the Committee's comments.

c. We will provide NUDOCS access to NSRRC members who have the required equipment at their disposal and wish to have access. We will contact members regarding arrangement details.

A2. ALWR Thermal-Hydraulic Research Integration

Comment (p.4):

"The Committee notes that appropriate management attention [to the ALWR Thermal-Hydraulic Integration Group (ATRIG)] is required, however, to ensure the timeliness and effectiveness of this effort in view of the variety and numbers of the participants. The Committee also suggests that such involvements with university faculties might enlarge the contacts with students leading them to consider careers with the NRC."

Response:

We recognize the need to keep close control of such a large group. Much of the work of the group is done through various subgroups, which are much easier to manage. The process has worked well so far, and some of the group members are university faculty. In light of your suggestion on enlarging the contacts with students, we are reexamining the process to determine how such an involvement could be effective.

A3. Proportion of Exploratory Research

Comment (p.5):

"The NSRRC recommends that this [10%] proportion [of exploratory, pragmatic, or readiness research] be increased."

Response:

We agree. The user-need letters are a good, effective way to elicit, document, and apply the recognized research needs of the agency. They should remain the usual basis of most but not all NRC research. Independent examination of technical issues that pose uncertainties regarding appropriate regulatory response and exploration of issues in anticipation of evolving needs have a necessarily lesser but nevertheless essential role. We share the Committee's view that these independent research functions must be pursued at an adequate level even under current tight budgets and budget projections.

There is, of course, a relation between research in current anticipation of need and user-need letters. Thus, even though we anticipate a user need request supporting it, the code development work proposed for the future would now qualify as "exploratory" or "readiness" work. It could approach 20% of our budget for thermal-hydraulic work.

A4. Direct Containment Heating

Comment (p. 6):

"The Committee recommends that RES expedite the preparation of a report for determining those Zion and Surry-like containments that meet the requirements of DCH resolution. RES reported that they have the methodology in place to resolve DCH issues with other types of containment, including the additional research needed for combustion engineering containments. The Committee requests that it be kept informed on the approaches and progress for reaching DCH resolution on all containments."

Response:

We share your concern about issuing the reports expeditiously. We applied considerable pressure on the contractor to complete the reports as soon as possible. One factor that constrains the extent to which the work can be accelerated is that much of the writing must be done by one key individual. Even if other individuals could be involved, their learning curve would not lead to significant shortening of the schedule. The current DCH resolution schedule which includes completion of peer review is:

- Westinghouse dry containment plants - November 1995
- Ice condenser plants - March 1996
- CE and B&W plants - July 1996

NUREG/CR-6109 (Surry DCH issue resolution report) is at the printer and will shortly be made available to the Committee.

Research required to address the methodology for other plants is scheduled. We will keep you informed of our progress and provide you with reports as they are completed.

A5. Listings for Contract Research Projects

Comment (p. 8):

"RES informed the Committee that the Research Plan budget documents are undergoing updating and the expected release date will be March 1995. These documents will provide the Committee with the grouping of FINS into research missions. The Committee requests that project managers be identified along with schedules for anticipated closures of projects."

Response:

The various program plans have been updated but the process continues as allocations under budget pressures are worked out. When the budget situation solidifies, we will generate new program plans. We will

provide them to the Committee as soon as they have some stability. Although the project managers are not identified in the program plans, we will identify them separately.

The research missions, the projects included within them, and priorities are a subject RES would like to discuss with the Committee at its July 1995 meeting.

A6. DOE Results

Comment (p. 8):

"... issues requiring further attention include ... concurrent DOE results for lower head integrity and fuel-coolant interactions."

Response:

We have had discussions with DOE staff involved with the research you mentioned. They have promised to provide us with the reports when they become available. Unfortunately, their contractor has been slow in providing the necessary documentation.

B. MATERIALS AND ENGINEERING

Responses to Recommendations and Comments in Letter, E. Kintner, NSRRC, to E. Beckjord, RES, 3/1/95.

Page numbers for the Committee's comments cited refer to the Enclosure to the above-cited letter.

B1. Organizational Balance in DET

Comment (p. 2):

"The Subcommittee noted that the existing allocation of workload rested unevenly on the three branches [of the new Division of Engineering Technology]. Approximate comparisons of load were indicated by estimated budgets for the branches. [table omitted]

The Subcommittee understood that this organizational arrangement was relatively new and appeared still to be in transition. Based on its limited view, the Subcommittee believes a more equitable division of work between the three branches than is indicated [in the table] would utilize available resources more effectively."

Response:

While the funding levels are different for the three branches in the Division of Engineering Technology, the management and staff believe that there is a logical basis for the division of responsibilities, that the work assignments are equitable, and that resources are being utilized effectively. The RES reorganization planning included a review of the responsibilities assigned to each Division and Branch. This was the basis for the revised staffing plan and associated funding levels.

The areas of responsibility are divided based on traditionally associated disciplines (electrical and mechanical, for example) and on emerging interactions among disciplines. For example, the EQ (environmental qualification of equipment) issue traditionally is an electrical-mechanical engineering issue. However, the cable insulation degradation issue is fundamentally a materials concern. Similarly, one concern in MOV performance is the effect of corrosion and wear on the valve parts. These are fundamentally materials issues. Thus, combining the electrical, mechanical, and materials disciplines into a single branch provides a more effective integration of technologies to address current issues.

While there are significant differences in funding levels, the staffing levels in each of the three branches are also different. The large preponderance of DET's contract research is carried out by the Electrical, Mechanical, and Materials Engineering Branch, and the Seismic and Geological Engineering Branch. Almost all of the work conducted by the Generic Safety Issues Branch is done in house by that

branch's staff, giving rise to an apparent imbalance in contract funding allocation. Further, the staff is employing a limited "matrix management" scheme to make use of staff talents in the Generic Safety Issues Branch to support efforts in the Electrical, Materials, and Mechanical Engineering Branch. Thus, the current workloads are equitably distributed among the staff.

The subject of organizational structures, staffing, and management is under exmaination at the Office and Division level within RES as the NRC makes its adjustments in response to changes in budget and the National Performance Review. A number of options will be examined and a series of changes are anticipated over the next few years.

B2. Seismic Hazard Methodology

Comment (p. 4):

"The Subcommittee is pleased to note that closure of this long standing issue [of seismic hazard methodology] appears in sight, certainly within FY96. The Subcommittee took no position as to whether the RES approach to closure was appropriate. The staff did confirm, however, that the guidelines are intended to be used in new site-related activities and not for reanalyses and backfitting of existing sites. The staff also indicated its intent that the guidelines be applicable to Western sites as well as those east of the Rocky Mountains. The Subcommittee cautioned that such universal applicability could require special approaches that may not be readily apparent, may not be technically supportable, and may not be cost-effective."

Response:

Progress has been made since we met with the Subcommittee and the activity continues on schedule. The staff's statement that guidelines are applicable to both Western and Eastern US locations pertains to the applicability of overall concept and procedures.

The staff recognizes that different tectonic environments, such as presence of active surface faults in coastal California versus consideration of only area sources in the Eastern US, present different technical issues and they have to be addressed differently. However, these technical issues do not change the overall concepts of propagating uncertainties or eliciting expert opinions.

B3. Northridge and Kobe Earthquake Effects

Comment (p. 4):

"The Subcommittee called attention to recent technical reports on effects of the Northridge earthquake. The Subcommittee requested that

it be kept informed as more analyses of these recent seismic events become available."

Response:

The staff continues to monitor the post-earthquake studies and will inform the Subcommittee of any significant results that emerge. An NRC-DOE report on the Northridge Earthquake will be published by Livermore by the end of April.

An eight-member NRC/DOE team, led by Dr. Nilesh Chokshi, of Structural and Geological Engineering Branch, also visited the Kobe area during February 13, 1995 through February 18, 1995 to observe the damage. A draft of the team report is expected to be completed in mid-May.

Committee members will be provided copies of both of these reports.

B4. ASME Code Criteria for Seismic Design of Piping

Comment (p. 4):

"The staff did not quantify this "unacceptably low margin" except to state that the piping could yield and have large deformations even at OBE levels. It was said that the incentive for the proposed ASME change is to permit removal of snubbers and hangers in some portions of piping systems to facilitate inservice inspection.

"The Subcommittee urges that the NRR/RES working group continue to seek completion of the review of the proposed code changes and assessment of their effects (by ETEC) scheduled for July 1995. The dialogue with the ASME code committee should also be continued. Development of a regulatory position should be pursued only after failure to reach agreement has become irrevocable."

Response:

It is the staff's intent to continue interactions with the Code Committee. ASME has appointed G. Eisenberg, of Nuclear Codes and Standards, as a contact person and NRC has appointed B. Sheron, Director, Division of Engineering, NRR, as the NRC's contact. A meeting between representatives of ASME and NRC is scheduled for May 25, 1995.

B5. Containment Corrosion

Comment (p. 6):

"The Committee noted that new methods of detecting metallic corrosion are being developed and might usefully be investigated by RES. These include neutron tomography and electrical property measurements."

Response:

One of the tasks in the research being carried out by Oak Ridge National Laboratory (ORNL) is an assessment of the techniques available to detect and estimate levels of corrosion. The staff will assure that these two techniques are included among those considered by ORNL.

B6. Containment Test Models

Comment (p. 6):

"The Subcommittee recalled that the NSRRC had observed some containment test models during one of its earlier visits to SNL. At that time, the Committee suggested that special consideration needed to be given to scaling effects. The Subcommittee reaffirmed that caution (the steel containment test is 1/10th size and the pre-stressed containment model is 1/4th size). The Subcommittee concern in this regard was primarily directed toward assuring that the test models are structurally valid representations. The Subcommittee also suggests that a plan be developed as to what results are expected from the test and analytical programs and what the NRC proposes that the results will be used for."

Response:

The staff agrees that assuring representative behavior of the models is of utmost importance.

The Subcommittee had visited the Containment Testing Site at Sandia National Laboratories (SNL) in 1990 and was briefed on the plans for a joint testing program with The Ministry of Trade and Industry (MITI) of Japan and the Nuclear Power Engineering Corporation (NUPEC). The NSRRC reported favorably on those plans and recommended a long range program. We are now carrying out that program.

The initial stages of the joint effort involved evolving test model designs over a period of two years. A summary of that undertaking is available in a joint paper presented last year at the Containment Workshop held in Toronto, Canada. (Copies are being mailed separately to Committee members.) It is expected that we will learn about the dominant failure modes of steel BWR and prestressed concrete PWR containments under overpressure loads and check the ability of calculational models to predict the location of failure and the associated load level. The results will be used both in the assessments of margins for existing plants and in judging the adequacy of new designs.

B7. Steam-Air Testing of Concrete Containment Structures

Comment (p. 6):

"The Committee noted that understanding containment performance during accidents includes post liner failure behavior. With reinforced concrete containments, failure occurs when the liner membrane becomes torn. Following liner failure, the ability of the containment to retain its contents appears to depend on whether the atmosphere contains steam. The Demona tests in Germany have indicated that steam-laden atmospheres depressurize more slowly than dry atmospheres. Plugging of concrete cracks by condensed steam has been postulated as the explanation. The Committee understands that past NRC containment failure tests at Sandia were performed using dry atmospheres.

The Committee suggested that it may be worthwhile for RES to supplement the testing programs for concrete structures to include a series involving steam-air mixtures. The Committee believes this may provide a more realistic basis for evaluating concrete containment performance."

Response:

The steel lined concrete structures test will examine containment performance with respect to pressure retention capability and failure modes. This test program is a cooperative effort with MITI/NUPEC (Japan). The planned test is a single experiment of a prestressed concrete containment model exposed to increasing internal pressure up to failure. When the steel liner fails and pressure retention capability is lost, we assume failure of containment and we will not investigate anything beyond the liner failure. While the suggested testing could provide some additional information, based on the significant additional costs that would be incurred, the staff does not believe that the containment structures test program should be modified as suggested.

B8. Environmental Qualification of Cables

Comment (p. 7):

"The Subcommittee is aware that a majority of operating nuclear plants have safety systems that rely on electric cable systems that were environmentally qualified to standards that were in effect at the time of their construction and were "grand-fathered" so as not to require requalification to present standards. Also the Subcommittee understands that about 1/3 of cables subject to the present EQ testing failed to meet specifications. The Subcommittee is not aware what portion, if any, of these "failed" cables retained the capability to perform their required function in an accident environment. Experience from other industries and other countries may be helpful to the NRC."

Response:

The tests described were generic "qualification" tests to demonstrate that cables could survive harsh testing conditions that are intended to envelop postulated generic accident conditions. Consequently, "failing" the test does not necessarily imply that a cable would not be able to fulfill its required function in an accident environment. This would be a plant and circuit specific determination that is beyond the scope of such tests.

The staff concurs with the Subcommittee's assessment that experience from other industries and countries could be helpful. Contacts have been made in the international community and we plan to work with other interested parties, nationally and internationally, to obtain pertinent information and data.

B9. Effect of Reactor Vessel Material Variation

Comment (p. 8):

"The Subcommittee learned that prior research has not adequately resolved questions of variations in material properties and their bearing on embrittlement. The current research plan is designed to provide the data and methodologies needed to deal effectively with this important, continuing concern."

Response:

The material chemistry and property variability issue described for the Subcommittee is a Palisades plant-specific issue, although it raises generic questions. The research program has been designed to provide the basic generic materials data and analysis methods necessary to perform plant-specific analyses. In that context, the research results have been fully successful in that the staff and our contractors were able to provide significant assistance to NRR in resolving the Palisades-specific issues. The research plan described for the Subcommittee is intended to contribute to resolution of the generic questions raised by the Palisades data.

B10. BWR Internals

Comment (p. 8):

"The Subcommittee was not made aware of the significance of these [BWR internals] cracking incidents. No instance of a safety system failure resulting from core shroud ring cracking was reported. The Subcommittee is pleased that RES is being anticipatory ("proactive") of future problems but urges careful review of the devotion of scarce resources to programs whose priority has not been established."

Response:

The safety significance of cracks in the BWR core shrouds has been discussed in a recent Commission paper (SECY-94-276), a copy of which is being sent to NSRRC members. As discussed on page 5 of that paper, the "main concern associated with cracks in the upper shroud welds is during a steam line break, since the lifting forces generated may elevate the top guide sufficiently enough so that lateral support of the fuel assemblies is lost and control rod insertion may be prevented. The main concern associated with cracks in the lower elevations of the core shroud is the postulated recirculation line break. This is because for the lower welds the recirculation line break loadings, if large enough, could cause a lateral displacement or tipping of the shroud which may affect the ability to insert the control rods and may result in the opening of a crack that could allow leakage through the shroud and out through the pipe break. If this leakage were large enough, it could potentially affect the ability to reflood the core and maintain adequate core cooling following a pipe break, and could affect the ability to shutdown the reactor with the standby liquid control system (SLCS)."

Regarding the priority assigned to this research area, the cracking of BWR internal components was reported to the Commission as an emerging technical issue. Because of the numerous cracking incidents in the shrouds and other internals components, the safety significance of the failure of these components, and the potential for cracking of other components in both BWRs and PWRs, RES and NRR have independently identified this research area as a high priority.

C. INSTRUMENTATION AND CONTROL AND HUMAN FACTORS

Responses to Recommendations and Comments in Letter, E. Kintner, NSRRC, to E. Beckjord, RES, 2/13/95.

Page numbers for the Committee's comments cited refer to the above-cited letter.

C1. Plant Personnel Error Rates

Comment (p. 2):

"The Subcommittee is very disturbed by recent research that suggests error rates by plant personnel may be an order of magnitude greater than the generally accepted error rates (about 1% vs. 0.1%). This discrepancy, if substantiated, could have a significant impact upon the validity of PRAs that use the lower value. Resolving this issue, including establishing a precise definition of error rate for personnel, should have a very high priority, and problems associated with getting the required data from the plants should not be allowed to slow or detour this task. The Subcommittee also wonders if there is an innovative way that I&C can be used to quantitatively assess and monitor human performance."

Response:

The error rates used in valid PRAs should be consistent with the degree of difficulty of the action, the stress level, feedback information, and other factors. The error rate discussed with the Subcommittee was based on failure of critical tasks during requalification exams for licensed operators, and are applicable only to limited uses in PRAs. The data showed that 45 Individual Simulator Critical Tasks were not performed satisfactorily in a population of 4071 Individual Simulator Critical Tasks reviewed (about 1%). Critical tasks are essentially those tasks whose failure to perform properly would place the plant in a less safe state. The project is attempting to find a substantiated comparison of this finding with the unsatisfactory rate that could be expected if calculated by the Accident Sequence Evaluation Procedure for estimating human error rates. We are still assessing the data. We agree that the project requires priority effort. The process of obtaining data from the plants has not delayed this project.

Currently, RES is not aware of any innovative non-intrusive uses of I&C in the assessment of human performance. Some types of human behavior can be monitored with I&C. Television monitors are quite useful for overall observations and some physiology can be monitored. However, such monitoring is very intrusive. As plans for human factors research evolve, RES will determine how it should undertake projects on human behavior monitoring and what priority they should receive.

C2. Functionally Identical Components

Comment (p. 2):

"The replacement of analog components with 'functionally identical' digital components is a current trend by industry. A more quantitative methodology for determining whether the resultant hybrid analog-digital system has the same risk level as the older analog systems is as safe or safer than the replacement system, is a critical need for NRR. (This would be consistent with the current NRC increased use of Probabilistic Risk Assessments in regulatory activities.) Current ad hoc determinations of adequacy by NRR and by utilities under 10CFR50.59 need to be enhanced by a more rigorous objective (or quantitative) methodology."

Response:

We agree. The appropriate work is in our plans but budget cuts may significantly delay the work. Since NRR's programs and approach were not reviewed at this meeting, it is inappropriate for us to comment on their determinations. The fundamental requirements for determination of adequacy remain unchanged whether the I&C system modification is analog or digital. The scope of the requirements that need to be addressed and the means of demonstrating compliance may change depending on the type and extent of the modification requested.

C3. Verification and Validation

Comment (p. 2):

"The Verification and Validation (V&V) research program seems to have a reasonable balance between short term (adaption of current V&V methodology) and long term ('rigorous' methods) approaches. The Subcommittee believes there are opportunities to secure results in a more timely manner through a more aggressive program in this area. Participation of NRC personnel in industry (IEEE, ANS, etc) standards preparation (with subsequent adaption of these standards in NRC regulations) is very beneficial. NRC still needs to clearly define to the utility industry its requirements for software V&V through the use of 'acceptance criteria.' The goal of the V&V research program needs to be directed toward this objective. The Subcommittee also encourages the continued investigation of CASE (Computer Assisted Software Engineering) tools in meeting the V&V requirements. The goal here is to utilize automation to the maximum extent possible in software preparation to correctly satisfy program performance requirements and to eliminate human programming errors."

Response:

RES has initiated an effort to endorse consensus standards as appropriate through the issuance of new and revised Regulatory Guides.

Part of this effort has been to increase our participation on standards committees as another means of expediting the effort. The schedule for the Regulatory Guides is rather aggressive and being driven by the revision to the applicable Sections of the Standard Review Plan.

The Standard Review Plan is being revised to clarify how licensees and applicants can meet the fundamental requirements for instrumentation and control systems. It should be noted that the fundamental requirements for instrumentation and control systems have not changed; rather the revisions to the Standard Review Plan will clearly define how the same fundamental requirements can be met when the modification or design contains instrumentation and control systems that are computer-based rather than analog.

The RES effort on CASE tools to review safety-critical software is continuing for the very purpose of providing the NRC reviewers with automated partitioning of source code to aid in checks for common code. This remains a high priority effort in the program.

C4. Halden Project

Comment (p. 2):

"The Subcommittee endorses continued participation in the Halden IC&HF project as a signatory member. Its representative should continue to push for projects that have direct benefit to NRC and to the U.S. nuclear utility industry. Furthermore, NRC should strive to have research reports prepared that can be distributed without restrictions to U.S. utilities."

Response:

Lessons learned reports from the Halden Reactor Project summarize their research experience in human factors design and experiments with computer driven interfaces and with high integrity software. The abstracts are being separately sent to the Committee members. The reports will be provided to members upon request. The reports are:

G. Dahll & T. Sivertsen, (HRP), "A Lessons Learned Report on Software Dependability, Part I.: Survey & Conclusions & Recommendations," HWR-374, June 1994;

G. Dahll & T. Sivertsen, (HRP), "A Lessons Learned Report on Software Dependability, PartII: Technical Basis," HWR-375, June 1994;

K. Folleso & F.S. Volden, (HRP), "Lessons Learned on Test and Evaluation Methods From Test and Evaluation Activities Performed at the OECD Halden Reactor Project," HWR-336, September 1993;

K. Folleso, P. Meyer, F.S. Volden, (HRP), "Source Material for Lessons Learned From Test and Evaluation Activities Performed at the OECD Halden Reactor Project - A Digest of Studies From 1982 Through 1992," HWR-337, September 1993; and

W. G. Kennedy, "Lessons Learned in Process Control at the Halden Reactor Project," NUREG-1361, December 1989.

The issue of the limitations on the availability of Halden Reactor Project reports was again discussed at the Halden program group meeting in March, 1995, by the USNRC technical representative to the program group. Additionally, technical papers are frequently presented by Halden Reactor Project staff at open conferences and seminars that accurately reflect the content of the Halden reports.

C5. Experience of Others

Comment (pp. 2-3):

"The U.S. nuclear power industry does not exist in a vacuum, and neither does the regulation of nuclear power. French, Japanese, German, and especially Canadian licensing authorities have dealt with the regulatory aspects of digital systems well ahead of the U.S. Their experience does not appear to have been adequately examined and/or factored into current RESEARCH and NRR plans. Furthermore, other Federal agencies (FAA, DOD, NASA, EPA, FDA, etc) as well as industrial groups have long ago converted many systems from analog to digital systems. NRC has much to learn from such groups. A short visit by a contractor followed by a report is not adequate. NRC or contractor personnel need to spend enough time to really understand the approaches and methodologies of other organizations, and consider how they might be adapted the NRR's needs. Furthermore, the Subcommittee strongly encourages participation by RESEARCH personnel in both industry and professional society standards activities related to systems that can shift from analog to digital operation."

Response:

NRC has attempted to incorporate the experience of others into its research plans. The NRC staff and contractors interact extensively with other Federal agencies, including the Air Force, FAA, NASA, FDA, NIOSH, and NIST, individually and in ad hoc forums. We interact with EPRI, and we have interacted with MIT on its "International Program for Enhanced Nuclear Power Plant Safety." NRC participates in international activities such as the Halden Project and have formal agreements for technical exchange from organizations within other countries (United Kingdom, Sweden, and France).

RES participation in standards activities includes the following organizations:

- International Standards Organization (Technical Committee 159, Subcommittee 6, Working Group 8) Ergonomic Design of Control Centers;

- American Nuclear Society, Standards Committee, Working Group ANS-58.8, Time Response Design Criteria for Safety-Related Operator Actions;

- Institute of Electrical and Electronic Engineers (IEEE 1012 Working Group) Sponsor Software Engineering Committee of the IEEE Computer Society;

- American Nuclear Society, "American National Standards for Selection, Qualification, and Training of Personnel for Nuclear Power Plants," Subcommittee ANS-3 Reactor Operations and Support Systems (Working Group ANS-3.1); and

- Institute of Electrical and Electronics, Inc., IEEE Std. 7-4.3.2-1993, IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations, Subcommittee 6.4 on Revision to IEEE 603.

C6. National Academy of Science Study

Comment (p. 3):

"The Subcommittee views with concern the slow progress with the National Academy of Science (NAS) study. The May 1995 deadline for Phase I is probably unrealistic if results are to be meaningful. RESEARCH personnel should monitor the NAS study progress by attendance at open meetings and seek opportunities for additional input if the believe the objectives of the study are not being addressed adequately. Indeed, the Subcommittee strongly believes that NRC should present a comprehensive picture of the current NRR procedures used to evaluate digital systems submitted for review (e.g, the type of material briefly summarized by Joe Joyce at our meeting) and seek either approval of the process or guidance for changes or alternative approaches that the NAS can provide. (Notice that such approval or alternatives is being sought should be conveyed to the NAS committee at its first meeting.) The Subcommittee encourages top management of RESEARCH and NRR to pre-review the NRC presentations to the NAS study with this objective in mind. A presentation that only describes the research program and its level of effort or gives a statistical picture of the program at RESEARCH and NRR would be of little value to either NAS or NRC. The focus must be on the process of evaluating proposed digital systems and establishing acceptance criteria."

Response:

The NAS study on digital instrumentation and controls plans to deliver a report on the issues by June 13, 1995. This is about six weeks behind the original schedule. During the first meeting of the NAS panel (Digital Instrumentation and Control Committee, January 31 through February 2, 1995) several presentations were made by instrumentation and control staff from NRR. These presentations responded to information requests made by the panel. There were no presentations made on the research program. However, written information on these programs was provided to the NAS panel. The Chairman of the NSRRC Subcommittee on Instrumentation and Controls and Human Factors Subcommittee participated in the first meeting of the panel and reported on the meeting (letter from R.E. Uhrig to E. S. Beckjord dated February 2, 1995). The NRR presentations for the panel had been pre-reviewed by branch chiefs from RES and NRR. Finally, Eric Beckjord and David Morrison each made presentations to the panel.

C7. Recruitment of Personnel

Comment (p. 3):

"... this delay in the NAS Study should not be used as an excuse to delay a number of important decisions, such as the replacement of retiring personnel, the recruiting of needed expertise (especially in digital systems) and the initiation of research projects. Regardless of what the NAS Study recommends, the types of expertise needed within RESEARCH to deal with digital systems is clearly apparent. Recruiting the appropriate personnel (which appear to be in short supply) should be allowed to proceed in a timely manner, even if this means reductions in other areas of RESEARCH. The Subcommittee is especially concerned about the lack of expertise in areas such as reliability and safety analysis od hybrid I&C and digital system architecture, and will continue to monitor progress in staffing in this and related areas."

Response:

We clearly recognize the need to recruit the expertise identified and the delay in recruiting and hiring is unrelated to the NAS study. We are bound by agency and office staffing levels and we have experienced significant reductions in those staffing levels as a consequence of budget reductions. The named expertise has been identified as a high recruiting priority.

C8. Basis for Priorities

Comment (p. 3):

"The RESEARCH program seems to have been slow to respond to changing technology. Part of this may be due to NRC's unreasonably complex

contracting procedures, but the back log of seemingly high priority items raises the issue of how these priorities are established. Such items as the safety implications of hybrid analog-digital systems and large screen displays are just now being addressed, even though they have been in use for several years. The basis for establishing priorities should be reviewed."

Responses:

Within the current human factors program, we have given highest priority to that work identified by NRR as needed for timely support of their regulatory needs. Priorities are reviewed regularly by NRR, RES management, and the Deputy Executive Director for Nuclear Reactor Regulation, Regional Operations and Research. Within current RES budgets, staffing, and priorities, we have not been able to expand the program to include a number of desirable items including those mentioned by the NSRRC.

C9. Timeliness of Research

Comment (pp. 3-4):

"Finally, the Subcommittee wants to express its concern regarding the timeliness of RESEARCH activities. (While this issue goes well beyond the aegis of the Subcommittee, it is also pertinent to the activities we reviewed.) Several of the NRR users expressed the view that when they wanted answers to current regulatory issues, the utilized contractor personnel, and that assistance from RESEARCH was requested only on long-term issues. RESEARCH needs to review its activities with the user Divisions of NRC to assure that its priorities reflect NRC needs and that a proper balance is given to short-term and long-term activities, least its activities become irrelevant to the rest of NRC. Perhaps the use of 'umbrella contracts' with experts and organizations would expedite the making of expertise available in a more timely manner."

Response:

We recognize the need to be timely in the delivery of our research products. We conducted a self-assessment last fall to identify causes of delays and we are working to improve the schedule effectiveness of the prioritizations and allocations of limited resources. We meet quarterly with our users to discuss priorities, progress, and problems. These formal meetings are in addition to routine interactions. We do not have sufficient staff to respond to all short-term and long-term needs of the user offices. NRR will continue to need to do some of their own short-term technical assistance contracting.

C10. Integrated Systems Approach

Comment (p. 4):

"The Subcommittee also reviewed certain aspects of the human factors research program, but a comprehensive review was deferred to a future meeting. However, the NSRRC reiterates its previous emphasis on the critical importance of an integrated systems approach for instrumentation and control, man-machine interface, and human factors."

Response:

We share the Subcommittee's view on the importance of an integrated approach.

D. PROBABILISTIC RISK ASSESSMENT

Responses to Recommendations and Comments in Letter, E. Kintner, NSRRC, to E. Beckjord, RES, 3/14/95.

Committee comments cited are from page 4 of the attachment to the above-cited letter.

D1. Risk-Based Regulation

Comment:

"Implementation of risk-based regulation involves many theoretical and practical subtleties. RES should provide leadership in formulating and contributing to experimental implementation projects concerning limited scope regulatory examples in order to identify the better ways to implement risk-based regulation. These projects should be undertaken with the greatest feasible collaboration with NRR, and, where feasible, should be coupled to the most urgent regulatory problems facing NRR. However, RES should not be held back in this work by any lack of participation by NRR."

Response:

The scope of changes to NRC practices to reflect risk-based regulation (RBR) is so large that all principal offices must be involved. The PRA Implementation Plan was originally developed to help guide this work. Since the plan was developed, additional management practices have been initiated, including holding monthly meetings of management to identify and address issues, establishing task groups for specific implementation plan items, and convening a "PRA Training Focus Group" to oversee the rapid evolution of the agency's PRA training. (An update of the Implementation Plan summarizing such changes was provided to the Commission as SECY-95-079; the Commission was briefed on this paper on April 5, 1995. We are separately mailing SECY-95-079 to NSRRC members.)

Within the context of the Implementation Plan, the Office of Nuclear Regulatory Research is providing leadership in implementing risk-based regulation. RES has lead responsibility in the development of a general framework for the agency's RBR activities, as well as the implementation of certain risk-based regulatory changes such as relaxations of 10CFR50 Appendix J (containment leak testing) and Appendix R (fire protection). It also has responsibility for a number of other supporting activities, as identified in the Plan, such as methods development.

Recognizing the large scope of RBR and the limitations in PRA expertise within NRC, the agency (including RES and the other offices) is focusing its attention on the most urgent regulatory problems. While this focusing may be taking more time than originally anticipated, a "lack of participation" by NRR has not been an issue. As with other offices, NRR

management has made a clear commitment to aggressively pursue risk-based regulation.

D2. PRA Capability

Comment:

"The PRA capabilities of the NRC should be greatly expanded in terms of trained personnel, modeling capabilities, and data bases. Concerning data bases, RES should formulate a plan for identifying the NRC's data needs and ensuring that they are satisfied."

Response:

NRR, AEOD, and RES are working closely on these issues. AEOD is responsible for offering the training and collecting the data but RES and NRR each contribute to defining the needs. A proposed rule is being processed to assure the data collection.

D3. IPEs

Comment:

"The reviews of the IPEs should be hastened and made more comprehensive. The results of the IPEs are likely to reveal vulnerabilities and strengths in individual plants and among sets of similar plants. However, they should also reveal inconsistencies among similar plants which can be helpful in refining the PRA tool. The current pace of review is inconsistent with the urgency for reaping the full safety benefits of the IPEs."

Response:

We agree that the schedule for IPE and IPEE reviews should be shortened. We have revised our review strategy to do that. However, there are no plans to do a comprehensive review of all IPEs and IPEEEs. If the IPEs are proposed for use in specific regulatory actions, they will get more review at that time.

D4. Human Reliability Research

Comment:

"The current program of human reliability research should be reexamined in order to determine how it could be structured to ensure that it will lead to results of practical regulatory value."

Response:

Human reliability research is structured to obtain results of practical regulatory value. Some of the research, e.g., the Organizational Factors research, is novel and may not reap the benefit needed; but the need for that type of research is great enough to justify the effort, even if the results are not assured. If we were sure of the outcome, there would be no need for the research. We believe that organizational factors can have a significant impact on plant safety but we currently have no good means of quantifying that impact.

D5. Communication of PRA Processes and Results

Comment:

"Methods should be developed for effectively communicating PRA-based regulatory processes and results to constituencies outside of the NRC."

Response:

We agree. In fact, this statement applies to the full spectrum of RES products, not just those which are PRA related. We are exploring options to do that and would welcome any specific suggestions.

BRIEFING PACKAGE

MEETING WITH NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE

July 27, 1995, 2:00-3:30

CONTENTS:

SCHEDULING NOTES

Meeting with Nuclear Safety Research Review Committee

Thursday, July 27, 1995 2:00 p.m. - 3:30 p.m.

2:00 - 2:30	Introductory remarks	E. Kintner, Chairman
	Overall research program plans and priorities	
2:30 - 2:40	Research on instrumentation and controls and human factors	R. Uhrig
2:40 - 2:50	Probabilistic risk assessment research	M. Golay
2:50 - 3:00	Waste disposal research	F. Molz
3:00 - 3:30	General discussion	Commissioners & NSRRC Members

JULY 1995

NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE (NSRRC)

Continuing Members

Mr. Edwin E. Kintner, NSRRC Chairman
Executive Vice President
GPU Nuclear Corporation (retired)

Dr. S. George Bankoff
Professor of Chemical and Mechanical Engineering (Emeritus)
Northwestern University

Professor Anthony J. Baratta
Professor, Department of Nuclear Engineering
Pennsylvania State University

Dr. E. Thomas Boulette
Sr. Vice-President, Nuclear Operations
and Station Director, Pilgrim Station
Boston Edison Company

Mr. Sol Burstein
Vice Chairman
Wisconsin Electric Power (retired)

Professor Michael W. Golay
Professor of Nuclear Engineering
Massachusetts Institute of Technology

Professor Robert D. Hatcher, Jr.
Professor, Department of Geological Sciences
University of Tennessee

Professor Charles Mayo
Associate Professor of Nuclear Engineering and
Director, Nuclear Reactor Program
North Carolina State University

Professor Fred J. Molz, III
Professor, Civil Engineering
Auburn University

Dr. Richard Vogel
Sr. Scientific Advisor, EPRI (retired)

Dr. Robert E. Uhrig
Distinguished Professor of Engineering
Department of Nuclear Engineering
University of Tennessee

Dr. Sumio Yukawa
Consultant (metallic materials, components)

NUCLEAR REGULATORY COMMISSION

CHARTER

NUCLEAR SAFETY RESEARCH REVIEW COMMITTEE

1. Committee's Official Designation

NRC Nuclear Safety Research Review Committee (NSRRC)

2. Committee's Objectives, Scope of Activities, and Duties

On a continuing basis, NSRRC will provide advice to the Director of the Office of Nuclear Regulatory Research and through him the Commission, on matters of overall management importance in the direction of the NRC's program of nuclear safety research. Matters requiring NSRRC's attention will be posed by the Commission, by the Director of the Research Office, or as an outcome of prior NSRRC deliberations. Nuclear safety research is understood to encompass technical investigations of the implications for public health and safety of the peaceful uses of atomic energy and the reduction of those investigations to regulatory practice.

NSRRC activities will include assessment of and recommendations concerning:

a. Conformance of the NRC nuclear safety research program to the NRC Philosophy of Nuclear Regulatory Research, as stated in the Commission's Strategic Plan, and to specific Commission directions.

b. Likelihood of the program meeting the needs of the users of research.

c. Appropriateness of the longer range research programs and the correctness of their direction.

d. Whether the best people are doing the work at the best places; whether there are other options, including cooperative programs, that would yield higher quality work, or otherwise improve program efficiency.

e. Whether the program is free of obvious bias, and whether the research products have been given adequate, unbiased peer review.

In addition, NSRRC will conduct specialized studies when requested by the Commission or the Director of the Office of Nuclear Regulatory Research. If appropriate, these studies will be published as reports.

3. **Time Period Necessary for the Commission to Carry Out its Purpose**

In view of the goals and purposes of the Committee, it is expected to be continuing in nature.

4. **Official to whom this Committee Reports**

The Director of the Office of Nuclear Regulatory Research and, as appropriate, through the Director to the Commission.

5. **Agency Responsible for Providing Necessary Support for this Committee**

Nuclear Regulatory Commission. Within the Commission, support will be furnished by the Office of Nuclear Regulatory Research.

6. **Description of Duties for which the Committee is Responsible**

The duties of the NSRRC are solely advisory and are stated in paragraph 2, above.

7. **Estimated Annual Operating Costs in Dollars and Man-Years**

$125,000; 0.7 person-year.

8. **Estimated Number and Frequency of Committee Meetings**

The Committee will meet at such times and places as it deems necessary, but not less than once a year. Subcommittees may meet as deemed necessary to achieve their assigned tasks.

9. **Committee's Termination Date**

Two years from the filing date, subject to renewal by the Commission. See also, paragraph 3 above.

10. **Members**

a. Committee members, including the Chairperson, shall be appointed by the Commission following nomination by the Director of the Office of Nuclear Regulatory Research.

b. Approximate number of Committee members: 9 to 12.

c. Members will be chosen to ensure an appropriately balanced representation of the research management community, taking into account: (1) demonstrated experience in high-level management of programs in

applied research; (2) demonstrated expertise in one or more disciplines of applied science and engineering; (3) broad acquaintance with the public health and safety issues associated with the peaceful uses of atomic energy, and (4) a balance of experience in the academic, industrial, and national and not-for-profit laboratory environments.

11. **Date of Filing:** February 9, 1994

John C. Hoyle
Advisory Committee Management Officer

[7590-01]

NUCLEAR REGULATORY COMMISSION

Nuclear Safety Research Review Committee

AGENCY: Nuclear Regulatory Commission.

ACTION: Notice of change of meeting schedule.

As announced on July 6, 1995 (60 FR 35240), the Nuclear Safety Research Review Committee (NSRRC) will hold its next meeting on July 26-27, 1995. The purpose of the present notice is to provide a revised schedule, reflecting a shift of the Committee's July 27 meeting with the Commission from the morning to the afternoon. The location of the meeting on July 26 and the morning of July 27 will be the Severn Room at the Hyatt Regency Hotel, One Bethesda Metro, Bethesda, MD. The location of the July 27 afternoon portion of the meeting will be the Commission Conference Room in the One White Flint North (OWFN) Building, 11555 Rockville Pike, Rockville, MD.

The revised schedule is as follows:

Wednesday, July 26	(Severn Room, HYATT REGENCY HOTEL, BETHESDA)
8:00 - 8:20	Introductory remarks
8:20 - 12:00	Overall research program plans and priorities
1:15 - 4:45	Subcommittee reports
4:45 - 6:00	Committee discussion in preparation for Commission briefing
Thursday, July 27, a.m.	(Severn Room, HYATT REGENCY HOTEL, BETHESDA)
8:00 - 10:15	Committee discussion in preparation for Commission briefing (continued)
10:30 - 12:00	Status update on steam generator tube integrity issues

Thursday, July 27, p.m. (COMMISSION CONFERENCE ROOM, OWFN, ROCKVILLE)

2:00 - 3:30 Meeting with the Commission

3:30 - 4:00 Committee discussion: follow-up plans

Any inquiries regarding this notice or any subsequent changes in the status and schedule of the meeting may be made to the Designated Federal Officer, Mr. George Sege (telephone: 301-415-6593), between 8:15 am and 5:00 pm.

Dated at Rockville, Maryland this 11th day of July, 1995.

For the Nuclear Regulatory Commission

/s/ Andrew L. Bates
Andrew L. Bates
Federal Advisory Committee
Management Officer