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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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MEETING WITH ADVISORY COMMITTEE

ON REACTOR SAFEGUARDS (ACRS)

- - -

PUBLIC MEETING

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Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland
Friday, December 6, 1996

The Commission met in open session, pursuant to notice, at 9:35 a.m., Shirley A. Jackson, Chairman, presiding.

COMMISSIONERS PRESENT:

SHIRLEY A. JACKSON, Chairman of the Commission
KENNETH C. ROGERS, Commissioner
GRETA J. DICUS, Commissioner
NILS J. DIAZ, Commissioner
EDWARD McGAFFIGAN, JR., Commissioner

STAFF AND PRESENTERS SEATED AT THE COMMISSION TABLE:

JOHN C. HOYLE, Secretary of the Commission

THOMAS KRESS, Chairman

ROBERT SEALE, Vice Chairman

GEORGE APOSTOLAKIS, Member

IVAN CATTON, Member

DON MILLER, Member

DANA POWERS, Member

WILLIAM SHACK, Member

P R O C E E D I N G S

CHAIRMAN JACKSON: Good morning, ladies and gentlemen. It is a pleasure to meet once again with Dr. Kress and the members of the NRC's Advisory Committee on Reactor Safeguards, who plan to discuss a number of topics of interest with the Commission at today's session.

However, since this is the last Commission meeting for ACRS member Dr. Ivan Catton, I want to pause for just a moment to express the Commission's appreciation for your eight years of dedicated service to the ACRS and to the Commission. In fact, I would like to present to you this letter expressing our sincere appreciation, signed by all members of the Commission, thanking you on behalf of each and all the Commissioners. Thank you very much.

MR. CATTON: Thank you very much.

[Applause.]

CHAIRMAN JACKSON: I also have a plaque.

MR. CATTON: Thank you very much.

[Applause.]

CHAIRMAN JACKSON: Over the years the ACRS has provided valuable and timely advice to the Commission on the safety aspects of proposed as well as existing nuclear facilities. I know you are considering a number of topics that are of critical importance to the Commission today. So we are fortunate to be able to draw on your expertise and

the views of you who are a selected group of technical experts as we try to solve and resolve various issues in licensing and regulation.

During today's briefing we will cover a number of topics and I will just detail them for the record.

Digital instrumentation and control systems.

The plan developed by the Office of Research for upgrading thermal-hydraulic codes.

Risk-informed, performance-based regulation and related matters.

The potential use of IPE and IPEEE results to compare the risk of the current population of plants with the safety goals.

Use of the Commission's safety goals on a plant-specific basis.

The use of RuleNet in the regulatory process.

Dr. Kress and members of the Committee, my fellow Commissioners and I welcome you to this meeting and anticipate another candid and informative session with the Committee.

I understand that copies of the briefing material are available at the entrances to the room.

If my colleagues don't have any opening comments, Dr. Kress, why don't you proceed.

MR. KRESS: Thank you once again. It is a

pleasure to meet with the full Commission in a way of communicating and exchanging the views and maybe clarifying some of our views for you.

I don't have much else to add other than that. So I think we ought to jump right into the agenda. The first item is the digital I&C. That, of course, is under the cognizance of Dr. Miller.

MR. MILLER: Thank you, Tom.

I'm pleased to report that a regulatory framework for digital I&C systems has been issued, and that has been issued for public comment in the form of a Standard Review Plan Chapter 7 update, various regulatory guides, a large group of branch technical positions, and an SER on EMI/RFI.

The ACRS met in three different meetings, in March, May and August, to discuss these documents with the members of the staff. I might say that dialogue has been very constructive on both sides. We issued reports to the Commission in June and October following those meetings.

We do expect final review of the overall regulatory framework sometime in either April or May, depending on various schedules, public comments and the National Academy study. The Committee also expects recommendations made by the Academy study will be factored into the regulatory framework at that time in addition to public comments and an SER on commercial, off-the-shelf

software.

CHAIRMAN JACKSON: When do you expect the National Academy Phase 2 report to be available?

MR. MILLER: The current date that I understand is the middle of December. So just in a few weeks. We will, of course, have that very quickly, and I'll be reviewing it, as well as other members, during the month of January.

COMMISSIONER DICUS: That report was clearly overdue. There is a little bit of information, I think in part, at least, because of some of the complexities involved. Is there something else why this is running behind schedule? I had heard perhaps it was going to be into next year before it was available.

MR. MILLER: Members of the ACRS have really not been too involved in their debates. I think only one member attended one meeting, as I recall.

CHAIRMAN JACKSON: I don't think you can really control that.

MR. MILLER: It's their study.

COMMISSIONER DICUS: I just wondered if you had anything else on it.

MR. MILLER: There are difficult issues. I know some members of that study panel and I know their views, and there are very diverse views on several issues. They are trying to reach a consensus, and that's a challenge at

times.

MR. APOSTOLAKIS: I attended the meeting. The differences of opinion were significant. So I can see how the report can be very late. Very significant.

MR. SEALE: I think there is one other point. The Committee was very much involved in the process, working with the staff to initially decide to do the study, that is, to refer the issue to the National Academy, and so on. There was a rather conscious decision that it would be inappropriate for the ACRS then to try to influence the direction of that study. So we've tried to keep our hands off of it and strictly act as observers to the extent that we did have any involvement at all.

CHAIRMAN JACKSON: Thank you.

MR. MILLER: Thanks for the question. We are anxious to see the report. It will certainly be very important to the regulatory framework.

There have been a number of issues and concerns we've expressed in our letters that I would like to review for you. Members of the Committee will probably make comment.

One is the level of detail provided in the regulatory guides.

The second is the balance and guidance between the review of design process versus assessment or product.

And then the linkage of the Standard Review Plan Chapter 7 update with other parts of the standard review plan, specifically probably Chapter 18, which is PRA.

A graded approach is based on importance of safety. I might make a comment. As the various parts of the Standard Review Plan PRA, which I know you are all interested in also hearing about, are evolving it is becoming evident that various parts of that might be important to digital I&C systems. So there may be an obvious linkage and obvious supporting situation between those parts.

Finally, we had a review of the I&C research program yesterday, and I'm pleased to say a number of issues there addressing both current research programs and planned research programs are important to I&C systems, particularly digital systems. Specifically, software and design, which are a noted weak link in the process of software development, and environmental stressors, which we have various interest in. Specifically, lightning, smoke and EMI/RFI, all being addressed by a research program.

I always like to close with a comment. As we look at digital I&C systems, particularly as they relate to safety systems, we always need to look back in history. I always like to look back at IEEE 279, which is part of regulation, which very clearly says safety systems in

nuclear power plants should be and must be maintained very simple. That means digital I&C systems with respect to safety systems have to be simple. In that respect, they should be able to be made safer and very effective in their use in nuclear power plants.

CHAIRMAN JACKSON: Let me ask you this question. I'm aware, and you've just made the point, that the Committee has raised concerns about the level of detail provided in the reg guides. Do the guidance documents contain acceptance criteria for things like software reviews and defense in depth and diversity, and if so, how would you characterize those criteria as they are currently laid out?

MR. MILLER: I think there is even diversity of opinion among the Committee members. First of all, the regulatory guides fundamentally endorse a set of industrial consensus standards, which really represent current software engineering practice.

In that sense, there is some debate about the level of acceptance criteria. I know my colleague Dr. Apostolakis will jump in on that one, because he has a lot of concern about that where the acceptance criteria are correctly specified.

I think in the area of diversity and defense in depth, those issues are more appropriately spoken to in branch technical positions rather than regulatory guides.

George, I'm certain you want to make comments on that one.

MR. APOSTOLAKIS: I really don't like what I see. I tried to follow the details of the guide. One of the things that strikes you is that you are continually referred to some IEEE standard. By the time you are done you have a whole pile of standards, each one sending you to another and another and another. I am exaggerating a little bit, but you follow all these references to another guide, another guide, another guide, and at the very end the ultimate advice is make sure you do a good job. To me that's not an acceptance criteria. You could have told me up front that I have to make sure I do a good job.

Example. You have to have a plan to review or to develop the software. That's great. Let's have a plan. So you go a little more deeply to see what does that mean. All it says essentially is the acceptance criteria is "here's my plan." Then you say, okay, you have a plan. To me that means nothing. That means absolutely nothing, just to say here is a plan, thank you very much; you do have a plan; let's go on to the next item.

I don't see any requirements or any criteria as to what constitutes a good plan. The mere existence of the plan seems to be the acceptance criteria. And that's a problem I'm having.

CHAIRMAN JACKSON: Any other members of the Committee have any comments?

MR. MILLER: I think the counterpoint is that the standards do specify the quality of the plan in various aspects. They do specify requirements for testing throughout the plan. Each step you go through the software development process requires testing.

In the end the staff has to audit whether the plan is carried out or not. Maybe Professor Apostolakis is worried about how do you audit it and verify the plan has been carried out in a high quality manner. It does require you to carry out a plan.

MR. APOSTOLAKIS: Obviously there is a disagreement here.

MR. MILLER: One of the strengths of this Committee is there is not always total agreement.

MR. APOSTOLAKIS: Trying to understand how these documents work, what is a regulatory guide, what is this, an SLP and so on, I went back and I found some other regulatory guides for other issues that dealt with more, let's say, technical issues, like thermal-hydraulics and so on. And I found acceptance criteria that are acceptance criteria: You should make sure that the humidity is below this value. To me that's an acceptance criteria. To say "make sure you have a plan" is not an acceptance criteria in my book.

On the other hand, Professor Miller has argued that there is a certain culture among software developers. To them this kind of advice means a lot, which perhaps means that we are at the mercy of the reviewer. If the reviewer is very good, perhaps you will get a good review. If the reviewer is mediocre, you will get a mediocre review, because certainly the documents will not force him to do a good job.

It's probably an extreme position, but it was also very frustrating, frankly.

MR. KRESS: I think part of the problem here is you're trying to put together a process to assure a very reliable set of software, software that does what you want it to do. An ideal acceptance criteria would be that it has a certain reliability and it has a certain fidelity. It's just impossible, I think, at this stage of the state of the art of evaluating software to come up with such definitive criteria. I think one has to back off to controlling and defining the process in developing the software, which is what the standards and the reg guides do.

I just don't think there was any choice other than to write the review plan and the reg guides in a way that you focused on process and not the final fidelity and reliability of the product. This has been a debate among the Committee itself, process versus product, for quite a

while.

MR. MILLER: Each stage of development does test the product in the sense of that stage. What is missing and what is frustrating to some members is a final test of the final product to give you a number which says this product will perform with this amount of reliability. That's difficult. That's not able to be done with current software engineering practice.

MR. APOSTOLAKIS: That's a different issue, though. I was arguing about the quality of the process itself. The issue of process versus product is another issue. There I tend to agree with you that in this particular case it's very hard to test the product itself. So you have to control the process. What does controlling the process mean? Give me a plan? To me that is not controlling the process.

By the way, hardware also we have a problem when it comes to design errors, because that is essentially what we are talking about.

CHAIRMAN JACKSON: Is your difference of opinion due to what you think the IEEE standards that are endorsed in these reg guides actually accomplish, or you just don't like the kind of structural layout of the reg guide?

MR. APOSTOLAKIS: I would say both, but especially the former. I don't know what the standards actually

accomplish. In fact, Dr. Powers raised a very interesting question as to who actually puts together these standards, but maybe he can tell us about that.

Dana, I put you on the spot here.

MR. POWERS: It strikes me it's not the best example to raise on this issue of how you use expert opinion. In an area where you don't have a vast amount of experimental data to calibrate that expert opinion, you are really asking experts to prognosticate the future. We have a fair history that experts do a very poor job in prognosticating the future.

MR. KRESS: Present company excepted.

[Laughter.]

MR. POWERS: I've got several little skeletons in the closet that I've not told you about.

The NRC is frequently in the position where it has to prognosticate the future in its probabilistic risk assessments because it can't develop an experimental database on everything that we want to know about reactor accidents, and they have set a standard for how you use expert opinion in those circumstances. It's a fairly detailed, prescriptive approach.

The question I posed is, when we set these standards like this where we don't have a lot of experimental data, ought we not use this fairly detailed

approach that the NRC has set for using expert opinion?

Instead of saying to the community, in the case of software engineers, I'm going to write a standard and you are invited to comment on this, you say, no, I want to be sure I get comments from the width and the breadth and depth of that community. I want comments not from those people that attend the meetings and those people that are active in the community alone, but I want the comments from those people that are the Lone Rangers, the wild thinkers, the non-joiners as well, because they may actually have the insight that I need to prognostic the future here.

In fact, a study on expert opinion as it has been used in Great Britain when they frequently formulate royal commissions to look into various things like -- I believe one of the more famous ones is whether heavier than air aircraft could exist or not, and more recently, on utility of pressurized water reactors in nuclear power. When people went back and looked at the history of these committees, they found that if you were to bet on the most outlandish view as opposed to the majority view, you would be more right than wrong.

I think that is why you want a breadth of opinion on these areas where you just don't have experimental data to calibrate experts. The consensus standard approach that is used I think confines you to getting the much more

conformist view, because you tend to get members of the societies; you get the members who are employed by companies that are large enough that they can afford to have people devote time to this; and you don't get as extensive participation of those people in the startup organizations that are struggling to make a living but who may have the real insights for the future. The wilder opinion.

The question I posed is, is this consensus process correct for those circumstances where there is not a wealth of experimental data, or would it be better to use the process that in fact the NRC has developed and is now being academically researched? It has always been a great amazement to me that there are actually experts and expert opinion in the world. I'm very interested in the kinds of things that they are trying to do, because we do have to use expert opinion a lot.

This is one of those areas where I'm simply raising the question. Is the consensus process adequate for the NRC's needs here?

CHAIRMAN JACKSON: Let me make sure I understand one point coming out of all that you have said. Are you essentially positing that it is impossible to have a balance between the design process or the quality of the design process and the assessment of the final digital product in the end, the software?

MR. KRESS: No, of course not. There has to be a connection between those two. The quantification of the final product is a difficult problem.

CHAIRMAN JACKSON: Is that a particular problem in this specific context, or is it one that is throughout many industries?

MR. KRESS: I think it is in the specific context of software reliability.

MR. MILLER: But that still applies to every industry.

MR. KRESS: Yes.

MR. SEALE: It's generic in the software in the I&C sense, not in the regulatory sense.

CHAIRMAN JACKSON: In the nuclear sense.

MR. APOSTOLAKIS: It may be in fact simpler for us in some respects, because according to the experts we are not really using systems that are too complex. All the horror stories about software that are in the literature come from very complex systems, like a shuttle, and so on. We don't have those. We don't have those. So for simpler systems probably you can do a better job. There is no question that the answer to your question is, yes, we can have a nice balance.

COMMISSIONER ROGERS: You say do a better job. Do a better job on what, the process?

MR. APOSTOLAKIS: The product.

COMMISSIONER ROGERS: I seem to hear you saying you could focus more on the product for simpler systems rather than the process.

MR. APOSTOLAKIS: Yes.

CHAIRMAN JACKSON: Or equally.

MR. APOSTOLAKIS: Or equally, yes.

COMMISSIONER ROGERS: Or some combination.

MR. APOSTOLAKIS: Yes. You can test it. If it's simple, you can test it. You can apply simple methods for analyzing it. If you have a huge system that is controlling a shuttle, that's a different story.

COMMISSIONER DIAZ: Is it possible to really make a very specific QA program for the process and the product, so specific that it will actually give you guidance of acceptability of both?

MR. APOSTOLAKIS: By specific, you mean for the specific product?

COMMISSIONER DIAZ: Right. Sometimes we tend to take QA programs as very broad things. Can we really be more specific and actually apply it to the process and the product with some common points that enables you to conduct the process?

MR. APOSTOLAKIS: I believe that would help a lot. That would help a lot. If you look now at the guides, they

really don't address, as far as I can tell, the specific systems we are using or are about to use.

Again, when I visited the Academy committee, it was the same thing. You say something and you are hit with three weird incidents someplace in a very complex system. Then you scratch yourself: Does that apply to me?

I think the fact that our systems are not very complex has to play a very central role here.

MR. MILLER: The standards themselves are developed for the software industry, not specifically for our particular type system.

MR. APOSTOLAKIS: That's correct.

MR. MILLER: As a consequence, they were developed generically for complicated systems like you find in the space shuttles and airplanes, and so forth. As long as we keep focusing on the fact that nuclear power plant safety systems should be simple, then agreeably we should be able to maybe do better than we are doing with these standards. But what we are endorsing is these standards which are current software practice, and we just need to keep looking for better ways to do it.

CHAIRMAN JACKSON: I think, though, that there are two things that one could ask, one of which Commissioner Diaz has already asked, and that is, can an appropriately focused QA program or effort as part of the design process

itself track to certain comfort about the quality of the product?

The second issue is, if you are already saying that the existing standards are for more complex systems than one typically is focused on in a nuclear plant, that these are the accepted standards, but therefore a more complex universe, but we are somehow saying that our universe is more simple, then it strikes me that should not embedded in those be the ability to try to develop something like what Commissioner Diaz is talking about, and why can there not be focus in that particular area?

MR. APOSTOLAKIS: Do you want an answer?

CHAIRMAN JACKSON: A short one.

MR. APOSTOLAKIS: I think what you said can be done. I think the next round it would really be useful if the staff summarized or took what they felt was important from these IEEE standards and not keep referring to one standard after the other, after the other. It can be done in a simple document.

CHAIRMAN JACKSON: In fact, then, it would be fair, as you call it, in the next round, however that is defined, to ask the staff to do that and to think about how that can be used in the context of Commissioner Diaz' focus and then to have you gentlemen come back and comment again.

Let me see if any of the other Commissioners have

any questions. Commissioner Dicus.

COMMISSIONER DICUS: No.

CHAIRMAN JACKSON: Commissioner McGaffigan.

COMMISSIONER McGAFFIGAN: No.

CHAIRMAN JACKSON: Commissioner Rogers, do you have any further questions?

COMMISSIONER ROGERS: No.

CHAIRMAN JACKSON: Commissioner Diaz.

COMMISSIONER DIAZ: No.

CHAIRMAN JACKSON: Let's move on.

MR. KRESS: Very good. Let's move to the next item, which is the research plans for upgrading the thermal-hydraulic codes.

Ivan, you're on.

MR. CATTON: I believe the path that was initiated by RES is a good one and the ACRS supports it. I basically agree with the views expressed in the letter but would like to balance the initial euphoria with a few of my own views.

In the past, the ACRS has recommended that further development of codes like TRAC and RELAP5 be curtailed and that some resources be focused on a fast running code for a PWR and like the BNL code for BWRs. At this time the BNL code has disappeared and a fast running code for PWR has never appeared.

There are a number of reasons why I still lean

towards this view.

First, the two-fluid modeling that is the basis for both TRAC and RELAP5 is one of the more challenging problems in heat transfer and fluid mechanics. Because of its complex closure relations, a great deal of detailed experimental data is needed, and for the most part it does not exist. As a result, there are many ad hoc relations that are tuned to macroscopic data in these codes.

Some examples are simple things. Like a droplet in a decelerating flow versus an accelerating flow. What happens to it? A good example is, if you have fog in a room and the velocity goes to zero, these codes will predict the water falls on the floor.

There are others. Dynamic flow regimes. How do these things change as the conditions of the problem change?

Unfortunately, in the past, agency support for producing the needed data and understanding has not been forthcoming. And I don't see it now. Without it, two-fluid modeling has evolved about as far as it is going to.

The three facilities, an AP600 at Oregon State, an SBWR at Purdue, and a B&W plant at the University of Maryland, along with the relationship with the French will yield a great deal of what is called integral system data. This is the macroscopic data. And because they are very well instrumented, in fact they are far better than anything

we've had in the past, some of the detail type information needed for support of codes like TRAC and RELAP may be forthcoming. Without special emphasis, however, I think it will fall short.

This doesn't mean that codes like TRAC are not valuable. They are, and they have been terribly neglected and for the most part the user has been ignored, leaving their use to the dedicated code jock. I can define that if you want.

The plan to revitalize TRAC by updating the FORTRAN and development of graphical interface and input along with consolidation of all that is good is long overdue and should be encouraged. You have several people in RES who are highly qualified to do so. Further, the involvement of users from NRR and AEOD will add another dimension to the process. I believe this is essential.

In the past, the problem has been that once the code process started, it was somewhere else and the user came later. As a result, these codes were not very user friendly, and I think if you want to make good use of the computational capabilities within the agency, they damn well better be user friendly. They have to be other things too, but that's important.

What else should you do?

Codes like TRAC have a history of not performing

well when presented with new problems. This is not surprising when you realize that the code was developed for a large-break LOCA, which is a fast transient. That makes many facets of the two-phase flow and heat transfer relatively unimportant. And that there was sufficient data to tune the codes. We have a great deal of large-break LOCA data. It essentially became the biggest empirical fit you've ever seen.

There is nothing wrong with this, and much of the complexity in the code was needed in order to get it done. A simpler tool, however, would also have done the job. There are lots of examples of this where a much simpler tool can accomplish the same thing as the big code. It requires skilled people to make the judgments as to when you can do what.

The problem was we were carried away with the view that given the right set of equations we could solve any problem, and it took a long time for that euphoria to wear off. This started in the early 1970s. It was a very heavy-duty committee that was put together to help start this thing off and running, and when all those equations were up on the board, we all got excited.

There are many difficulties with the codes. For example, one cannot do time and space conversion. The basic part of the code is quite weak. This is one of the reasons

you have to tune them. You can't do the conversion studies. A lot of what is done with them is just because that's the way it was done before; we've interpreted data to fit the way we've done it. This is a problem.

Yet the code did meet its target mission, and much more. I think these codes are very good for problems where we know how to use them, and they will continue to be useful, but how far you can push it is another question.

During the past 20 years we have seen a number of issues arise and found our computational tools to be defective. The problem was they were too inflexible and rigid to allow changes needed to focus more on a particular phenomena. I can name a few of these if you wish.

The new plan includes a task that will supposedly deal with this, and it is to make the code modular so that a separate model can be incorporated. For example, if you are treating the pressurized thermal shock, you can have a CFD code that could be inserted somewhere to deal with it.

There are a lot of things you have to think about before you do that. If you are going to start interfacing different kinds of tools, you damn well better make sure that whatever the structure is can accommodate this. If it's successful, it will go a long way towards dealing with my concerns. A demonstration that this can be done supposedly is underway. I've not heard about it. I don't

know when the results will be put on the table.

Another aspect is computational time. I think you need to have codes that you can get answers quick and you can look at a lot of parameter variations. If you don't have that, you don't properly evaluate the problem you have at hand.

Again, the large-break LOCA was a fast transient and required a particular kind of time advancement algorithm. It was also forgiving. So one could be numerically careless and not worry too much about things like numerical dissipation. If you want to treat reactor instabilities of some kind or another, you don't want something built into your code that damps disturbances. You just don't want that. And you have to go to special lengths to make sure it doesn't happen.

With the AP600 and the small-break LOCA on the table, we are now faced with long duration transients. AP600 long-term cooling is an example. And as Westinghouse is finding out, they can't afford to do the calculations. So they have to play all sorts of games to pick up pieces of it as it moves along.

A problem like this is a quasi-steady problem. Why the hell are you using a transient code? I don't understand, but some aspects of this business are beyond me.

To summarize, I believe the cleanup,

standardization and consolidation plans are essential. Right now you have a tool that is difficult to use, inflexible, and it costs you probably more money in trying to use it than it will cost you to fix it.

Before further development, however, I think RES should take a serious look at future needs of the agency and assure you that the bases and resources are available. There must be sufficient reason and resources coupled with a commitment to pursue the basic understanding needed to support the underlying two-fluid modeling concept before marking on a new two-fluid code program.

The needs have been delineated repeatedly for the past ten years. Almost every meeting you go to. You were at the CSNI meeting, and I bet somebody could show you a viewgraph from that meeting that doesn't look very much different than one we would have put up ten years ago. There are just difficult problems, and nobody has come forth with the resources to eliminate them.

Flexibility and modularity are another aspect. If they cannot be accomplished, I think the effort should be downscaled and consideration should be given to different codes for different problems.

Sort of as a final note, the computer code should not be more detailed than your understanding and data will allow. Don't make the same mistake we did in 1974.

CHAIRMAN JACKSON: Let me ask you a couple of quick questions. When you talk about the need to deal with issues having to do with computational time with an ability to have variation of parameters, are you saying that it's an issue having to do with modeling, the kind of algorithms used, or the platforms, or all of the above?

MR. CATTON: All of the above. I think that Wolfgang Wolf did that at BNL. He set out to put together what he called a plant analyzer, but he set out to put together a program that was based on data as he had it to analyze the BWR. His ground rules were fast, reasonably accurate, and an ability to address a wide range of types of problems. When the LaSalle instability incident occurred, it was really good that the agency had that capability, because GE said it's not a problem.

Wolfgang, because of the kind of program he had, was modeling the entire plant. The TRAC-GE really hadn't done that because it was too expensive. The result was people who lean more towards the PRA view took a bunch of sequences, said these are possible things that can happen, and calculated the end point. He did 60-plus calculations in a very short period of time and clearly demonstrated where the problem was. Whereas the TRAC-B, which was the agency's program, they never got it running. They couldn't solve the problem. They couldn't make it work.

Eventually that code wound up at Penn State and some students managed to make it work, but that's a separate issue.

So I think it is sort of all of the above. You really need to focus on what you want. If what you want is a fast running, highly reliable code, you know when you start you are going to give up something. You need to try to figure out what it is you are going to give up. Maybe you want to give up being able to solve the large-break LOCA, because it's a relatively low risk thing anyway.

You want to address other kinds of problems: What kind of transients do people like Caruso deal with for NRR? Maybe compile a list and then ask yourself, what do I need? Most of the time you don't need very much of the horsepower in these big codes.

CHAIRMAN JACKSON: Let me ask you this.

MR. CATTON: I think I answered more than you asked.

CHAIRMAN JACKSON: That's right. It's like the algorithm that has more than the data.

[Laughter.]

CHAIRMAN JACKSON: I take that back.

I noted that you had indicated that you felt that financial constraints forced NRC to allow the codes that would be predictive of fuel behavior to kind of wither on

the vine. Do you think that was because of an undue focus on severe accidents, and issues related to, say, high burnup fuel hadn't been identified?

The real question I have is, the codes that we have and that are not state of the art, the ones that have to do with prediction of fuel behavior, are you saying that they can't adequately predict fuel and clad behavior at the burnups now being used by licensees?

MR. CATTON: One thing I very deliberately did was avoid discussing the fuel codes. I'm starting at the clad working out.

I really don't know, but maybe Dana could help, because Dana has been paying a little more attention to the fuels problems.

To me, as far as the thermal-hydraulics is concerned, if you change the burnup, you change some of the conditions that the code has got to operate under.

MR. POWERS: The agency will admit that indeed its codes aren't capable of treating fuels at the very high burnups right now, that they have been allowed to atrophy. The research program is trying to amend that problem.

I don't think we have reviewed the length and the breadth of their attempts to amend that, but certainly it is my impression that we do not now have a program that carries our understanding of the way fuels behave, especially when

you go to burnup sufficient to develop a rim effect; that we have a physical understanding of all that goes on in the fuel.

Perhaps of more importance is we don't have a good understanding of all the degradation that occurs in the clad as we go to very high burnups. A lot of the concerns about high burnup fuel have been prompted by some experiments dealing with reactivity insertion accidents.

Those are interesting, but I don't think that is where the big difficulties are going to arise with very high burnup fuel. I think it is really the degradation of the cladding and other kinds of operational accidents where that clad failure is going to pose difficulties to you.

I don't think we have a good understanding of all the metallurgical processes that take place at this high burnup, and they are going to be very stochastic type of processes. Much of the difficulties that arise with the cladding occur because you get high hydride precipitation at local fluctuations in the temperature in the clad. Those are caused by discontinuities in clad thickness, discontinuities in the fuel clad gap. Small perturbations in the manufacturing process lead to localized deposition of large hydrides that make the clad brittle.

You can understand that brittle clad now affects everything else that you are going to do with this fuel.

It's going to affect accident situations. It's even going to affect handling and storage subsequently.

I don't think we have predictive tools in this area right now. I think the staff has now embarked on a research program that they are fairly enthusiastic about. We have not as a committee or as a subcommittee reviewed that research program, though our intention is to do that when they are ready to come forward.

The research program is interesting because it is not the NRC going it alone; it is the NRC joining with the world in this area, because all reactors are interested in using fuel to longer and longer burnups. It contributes enormously to the economics of nuclear power. So the research program is a consortium of efforts between NRC, France and Japan in particular, and it may be a broader community than that. I'm uncertain.

CHAIRMAN JACKSON: How close are we to the edge relative to the current burnups?

MR. POWERS: Our codes were developed for predicting fuel behavior under things like reactivity insertion and were prepared and validated against a database that extended no higher than 33,000 megawatt days per ton. We now approve fuels going up to, I believe, 55,000 megawatt days per ton. So it's not a case of being close to the edge. We are now beyond our validation limits.

That probably is not terribly important. You can probably extrapolate the behavior that we saw up to 33,000 megawatt days per ton up to around 50,000 or 55,000 megawatt days. When you go over that and you start developing rim effects and hydride precipitation is when you get into the problem. I believe right now that licensees need to make a very special and elaborate case to go beyond that. I don't know of anybody that has tried to go beyond that.

So our codes aren't validated into this regime, but it's the next step to go beyond the 55,000, where I think that would be an unacceptable situation.

CHAIRMAN JACKSON: Commissioner Rogers.

COMMISSIONER ROGERS: Coming back to the thermal-hydraulic questions, I know in your letter, your comments, Dr. Catton, you said that you thought a broader approach is needed where different modeling schemes would be tied together. I take it this relates to your comments about modularity and flexibility. Is that correct?

MR. CATTON: That's correct, and that's not going to be an easy task.

COMMISSIONER ROGERS: But you also go on to say that a skilled code user who is also knowledgeable in the field of thermal-hydraulics is needed to decide what is important and how do we implement it in a code. Where do you see us standing with that in-house capability now or our

ability to tap that?

MR. CATTON: In the past few years there has been a significant change. I don't remember when one of the Commissioners decided that it might be nice if your own people could run your codes, but I think it has happened. You have people like Caruso in NRR, who is really very good at using the code. You have people like Joe Kelly in Research, who is really very good.

There was a very nice paper by Mr. Caruso where he talks about three kinds of users. One is the guy who understands all of these things and knows how to run the code; the second is just a good engineer; and the third is a systems kind of guy.

I think you should develop some sort of administrative controls on how you do business so that if it's a run of the mill kind of problem the systems engineer is welcome to do whatever he wants to do. If the problem is a new one, you need to get your category 1 person involved and maybe develop some sort of a sign-off system.

Too many times people get too complacent about the results of the code. If that printer, or whatever, the screen, runs the numbers up and they are like you've seen them before, you tend to believe it. If it's new and you're not experienced with actually touching some of the data, you don't recognize good from bad, and usually you can generate

all kinds of arguments as to why it's good: the code did it; and this code compared with that code. That can lead you into troubles.

The category 1 type, there are not very many of them in the agency, and I think you have got to maintain them somehow, and you need to establish a procedure so that anytime they move into new problems, like boron mixing or whatever, the category 1 person is involved with the process at least in a review capacity.

CHAIRMAN JACKSON: Commissioner Dicus.

COMMISSIONER DICUS: Let me follow up on that. Not so much in terms of the capabilities of the individuals, but you seem to be implying -- and correct me if this is a wrong implication -- that perhaps three people is adequate for staffing for what we need to accomplish here. Or would you suggest we need additional staffing?

MR. CATTON: I really haven't seen a plan showing what all the tasks are. That aspect of our interaction was somewhat superficial. I don't know all that they are going to do. I think the three people in Research are very good. What kind of workload they are going to pick up relative to what they send out the gate, I don't know. So I really can't address that question.

I think within NRR you have a very good team, and as near as I can tell it's adequate, but you probably have

to ask them if they are overworked.

CHAIRMAN JACKSON: Commissioner Diaz.

COMMISSIONER DIAZ: Long time no see.

MR. CATTON: About ten years, I guess.

COMMISSIONER DIAZ: First, a generic comment. I've been looking at the past history. I realize that ACRS really in a very consistent way has emphasized the use of systematic, practical, auditable, flexible and traceable methods to integrate the experiments with the codes and develop the capabilities. I believe that is a very, very worthwhile sense of direction that we need, and I hope we keep doing that. I have a small interest in the area from past experiences.

I think that some of the smaller issues that always keep coming up, those we need to determine that we have the staff to solve them. I do agree with Dr. Catton that there is a time in which flexibility is important and there is a time in which we need to assess our capabilities to develop codes or change them and to use them properly.

I believe that we have the capability to use them properly, and if we are going to really take this five year plan, which I guess everybody agrees is basically and fundamentally a good plan, we need to really focus on what capabilities you have to have, code developers inside, people that can interact with the community on a one-to-one

basis and not be lost when Dr. Catton comes out with a new project, which he is quite capable of doing very quickly, as I well know.

I have a question in this area which may be addressed to the Committee. I have done some experiments. I always like to see that we have some experimental verification of thermal-hydraulic codes. We know that codes are one-dimensional or are dynamic, and going into static or vice versa might have some problems.

Are there financial constraints that NRC has in the international arena, in this experimental base that we are trying to get that are really affecting our ability to guide the experimental programs to the things that we need?

MR. CATTON: We need to first separate the kinds of experimental programs and their purpose. The large facilities are integral facilities. You don't get the detailed physics that you need to address the issues about the internals of the code. So what do you do?

You're a person who has been tasked with creating this computer program. You just make sure it gets the right answer that you measured. But you have a lower level. You have droplet sizes. Are they ligaments? What's their shape? You have all sorts of constitutive relations. Nobody really agrees on what they all are. But once you pick a set of equations, then you tune them. This is very

true in two-phase flow. Even in porous media where the bed is fixed there are lots of disagreements on what the equations should be.

Under these kind of circumstances you need to do the necessary work to understand the basic physics or else back off on your expectations from the code. I think it's a mistake to build a model that requires data input at a level that you don't have it unless you plan to go get it.

If you go back through the history of the ACRS' views, when the program first started this was a complaint, that you get a major group like the people at Los Alamos, Frank Harlow and those guys, who are just super at developing codes, but unless you feed them the bottom physics, they are not going to get it done right. But they're going to make it work.

So now you have this on the table. What do you do with it? As long as you are working within the macroscopic data you have at hand, you know. In Japan they had the SCTF. I forget what SCTF stands for, but it was a reflood facility. The first thing they found is that if you got the friction factor right, the interfacial friction factor, the heat transfer was wrong. If you got the heat transfer right, something was wrong with the other. What it was is a basic inconsistency, but the code had been tuned to deal with it.

Some of these things have been taken out, but you still have, for example, the heat transfer packages. Most data is taken by measuring a heat flux from a boundary into this mix. You don't know whether the heat goes to the vapor, then the droplet, or the droplet to the vapor, or wherever. Now the code person has to do something with this. So they somewhat arbitrarily split them. Sometimes good, sometimes bad. A guy with a lot of insight might even get it right.

But you're never really sure until you try to measure these things. If you don't want to measure these things, then rewrite the way you work your code so it deals with this thing that you measured. What this allows you to do is to have good traceability. You can make a good statement about uncertainty in the results.

I don't know if I answered your question.

COMMISSIONER DIAZ: I don't think so, but that's okay.

[Laughter.]

CHAIRMAN JACKSON: Commissioner McGaffigan.

COMMISSIONER McGAFFIGAN: I'd like to ask about the balance of what the appropriate role is of the different actors that we can call on, the staff, the three people you talked about in Research, the labs. I know there has been some history of problems in dealing with at least one of the

labs. The universities and the university community, which you have built into the plan, and the private sector. How do you get the sort of continuity, the data so that the codes don't get more complex than the basic physics? What is the role of the different entities as you see it, and are there dangers?

My original concern was we might be trying to do too much in house. What is the appropriate role of the different institutions?

MR. CATTON: Let me try. I think, first, you have to have some kind of an in-house effort going on. If you don't, you won't have that category 1 person -- you just won't -- who is interested in these things enough, that understand them well enough to help you. That's number one. You need some people. They need to be somewhat unencumbered with all of the bureaucratic management stuff that is a necessary part of federal government. I was going to use some other words, which I did not do.

CHAIRMAN JACKSON: We are not bureaucrats. I don't know what you are talking about.

[Laughter.]

MR. CATTON: And I think at present the management within RES seems to have done that. These three people are pretty unfettered.

What kind of support do they need? In the past

they have just gone to the national labs, and I think there there has been an uncoupling, because they don't manage the labs. I don't know whether this is a characteristic of government or what, but the programs just have not been managed well at any of the labs in the sense that there is a clear definition of what you want and a clear statement of when you got it.

I think the labs can play a role. I think places like Los Alamos have the people who could take some of these things and put it into good programming. They certainly could do that. But when it comes to trying to understand the basic science of two-phase flow and heat transfer and these kind of things, you are not going to get it from the labs. The labs are professional people who have a job to do from eight to five. Somehow you need that graduate student who can't get out unless he understands it.

There is a problem with getting that set up. If you just do a grant, the professor and a student can go off on a different tangent, spend your money, and thank you very much. I think what you need is an institute, because the institute then is staffed by some full-time professional people, and they can lean on the professor or cut him off if whatever it is is headed in the wrong direction, and you also have somebody that you can reach out and touch. If you set this up properly, it can be the focal point.

I was very impressed with the French and the way they do business. In France, typically the lab, or whatever, is directly attached to the university. A French professor usually has a managerial role in that, and he's got his interest in what the students do. The French felt that if we do this in the thermal-hydraulics area, which is Grenoble, we're going to maintain the capability that we need; new people are going to come into it because, let's face it, the professor is going to hammer students wherever he is.

I think the process works. Not necessarily as direct grants, although there is a way you can deal with that. Other agencies do it through workshops, and the professors who go to them are not stupid. They know if they want your money, they had better propose something within that spectrum.

COMMISSIONER McGAFFIGAN: This institute or center, would it involve potentially a consortium of universities? It wouldn't necessarily be tied to a single one? Or would you see it as a consortium that had an institute at one but the ability to tap universities nationwide if it was needed?

MR. CATTON: If I were doing it, that's the way I would do it. I think there is a nice example of what was done in the thermal spray area at Stony Brook. They sort of

sit in the lead position. However, there it's an NSF center. I wouldn't do that. It would have to be an institute so that I could get some assurance that whatever the path is I'm trying to follow will be followed.

They have a whole range. I think Sandia and Idaho both have very good thermal deposition, spray deposition kind of laboratories. They're involved with them. So they sit at the top, and you have the national labs associated with them.

There is another thing that I have been bothered by too.

CHAIRMAN JACKSON: I think we are going to have to move along.

MR. CATTON: Sure.

CHAIRMAN JACKSON: Finish your sentence.

MR. CATTON: I was just going to say that other government agencies seem to be able to control the labs. I don't know why NRC cannot.

CHAIRMAN JACKSON: Okay.

MR. KRESS: I resist the temptation to try to defend the labs.

CHAIRMAN JACKSON: Why don't we move on to the next topic.

MR. KRESS: Let's move on to a subject that is of much interest and one which we have paid a great deal of

attention to recently, and that's the risk-informed, performance based regulation and related matters.

Dr. Apostolakis.

MR. APOSTOLAKIS: We have been meeting with the staff on a fairly regular basis. The PRA subcommittee had two meetings last summer. The full Committee heard from the staff in August.

I thought we were proceeding well and according to schedule. There were some differences on specific guidance, but the discussions were technical, and so on, until we found yesterday that things are now up in the air, that there are some questions that have been raised at the high levels regarding allowed risk increases and whether they should be allowed at all.

The original schedule now is not valid anymore. We have tentatively scheduled a supplemental meeting with the staff for, I think, the third week of February to review the documents that will be delivered to us by the first week of February. This will be the final review, and we will write a letter to you during the March meeting the first week of March. That seems to wrap it up.

Do you have any questions?

CHAIRMAN JACKSON: What progress is the staff making in addressing the issue of uncertainty in the use of PRA results?

MR. APOSTOLAKIS: You mean in the regulatory guides, how they are dealing with uncertainty?

CHAIRMAN JACKSON: Correct.

MR. APOSTOLAKIS: That is one of many issues. There is a disagreement there. I think the staff wants to give prescriptive guidance as to what kind of PRA one should have, depending on the application and the change in risk.

For example, a rough point estimate calculation would be acceptable if the change was very, very, very small, like ten to the minus six or something, without external events, and so on. And there is some point to that.

But I've always felt that we are trying to overdo it and be too prescriptive. It seems to me the guidance should be that we should be using the models and analyses that are appropriate to the situation. People feel that that is too general, that we have to be more specific.

The thing that is missing is how do you handle uncertainties that have not been quantified. In fact, we had an interesting discussion at the last meeting as to whether the ten to the minus four core damage frequency subsidiary goal was set as an absolute goal or was set with respect to what can be quantified. In other words, I can go as close to the ten to the minus four goal as I can if I can prove with my calculations and analytical tools that I have

done a good job.

If, on the other hand, that subsidiary goal is an absolute goal for the core damage frequency period, then I should not be allowed to go very close to it because I know that there are certain things that are not in the PRA that contain the risk to the frequency of core damage. We were told that the original intent was to exclude these.

I'm not sure the things that have not been quantified have attracted the attention they deserve. On the other hand, I don't think that that is because people feel that these are not important. The staff has had its hands full trying to develop all these regulatory guides in the last several months. But these are certainly things that both sides are aware of.

CHAIRMAN JACKSON: I'm not sure how happy I am with your answer.

What are your views on the plant-specific application of PRA results?

MR. APOSTOLAKIS: First of all, you are not happy with my view or with the way things are?

CHAIRMAN JACKSON: I'll make it explicit. I asked the question of what progress you feel the staff is making in addressing the issue of uncertainty in the use of PRA results, and you said that is one of many issues. Then you talked about uncertainty that had not been quantified.

I think what is missing here is, if there really are some issues of points of vulnerability, et cetera, in terms of what the staff is doing, what would be needed to be able to give comfort to make use of PRA and how it's handled in these guidance documents without being what you consider to be too prescriptive, it would be useful for the Commission to get a listing of that.

As long as we kind of talk out in space, it's very hard to pin down just where the problem or problems seem to be. Perhaps that is what you will be addressing in your letter to the Commission once you have reviewed these documents in February.

I like PRA and I know on a rudimentary basis how to do PRA calculations, but that's not my job. However, in order for me to do my job and the Commission to do its job, we need to have more understanding and specificity about where you think the problems really are, because that forms the basis of giving guidance back to the staff in terms of what needs to happen. That's really what I was trying to talk about.

MR. APOSTOLAKIS: My answer to that would be, yes, they are making good progress. There are some disagreements but the disagreements are not fundamental. In particular, they are trying to be more prescriptive than I would like.

CHAIRMAN JACKSON: Are there any advantages or

benefits to our assembling a group of specialists to review the PRA guidance documents beyond the review that ACRS is itself providing?

MR. APOSTOLAKIS: The documents that will be produced in February?

CHAIRMAN JACKSON: Right.

MR. APOSTOLAKIS: I would say no. You will be getting general comments that you already have.

CHAIRMAN JACKSON: Commissioner Rogers.

COMMISSIONER ROGERS: Nothing else.

COMMISSIONER DICUS: Nothing else.

CHAIRMAN JACKSON: Commissioner Diaz.

COMMISSIONER DIAZ: You just brought up the issue a while ago of allowing small increases in risk under certain conditions. Would you elaborate why that is a problem to you?

MR. APOSTOLAKIS: It is problem in the following sense, in my mind. If we declare in advance that we would have a risk-informed and performance-based system that will not allow increases in risk, then we might as well forget about trying. Why are we doing it?

You have to be able to allow increases, because in essence you are saying, well, keep it the way it is, or play games and package changes in such a way that the net increase appears to be zero.

It seems to me that when the Commission states quantitative health objectives and you are well below the objectives in the subsidiary goals, you should be allowed to increase a little bit. How fast, whether we should allow all the units around the country to come just close to the goal, these are questions that certainly deserve consideration.

But to say that no increases are allowed when in fact we are doing this every day without quantifying risk -- the staff told us that we have about 1,000 requests for changes in the licensing basis every year that are not done using risk assessment. So when we look at the risk number, we say, no, we don't want it to go up. But when we don't have a risk number, it's okay?

COMMISSIONER DIAZ: I do agree with you that we need to visit that area very carefully.

CHAIRMAN JACKSON: Isn't it a question of the context within which you talk about increase in risk?

MR. APOSTOLAKIS: Sure.

CHAIRMAN JACKSON: And the question is, what is the goal and what margin has one relative to that goal? When you then talk about risk increase, you are talking about risk increase relative to something.

MR. APOSTOLAKIS: Sure.

CHAIRMAN JACKSON: I think that is where some

clarification is needed in terms of that you just can't talk about it in a vacuum. It strikes me that that is where there has to be some convergence of the discussion here.

MR. APOSTOLAKIS: And the assumption is, of course, that the quantitative health objectives and the subsidiary goals have already been met. We're talking about increases without constraint. If you are safe above ten to the minus four in core damage frequency, the question doesn't even come up, because you have violated the law.

CHAIRMAN JACKSON: That's the point. One has to put the discussion in the proper context.

MR. APOSTOLAKIS: Sure.

COMMISSIONER DIAZ: I have one minor question. The current set of pilots that you are running to try to check the applications, the ISI, the ISD, the graded QA, are those providing you with sufficient feedback to address the adequacy of the program?

MR. APOSTOLAKIS: We know what is going on. So far, at least my personal opinion is that I haven't seen anything that has helped me understand things better.

COMMISSIONER DIAZ: Okay.

MR. APOSTOLAKIS: But that may be coming. I don't know.

COMMISSIONER DIAZ: There might be a little bias.

MR. SEALE: I would say, though, that my

impression is that the pilots have provided me with a considerable confidence that the people in the utilities are rapidly learning how to use PRAs in what they feel is a very constructive way. So it's not a tool that is going to be thrust into the hands of neophytes or anything like that.

The other point is that the review that you will get from those people on the SRP when it goes out for public comment will be a very competent review from their point of view. You should expect to get comments from them which are very practical, very focused on the issues that may remain due to perhaps difficulties in articulating the review plan, or whatever. But they're applying PRA methodology and doing a pretty good job of it.

MR. APOSTOLAKIS: One last comment. I think the interesting thing to see in this whole process is how difficult it is for people who are used to doing things in a highly prescriptive way, how difficult it is for them to free themselves from that and move more towards a performance-based system.

There are phrases in the guides that in the hands of someone clever who wants to undermine the process are killers. For example, one of the principles is "maintain adequate defense in depth." Give that to me and I would not approve any change, because you will never meet adequate defense in depth, in my mind, if I want to act that way.

What is the alternative? We all seem to like defense in depth even though that is a concept that is up in the air. I don't think anybody has ever defined it. You do have to have defense in depth. What is adequate defense in depth? That kind of fuzziness has to be there, but I must say it makes me very uncomfortable, because we have also other principles of that kind.

I appreciate the fact that you cannot just drop everything and say make sure the core damage frequency is below the goal. That's the other extreme. But this is, I think, the primary difficulty in writing a good guide right now.

CHAIRMAN JACKSON: In some sense that's why it's a longer window than the end of this year and in fact it's the end of next year that presumably there is going to be iteration and re-normalization when there is review on the outside not only by those who look at these things from an intellectual perspective, but those who actually are trying to make practical application of them.

Part of the reason I asked the question about assembling a group of specialists is that many times if we study our own navels that's as much as we see. That's true in terms of how soon we propagate things to the outside, to let the world take a look, but also in letting the world take a look that there are other industries that use risk

assessment methodologies and PRA, and presumably they could share some of their wisdom. It may not be directly specific in terms of application to nuclear plants, but there are some fairly sophisticated uses of it at other places. I don't know if you have any reaction to that, but it's a bias that I have.

MR. APOSTOLAKIS: I don't think we will get much help from other industries. I think we are at the forefront. They may be using it or they may say they are using it, but I don't think anybody is using PRA to make decisions in other industries. Look how long it took in our industry. The reactor safety study was published in 1974, 22 years ago. Now we are talking about risk-informed regulation, not even risk-based, 22 years later.

CHAIRMAN JACKSON: Better late than never.

Commissioner McGaffigan.

COMMISSIONER McGAFFIGAN: I'm going to pass.

CHAIRMAN JACKSON: Dr. Kress.

MR. KRESS: The next item on our agenda is the potential use of IPE/IPEEE results to compare the risk status of the current population of plants with respect to the safety goals. It was my initial thought that this was something that should be done, and it sounded like a very good idea at the time I brought it up.

We then took a closer look at the IPEs and the

IPEEEs to see how this might actually be implementing. As it turns out, in our view, these as PRAs are just too uneven and incomplete. In order to compare with the QHOs, for example, you really do have to have some form of a full-scope level 3 PRA or some surrogate that approximates it or bounds it.

Most of the IPE/IPEEEs cannot be characterized that way, as full scope. None of them did shutdown risk. They did a margins analysis for the seismic. Most of them did a FIVE analysis. Many of them didn't go to level 2 even, especially with the fission product transport and the source term part of it.

After looking at those and actually doing a great deal of work of trying to figure out how to bound the missing parts, for example, how to bound the consequences that would come out of level 3 on a site-specific basis and how to bound the missing parts in the level 1 and 2, we thought that the results you would get by such bounding analyses would just be too uncertain and too questionable for the purpose, and that it really wasn't worth the effort that it would take just for the purpose of seeing what the status is with respect to safety goals.

The feeling is, looking at full-scope PRAs that do exist, that we do meet the safety goals by considerable margin. That's not a definitive answer because of the

limitations in these studies, but that feeling is there.

We really think it ought to wait until sometime in the future when better, more complete full-scope level 3s are available, and then one can make a definitive statement. We just didn't think it was worth the resources and the expenditure to try to do that now.

CHAIRMAN JACKSON: Let me ask you these two questions which kind of relate to that. Do you know what percentage of the IPEs would meet the PRA review guidance criteria being developed in the guidance document and the Standard Review Plan?

MR. KRESS: The answer is no, I don't know. We may have some other opinions.

MR. APOSTOLAKIS: Zero or perhaps one or two.

CHAIRMAN JACKSON: Dr. Powers.

MR. POWERS: Zero.

MR. KRESS: That was my opinion too. We have to remember that the IPEs and IPEEEs weren't intended for that purpose. So it's not a criticism.

CHAIRMAN JACKSON: I know they weren't, but the second question bears on that. Do you have a feel for how much use is currently being made, is trying to be made, or should be made of the IPE results in the regulatory decision-making process? That is, are they being made use of, should they be made use of, and how much are they being

used?

MR. KRESS: Very interesting question. I can't answer the part of it that says how much they are being used. I can address the "should."

CHAIRMAN JACKSON: Are they being used as far you know?

MR. KRESS: I think they are, yes.

CHAIRMAN JACKSON: In spite of what you've just said?

MR. KRESS: Yes. Some of them are quite good on the level 1 in addressing the core damage frequency. That is a fairly appropriate and frequent use of them, I think, in regulatory decision-making. That is being used.

CHAIRMAN JACKSON: What is our metric for determining their acceptability in that context?

George, do you want to address that?

MR. APOSTOLAKIS: It pains me to say this, but you really don't need to do a good uncertainty analysis and a full-scope PRA to get excellent insights about your plan. I used to think that unless you did that you didn't have a good PRA. Of course you don't have a good PRA, but the basic results that are of great use to the licensee and the staff, namely, ranking the accident sequences, identifying important systems, you can get those with very simplistic analysis, point estimates and so on.

When in doubt, if you are a bit conservative, in other words, should I include or exclude this particular sequence, is it important or not, don't play games. Include it. You know your analysis was crude. Keep it. But it turns out that you really get a lot of good information that way. In fact, some of the risk meters, the risk monitors that some of the utilities are using now are using these simple models.

CHAIRMAN JACKSON: I'm trying to make a separation between the use that licensees make of it for their own purposes within the current regulatory context and changes in that regulatory context or regulatory decisions being actually made based on them. There is a difference.

MR. APOSTOLAKIS: Yes.

MR. SEALE: There is a comment on the borderline, though, and that is that a lot of the licensees are using their PRAs as a part of the process of the pilot studies which are input to regulatory decision-making.

I think almost across the board a common feature is that most licensees are finding deficiencies in the IPEs or IPEEEs as they were originally cast and are going back and reexamining certain issues in coming up with the input that they then have to their pilot evaluations.

That sort of demonstrates the other part of the purpose of the IPE program, which was to get the utilities

to assess the showstoppers, and so forth. They are getting used to using them, and when the questions arise, apparently they are prepared to examine the issue in more detail.

As I say, that is an input to the regulatory system, I think.

MR. KRESS: Back to your question of the acceptability for regulatory uses, I think our biggest problem with them is their incompleteness, particularly that they don't deal with the shutdown risk, and their incomplete characterization of the effects of seismic. There are some questionable parts in how they treat common cause failures, and some of the reliability numbers that come out of different databases don't seem to be consistent.

In terms of acceptability, the biggest problem we have with them is their completeness.

CHAIRMAN JACKSON: How much progress is there in terms of being able to incorporate into PRAs degradation of equipment systems, components and equipment within certain systems?

MR. KRESS: I would defer to George on this one too, but my own personal opinion is it's hardly in the PRAs at all.

CHAIRMAN JACKSON: In a certain sense, if one wants to look at performance and the effect of maintenance and effectiveness of maintenance and examine it within a

risk perspective, one has to be able to incorporate that, and most of the PRAs and level 1 PRAs and the kind of accident sequences that are modeled do not incorporate that. It's a success/failure, a binary approach.

MR. KRESS: Presumably some of the reliability numbers ought to implicitly reflect the status of maintenance and QA and how that affects reliability, but once it's in the PRA it's not changed. There is no time variation; there is no differentiating between a good maintenance program and a bad one.

George, you might want to talk about this. You know a lot more about the PRA.

MR. APOSTOLAKIS: It's true that aging effects are not in the PRA right now, but the real question is whether they would make a difference. The studies that I have seen are very inconclusive. In other words, you cannot conclude that the failure rate really goes up for particular components.

CHAIRMAN JACKSON: I've seen plant-specific data that indicates an ability to discern the effectiveness within a given system, which has a certain reliability or unavailability, the relative importance of certain components within that system, which can change dramatically the risk profile and in certain cases goes against the conventional wisdom of what components or subsystems within

the larger one are affecting that overall system reliability, but it requires a treatment that has to do with a non-binary approach to condition or degradation.

MR. APOSTOLAKIS: Sure.

CHAIRMAN JACKSON: So it's a different dimension in terms of the statistical approach and the kind of statistical modeling that goes into the PRAs, but it is one that, at least based on a couple of examples that were shared with me -- and I'll be happy to talk with you about those --

MR. APOSTOLAKIS: I would like to see those.

CHAIRMAN JACKSON: They have a very dramatic effect. So if you are really talking about efficacy of maintenance, and so forth, it's an issue. If you are talking about real plant-specific applications and understanding how the risk profile changes in a given plant as a consequence of a maintenance program, I think this is relevant.

MR. KRESS: I think it would be a quantum improvement in the PRAs to incorporate that sort of variable probability of failure or variable reliability that is not just binary, yes or no, fail, and relate it to plant specific items. That is a good idea. I hope somebody is approaching that.

CHAIRMAN JACKSON: I've seen some work that is

along that line.

MR. APOSTOLAKIS: It seems to me that before we jump to conclusions we should really look at how that work was done. I have seen some of that work too. I don't know if it's the same work.

CHAIRMAN JACKSON: I don't think the issue is to debate the specifics. I think the issue has to do with an ability to migrate into this framework some capability of really understanding on a plant-specific basis what equipment degradation means in terms of the risk profile of the plant and what that can or cannot say about the efficacy of maintenance and maintenance programs, because that in fact is relevant to us in terms of the implementation of things like the maintenance rule, and particularly if one is going to marry these PRA and risk-informed approaches to real life situations.

MR. APOSTOLAKIS: I agree with you, but I think right now, based on the evidence I have seen -- not the models, the evidence -- I would say that it's inconclusive. The evidence is not telling us that this is an urgent issue. Let me put it that way. I'm getting now awfully close to being conflicted, by the way. We should have that capability, but I don't think it's an urgent issue.

MR. KRESS: It's another good reason to be in favor of the reliability database program.

CHAIRMAN JACKSON: Why don't we go on. We are running out of time.

MR. KRESS: The next issue we have touched on a little is also mine. It's the use of safety goals on a plant-specific basis.

It's our view that the safety goals were not originally intended for that purpose, but if the desire is to move toward a more risk-informed or risk-based regulatory program, one will have to deal with specific plants, because that's what you are doing with them. They all come in with requests for changes to the licensing basis and a decision will have to made, for example, as to whether it should be granted, and you will want to be risk-informed on that. You will have to have some sort of, I guess we could call them, acceptance criteria as to whether you will grant particularly, say, increases in risk, small increases in risk, or grant a change at all, or whatever.

We felt that it's not necessary that the safety goals be these acceptance criteria but that that would be a good place to start since we do have defined things intended to tell us how safe is safe enough.

We think that it's a good place to start, that you will need to be plant specific in application in a risk-informed, performance-based world, and that in order to do it with the safety goals there is the subsidiary goal of

ten to the minus fourth, which is the most useful one because it's directly obtainable from PRAs that we now have.

The tough ones to deal with are the QHOs, which are the more important ones. Well, I think they are the more important ones, but ten to the minus fourth is just as important. In order to really deal with that as an acceptance criteria you do have to have some surrogate for a full-scope level 3 PRA with consequences that are site specific.

In our letter we said that that would be the ultimate that you are looking for, but it's going to be some time before each plant, or at least a substantial fraction of them, have such a full-scope capability, and it would be appropriate to back off from that and develop surrogates for the QHO that would be bounding.

We feel very strongly that such surrogates can be developed. They will take the form of a combination of core damage frequency and a large early release, which has to be defined, but we have some ideas on how to define that. Or an even lower tier than that would be a core damage frequency combined with a conditional containment failure probability, which might be different for different classes of plants, BWRs versus PWRs.

We have endorsed the concept of developing these lower tier surrogates that can be used as acceptance

criteria. We are in the process now of putting together what I guess I would call a white paper that would more fully define what we mean by things like an LERF and a conditional core damage frequency for this use, how they would be derived directly from the QHOs, and how one would derive them in such a way that you're sure they are bounding but yet are still useful tools in such an acceptance criteria.

We are not quite through with that white paper. It's under discussion by the Committee, but I think it would be useful in defining and further clarifying our views on this subject.

CHAIRMAN JACKSON: When do you think you would have that?

MR. KRESS: I expected to have it this ACRS meeting, but it didn't quite get there. It will surely be finished by next week and circulated.

CHAIRMAN JACKSON: So you're talking within weeks.

MR. KRESS: Oh, yes. It's not that far away.

CHAIRMAN JACKSON: Commissioner Rogers.

COMMISSIONER ROGERS: There are lots of questions here. How the safety goals relate to an adequate protection standard. What's the relationship between these things? If you want to start using safety goals for regulatory purposes, what does that really mean if we already have an

adequate protection standard that is being met?

I think one has to try to sort this out. I know it's a very, very difficult question. I certainly have struggled with it in my own mind for years. But if you want to use safety goals, surrogates or not, for regulatory purposes, I think you are going to have to come to grips with how will a regulatory decision based on safety goals, which will be a probabilistic statement of affairs, be related to the adequate protection standard, which is not a probabilistic standard, I don't think.

MR. KRESS: It's not.

COMMISSIONER ROGERS: I'm not even sure what it is. We know it's there, but what is it?

I think we are going to have to come to grips with that if we want to start regulating using safety goals.

MR. KRESS: I think that is a wonderful question.

COMMISSIONER ROGERS: I don't know if it's wonderful, but it's certainly --

MR. KRESS: I've thought about it considerably.

COMMISSIONER ROGERS: I think we need your best thoughts on this, because it seems to me this is where the treacherous territory is going to come.

MR. KRESS: It really is. The real question is, where do the safety goals lie with respect to adequate protection in terms of level of risk? It is my personal

feeling that adequate protection is a level of risk, if you could translate it into risk, that is below the safety goals.

I say that because what we have now is an adequate protection type of concept, and from all the PRAs I've seen and everything that I can get from the IPEs to see what the status of risk is, we are well below the safety goals, which tells me that adequate protection is a level of safety that is better than the safety goals.

COMMISSIONER ROGERS: I think we could argue that, because if in fact you believe that all the plants meet safety goals, they have gotten there through application of an adequate protection standard.

MR. KRESS: But adequate protection is a different level of safety for each plant; it's plant specific; and it has never really been quantified in terms of what is a risk. If we were to now say we want to move to another criteria, which is safety goals, you are treading on very thin ice, because if it is a level above that, you really have to be careful how you are going to define these acceptance criteria. This is one of the reasons I think, as you saw in one of our letters, that the safety goals are not quite well formulated for this purpose of plant-specific application. That is one of the main reasons that we mentioned, because you are probably putting forth a set that is not as good in

terms of risk level as adequate protection, and that is a real concern that I think has to be dealt with.

COMMISSIONER ROGERS: I'm sure we are not going to settle it right here, but I do think that it is a very key question in thinking about the use of safety goals for regulatory purposes.

MR. KRESS: It is, definitely.

COMMISSIONER ROGERS: Yes, Dr. Apostolakis.

MR. APOSTOLAKIS: I think there are a couple of thoughts here. First of all, I don't think that what we have now, the deterministic system we have now defines adequate protection. I think the clear statement about adequate protection was the QHOs the Commission approved a number of years ago.

CHAIRMAN JACKSON: Why don't you define for the Commission the QHOs. He knows. We have new Commissioners.

MR. APOSTOLAKIS: I'm sorry. Those were approved in the mid-1980s, I understand.

MR. CATTON: Quantitative health objectives.

MR. APOSTOLAKIS: They are both qualitative and quantitative, and the quantitative part says, I think, in terms of individual risk that the risk from nuclear power plants should not exceed one tenth of one percent of the risks from all other causes, and similar kinds of things for delayed deaths, and so on. It's one tenth of one percent of

societal risks.

It seems to me that really defined adequate protection. The other one was sort of haphazard: let's do this, let's do that, and then that's adequate protection.

It's interesting to remember, by the way, that when the reactor safety study was published a lot of the old-timers were surprised that the core damage frequency was so high. They didn't think it was going to be close to ten to the minus four and five. They were very surprised. So when you quantify things you see them from a different perspective.

One other thing that maybe is not directly related but I really think I ought to tell you is I'm extremely uncomfortable with this notion that the safety goals, the quantitative health objectives apply on the average. I don't know what that means to the industry, on the average, and the sooner we get out of it the better off we'll all be.

COMMISSIONER ROGERS: It's really just hand waving. It isn't really established when one says that. So I agree with you. I'm not disagreeing.

The other point that I would like to raise, Dr. Kress, is you seem to imply that somehow there would be eventually the development of level 3 PRAs by all plants. I don't understand what would drive anybody to that at this point. Why would you do it?

MR. KRESS: I believe that if we do move into a risk-informed, performance-based or risk-based system, then what that means to the industry is -- one of the things it means is that they can come in now with requests for relief from burdensome regulations that don't add to their safety but really causes them a great deal of problem in terms of resources and time and actually may detract from safety.

If they see the probability or good possibility of getting some relief like this and the acceptance criteria that we have on granting such relief has to do with meeting QHOs, which require a level 3, that would be their incentive to develop. The owners of these level 3s will have to be the plants, not NRC. It will have to be in their hands to come forth with sufficient justification in terms of their position with respect to the QHOs and how a change changes that position. I think the incentive is a relief of burden.

COMMISSIONER ROGERS: Provided that there is some clear regulatory statement from NRC that it would accept something and allow some relief, if you want to call it that. I don't think we have done that.

MR. KRESS: No. I think that is part of what you will see in the Standard Review Plan for implementation of PRA and the reg guides that we are reviewing now. That was one of the concepts that is built into that. It does involve relief and allowing small increases in risk in the

interest of overall improvements in the whole process. I think that's the incentive, and without that, I don't think we will see level 3 PRAs.

COMMISSIONER ROGERS: I think you have to be very explicit in your comments on this.

MR. KRESS: I think we intend to be on that particular one.

COMMISSIONER ROGERS: Thank you.

CHAIRMAN JACKSON: Commissioner Dicus.

COMMISSIONER DICUS: No.

CHAIRMAN JACKSON: Commissioner Diaz.

COMMISSIONER DIAZ: No. I support strongly Commissioner Rogers' question.

MR. KRESS: There is one more item. We probably can finish it very quickly. That's the use of the RuleNet in the regulatory process.

Dr. Shack.

MR. SHACK: Several of our members have looked at the RuleNet site, although none of us managed to register in time for formally participating in the process.

I believe that most of us think that the technology represented by RuleNet does offer a great promise as a way to involve the public, licensees, intervenors, and staff in a more effective interaction in the regulatory process. This improved interaction can lead to greater

confidence in agency decisions and greater public confidence in the way the agency deals with the industry.

The whole process will obviously have growing pains and evolve as we are doing it. It's hardly transparent to use in some ways. There is some concern that Internet access is kind of still an elitist thing, although I think that is widely becoming much more accessible. From my point of view, even in the current state it still offers the easiest public access to the regulatory process that I can envision.

I have certain biases as a computer jock. I think the give and take of an electronic forum is far superior to sending in a comment or a letter that sort of goes into a black hole and sometime later comes out as a resolution of public comment. There is a real give and take in near real time in electronic forum. And it may even offer greater opportunities for reflection than a public meeting. One just reads the threads in the letters and there is a discussion and you begin to think about it. I think it offers a great deal of promise.

I was a little disappointed in how few people participated in RuleNet, and that may be partly just the uncertainties involved with it. They certainly didn't make it very easy to find. I could never understand why there wasn't a direct link from the NRC home page to RuleNet, and

there is still no direct link from the home page to the LSS Net, which is the sort of successor attempt at this. If you are going to make this publicly accessible, it should be a little more transparent to the public in how to get there.

Again, we have no formal ACRS position on this, but I think those of us who looked at it thought it was a very interesting attempt to increase public involvement.

CHAIRMAN JACKSON: Thank you.

Commissioner Rogers.

COMMISSIONER ROGERS: No thank you.

CHAIRMAN JACKSON: Commissioner Dicus.

COMMISSIONER DICUS: No.

CHAIRMAN JACKSON: I'd like to thank the ACRS very much for another informative briefing and again to thank particularly Dr. Catton.

The topics of today's presentation obviously focused on a number of issues that are critical for maintaining and improving the NRC's ability to regulate effectively. I want to encourage the ACRS to continue to provide the Commission its perspective on issues important to our mission and to be forward looking in bringing developing concerns to the Commission's attention in order to help ensure that we are prepared to meet the future challenges.

Clearly there are a number of follow-up issues

here that we have discussed, several of which have been explicitly discussed here today and are of concern to the Commission. Two examples. Some of our discussion in the digital I&C area and then the later discussion of the relation of the safety goals to the adequate protection standard. I think we all know where we have to go from here.

Unless my fellow Commissioners have any further comments, I'm about to adjourn. In adjourning, I am going to ask that we clear, because we have an affirmation to do, and then we can follow up and have any follow-on discussions that anyone would like to make. Thank you. We're adjourned.

[Whereupon, at 11:29 a.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 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS) - PUBLIC MEETING

PLACE OF MEETING: Rockville, Maryland

DATE OF MEETING: Friday, December 6, 1996

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: Michael Paulus

Reporter: Michael Paulus

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

November 26, 1996

MEMORANDUM TO: John C. Hoyle
Secretary of the Commission

FROM: John T. Larkins, Executive Director
Advisory Committee on Reactor Safeguards

SUBJECT: ACRS MEETING WITH THE NRC COMMISSIONERS, DECEMBER 6, 1996—SCHEDULE/BACKGROUND INFORMATION

The ACRS is scheduled to meet with the NRC Commissioners between 9:30-11:00 a.m. on Friday, December 6, 1996, to discuss the items listed below. Background materials related to these items are attached.

A.		Introduction - NRC Chairman	9:30-9:35 a.m.
B.	1.	Digital Instrumentation and Control Systems - Dr. Miller (pp. 1-13)	9:35-9:45 a.m.
	2.	Office of Nuclear Regulatory Research Plan for Upgrading Thermal-Hydraulic Codes - Dr. Catton (pp. 14-37)	9:45-10:10 a.m.
	3.	Risk-Informed, Performance-Based Regulation and Related Matters - Dr. Apostolakis (pp. 38-49)	10:10-10:30 a.m.
	4.	Potential Use of IPE/IPEEE Results to Compare the Risk of the Current Population of Plants with the Safety Goals - Dr. Kress (pp. 50-66)	10:30-10:40 a.m.
	5.	Use of Safety Goals on a Plant-Specific Basis - Dr. Kress (pp. 67-77)	10:40-10:50 a.m.
	6.	Use of RuleNet in the Regulatory Process - Dr. Shack (pp. 78-86)	10:50-10:55 a.m.
C.		Closing Remarks - NRC Chairman	10:55-11:00 a.m.

Attachment: As stated

cc: ACRS Members
ACRS Technical Staff

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NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
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Attachment: As stated

cc: ACRS Members
ACRS Technical Staff

ITEM B.1:

DIGITAL INSTRUMENTATION AND CONTROL SYSTEMS

(DR. MILLER)

ITEM B.1: DIGITAL INSTRUMENTATION AND CONTROL SYSTEMS

During the May 24, 1996 meeting with the Commissioners, the ACRS discussed the issues associated with the use of digital instrumentation and control (I&C) systems in nuclear power plants. The ACRS discussed the status of its review of the proposed update to Standard Review Plan (SRP), Chapter 7, "Instrumentation and Controls," which includes SRP sections, Branch Technical Positions (BTPs), and regulatory guides for digital I&C systems. The ACRS also discussed the results of its review of the National Academy of Sciences/National Research Council (NAS/NRC) Phase 1 study report and its expectation to review the Phase 2 study when available. The NAS/NRC Phase 2 study report was initially scheduled to be completed on September 30, 1996. However, it has been delayed and the exact date of availability of this report is uncertain at this time.

On October 10, 1996, the ACRS completed its review of the proposed SRP Chapter 7 update. ACRS Subcommittee on I&C Systems and Computers also met with representatives of the NRC staff and its contractor, the Lawrence Livermore National Laboratory, to discuss proposed SRP sections, BTPs, and regulatory guides on October 8, 1996.

The Committee issued letters dated June 6, and October 23, 1996, regarding the draft SRP sections, BTPs, associated regulatory guides, and a safety evaluation report (SER) on a topical report by the Electric Power Research Institute (EPRI) on electromagnetic/radiofrequency interference (EMI/RFI). In those letters, the ACRS identified several issues regarding the level of detail provided in the regulatory guides, the balance in the guidance between the review of the design process and the assessment of the product, the linkage between Chapter 7 and other SRP Chapters, and graded approaches based on importance to safety. As stated by the EDO in the November 1, 1996 letter to T.S. Kress, the ACRS plans to discuss these matters with the staff during future meetings. The Committee did, however, inform the staff that it has no objection to issuing the draft SRP Chapter 7 and associated guidance documents for public comment. The staff is scheduled to brief the ACRS on the proposed final SRP, BTPs, and regulatory guides in April-May 1997, after reconciliation of public comments.

The ACRS expects to hear a briefing on the NAS/NRC Phase 2 study report in February 1997, depending on the availability of this report. The Phase 1 study report identified safety and reliability issues arising from the introduction of digital I&C technology. The Phase 1 study report identified the following eight key issues - six technical and two strategic:

Technical

- software quality assurance
- common-mode software failure potential
- system aspects of digital I&C technology
- human factors and human-machine interfaces
- safety and reliability assessment methods
- dedication of commercial off-the-shelf hardware and software

Strategic

- case-by-case licensing
- adequacy of technical infrastructure

The Phase 2 study report is expected to identify criteria for review and acceptance of digital systems in retrofits of existing plants and in new standard plant designs. This report is also expected to characterize and evaluate alternative approaches to certification of digital systems and to recommend guidelines for reviewing licensee submittals. The staff plans to incorporate the insights from the Phase 2 study into the proposed final SRP, BTPs, and regulatory guides.

The ACRS also expects to review an SER on an EPRI topical report on commercial off-the-shelf (COTS) software. The staff is working closely with an EPRI working group on this matter. The use of COTS software and hardware is an important issue. The staff plans to incorporate appropriate guidance into the proposed final SRP and associated guidance documents, as appropriate. The ACRS also plans to review the draft regulatory guide for equipment protection against lightning and other guidance for environmental stressors. The Committee will review these matters when the documents become available.

Attachments:

- Letter dated October 23, 1996, from T. S. Kress, ACRS Chairman, to James M. Taylor, Executive Director for Operations, Subject: "Draft Update of Standard Review Plan, Chapter 7, 'Instrumentation and Controls'" (p. 4)

- Letter dated November 1, 1996, from James M. Taylor, Executive Director for Operations, to T. S. Kress, ACRS Chairman, Subject: "Draft Update of Standard Review Plan, Chapter 7, 'Instrumentation and Controls'" (pp. 5-6)

- Letter dated June 6, 1996, from T. S. Kress, ACRS Chairman, to James M. Taylor, Executive Director for Operations, Subject: "Regulatory Guidance Documents Related to Digital Instrumentation and Control Systems" (pp. 7-9)

- Letter dated June 21, 1996, from James M. Taylor, Executive Director for Operations, to T. Kress, ACRS Chairman, Subject: "Regulatory Guidance Documents Related to Digital Instrumentation and Control Systems" (p. 10)

- Report dated October 13, 1995, from T. S. Kress, ACRS Chairman, to Shirley Ann Jackson, NRC Chairman, Subject: National Academy of Sciences/National Research Council Study on "Digital Instrumentation and Control Systems, Safety and Reliability Issues" - Phase 1 (pp. 11-12)

- Letter dated October 31, 1995, from James M. Taylor, Executive Director for Operations, to T. S. Kress, ACRS Chairman, Subject: "The National Academy of Sciences' Report on Digital Instrumentation and Control, Safety and Reliability Issues" (p. 13)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

October 23, 1996

Mr. James M. Taylor
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Taylor:

SUBJECT: DRAFT UPDATE OF STANDARD REVIEW PLAN, CHAPTER 7, "INSTRUMENTATION AND CONTROLS"

During the 435th meeting of the Advisory Committee on Reactor Safeguards, October 9-12, 1996, we reviewed portions of the draft update of Standard Review Plan (SRP), Chapter 7, "Instrumentation and Controls." We heard presentations by and held discussions with representatives of the NRC staff and its contractor, the Lawrence Livermore National Laboratory (LLNL), regarding proposed SRP sections and Branch Technical Positions (BTPs) related to digital instrumentation and control (I&C) systems. In addition, our Subcommittee on Instrumentation and Control Systems and Computers met with the NRC staff and LLNL on October 8, 1996, to discuss this matter. We had previously met with the staff and LLNL in March and May 1996 to discuss draft SRP sections, BTPs, and associated regulatory guides, and provided comments in a letter dated June 6, 1996. We also had the benefit of the documents referenced.

We have no objection to the staff's proposal for issuing the draft update of SRP Chapter 7 and associated BTPs for public comment. However, in the June 6, 1996 letter, we identified issues regarding the level of detail provided in the regulatory guides, the balance in the guidance between the review of the design process and the assessment of the product, the linkage between Chapter 7 and other SRP chapters, and graded approaches based on importance to safety. In a letter dated June 21, 1996, you responded to our letter of June 6, 1996, stating that the staff will continue its discussions with the ACRS on these issues. We plan to discuss these matters with the staff during our future meetings.

Sincerely,

T. S. Kress

T. S. Kress
Chairman

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

November 1, 1996

Dr. Thomas S. Kress, Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Dr. Kress:

SUBJECT: DRAFT UPDATE OF STANDARD REVIEW PLAN, CHAPTER 7, "INSTRUMENTATION AND CONTROLS"

The ACRS, in its letter dated October 23, 1996, commented on the staff's proposed draft update of Standard Review Plan (SRP), Chapter 7, "Instrumentation and Controls." The ACRS stated that it has no objection to the staff's proposal for issuing the draft SRP Chapter 7 for public comment. The staff plans to issue the draft SRP Chapter 7 update for public comment in November 1996.

The staff will continue its discussion with the ACRS, in conjunction with the resolution of public comments, on the level of detail in the regulatory guides referenced in the SRP, the balance in the guidance between the review of the design process and the assessment of the product, the linkage between Chapter 7 and other SRP chapters, and graded approaches based on importance to safety. The staff plans to meet with the ACRS in the first quarter of 1997, when the final SRP Chapter 7 update is completed.

Sincerely,

James M. Taylor
Executive Director
for Operations

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
SECY

References:
1. Memorandum dated September 16, 1996, from Frank J. Miraglia, Jr., Office of Nuclear Reactor Regulation, to Edward L. Jordan, Committee to Review Generic Requirements, Subject: Request for Review of Updated Standard Review Plan Chapter 7, Instrumentation and Controls (attached)
2. Letter dated June 6, 1996, from T. S. Kress, ACRS Chairman, to James M. Taylor, Executive Director for Operations, Subject: Regulatory Guidance Documents Related to Digital Instrumentation and Control Systems
3. Letter dated June 21, 1996, from James M. Taylor, Executive Director for Operations, to T. S. Kress, ACRS Chairman, Subject: Regulatory Guidance Documents Related to Digital Instrumentation and Control Systems

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

June 6, 1996

Mr. James M. Taylor
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Taylor:

SUBJECT: REGULATORY GUIDANCE DOCUMENTS RELATED TO DIGITAL INSTRUMENTATION AND CONTROL SYSTEMS

During the 429th and 431st meetings of the Advisory Committee on Reactor Safeguards, March 7-9 and May 23-25, 1996, we reviewed portions of the proposed Standard Review Plan (SRP), Branch Technical Positions (BTPs), and Regulatory Guides related to digital instrumentation and control (I&C) systems. We held discussions with representatives of the NRC staff and its contractor, the Lawrence Livermore National Laboratory (LLNL). In addition, our Subcommittee on I&C Systems and Computers met with the NRC staff and LLNL to discuss these documents on March 6 and May 22, 1996. We also had the benefit of the documents referenced.

The staff requested ACRS to review the SRP Chapter 7 update in the early stages of development to accommodate the schedule set forth in the Digital I&C Task Action Plan. The staff expects to complete development of the SRP Chapter 7 update and associated guidance in September 1996, integrate the recommendations from the National Academy of Sciences/National Research Council (NAS/NRC) Phase 2 study report in October 1996, publish the Draft SRP Chapter 7 and associated guidance for public comment in December 1996, and issue the final SRP and related guidance in May 1997.

The staff is revising the SRP, adding two new sections, developing new BTPs, and preparing six regulatory guides that endorse eight industry standards. The staff presented a safety evaluation report (SER) on an Electric Power Research Institute (EPRI) topical report for electromagnetic/radiofrequency interference (EMI/RFI) design requirements and testing. A planned BTP on commercial off-the-shelf (COTS) software may be replaced by an SER on a topical report being developed by an EPRI working group. We concur with the staff conclusions in the SER associated with the EPRI topical report on EMI/RFI and encourage the staff to complete an SER for the EPRI topical report on COTS.

Considering the fact that the staff is using generally accepted U.S. software engineering practices, it appears that the staff approach is appropriate to update the SRP and associated guidance to codify the current regulatory framework for digital I&C. We raised several issues (e.g., the linkage between SRP Chapter 7 and other SRP chapters, and graded approaches based on importance to safety) that were subsequently clarified by the staff. The staff agreed to document these clarifications.

We have raised other issues that include the level of detail provided in the regulatory guides and the balance in the guidance between the review of the design process and the assessment of the product. We plan to report on these and other digital I&C issues at a later date.

We plan to review the staff's remaining SRP sections, the BTPs, and the SER on the EPRI topical report on COTS when they become available.

Sincerely,

T. S. Kress

T. S. Kress
Chairman

<u>References</u>:

1. U. S. Nuclear Regulatory Commission, Standard Review Plan, Section 7.0, "Instrumentation and Controls—Overview of Review Process," Draft Version 3.0, February 12, 1996
2. U. S. Nuclear Regulatory Commission, Standard Review Plan, Section 7.1, "Instrumentation and Controls—Introduction," Draft Version 7.0, February 14, 1996
3. U. S. Nuclear Regulatory Commission, Standard Review Plan, Section 7.2, "Reactor Trip System," Draft Version 6.0, April 17, 1996
4. U. S. Nuclear Regulatory Commission, Standard Review Plan, Section 7.9, "Data Communications," Draft Version 4.1, April 18, 1996
5. U. S. Nuclear Regulatory Commission, (Proposed) Branch Technical Position HICB-14: "Guidance on Software Reviews for Digital Computer-Based Instrumentation and Control Safety Systems," Version 9.0, February 14, 1996
6. U. S. Nuclear Regulatory Commission, (Proposed) Branch Technical Position HICB-16: "Guidance on the Level of Detail Required for Design Certification Applications Under 10 CFR Part 52," Version 7.0, April 12, 1996

7. U. S. Nuclear Regulatory Commission, Draft Regulatory Guides, transmitted by memorandum dated February 9, 1996, from M. Wayne Hodges, Director, Office of Nuclear Regulatory Research, NRC, to John T. Larkins, ACRS:
   - U. S. Nuclear Regulatory Commission, Draft Regulatory Guide DG-XXXX, Version 2.7.2, "Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants"
   - U. S. Nuclear Regulatory Commission, Draft Regulatory Guide DG-XXXX, Version 2.0.7, "Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants"
8. U. S. Nuclear Regulatory Commission, Draft Regulatory Guides, transmitted by memorandum dated April 26, 1996, from M. Wayne Hodges, Director, Office of Nuclear Regulatory Research, NRC, to John T. Larkins, ACRS:
   - Draft Regulatory Guide DG-XXXX, Version 2.0, "Software Unit Testing for Digital Computer Software Used in Safety Systems of Nuclear Power Plants"
   - Draft Regulatory Guide DG-XXXX, Version 2.0, "Developing Software Life Cycle Processes for Digital Computer Software Used in Safety Systems of Nuclear Power Plants"
   - Draft Regulatory Guide DG-XXXX, Version 2.0, "Software Requirements Specifications for Digital Computer Software Used in Safety Systems of Nuclear Power Plants"
   - Draft Regulatory Guide DG-XXXX, Version 2.0, "Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Plants"
9. Memorandum dated January 30, 1996, from F. Miraglia, Office of Nuclear Reactor Regulation, NRC, to E. Jordan, Committee to Review Generic Requirements, NRC, Subject: Request for Endorsement of the Safety Evaluation Report on Electric Power Research Institute Topical Report, TR-102323, "Guidelines for Electromagnetic Interference Testing in Power Plants"

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

June 21, 1996

Dr. T.S. Kress, Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: REGULATORY GUIDANCE DOCUMENTS RELATED TO DIGITAL INSTRUMENTATION AND CONTROL SYSTEMS

Dear Dr. Kress:

The ACRS, in its letter on this subject dated June 6, 1996, commented on the staff's proposed Standard Review Plan (SRP) update, Branch Technical Positions (BTPs), and new Regulatory Guides related to digital instrumentation and control systems. The ACRS stated that it appears that the staff approach is appropriate to update the SRP and associated guidance (BTPs and Regulatory Guides). Additionally, the ACRS concurred with the staff conclusions in the Safety Evaluation Report (SER) associated with the Electric Power Research Institute (EPRI) topical report on electromagnetic/radiofrequency interference.

The ACRS encouraged the staff to complete an SER for another EPRI topical report on commercial off-the-shelf software. The staff will continue to work toward an SER on the EPRI document.

The staff will continue its discussion with the ACRS on the level of detail in the proposed new guidance and the balance between review of the digital system design process and the assessment of resulting digital system products during meetings with the ACRS in August and October of this year.

Sincerely,

James M. Taylor
Executive Director for Operations

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
SECY

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

October 13, 1995

The Honorable Shirley A. Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Jackson:

SUBJECT: NATIONAL ACADEMY OF SCIENCES/NATIONAL RESEARCH COUNCIL STUDY ON "DIGITAL INSTRUMENTATION AND CONTROL SYSTEMS IN NUCLEAR POWER PLANTS, SAFETY AND RELIABILITY ISSUES" - PHASE 1

During the 425th meeting of the Advisory Committee on Reactor Safeguards, October 5-7, 1995, we reviewed the National Academy of Sciences/National Research Council (NAS/NRC) Phase 1 report on Digital Instrumentation and Control Systems in Nuclear Power Plants, Safety and Reliability Issues. The NAS/NRC Committee Chairman described the results of the Phase 1 report. We also had the benefit of the documents referenced.

The objective of the Phase 1 study was to define the important safety and reliability issues concerning hardware, software, and human-machine interfaces that arise from the use of digital instrumentation and control technology in nuclear power plant operations. The report identifies eight key issues: six technical and two strategic. It notes that these issues are common to other industries where software is required for dependable operation of systems. The report succinctly presents the issues that the NAS/NRC Committee found to be important.

We agree that the issues identified in the Phase 1 report will be important considerations as digital technology is used more extensively in nuclear power plants. In the past, we have called attention to the effects of environmental stressors. The NAS/NRC Chairman stated that the NAS/NRC Committee considered, but decided not to raise this issue to the level of a "key technical issue." We continue to believe this is an important issue that the staff must address as it develops its regulatory guidance for digital systems. However, this is part of the broader issue of environmental qualification of safety-related equipment and does not need to be a key issue of the Phase 2 study.

We have concerns regarding a potential conflict between the Phase 2 completion schedule and the staff's schedule for issuing the Standard Review Plan (SRP) and associated regulatory guides. We believe it is important that the SRP and other regulatory guidance benefit from the insights in the Phase 2 report.

Sincerely,

T. S. Kress

T. S. Kress
Chairman

References:

1. Report dated 1995, from the Committee on Application of Digital Instrumentation and Control Systems to Nuclear Power Plant Operations and Safety, Board on Energy and Environmental Systems, Commission on Engineering and Technical Systems, National Research Council, Subject: Digital Instrumentation and Control Systems in Nuclear Power Plants, Safety and Reliability Issues - Phase 1
2. Memorandum dated December 2, 1993, from Ivan Selin, Chairman, NRC, to NRC Commissioners, Subject: Computers in Nuclear Power Plant Operations
3. Letter dated July 14, 1994, from T. S. Kress, Chairman, ACRS, to Ivan Selin, Chairman, NRC, Subject: Proposed National Academy of Sciences/National Research Council Study and Workshop on Digital Instrumentation and Control Systems
4. Letter dated August 23, 1994, from Ivan Selin, Chairman, NRC, to T. S. Kress, Chairman, ACRS, regarding ACRS letter of July 14, 1994 on National Academy of Sciences/National Research Council Proposal for a Study and Workshop on the "Application of Digital Instrumentation and Control Technology to Nuclear Power Plant Operations and Safety"

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

October 31, 1995

Dr. Thomas S. Kress, Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: THE NATIONAL ACADEMY OF SCIENCES' REPORT ON DIGITAL INSTRUMENTATION AND CONTROL, SAFETY AND RELIABILITY ISSUES

Dear Dr. Kress:

I am responding to your letter on this subject, dated October 13, 1995, in which the Advisory Committee on Reactor Safeguards (ACRS) commented on the National Academy of Sciences/National Research Council (NAS/NRC) Phase 1 Report, "Digital Instrumentation And Control Systems In Nuclear Power Plants, Safety And Reliability Issues."

We agree that the issue of environmental stressors is key to the qualification of safety-related digital instrumentation and control systems. Environmental stressors are defined as an issue in the NAS/NRC study Phase 1 report, but not as a "key technical issue." As you know from past briefings to the ACRS, the staff is conducting confirmatory research to investigate and characterize the failure modes and degradation mechanisms of digital technologies proposed for use in nuclear power plants. Furthermore, this research is assessing the impact of smoke on advanced instrumentation and control hardware in nuclear power plants. The goal of this research is to provide the technical basis for a regulatory guide on the environmental qualification of digital instrumentation and control systems. We informed the NAS/NRC Committee about our activities on this key issue in an October 17, 1995, meeting with them.

We share your concerns regarding a potential conflict between the Phase 2 completion schedule and the staff's schedule for issuing the Standard Review Plan (SRP) and associated regulatory guides. Our contract with NAS/NRC calls for the completion of the study by September 30, 1996, which includes the delivery of the Phase 2 report. The staff has expressed its concern and will continue to encourage a timely completion of the NAS/NRC study. We agree that it is important that the SRP and other regulatory guidance benefit from the insights expected from the Phase 2 report.

Sincerely,

James M. Taylor
Executive Director
for Operations

cc: Chairman Jackson
Commissioner Rogers
SECY

ITEM B.2:

OFFICE OF NUCLEAR REGULATORY RESEARCH PLAN FOR UPGRADING THERMAL-HYDRAULIC CODES

(DR. CATTON)

ITEM B-2: OFFICE OF NUCLEAR REGULATORY RESEARCH PLAN FOR UPGRADING THERMAL-HYDRAULIC CODES

In response to concerns expressed by Chairman Jackson and the ACRS, the Office of Nuclear Regulatory Research (RES) has undertaken a Five-Year Plan, the central goal of which is to upgrade the NRC thermal-hydraulic codes. Key points regarding this Plan include the following:

- There are four goals of this Plan: (1) improve and maintain the reactor safety codes, (2) improve the two-phase flow formulation and constitutive relations used in the codes, as supported by detailed experimental data, (3) maintain experimental facilities and conduct tests for code validation, and (4) develop and maintain in-house capabilities.

- The work to improve the thermal-hydraulic codes will progress in two Phases. In Phase I, the capabilities of the current suite of codes will be consolidated into one code. RES proposes to use the TRAC-P code as the base architecture for this effort. In Phase II, pilot studies of a few promising schemes will be performed that may lead to an improved code. Phases I & II will be performed in parallel.

- A supporting experimental program will be conducted at three test facilities available to NRC: OSU (Oregon State University), PUMA (Purdue University), and THECA (University of Maryland). In addition, cooperative programs are expected to be established with JAERI (Japan) and the CEA (France) to obtain test data and analysis expertise.

Detailed information concerning this matter was provided to the Committee via a (predecisional) memorandum, dated September 6, 1996, from James M. Taylor, Executive Director for Operations (EDO), to the Commission.

On September 18-19, 1996, the ACRS Thermal Hydraulic Phenomena Subcommittee reviewed RES' scope and approach for the conduct of the Five-Year Plan. This matter was subsequently reviewed by the ACRS during its October 1996 meeting. Formal comments on the results of the Committee's review were provided in an October 21, 1996 report to the Commission. In a letter dated November 12, 1996, the EDO responded to the ACRS comments and recommendations, stating that "we are pleased that the ACRS finds this plan holds much promise to revitalize the NRC Thermal-Hydraulics Research Program. We look forward to constructive interactions between the staff and the ACRS Thermal Hydraulic Phenomena Subcommittee in implementing the different elements of the program."

In a November 12, 1996 memorandum to the ACRS Executive Director, Commissioner Diaz requested a summary of the specific recommendations made by the ACRS over the past two years that pertain to NRC thermal-hydraulic codes. The requested information was provided via a November 14, 1996 memorandum.

RES Code Upgrade Plan:
Commission Meeting

In addition to the above, a copy of a November 20, 1996 memorandum is attached that transmitted a summary of ACRS comments on the NRC research program pertaining to thermal-hydraulic codes, which were made between 1972 and 1991.

The ACRS plans to continue its review of the RES Five-Year Plan in tandem with the staff's progress on this matter.

<u>Attachments</u>:

- Report dated October 21, 1996, from T.S. Kress, ACRS Chairman, to Shirley Ann Jackson, NRC Chairman, Subject: Thermal-Hydraulics Research Plan (pp. 16-18)

- Letter dated November 12, 1996, from James M. Taylor, Executive Director for Operations, to T. S. Kress, ACRS Chairman, Subject: Thermal-Hydraulics Research Plan (pp. 19-20)

- Memorandum dated November 12, 1996, from Commissioner Nils J. Diaz, to John T. Larkins, ACRS Executive Director, Subject: Thermal Hydraulic Codes, and, Memorandum dated November 14, 1996, from John T. Larkins, ACRS Executive Director, to Commissioner Nils J. Diaz, Subject: Previous ACRS Comments on NRC Thermal-Hydraulic Codes and Programs (pp. 21-26)

- Memorandum dated November 20, 1996, to ACRS Members, from Paul A. Boehnert, ACRS Staff, Subject: ACRS Review of NRC Thermal- Hydraulic Research Program - Recommendations Regarding NRC's Thermal-Hydraulic Codes, 1972-1991 (pp. 27-37)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

October 21, 1996

The Honorable Shirley Ann Jackson
Chairman
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Chairman Jackson:

SUBJECT: THERMAL-HYDRAULICS RESEARCH PLAN

During the 435th meeting of the Advisory Committee on Reactor Safeguards, October 9-12, 1996, we reviewed the scope and approach of the Thermal-Hydraulics Research Plan of the Office of Nuclear Regulatory Research (RES). Our Subcommittee on Thermal-Hydraulic Phenomena met on September 18-19, 1996, to review this matter. During this review, we had the benefit of discussions with representatives of the NRC staff. We also had the benefit of the documents referenced.

The overall plan developed by RES to consolidate existing computational tools into a single computer code is timely and should be implemented. We agree with its objectives of standardized programming, better physics, flexibility (modularity), computational efficiency, a graphical user interface, and thorough documentation. The RES plan to review the past 22 years of experience with codes like TRAC and RELAP, as well as the successful Code Scaling Applicability and Uncertainty evaluation methodology, should help avoid some of the problems of the past. We recommend that this review also consider the French code, CATHARE, and its uncertainty evaluation methodology.

The RES staff expects to identify the key physical processes that the new code must model. Also, RES plans to determine whether TRAC-P has an architecture that will allow it to provide flexibility with respect to insertion of new models or modules and whether it has the capability to interface with other codes like CONTAIN and SCDAP. We concur in these plans and emphasize that highest priority should be given to the development of sufficient flexibility to facilitate modifications in response to future modeling challenges.

The NRC Office of Nuclear Reactor Regulation and the Office for Analysis and Evaluation of Operational Data are primary users of thermal-hydraulic codes. They should be a part of this process from the beginning. Consequently, we recommend that a code users group be instituted early in the development program.

We concur in the RES plan to incorporate the integral effects test programs at Oregon State University, the University of Maryland, and Purdue University into the overall verification and validation program. The cooperative agreement with the French authorities to obtain analytical and experimental data developed at the Grenoble facility should also prove to be valuable for validating the code. The present RES relationship with the above three universities and the French authorities should significantly enrich the proposed thermal-hydraulics research Plan. These, along with other cooperative agreements, should be pursued, independent of the final direction of the RES Plan.

We commend the staff for the development of this Plan which holds much promise to revitalize the NRC Thermal-Hydraulics Research Program.

Additional comments by ACRS Member Ivan Catton are presented below.

Sincerely,

T. S. Kress

T. S. Kress
Chairman

<u>Additional Comments by Ivan Catton, ACRS Member</u>

I agree with the views of my colleagues expressed above but would like to emphasize the need for careful planning at the outset of the RES Thermal-Hydraulics Research Plan. The research program that led to the present suite of thermal-hydraulic codes was initiated in 1974 to address the large-break loss of coolant accident. The mission was well defined and the agency met its objectives.

At the outset, it was thought that a properly designed thermal-hydraulic code would be able to model all related problems. Over the years, however, experience has shown that the codes did not meet this objective; i.e., whenever we needed solutions to a new problem that was a little different, the codes were inadequate, because they could not be readily modified to accommodate the special circumstances demanded by the new problem.

The inability of the codes to address numerous new problems emphasizes the need for a different approach. There is no single code that can model all the different physical phenomena that occur in a nuclear power plant. A broader approach is needed where different modeling schemes can be tied together to successfully address the problem at hand. Further, a skilled code user, who is also knowledgeable in the field of thermal-hydraulics, is needed to decide what is important and how to implement it in a code. A code, no matter how good, will never substitute for a capable thermal-hydraulic analyst.

Some of these problems will be heavily dependent on the use of what is commonly known as computational fluid dynamics (CFD), some on the use of the kind of modeling found in today's codes, and some will require an empirical approach. There will be some problems that may even require the use of stand-alone CFD codes. Further, the development of a single code for all users may not be a realistic goal. A skilled user needs a different level of computational power than does a less-skilled user. Ensuring adequate flexibility in a single code to accommodate the needs of both computational power and user skills will require a great deal of thoughtful planning; this planning should take place at the beginning of the development of the RES Thermal-Hydraulics Research Plan.

<u>References</u>:

1. Memorandum dated September 6, 1996, to the Commission from James M. Taylor, NRC Executive Director for Operations, Subject: Thermal-Hydraulic Five-Year Research Plan, (Predecisional - For Internal Use Only)
2. U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Analytical Support Group, Technical Analysis Reports, SASG-94-01 - SASG-94-05; SASG-95-01 - SASG-95-07; SASG-96-01 - SASG-96-07 (Proprietary Information)
3. ACRS report dated June 15, 1989, from David A. Ward, ACRS Chairman, to Lando W. Zech, Jr., NRC Chairman, Subject: NRC Thermal-Hydraulic Research Program
4. ACRS report dated June 7, 1988, from David A. Ward, ACRS Chairman, to Lando W. Zech, Jr., NRC Chairman, Subject: NRC Research Related to Heat Transfer and Fluid Transport in Nuclear Power Plants

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

November 12, 1996

Dr. Thomas S. Kress, Chairman
Advisory Committee on Reactor Safeguards
U. S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: THERMAL-HYDRAULICS RESEARCH PLAN

Dear Dr. Kress:

The staff met with the ACRS Subcommittee on Thermal Hydraulic Phenomena on September 18-19, 1996, and the Full Committee on October 11, 1996, to discuss the scope and approach of the Thermal-Hydraulics Research Plan. The result of the ACRS review is reported in a letter to me dated October 21, 1996, "Thermal-hydraulics Research Plan." We are pleased that the ACRS finds this plan "holds much promise to revitalize the NRC Thermal-Hydraulics Research Program." We look forward to constructive interactions between the staff and the ACRS Thermal Hydraulic Phenomena Subcommittee in implementing the different elements of the program.

The plan to consolidate the existing computational tools into a single code will use a modernized TRAC-P architecture with FORTRAN-90 programming, better physics, flexibility (modularity), computational efficiency, graphical user interface, and thorough documentation. The current modularity of TRAC-P will form the base of the consolidated code and will permit the use of different correlations, models and data for different components. It will also provide an improved user interface to the code input deck and output display. As part of the code requirements specification we will identify the appropriate interfaces to link the consolidated code with other codes and to facilitate modifications in response to future modeling challenges. Interface with the CONTAIN code is straightforward and can be accomplished using existing software e.g., Message Passing Interface (MPI). However, interfaces to the SCDAP code might not be straightforward and may require developing a cleaner SCDAP package with appropriate interface to the consolidated code. We will continue our assessment of the need to link the SCDAP code to the consolidated code and will discuss the rationale for and the staff finding regarding this issue with the ACRS before final implementation.

An NRC Thermal-Hydraulic Code User Group is being formed to facilitate communication between the various NRC offices (NRR, AEOD, and RES) with responsibilities in the area of thermal-hydraulic analysis and the RES staff who have the responsibility of developing and assessing the NRC thermal-hydraulic codes. Enhanced communication between representatives of the thermal-hydraulic code user community and those charged with the development of the thermal-hydraulic code and the associated experimental program will enable RES to better focus its efforts and carry out its responsibility to ensure that the future analysis needs of the agency and the NRC thermal-hydraulic code user community will be met.

Finally, we will continue our efforts to increase collaboration with other international organizations that are performing thermal-hydraulic research, similar to the existing collaborations with CEA of France and JAERI of Japan.

Sincerely,

James M. Taylor
Executive Director
for Operations

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
SECY

COMPILATION OF ACRS COMMENTS PERTAINING TO NRC THERMAL-HYDRAULICS CODES (1994-96)

(INFORMATION REQUESTED BY COMMISSIONER DIAZ)

NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

COMMISSIONER

November 12, 1996

MEMORANDUM TO : John Larkins, Executive Director
Advisory Committee on Reactor Safeguards (ACRS)

FROM: Commissioner Nils J. Diaz

SUBJECT: THERMAL HYDRAULIC CODES

Since understanding the thermal hydraulic phenomena in nuclear power plants is essential to ensuring reactor safety, I am interested in our current analytical capabilities in thermal hydraulics and in our plans to maintain and enhance NRC's thermal hydraulic codes.

In addition to reviewing the NRC's "Thermal-Hydraulic Five-Year Research Plan," I would appreciate it if you could provide me a summary of the specific recommendations made by the ACRS in the last two years regarding NRC's thermal hydraulic codes.

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
Commissioner McGaffigan
SECY

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

November 14, 1996

MEMORANDUM TO: Commissioner Nils J. Diaz

FROM: John T. Larkins, Executive Director
Advisory Committee on Reactor Safeguards

SUBJECT: PREVIOUS ACRS COMMENTS ON NRC THERMAL-HYDRAULIC CODES AND PROGRAMS

In response to your November 12, 1996 memorandum, attached is a compilation of specific recommendations and relevant comments made by the Advisory Committee on Reactor Safeguards on the subject of the NRC thermal-hydraulic codes and programs over the past two years. The material provided was directly excerpted from the relevant ACRS letter reports.

Attachment: ACRS Comments Pertaining to NRC Thermal-Hydraulic Codes

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
Commissioner McGaffigan
SECY

COMPILATION OF ACRS COMMENTS PERTAINING TO NRC THERMAL-HYDRAULIC CODES (1994-1996)

As noted below, the ACRS provided four letters over the past two years that pertain directly to the subject matter. In some cases, the comments and recommendations provided do not appear to apply specifically to code development. However these items [e.g., development of Phenomena Identification and Ranking Table (PIRT), scaling analyses] are considered by the Committee to be vital to ensuring that the codes will be able to adequately model the phenomena in question.

October 21, 1996 Letter: "Thermal-Hydraulics Research Plan"

The overall plan developed by RES to consolidate existing computational tools into a single computer code is timely and should be implemented. We agree with its objectives of standardized programming, better physics, flexibility (modularity), computational efficiency, a graphical user interface, and thorough documentation.

The RES plan to review the past 22 years of experience with codes like TRAC and RELAP, as well as the successful Code Scaling Applicability and Uncertainty evaluation methodology, should help avoid some of the problems of the past. We recommend that this review also consider the French code, CATHARE, and its uncertainty evaluation methodology.

The RES staff expects to identify the key physical processes that the new code must model. Also, RES plans to determine whether TRAC-P has an architecture that will allow it to provide flexibility with respect to insertion of new models or modules and whether it has the capability to interface with other codes like CONTAIN and SCDAP. We concur in these plans and emphasize that highest priority should be given to the development of sufficient flexibility to facilitate modifications in response to future modeling challenges.

The NRC Office of Nuclear Reactor Regulation and the Office for Analysis and Evaluation of Operational Data are primary users of thermal-hydraulic codes. They should be a part of this process from the beginning. Consequently, we recommend that a code users group be instituted early in the development program.

We concur in the RES plan to incorporate the integral effects test programs at Oregon State University, the University of Maryland, and Purdue University into the overall verification and validation program. The cooperative agreement with the French authorities to obtain analytical and experimental data developed at the Grenoble facility should also prove to be valuable for validating the code.

March 19, 1996 Letter: "NRC Staff Program on the Adequacy Assessment of the RELAP5/MOD3 Code for Simulation of AP600 Passive Plant Behavior"

We have been asked to comment on the approach and methodology for demonstrating the adequacy of the RELAP5/MOD3 code to calculate AP600 passive plant behavior in support of the design certification review. We believe that the overall approach and methodology being employed by RES for this assessment is acceptable. Most of the necessary elements are in place. A substantial amount of work remains, however, and we believe that the schedule for successful completion cannot be met.

RES should perform a more robust and complete top-down system scaling analysis for ROSA, SPES, and OSU. An entire transient should be evaluated to quantify the effects of various distortions in the three facilities and to demonstrate that the experimental database is sufficient to validate the code. Any additional distortions or anomalies identified should be added to the list of distortions compiled by RES in late-1994, and that remain to be addressed. The scaling effort should be integrated with the Phenomena Identification and Ranking Table.

The thermal stratification in the Core Makeup Tank (CMT) observed in the tests needs to be studied. Its effects on core inventory have to be understood because neither RELAP5/MOD3 nor the Westinghouse computer codes can, at present, reliably predict thermal stratification.

RELAP5 is still undergoing significant and rapid modifications. A calculation has not yet been performed with a version of the code that contains all the planned changes. Numerous calculations will need to be performed to mature the code and validate it using data obtained from various separate effects and integral facilities tests.

Overall, the approach and methodology for qualifying RELAP5/MOD3 for AP600 simulation appear to be adequate. However, two possible "show stoppers" remain: 1) simulation of the CMT thermal stratification and 2) simulation of long-term cooling, which is still an issue. Serious consideration should be given to addressing these obstacles.

April 12, 1995 letter: "NRC Test and Analysis Program in Support of AP600 Advanced Light Water Passive Plant Design Review"

Completion of the Phenomena Identification and Ranking Table (PIRT) for the AP600 remains an important task. It was much easier to develop the PIRT for the current operating plants because a great deal of relevant test data were available. This is not the case for the AP600 and SBWR passive plants. Development of the PIRT should be concurrent with a scaling analysis and review of test results to provide quantitative support for the engineering judgments that must be made. The RES approach appears to be systematic and well organized. We recommend, however, that RES fully document the development of the PIRT.

We are concerned about the applicability of the present thermal-hydraulic codes (TRAC, RELAP5) for analysis of plants like the AP600. These codes have to predict types of thermal-hydraulic behavior for which they have been shown to be weak; i.e., prediction of condensation, thermal stratification, and water level. We recommend that RES consider

developing a contingency plan in the event that the codes cannot adequately predict these key phenomena.

Although the focus of our meetings with RES was on the development of the PIRT, some reference was made to determination of computational uncertainty. The uncertainty parameter of choice is peak clad temperature for the large-break LOCA while reactor vessel primary system inventory is the choice for the small-break LOCA. With resources being reduced, we recommend that RES focus its attention on the more safety-significant small-break LOCA.

November 10, 1994 Letter: "NRC Test and Analysis Programs in Support of AP600 and SBWR Advanced Light Water Reactor Passive Plant Design Certification Reviews"

In the absence of a full-scale test facility, an understanding of the thermal hydraulic behavior of a passive plant design will depend on the use of computer codes. The NRC staff has decided to modify RELAP5/MOD3 for its confirmatory thermal hydraulic analysis of the AP600 and SBWR designs. The important phenomena the code must simulate should be delineated in the Phenomena Identification and Ranking Table (PIRT), thus allowing one to formulate integral and separate effects experiments that will yield appropriate data for code validation. Code validation should be an integrated process involving code development, experimentation, and an understanding of the physics of two-phase flow and heat transfer.

The major objective of the thermal hydraulic code development effort should be to produce a code capable of predicting the behavior of a full-scale nuclear power plant with acceptable uncertainties. For existing nuclear plant designs, we have had the benefit of many integral and separate effects experiments at a wide variety of scales to help arrive at an estimate of the uncertainties in the code predictions. We are now dealing with two passive plant designs which evidence more complex thermal hydraulic system dynamics, and for which there is a paucity of relevant experimental data. There are several causes for this more complex dynamic behavior: (1) steam condensation at low pressure, (2) use of gravity-driven coolant injection, and (3) the existence of many components and complex hydraulic paths that give the system many degrees of freedom. Understanding this dynamic behavior requires evaluation of scale distortion effects and dynamic characteristics in the various test facilities. In this regard, two questions should be addressed and resolved: (1) is the evolution of a particular transient influenced by configurational and/or scale distortions, and (2) do configurational and/or scale distortions in the various test facilities preclude simulation of some important dynamic effects while introducing other dynamic effects that may not be important in a full-scale plant design? To address these questions, a top-down scaling analysis must be performed.

Direct counterpart tests in ROSA, OSU, and SPES are not possible. This makes it difficult to extrapolate the observed thermal hydraulic behavior to full scale. A well-planned effort to integrate experiments with code improvement and assessment is needed to quantify uncertainties. At present, RELAP5/MOD3 predicts strong oscillations both when they are observed in tests and when they are not. Consequently, the calculated behavior can neither be attributed conclusively to numerical nor physical effects. The mechanisms by which the various observed modes of oscillation are initiated and maintained need to be understood so

that their potential influence on the thermal hydraulic behavior of the AP600 can be evaluated. The judicious selection of test conditions for the facilities, together with the conduct of a careful data analysis and scaling, should provide a satisfactory solution.

Again, a PIRT has not been completed. The PIRT effort should be brought to a close so that a proper evaluation of PUMA[1] and the GENE test facilities (GIST, GIRAFFE, and PANDA) can be made.

To preclude atypicalities in the interactions of the various systems and to help determine an appropriate set of initial and operating conditions for the PUMA system, the scaling of the global dynamic component interactions (among the reactor vessel, drywell, wetwell, PCCS, ICS, and GDCS) should be completed before the facility design is frozen.

[1] The PUMA test facility was initially constructed in support of the SBWR design certification review. Since GE Nuclear Energy has, in effect, terminated the SBWR design certification review, RES has redirected the PUMA program to support its current Thermal-Hydraulic Five-Year Research Plan.

COMPILATION OF ACRS COMMENTS PERTAINING TO NRC THERMAL-HYDRAULICS CODES (1972-1991)

November 20, 1996

MEMORANDUM TO: ACRS Members

FROM: P. Boehnert, Senior Staff Engineer /s/

SUBJECT: ACRS REVIEW OF NRC THERMAL HYDRAULIC RESEARCH PROGRAM - RECOMMENDATIONS REGARDING NRC's THERMAL-HYDRAULIC CODES, 1972-1991

In response to inquiries from Commissioner Diaz's Office, I undertook a review of the Committee's recommendations relative to NRC/AEC programs for development and use of thermal-hydraulic codes. Subsequently, the Commission requested that the ACRS discuss its review of the Office of Nuclear Regulatory Research (RES) Five-Year Thermal-Hydraulic Research Plan during the ACRS Meeting with the Commission, scheduled for Friday, December 6, 1996. Commissioner Diaz also made a written request for a summary of the Committee's recommendations pertaining to RES thermal-hydraulic codes over the past two years. A copy of this memorandum and this Office's response are attached.

As background to the Committee's December 6 meeting with the Commission, a compilation of the Committee's recommendations and comments on the subject matter, as excerpted from its relevant reports dating back to 1972, is attached as separate copy. I have divided these comments into two subsets: comments made in ACRS reports (prior to 1994 - the post-1994 reports are subsumed into the response to Commissioner Diaz's request noted above), and, comments made in the ACRS Annual Reports to Congress on the NRC Safety Research Program.

Attachments: As stated

cc: J. Larkins
R. Savio
S. Duraiswamy
ACRS T/H Phen. Sub. Consultants
ACRS Fellows

COMPILATION OF ACRS COMMENTS PERTAINING TO NRC THERMAL-HYDRAULIC CODES (1972-1991)

Below, is a compilation of the comments made by the ACRS relevant to the NRC thermal-hydraulic code development and assessment program. The excerpted comments are subdivided into two groups: those made in ACRS letter reports, and those made in the Committee's annual report to Congress on the NRC-RES safety research program.

ACRS Letter Reports

- Documentation of Computer Codes", dated May 17, 1991 and "NRC Computer Codes and Their Documentation", dated October 11, 1990

  The guidelines for code documentation supplied to us by RES should be fleshed out and cited by reference in all code development work statements. Programs to maintain existing codes should include a task to bring code documentation into compliance with the proposed guidelines.

  A similar set of guidelines should be developed for use by NRR in its review of industry codes used for safety evaluations.

  A portion of the regulatory process depends heavily on the results of calculations done for the NRC by the national laboratories or other contractors. The codes used for these calculations range from thermal hydraulic codes like RELAP5 or TRAC to severe accident codes like SCDAP or MELCOR. Many of these codes are poorly documented, thus leaving one unable to determine either their capabilities, or perhaps more importantly, their limitations.

  Many millions of dollars have been spent on the development of the computer codes used by the NRC, nearly $20 million for RELAP5 alone. The NRC should make sufficient funding and resources available to ensure that the documentation associated with the development of the agency's codes is adequate.

- "NRC Thermal-Hydraulic Research Program", dated June 15, 1989

  Maintain the present large system codes, TRAC-PFI/MOD1, RELAP5/MOD2, TRAC-BWR, and RAMONA-3B, for an indefinite period. Limit improvements only to those required by: (a) the discovery of important errors, or (b) crucial new information from the foreign experimental and assessment programs or the B&W testing program. Do not undertake major new restructuring or 'zero-based' improvements to the constitutive equations or numerical algorithms in these codes. We are not convinced by the arguments given for the need to develop TRAC-PF1/MOD2 and RELAP5/MOD3. It is our view that the proposed modifications will not substantially improve the codes.

Instead, consideration should be given to the development of a new type of systems code that will be more useful for analysis of extended plant transients involving interactions of plant systems. The Committee also made this recommendation in its June 7, 1988 report. TRAC and RELAP were originally designed to analyze the LB-LOCA. A rapid and severe reactor transient, in great detail. There is a need for a more empirical and efficient analytical tool. We envision a code that would be able, for example, to make a rapid and sufficiently accurate analysis of the power oscillations observed last year at the LaSalle County Station, Unit 2 plant. Such a code would be more akin to advanced simulator codes than to TRAC and RELAP. The BWR code (HIPA) now in use at Brookhaven National Laboratory is an example of the type of code we are suggesting.

- "NRC Research Related to Heat Transfer and Fluid Transport in Nuclear Power Plants", June 7, 1988

  The designs for so-called evolutionary LWRs and especially the "passive" LWR being developed by the Electric Power Research Institute and DOE, will require research by the NRC to confirm certain favorable characteristics being claimed. The DOE Advanced Reactor Severe Accident Program is not sufficient for this purpose. The NRC should use existing codes to review these designs so there is sufficient lead time to conduct more experimental or code development work, if necessary.

  There is some uncertainty about applicability of the RELAP-5 code to BWRs and to LBLOCAs. This should be resolved.

  Full documentation should be completed for the NRC codes that are maintained for active use. This should include not only user manuals but developmental assessment reports and models and correlations documents. Ideally, these would be published as NRC documents in the NUREG series to ensure widespread availability.

- "ACRS Comments on the Code Scaling, Applicability and Uncertainty Methodology for Determination of Uncertainty Associated With the Use of Realistic ECCS Evaluation Models", dated September 16, 1987

  Before Code Scaling, Applicability and Uncertainty (CSAU) evaluation methodology can be applied to a given code, complete documentation (e.g., code manual, model and correlation quality assurance document, and assessment reports) is necessary. In the past, such thorough documentation has not always been available for licensing codes. We recommend that steps be taken to ensure that future development of codes for licensing activities be performed in a manner that ensures completion and availability of needed documentation before the code is released.

The codes used to analyze thermal-hydraulic behavior are very large and complex. Validity of calculated results is dependent on the competence of the code user and the way in which the code is used. For CSAU to be effective, the code developers, assessors and users must use the code consistently. We recommend the NRC Staff take the necessary steps to ensure that proper controls are established.

- "ACRS Comments on the Safety Research Program and Budget for Fiscal Year 1987", dated June 11, 1985

We believe that a major capability for thermal-hydraulic research should be maintained. It is especially important to ensure the continued availability of experienced specialists. We support the concept for a new or modified integral test facility to be co-located with a technical staff capable of analysis and code development. The budget proposal of $4.5 million for this effort is appropriate if firm planning for such a facility is begun immediately and if it leads to a decision to proceed.

The advanced thermal-hydraulic codes, such as TRAC and RELAP, have contributed greatly to an understanding of reactor operation and risk. To ensure their continued availability and utility, they must be effectively maintained. We endorse the NRC program to maintain these codes and to continue their assessment and improvement by a program of cooperation with foreign research institutions. We caution, however, that a strong domestic capability for maintaining and using these codes must continue.

The nuclear plant databank (NPDB) and nuclear plant analyzer (NPA) programs are intended to extend the utility of the major thermal-hydraulic codes. The NPDB program, while important to users in both NRR and RES, is not research. We recommend that it be funded from the NRR budget. The NPA program has the potential for providing an extremely flexible and useful tool for nuclear systems analysts. We believe this development program is important and should be continued. However, one part of the NPA program involves development of parallel- processing using smaller, special-purpose computers as a substitute for mainframe computers used for the major thermal-hydraulic codes. While this work is interesting and may be of general use, it is not directly related to the NRC's thermal-hydraulic research program. We recommend that it be funded elsewhere.

- "Comments on the NRC Safety Research Program Budget for Fiscal Years 1985 and 1986", dated June 16, 1983

The main focus of effort is on the development of a Plant Analyzer and a Plant Data Bank. The Plant Analyzer effort is divided between the Brookhaven National Laboratory (BNL), and a cooperative program at the Los Alamos National Laboratory (LANL) and the Idaho National Engineering Laboratory (INEL). The former is to develop a parallel processor approach for a BWR Plant Analyzer and the latter is to

develop a pressurized water reactor (PWR) Plant Analyzer using fast-running versions of the TRAC and RELAP-5 codes. We believe that the goal of the Plant Analyzer research is not sufficiently well focused. NRR, the intended customer for a Plant Analyzer, has recommended a low priority for this program. While we believe that the Plant Analyzer could become an important and useful tool for NRR, the development will be expensive. This program should be deferred until NRR becomes more enthusiastic and involved in defining the research goals.

Further, it is not clear that the two programs are coordinated well enough to lead to equally competent systems for both BWRs and PWRs. It appears that the parallel processor concept, if effective, could apply to both BWRs and PWRs. Broader aspects of the BWR analyzer are apparently not being developed in the current BNL effort.

A vital part of the Plant Analyzer and Plant Data Bank Programs is the review of actual plant data on normal and transient operating parameters to validate codes. RES has noted that it has been extremely difficult to obtain these data from U.S. licensees. We recommend that NRC explore the possibility of a cooperative program, perhaps with EPRI, to obtain needed information.

- "Report on Water Reactor Safety Research", dated November 20, 1974

  The RSR advanced code development program has been extended from one to three contractors. The Committee concurs in obtaining a broader-based participation for technical input into the AEC's advanced code, Reactor System Transient (RST). The RST code is to have the capability of utilizing inputs based upon realistic estimates, as well as conservative estimates, so that safety margins can be more quantitatively determined. Special effort is needed to develop analytical predictive methods for realistic evaluations. Major benefits from a successful RST code would be in resolving questions relating to the significance of modeling techniques and parameters, and in allowing the use of scaled experiments in place of full-scale tests.

- "Report on Water Reactor Safety Research", dated February 10, 1972

  Improved ECCS computer codes. The mathematical modeling of the reactor system should include both improvement in current capabilities and the development of new and improved integrated computer codes which better represent the actual phenomena involved.

ACRS Reports to Congress on NRC Reactor Safety Research

From 1977 through 1985, the Committee provided comprehensive stand-alone reports to the Congress, pursuant to an amendment of the Atomic Energy Act of 1954 by Section 5 of

Public Law 95-209.[2] Below, are relevant excerpts from these reports pertaining to the NRC programs on thermal-hydraulic codes.

- "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program for Fiscal Years 1986 and 1987 - A Report to the Congress of the United States of America", dated February 1985 (NUREG-1105)

  The need for a future integral test program and companion code development capability should be evaluated as part of the NRC long-range planning. Such an evaluation should consider the merits of low-pressure integral facilities (such as that being operated at the University of Maryland for B&W plants); or, NRC might become one user of a general-purpose facility sponsored by DOE and the nuclear power industry.

  Funding for the Separate-Effects Testing and Model Development program should be maintained approximately at the present level.

  Funding for the code assessment work should be substantially reduced. A critique should be performed of the base assumptions and other relevant aspects of the existing methodology to evaluate possibly significant deficiencies in the codes. A review should be made also of additional thermal-hydraulic phenomena, such as water hammer, that may warrant inclusion in the code models.

  The program related to international agreements should be continued to obtain foreign experimental data in exchange for overseas use of the TRAC and RELAP codes. Sufficient funding should be committed in maintaining these codes to ensure their continuing utility.

  Funding for the Plant Analyzer and Plant Data Bank can be curtailed, if necessary, to provide funds for other essential safety research.

- "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program for Fiscal Year 1985 - A Report to the Congress of the United States of America", dated February 1984 (NUREG-1039)

  We support the NRC effort towards increasing international cooperation in the area of code assessment. Funding for the code assessment work should be maintained approximately at its present level.

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[2] Since 1985, the Committee has met the intent of Public Law 95-209 by the annual issuance of a report consisting of all relevant ACRS reports written in a given year that pertained to the NRC Safety Research Program.

The NRC should assure that its major codes are maintained so that they do not lose their value in the international exchange of information.

In regard to plans to choose between TRAC and RELAP for future development, the NRC should assure that support is available for licensing audit calculations regardless of the choice made.

The NRC should focus effort on making code results less dependent on the skill and judgment of the user.

We believe that more emphasis should be placed on development of the data bank. We also believe that the goal of the development of an accurate, fast, and user- friendly code would be best served by a near-term (2 years) focus on this effort.

We believe that the thermal-hydraulic code development is now a mature enough technology so that the competition for development of a fast-running code, now involving three national laboratories (BNL, INEL, LANL), should be ended as soon as possible, and that resources should be concentrated on one effort.

- "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program for Fiscal Years 1984 and 1985 - A Report to the Congress of the United States of America", dated February 1983 (NUREG-0963).

Special attention should be given to developing an effective analytical support effort for the B&W test program. A comprehensive program of separate-effects tests and associated analyses is a necessary adjunct to this test program.

The focus of the code assessment effort should be shifted more towards assessment of plant transients with a corresponding reduction in the large-break LOCA assessment program.

NRC should take an active and aggressive role in planning and coordinating the Plant Analyzer Program to assure its usefulness to NRC.

- "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program for Fiscal Year 1983 - A Report to the Congress of the United States of America", dated February 1982 (NUREG-0864)

NRC should continue to support the Code Improvement and Maintenance Program. Also, it should consider coordinating the LWR and Advanced Reactors code development programs.

The development and assessment of TRAC and RELAP-5 codes should be continued.

The NRC has initiated steps to develop fast running systems codes. This effort should be broadened and accelerated.

NRC should undertake a more limited and carefully monitored code assessment program to provide guidance before embarking on a massive assessment program.

- "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program for Fiscal Year 1982 - A Report to the Congress of the United States of America", dated February 1981 (NUREG-0771)

  The NRC proposes to complete in FY 1982 best estimate codes for PWR and BWR systems. These codes will be adaptations of TRAC. The NRC appears to believe that TRAC has been adequately developed and assessed so that these efforts will be meaningful. We believe that TRAC has been inadequately developed and assessed in spite of the large effort that has been expended. We strongly support the RELAP-5 effort.

  The version of TRAC which has just been developed by NRC for BWRs is totally inadequate. Among other deficiencies, we especially note that the present version of this code has no treatment of the upper plenum. We also note that the NRC has not yet sponsored a BWR version of RELAP-5. We believe that this omission is inexcusable and recommend the prompt development of such a code.

  It has been noted that the NRC code assessment is inadequate, particularly in the case of TRAC. In spite of a large effort, TRAC is not yet a code that is adequately developed and assessed. In some respects RELAP-5 has indicated greater promise with a smaller effort than TRAC has received. We nevertheless recommend that both TRAC and RELAP-5 be continued since the NRC has already made a large investment in TRAC and this code may eventually give a 2- or 3-dimensional calculational capability.

  We recommend that the NRC drastically reduce, or even terminate, the effort going into the development of component codes. Further, the tendency toward a multiplicity of such codes should not continue. These efforts should be replaced with attaining increased code capabilities for small-break LOCAs and other reactor transients with RELAP-5 and TRAC.

  The program of code assessment is so arranged that it is difficult to incorporate changes and improvements into the codes as research and development proceeds. Such a bureaucratic approach is clearly undesirable. We also believe that the code assessment matrix is much too heavily skewed toward concerns with large-break LOCAs. The code assessment matrix should be immediately revised to reflect the need for emphasis on small-break LOCAs and operational transients. Before embarking on a massive

assessment program, the NRC should undertake a limited and carefully monitored code assessment program on a modest scale.

The effective development of RELAP-5 shows the value of an integral facility, even one of modest scale like Semiscale. The close association with observation in such facilities contributes to better understanding of what is needed to make a code an effective tool for the description of reactor transients.

As a general comment on the code development program, we approve the development of the so-called "advanced codes" like TRAC, but we consider it unfortunate that the NRC does not yet have a full and adequate audit calculation capability. This essential need of the NRC has not been met even though great attention has been given to these advanced codes. We question whether the WRAP code is being pursued effectively so as to fulfill the NRC audit needs in a timely manner.

- "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program for Fiscal Year 1981 - A Report to the Congress of the United States of America", dated February 1980 (NUREG-0657)

The objective of the code development program is the development, for predictive purposes, of computer codes for the quantitative analyses of reactor transients and accidents. While the objective of the program has not yet been achieved, the program has made some progress.

The principal computer code of choice, TRAC, suffers so far from incomplete knowledge of some of the necessary physical parameters. It should be pointed out that a fairly complete description of the possible physical situations in a reactor transient is required for the microscopic description used in TRAC. This microscopic description leads to long running times and thereby limits a rapid survey of the many possible transients. While an effort is under way to develop a fast running version of TRAC, the ACRS believes the RELAP-5 computer code, which is already somewhat faster than TRAC, also should be developed to provide a second fast running code.

The ACRS believes that the program is progressing reasonably well in view of the difficulty of the task. The ACRS supports the code development program.

The ACRS recommends the continued development of RELAP-5 as another general code of potential value. The ACRS recommends also that a strong program be initiated for the development of methodology and techniques that would facilitate the implementation of more sophisticated reactor simulators, not necessarily limited to real-time analysis. This would enable a more detailed understanding of the course of events in complex transients that include multiple failures and operator intervention. The

ACRS believes that the proposed budget is adequate to include these developments without additional funds.

- "Comments on the NRC Safety Research Program Budget", July 1979 (NUREG-0603)

  The budget request, for the code development program is $15.2 million which has been reduced to $13.2 million by the Budget Review Group (BRG). The entire reduction was in TRAC Assessment and Applications which the BRG indicated contained some duplication in TRAC application funds in RES and NRR. The ACRS cannot comment on this point except to say that TRAC Assessment and Applications are important activities.

- "1978 Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program", December 1978 (NUREG-0496)

  The ACRS is aware of the criticisms implying that code developers continue to tune their models to fit experimental results, and thus a code may fit particular experiments but still not be suitable for final application to a nuclear power reactor. ACRS members and consultants have reviewed these matters. The present two-step system of code development and independent code assessment, with the requirements of prediction of test results, has been developed in an attempt to address this concern. It should be noted that an independent code assessment has not yet been completed, and thus special attention needs to be focused on this matter in future reviews. Each major test, where appropriate, should be preceded by blind predictions from best estimate codes; blind predictions should also be made with the advanced code, TRAC, for the 3D-2D international test series.

  The NRC has planned an approach that would characterize best estimate code uncertainties and would expose any inherent code errors or bias. It is envisioned that a peak clad temperature probability surface could be obtained from assignment of probabilities for various combinations of plant conditions. This is an important area for continued ACRS involvement.

- "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program - A Report to the Congress of the United States of America", December 1977 (NUREG-0392)

  During the period of review by the ACRS, the NRR Staff recognized that their needs for Best Estimate and Evaluation Model versions of the computer codes were not being met by their Technical Assistance contracts. A formal request was made to RES to reorient some of the LOCA analysis computer programs. The ACRS has not reviewed the response to this request, and will include this item in its continuing reviews.

ACRS Comments on
T/H Codes

The ACRS identified the following matters requiring additional attention:

- Inclusion of representatives from the reactor vendors as consultants to the review groups for advanced code development.

- More thorough planning for code verification for justifying scaling of experiments.

ITEM B.3:

RISK-INFORMED, PERFORMANCE-BASED REGULATION AND RELATED MATTERS

(DR. APOSTOLAKIS)

ITEM B.3: RISK-INFORMED, PERFORMANCE-BASED REGULATION AND RELATED MATTERS

During the May 24, 1996 meeting with the Commissioners, the ACRS discussed the use of Individual Plant Examinations (IPEs) in the regulatory process, the Probabilistic Risk Assessment (PRA) framework document, pilot applications, and next steps to expand the use of PRA in the regulatory decision-making process. The ACRS discussed the status of its reviews and summarized the points highlighted in the ACRS reports to the Commission dated March 8 and April 23, 1996.

In the May 15, 1996, Staff Requirements Memorandum (SRM), resulting from the April 4, 1996, staff briefing to the Commission on the PRA Implementation Plan, the Commission asked that,

> "The staff should prepare a policy paper, with recommendations, addressing the resolution of the four emerging policy issues identified in its March 26, 1996, memorandum regarding: 1) the role of performance-based regulation in the PRA Implementation Plan; 2) plant-specific application of safety goals; 3) risk neutral versus increases in risk; and 4) changes to risk-informed inservice testing (IST) and inservice inspection (ISI) requirements,.."

The ACRS heard presentations by and held discussions with the staff regarding these matters on August 8-10, 1996. During this meeting, the Committee also discussed the pilot applications for risk-informed, performance-based regulation. The ACRS Subcommittee on PRA also met with the staff on July 18 and August 7, 1996, regarding these matters. The ACRS provided a report to the Commission on August 15, 1996. In that report, the Committee made several comments and recommendations, including the following:

- The Commission's Safety Goals and subsidiary objectives can and should be used to derive guidelines for plant-specific applications. It is, however, impractical to rely exclusively on Quantitative Health Objectives (QHOs) for routine use on an individual plant basis. Criteria based on core damage frequency (CDF) and large, early release frequency (LERF) focus more sharply on safety issues and can provide assurance that QHOs are met.

  The ACRS recommended that the staff develop guidance for handling situations in which high values of CDF occur for short periods of time.

- Accounting for uncertainties is a difficult issue. There are models and formal methods to account explicitly for a large number of uncertainties. However, other uncertainties are unquantifiable at this time.

  For the characteristics or phenomena which are modeled, the ACRS recommended that the uncertainties be explicitly quantified and propagated through the PRA. The ACRS also recommended that the use of mean values of distributions be used for comparison with goals and criteria.

- The ACRS agrees with the staff and industry that some increases in risk should be permitted in some situations. The ACRS believes that it is the overall impact on plant risk that is important, and related changes should be handled as a package. The ACRS also recommended that such changes be consistent with the current philosophy of risk management; i.e., that the "bottom-line" numbers should not be the only input to the decisionmaking process, and other concepts such as defense-in-depth must be maintained.

- The ACRS agrees with the staff that, where practical, performance-based strategies should be included in the implementation and monitoring steps of the risk-informed decisionmaking process. The pilot programs may provide a more concrete definition and development of performance-based strategies.

In general, the ACRS supports the staff's recommended options regarding these matters. The Executive Director for Operations responded to the ACRS in a letter dated September 6, 1996, stating that the insights and recommendations of the ACRS will be reflected in the staff response to the Commission.

In the June 11, 1996, Staff Requirements Memorandum, resulting from the ACRS meeting with the Commission on May 24, 1996, the Commission requested the ACRS to,

> "continue to interact with the staff in the development of regulatory guidance and a standard review plan for the performance and review of PRAs. In particular, the ACRS should advise the staff regarding appropriate methods for judging the acceptability or unacceptability of assumptions and models to be used when performing PRAs."

The Committee heard presentations by and held discussions with the staff regarding these matters during the ACRS meeting on December 5-7, 1996. The ACRS Subcommittee on PRA also discussed these matters with the staff on October 31, November 1, 21, and 22, 1996. During these meetings, the ACRS reviewed the following documents:

- Draft Regulatory Guide DG-1061, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Current Licensing Basis," dated November 8, 1996

- Draft SRP Chapter 19, Revision 7, "Use of Probabilistic Risk Assessment in Plant-Specific, Risk-Informed Decisionmaking: General Guidance," dated November 8, 1996

- Draft Regulatory Guide DG-1062, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Inservice Testing"

- Draft SRP section 3.9.7, Revision 1, "Standard Review Plan for the Review of Risk-Informed Inservice Testing Applications," dated November 15, 1996

- Draft Regulatory Guide DG-1065, Revision 5, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications," dated November 11, 1996

- Draft SRP Section 16.X, Revision 9, "Risk-Informed Decisionmaking: Technical Specifications," dated November 15, 1996

- Draft Regulatory Guide DG-1064, Revision 3, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Graded Quality Assurance," dated November 15, 1996

The ACRS plans to review Draft NUREG-1602, "Standards for Probabilistic Risk Analyses (PRAs) to Support Risk-Informed Decisionmaking," dated October 11, 1996, during a future meeting. The ACRS plans to prepare a report to the Commission regarding the overall approach and direction of the SRP sections and associated regulatory guides during a future meeting. The Committee also plans to continue its discussions with the staff regarding technical issues, within the individual guidance documents, during the public comment period.

Attachments:

- Staff Requirements Memorandum dated May 15, 1996, from John C. Hoyle, Office of SECY, to John T. Larkins, ACRS Executive Director (pp.41-42)

- Staff Requirements Memorandum dated June 11, 1996, from John C. Hoyle, Office of SECY, to John T. Larkins, ACRS Executive Director (pp. 43-44)

- Report dated August 15, 1996, from T. S. Kress, ACRS Chairman, to Shirley Ann Jackson, NRC Chairman, Subject: "Risk-Informed, Performance-Based Regulation and Related Matters" (pp. 45-48)

- Letter dated September 6, 1996, from James M. Taylor, Executive Director for Operations, to T. S. Kress, ACRS Chairman, Subject: "Risk-Informed, Performance-Based Regulation and Related Matters" (p. 49)

IN RESPONSE, PLEASE
REFER TO: M960404A

May 15, 1996

MEMORANDUM TO: James M. Taylor
Executive Director for Operations

FROM: John C. Hoyle, Secretary /s/

SUBJECT: STAFF REQUIREMENTS - BRIEFING ON PRA IMPLEMENTATION PLAN, 10:00 A.M., THURSDAY, APRIL 4, 1996, COMMISSIONERS' CONFERENCE ROOM, ONE WHITE FLINT NORTH, ROCKVILLE, MARYLAND (OPEN TO PUBLIC ATTENDANCE)

The Commission was briefed by the NRC staff on the PRA implementation plan.

The Commission requested that the staff provide the following supplemental information.

1. The staff should prepare a policy paper, with recommendations, addressing the resolution of the four emerging policy issues identified in its March 26, 1996 memorandum regarding: 1) the role of performance-based regulation in the PRA Implementation Plan; 2) plant-specific application of safety goals; 3) risk neutral vs increases in risk; and 4) changes to risk-informed inservice testing (IST) and inservice inspection (ISI) requirements, for Commission decision prior to the staff's issuance of any final safety evaluation, position, or guidance. However, the Commission does not wish to inhibit any dialog with the public or industry on the resolution of these issues. The bases as well as pros and cons of alternatives should be included.

2. The staff should provide an update on the implementation and use of subsidiary safety goal objectives including any plans for their use in Standard Review Plans (SRPs) and Regulatory Guides (RGs).

3. The staff should clarify how it intends to address uncertainty in the implementation of risk-informed and performance-based regulation.

(EDO) (SECY Suspense: 9/20/96)

The IPE reviews and pilot applications should be reviewed for any lessons that may be applicable to the development and use of SRPs and RGs.

The use of expert judgment, such as is being applied in the high-level waste area, should be considered as a source of useful guidance to the expert panels in the maintenance rule.

The staff ~~is~~ requested to keep the Commission informed of significant policy issues relevant to risk-informed initiatives.

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
OGC
OCA
OIG
Office Directors, Regions, ACRS, ACNW, ASLBP (via E-Mail)
PDR - Advance
DCS - P1-24

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

OFFICE OF THE SECRETARY

June 11, 1996

IN RESPONSE, PLEASE REFER TO: M960524

MEMORANDUM TO: John T. Larkins, Executive Director
Advisory Committee on Reactor Safeguards

FROM: John C. Hoyle, Secretary

SUBJECT: STAFF REQUIREMENTS - MEETING WITH ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS), FRIDAY, MAY 24, 1996, COMMISSIONERS' CONFERENCE ROOM, ONE WHITE FLINT NORTH, ROCKVILLE, MARYLAND (OPEN TO PUBLIC ATTENDANCE)

The Commission was briefed by the ACRS on the following topics:

1. Use of IPEs in the regulatory process, PRA framework document, pilot applications, and the next steps to expand the use of PRA in the regulatory decision-making process

2. Fire protection issues, including fire PRA models and PRA-based scoping analysis of degraded fire barriers

3. Proposed final revisions to 10 CFR Parts 50 and 100

4. Status of ACRS review of Regulatory Guidance documents related to digital instrumentation and control systems

5. Status of ACRS review of standard plant designs:

   - ABWR and System 80+ design certification rules
   - AP600 design
   - Test and analysis programs associated with the AP600 and SBWR designs

6. Conformance of operating plants with NRC safety goals

The Commission requested ACRS input on GE's recent submittal containing safety significant design changes prior to the Commission briefing on the design certification rulemakings scheduled for late August.
(ACRS) (SECY Suspense: 8/22/96)

The ACRS should continue their review efforts, as noted in the meeting, in the digital instrumentation and controls area.

The ACRS should continue to interact with the staff in the development of regulatory guidance and a standard review plan for the performance and review of PRAs. In particular, the ACRS should advise the staff regarding appropriate methods for judging the acceptability and unacceptability of assumptions and models to be used when performing PRAs.

The ACRS should provide recommendations on how the Commission's safety goals and safety goal policy should be revised to make them acceptable for use on a plant-specific basis.

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
EDO
OGC
OCA
OIG
Office Directors, Regions, ACRS, ACNW, ASLBP (via E-Mail)
PDR - Advance
DCS - P1-24

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

August 15, 1996

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Jackson:

SUBJECT: RISK-INFORMED, PERFORMANCE-BASED REGULATION AND RELATED MATTERS

During the 433rd meeting of the Advisory Committee on Reactor Safeguards, August 8-10, 1996, we discussed the issues identified in the Staff Requirements Memorandum dated May 15, 1996. We also discussed the pilot applications for risk-informed, performance-based regulation. Our Subcommittee on Probabilistic Risk Assessment (PRA) met with representatives of the NRC staff and the nuclear industry on July 18 and August 7, 1996. We also had the benefit of the documents referenced.

The staff presentations dealt only with the development of guidelines from the Commission's safety goals to be used as an element of the evaluation of licensee-initiated changes to licensing commitments. All of our comments address the application of risk-informed regulation in that context. At a later time, we will discuss the larger question of the application of the safety goals on a plant-specific basis.

CONCLUSIONS

Issue 1: *Should the Commission's safety goals and subsidiary objectives be referenced or used to derive guidelines for plant-specific applications and, if so, how?*

We believe the safety goals and subsidiary objectives can and should be used to derive guidelines for plant-specific applications. It is, however, impractical to rely exclusively on the Quantitative Health Objectives (QHOs) for routine use on an individual plant basis. Criteria based on core damage frequency (CDF) and large, early release frequency (LERF) focus more sharply on safety issues and can provide assurance that the QHOs are met. They should be used in developing detailed guidelines.

Issue 2: *How are uncertainties to be accounted for?*

This is a difficult issue. There are models and formal methods to account explicitly for a large number of uncertainties. However, other uncertainties are unquantifiable. The staff proposes to explore a number of options, such as establishing margins in the acceptance guidelines, placing more importance on defense-in-depth, and others, to deal with such uncertainties. Such approaches seem appropriate, although much work remains to be done.

Issue 3: *Should requested changes to the current licensing basis be risk-neutral or should increases be permitted?*

We agree with the staff and industry that increases in risk should be permitted in some situations. Acceptance guidelines expressed in terms of the proposed change in risk and the current risk estimates should have three regions: a region in which some increase in risk is acceptable, one in which it is unacceptable, and one in which further analysis and evaluation would be required.

Issue 4: *How should performance-based regulation be implemented in the context of risk-informed regulation?*

We agree with the staff that, where practical, performance-based strategies should be included in the implementation and monitoring step of the risk-informed decision-making process. The pilot programs may provide an opportunity for a more concrete definition and development of performance-based strategies.

DISCUSSION

Issue 1

Even though a CDF could be derived from the QHOs that could be greater than 10^{-3} per reactor-year, the current subsidiary goal of 10^{-4} per reactor-year should be maintained and should be stated as a fundamental safety goal, along with the QHO. Accident sequences that have a high probability of leading to severe consequences could be controlled by the QHOs, but a more workable measure would be a subsidiary goal on the LERF. The definition of the latter needs to be improved. Whether the LERF should be a fixed value or derived from the QHOs, which would allow the LERF goal to include site-specific characteristics, needs to be investigated.

We recommend that the staff develop guidance for handling situations in which high values of the CDF occur for short periods of time (for example, 10^{-2} per reactor-year for a day).

Issue 2

In accounting for uncertainties, it is important to distinguish between those plant characteristics or phenomena that are modeled in the PRA and those that are not modeled (e.g., the actual layout of components and organizational factors). For those that are modeled, parameter and model uncertainties should be explicitly quantified and propagated through the PRA. The resulting distributions should be an input to the decision-making process along with other qualitative input.

Mean values of distributions should, in general, be used for comparison with goals or criteria, although the sensitivity of the mean value to the high tail of a distribution should not be overlooked. For very broad distributions, such as those that typically result when significant model uncertainty is present, reliance on the mean values may not be appropriate and a more detailed investigation of the reasons for this large uncertainty should be undertaken. This could possibly lead to decisions to conduct additional research or to take other measures.

Accounting for uncertainty in the case of plant characteristics or phenomena that are not currently modeled at all is much more difficult. The staff proposes to explore a number of options, such as establishing margins in the acceptance guidelines, placing more importance on defense-in-depth, and others. We agree and encourage the staff to actively pursue the resolution of this issue.

Issue 3

The concept of a "three-region" approach is consistent with the Electric Power Research Institute's PSA Applications Guide (PSAAG), although the boundaries of the regions used in the PSAAG are not necessarily the ones that the staff will adopt.

The staff has raised the issue of how "packaged" requests are to be handled. Packaging is the process by which risk trade-offs can be accomplished. It is a significant benefit of risk-informed regulation. We believe that it is the overall impact on plant risk that is important, and related changes should be handled as a package. Such changes should be consistent with the current philosophy of risk management; i.e., that the "bottom-line" numbers should not be the only input to the decision-making process, and other concepts such as defense-in-depth must be maintained.

We will continue to monitor the progress of the staff on these issues.

Sincerely,

T. S. Kress

T. S. Kress
Chairman

<u>References</u>:

1. Staff Requirements Memorandum dated May 15, 1996, from John C. Hoyle, Secretary, NRC, to James M. Taylor, Executive Director for Operations, NRC, regarding Briefing on PRA Implementation Plan on April 4, 1996
2. Memorandum dated June 20, 1996, from James M. Taylor, Executive Director for Operations, NRC, to the Commission, Subject: Status Update of the Agency-Wide Implementation Plan for Probabilistic Risk Assessment (PRA) (from March 1, 1996 to May 31, 1996)
3. Electric Power Research Institute, EPRI TR-105396, Final Report dated August 1995, "PSA Applications Guide"

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

September 6, 1996

Dr. Thomas S. Kress, Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: RISK-INFORMED, PERFORMANCE-BASED REGULATION AND RELATED MATTERS

Dear Dr. Kress:

Your letter of August 15, 1996, to Chairman Jackson provided the Advisory Committee on Reactor Safeguards (ACRS) views on several key policy issues related to risk-informed, performance-based regulation. These issues included: the use of NRC's Safety Goals in plant-specific applications; the treatment of uncertainties; whether to allow risk increases in risk-informed regulation; and the role of performance-based regulation in the context of risk-informed regulation. These are among the policy issues in the May 15, 1996, Staff Requirements Memorandum (SRM) requesting staff recommendations on the resolution of the four emerging policy issues. The insights and recommendations in your letter will be reflected in our response to the SRM, which will be attached to the next update of the Probabilistic Risk Assessment (PRA) Implementation Plan due to the Commission on September 27, 1996.

The staff has benefited from the meetings with the ACRS and is pleased that the ACRS supports the staff's preliminary recommendations on the resolution of these policy issues. We will continue our dialogue with the ACRS, and we appreciate your comments and advice regarding risk-informed, performance-based regulation.

Sincerely,

James M. Taylor
Executive Director for Operations

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
SECY

ITEM B.4:

POTENTIAL USE OF IPE/IPEEE RESULTS TO COMPARE THE RISK OF THE CURRENT POPULATION OF PLANTS WITH THE SAFETY GOALS

(DR. KRESS)

ITEM B.4: POTENTIAL USE OF IPE/IPEEE RESULTS TO COMPARE THE RISK OF THE CURRENT POPULATION OF PLANTS WITH THE SAFETY GOALS

In the December 27, 1995 Staff Requirements Memorandum (SRM), resulting from the meeting between the ACRS and the Commission on December 8, 1995, the Commission requested the ACRS views on,

> "the extent to which the current spectrum of IPEs can be used in the regulatory process."

During its February and March 1996 meetings, the ACRS discussed the use of Individual Plant Examinations (IPEs) in the regulatory process and other related matters with representatives of the NRC staff and provided a report to the Commission dated March 8, 1996. In that report the Committee made several points, including the following:

- The quality and consistency of the IPEs vary and the impact of assumptions and analytical models is difficult to assess. On a case-by-case basis, however, additional and extended use of these IPEs is possible. As specific regulatory issues arise, the PRA Standard Review Plan now being developed by the staff can serve as a template for judging the quality and acceptability of the individual plant PRA for the proposed application.

- To achieve consistency, some degree of standardization of PRA models and method will be required. IPEs should be reviewed to identify acceptable and unacceptable assumptions and/or models. Codification of assumptions and models ought not inhibit the continued development of PRA methods. These activities would be a significant first step toward addressing the Commission's statement in the June 16, 1995 SRM, "that more meaningful plant-to-plant or scenario-to-scenario comparisons based on risk could be achieved if PRAs were done on a more standardized, replicable basis."

- The NRC could make additional use of the present IPEs (expect those that the staff has found to use unacceptable methods or models) for a limited number of applications (e.g., regulatory analyses and prioritization of generic issues).

During its meeting on May 23, 1996, the ACRS discussed the potential use of IPE/Individual Plant Examination of External Events (IPEEE) results to compare the risk of the current population of plants with the Safety Goals. This was in response to a SRM dated September 20, 1994, in which the Commission requested further guidance and insight on determining where the current population of operating plants, both individually and collectively, fall in relation to the Safety Goals. The ACRS provided a report to the Commission dated June 6, 1996. In that report the Committee made several points, including the following:

- The prompt fatality and latent health effects quantitative safety goals are posed in risk terms. Consequently, to establish the status of the population of plants with respect to these goals, a full-scope Level 3 probabilistic risk assessment (PRA) of acceptable quality for every plant would seem to be required. Such PRAs would need to include all internal and external events (including the low-power and shutdown operations) and would also need to take into consideration the individual site characteristics.

- In almost all cases, the IPEs and IPEEEs are not and were not intended to be full-scope PRAs. For example, a large number of IPEEEs used the Fire Induced Vulnerability Evaluation (FIVE) Methodology to search for potential fire vulnerabilities and the Seismic Margins Methodology to search for seismic vulnerabilities, neither of which gives a direct expression of risk. Furthermore, shutdown risk was not a part of the IPE/IPEEEs. While most licensees performed some type of Level 2 containment analysis, the vast majority did not perform a Level 3 offsite consequences analysis.

- The BNL study represents a good attempt to estimate the effects of some of the missing elements in the IPEs/IPEEEs. This study did not attempt to evaluate the risk resulting from seismic and fire events, nor did it attempt to evaluate risk in the shutdown mode.

- Information is available that arguably would make it possible to bound the effects on risk of elements missing from the IPEs/IPEEEs and to develop an approximate comparison with the safety goals. Such a bound would be of questionable value and would have very large uncertainties. We do not recommend that this be done.

- The evidence from the BNL study, NUREG-1150, other PRAs, and scoping studies of shutdown risk indicates that, on average, the population of plants meets the safety goals. A definitive determination of this, however, will only be possible when acceptable, full-scope Level 3 PRAs are available for all the plants.

- The required effort to develop full-scope Level 3 PRAs cannot be justified for the sole purpose of comparison with the safety goals. Such PRAs, however, will be needed in the long run to move toward a coherent risk-informed regulatory system.

The Executive Director for Operations responded to the ACRS comments and recommendations on the above subject in a letter dated July, 18, 1996, stating that,

> "The staff agrees with the ACRS conclusion 'that, on average, the population of plants meets the safety goals[i.e., quantitative health objectives][but that] a definitive determination of this...will only be possible when acceptable, full-scope Level 3 PRAs are available for all the plants.' The staff also agrees with the ACRS conclusion that 'the required effort to develop such comprehensive PRAs cannot be justified for the sole purpose of comparison with the safety goals.'"

Attachments:

- Staff Requirements Memorandum, dated December 27, 1995, from John C. Hoyle, Office of SECY, to John T. Larkins, ACRS Executive Director (pp. 53-54)

- Report dated March 8, 1996, from T.S. Kress, ACRS Chairman, to Shirley Ann Jackson, NRC Chairman, Subject: "Use of Individual Plant Examinations in the Regulatory Process" (pp. 55-58)

- Staff Requirements Memorandum, dated June 16, 1995, from Andrew L. Bates, Office of SECY, to the File (pp. 59-60)

- Staff Requirements Memorandum, dated September 20, 1994, from John C. Hoyle, Office of SECY, to John T. Larkins, ACRS Executive Director (p. 61)

- Report dated June 6, 1996, from T.S. Kress, ACRS Chairman, to Shirley Ann Jackson, NRC Chairman, Subject: "Potential Use of IPE/IPEEE Results to Compare the Risk of the Current Populations of Plants with the Safety Goals" (pp. 62-64)

- Letter dated July 18, 1996, from James M. Taylor, Executive Director for Operations, to T.S. Kress, ACRS Chairman, Subject: "Potential Use of IPE/IPEEE Results to Compare the Risk of the Current Population of Plants with the Safety Goals" (pp. 65-66)

OFFICE OF THE SECRETARY

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

December 27, 1995

IN RESPONSE, PLEASE REFER TO: M951208

REVISED

MEMORANDUM TO: John T. Larkins, Executive Director
Advisory Committee on Reactor Safeguards

FROM: John C. Hoyle, Secretary

SUBJECT: STAFF REQUIREMENTS - MEETING WITH ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS), 1:30 P.M., FRIDAY, DECEMBER 8, 1995, COMMISSIONERS' CONFERENCE ROOM, ONE WHITE FLINT NORTH, ROCKVILLE, MARYLAND (OPEN TO PUBLIC ATTENDANCE)

The Commission met with the ACRS on the following topics:

1. Proposed resolution of Generic Issue 78, "Monitoring of Fatigue Transient Limits for the Reactor Coolant System"
2. The NEI petition for rulemaking to amend 10 CFR 50.48, "Fire Protection"
3. Development of improved nondestructive examination (NDE) techniques
4. National Academy of Sciences/National Research Council study on "Digital Instrumentation and Control Systems in Nuclear Power Plants, Safety and Reliability Issues"
5. Proposed final revision 1 to Regulatory Guide 1.152, "Criteria for Digital Computers in Safety Systems of Nuclear Power Plants"
6. Status report of IPEs

The Commission requested feedback from the ACRS on use of RuleNet during the next meeting with the Commission.
(ACRS~~EDO~~) (SECY Suspense: 5/24/96)

The Commission also requested the ACRS views on the extent to which the current spectrum of IPEs can be used in the regulatory process.
(ACRS) (SECY Suspense: 2/23/96)

In addition, the Commission requests ACRS views on the PRA framework document, its relationship to the pilot applications (SECY-95-280), and the next steps in the process to expand the use of PRA in the regulatory decision-making process.

(ACRS~~EDO~~) (SECY Suspense: 4/30/96)

cc: Chairman Jackson
Commissioner Rogers
EDO
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Office Directors, Regions, ACNW, ASLBP (via E-Mail)
PDR - Advance
DCS - P1-24

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

March 8, 1996

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Jackson:

SUBJECT: USE OF INDIVIDUAL PLANT EXAMINATIONS IN THE REGULATORY PROCESS

During the 428th and 429th meetings of the Advisory Committee on Reactor Safeguards, February 8-10 and March 7-9, 1996, respectively, we discussed the Individual Plant Examination (IPE) review process and findings with the NRC staff. Our Subcommittee on IPEs also met with the staff and its contractors on January 26, 1996, to review this matter. We also had the benefit of the documents referenced. This report is in response to the December 27, 1995 Staff Requirements Memorandum (SRM).

In the SRM, the Commission requested "the ACRS views on the extent to which the current spectrum of IPEs can be used in the regulatory process." We interpret this request as referring to potential regulatory uses of the IPEs that were not delineated in Generic Letter 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities." This report includes comments on both the Generic Letter goals and the Commission request.

Goals of Generic Letter 88-20

The purpose of the IPE program, as stated in Generic Letter 88-20, was for each licensee:

(1) to develop an appreciation of severe accident behavior

(2) to understand the most likely severe accident sequences that could occur at its plant

(3) to gain a more quantitative understanding of the overall probabilities of core damage and fission product releases

(4) to reduce, if necessary, the overall probabilities of core damage and fission product releases by modifying, where appropriate, hardware and procedures that would help prevent or mitigate severe accidents.

We note that the IPEs were to be limited to the examination of internal initiating events and internal floods with the reactor at power and that individual and societal risks were not to be estimated. Other programs deal with external events and shutdown risk.

The IPE program has been successful at most utilities in meeting goal (1) and, to a lesser extent, goals (2) and (3) of the Generic Letter. Goal (4) of the Generic Letter also appears to have been achieved. We were told that most licensees discovered weaknesses and took corrective actions. In addition, this program has been beneficial in educating a broader segment of the NRC staff about the issues related to these goals.

We were told by the staff that all licensees submitted a Level-1 probabilistic risk assessment (PRA). Most licensees also submitted a Level-2 PRA, although some addressed Level-2 phenomena in a rudimentary manner. The methods and data sources used by different licensees varied widely. In some cases, the choices appeared to be arbitrary. Some licensees chose to include common-cause failures only for major components, while others chose to ignore them completely.

It is difficult to determine the extent to which the variability in IPE results for similar classes of plants is due to actual plant differences or to modeling assumptions. Although some of the causes for this variability may be immediately apparent, others are not. The latter include assumptions made about success criteria, the assumed dependencies between operator actions, and the level of decomposition in fault-tree analyses. (We note that the fault trees were not requested as part of the IPE submittals.)

An example of a potentially significant impact of modeling differences is the range of core-damage frequencies (CDFs) for BWR 3/4s that the staff has compiled. This range is from about 10^{-7} to about 10^{-4} per reactor-year. Although the staff has stated that such differences are primarily due to plant differences, this range of results seems unrealistic given the similarity among BWR 3/4s.

Use of IPEs in the Regulatory Process

As discussed above, the quality and consistency of the IPEs vary and the impact of assumptions and analytical models is difficult to

assess. On a case-by-case basis, however, additional and extended use of these IPEs is possible. As specific regulatory issues arise, the PRA Standard Review Plan now being developed by the staff can serve as a template for judging the quality and acceptability of the individual plant PRA for the proposed application.

As the agency moves toward risk-informed regulation, there will be an increasing need for full-scope PRAs that incorporate fire risk, external events, other modes of operation, and site-specific consequences. When requests for risk-informed regulatory action arise, the NRC staff should make it clear that a relevant PRA should be used.

To achieve these goals, especially consistency, some degree of standardization will be required. Standardizing PRA models and methods has been a controversial subject. Proponents argue that it would create a basis for comparison of PRA results, while opponents fear that it would inhibit methodological developments. We recommend that IPEs be reviewed to identify acceptable and unacceptable assumptions and/or models. Codification of assumptions and models ought not inhibit the continued development of PRA methods. These activities would be a significant first step toward addressing the Commission's statement in the SRM dated June 16, 1995, "that more meaningful plant-to-plant or scenario-to-scenario comparisons based on risk could be achieved if PRAs were done on a more standardized, replicable basis."

We believe that the NRC could make additional use of the present IPEs (except those that the staff has found to use unacceptable methods or models) for a limited number of applications (e.g., regulatory analyses and prioritization of generic issues).

The staff stated that the CDFs for several PWRs are greater than 10^{-4} per reactor-year. Several BWRs have CDFs that are very close to 10^{-4} per reactor-year and the conditional containment failure probabilities for BWR Mark I containments range from about 0.02 to about 0.6. Although the PRAs have limitations as discussed above, these numbers suggest that an investigation would be warranted to reassess their validity and to verify that the very low numbers reported by some other plants reflect actual plant differences.

Our conclusion is that the IPE program has met successfully the objectives of Generic Letter 88-20. This program has developed a risk awareness, both in the utilities and the NRC, that will contribute significantly to efforts to establish a risk-informed and performance-oriented regulatory system. The plant-specific

IPEs are an extremely valuable asset that should not be permitted to languish unimproved and unused.

Sincerely,

T. S. Kress

T. S. Kress
Chairman

<u>References</u>:

1. Staff Requirements Memorandum dated June 16, 1995, from Andrew L. Bates, Acting Secretary, NRC, to the File regarding Meeting with ACRS on June 8, 1995
2. Staff Requirements Memorandum dated December 27, 1995, from John C. Hoyle, Secretary, NRC, to John T. Larkins, ACRS regarding Meeting with ACRS on December 8, 1995
3. Generic Letter 88-20, dated November 23, 1988, to All Licensees Holding Operating Licenses and Construction Permits for Nuclear Power Reactor Facilities, Subject: Individual Plant Examination for Severe Accident Vulnerabilities - 10 CFR §50.54(f)

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

OFFICE OF THE
SECRETARY

IN RESPONSE, PLEASE
REFER TO: M950608A

June 16, 1995

MEMORANDUM TO THE FILE

FROM: Andrew L. Bates, Acting Secretary /s/

SUBJECT: STAFF REQUIREMENTS - MEETING WITH ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS), 10:00 A.M., THURSDAY, JUNE 8, 1995, COMMISSIONERS' CONFERENCE ROOM, ONE WHITE FLINT NORTH, ROCKVILLE, MARYLAND (OPEN TO PUBLIC ATTENDANCE)

The Commission met with the Advisory Committee on Reactor Safeguards for discussion of the following topics:

1. Thermal hydraulic issues
2. Status of Westinghouse AP600 design review
3. Regulatory analysis guidelines
4. Application of risk analysis in rulemaking
5. Proposed final rule on technical specifications
6. Cracking and fatigue in nuclear components
7. Digital instrumentation and control
8. Operating reactors conformance to the safety goals - status report.

During the discussion on cracking and fatigue in nuclear components, the Commission requested the ACRS to lend assistance to the staff in encouraging industry to undertake research to improve NDE techniques with the aim of more accurately detecting and assessing steam generator tube defects.

During discussion of the last topic, the Commission expressed concern about the lack of consistency among current IPEs and suggested that, modifications to the IPE PRAs may be necessary if they are to be used for other regulatory applications. In addition, the Commission noted that more meaningful plant-to-plant or scenario-to-scenario comparisons based on risk could be achieved if PRAs were done on a more standardized, replicable basis.

There were no requirements identified for staff action.

cc: The Chairman
Commissioner Rogers
Commissioner de Planque
Commissioner Jackson
OGC
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PDR - Advance
DCS - P1-24

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

IN RESPONSE, PLEASE
REFER TO: M940908A

September 20, 1994

MEMORANDUM TO: John T. Larkins, Executive Director
Advisory Committee on Reactor Safeguards

FROM: John C. Hoyle, Acting Secretary /s/

SUBJECT: STAFF REQUIREMENTS - PERIODIC MEETING WITH ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS), 1:30 P.M., THURSDAY, SEPTEMBER 8, 1994, COMMISSIONERS' CONFERENCE ROOM, ONE WHITE FLINT NORTH, ROCKVILLE, MARYLAND (OPEN TO PUBLIC ATTENDANCE)

The Commission was briefed by the Advisory Committee on Reactor Safeguards.

The Commission requested further guidance and insight on determining where the current population of operating plants, both individually and collectively, fall in relation to the safety goals.

The ACRS committed to provide the Commission with a copy of the trip report which discusses the French move toward performance-based fire regulations. (Subsequently, on September 12, 1994 the ACRS staff forwarded a copy of the report to the Acting Secretary for distribution to the Commission.)

The Commission requested that the ACRS continue to monitor the NRC's actions and ensure there are no areas being ignored or overlooked through an error of omission.

cc: The Chairman
Commissioner Rogers
Commissioner de Planque
EDO
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

June 6, 1996

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Jackson:

SUBJECT: POTENTIAL USE OF IPE/IPEEE RESULTS TO COMPARE THE RISK OF THE CURRENT POPULATION OF PLANTS WITH THE SAFETY GOALS

This report is in response to a Staff Requirements Memorandum dated September 20, 1994, in which the Commission requested further guidance and insight on determining where the current population of operating plants, both individually and collectively, fall in relation to the safety goals. Our intent in developing a response was to examine the Individual Plant Examinations (IPEs)/Individual Plant Examinations of External Events (IPEEEs) results to see if they can be extended so as to compare the risk of the current population of plants with the safety goals.

During the 431st meeting of the Advisory Committee on Reactor Safeguards, May 23-25, 1996, we completed our discussions on this subject. During the 418th, February 1995, and 419th, March 1995 meetings, we heard presentations by an ACRS Senior Fellow on an approach for estimating the risk associated with some of the missing or incomplete elements of the IPEs. During our 431st meeting, we reviewed a study by the Brookhaven National Laboratory (BNL) (performed as part of the IPE Insights Program) that investigated the use of some of the IPEs to compare the plant risk to the safety goals. We also had the benefit of the documents referenced.

The prompt fatality and latent health effects quantitative safety goals are posed in risk terms. Consequently, to establish the status of the population of plants with respect to these goals, a full-scope Level 3 probabilistic risk assessment (PRA) of acceptable quality for every plant would seem to be required. Such PRAs would need to include all internal and external events (including low-power and shutdown operations) and would also need to take into consideration the individual site characteristics.

In almost all cases, the IPEs and IPEEEs are not and were not intended to be full-scope PRAs. For example, a large number of IPEEEs used the Fire Induced Vulnerability Evaluation (FIVE) Methodology to search for potential fire vulnerabilities and the Seismic Margins Methodology to search for seismic vulnerabilities, neither of which gives a direct

expression of risk. Furthermore, shutdown risk was not a part of the IPEs/IPEEEs. While most licensees performed some type of Level 2 containment analysis, the vast majority did not perform a Level 3 offsite consequences analysis.

The BNL study represents a good attempt to estimate the effects of some of the missing elements in the IPEs/IPEEEs. This study did not attempt to evaluate the risk resulting from seismic and fire events, nor did it attempt to evaluate risk in the shutdown mode.

Information is available that arguably would make it possible to bound the effects on risk of elements missing from the IPEs/IPEEEs and to develop an approximate comparison with the safety goals. Such a bound would be of questionable value and would have very large uncertainties. We do not recommend that this be done.

The evidence from the BNL study, NUREG-1150, other PRAs, and scoping studies of shutdown risk indicates that, on average, the population of plants meets the safety goals. A definitive determination of this, however, will only be possible when acceptable, full-scope Level 3 PRAs are available for all the plants. We believe that the required effort to develop such comprehensive PRAs cannot be justified for the sole purpose of comparison with the safety goals. Such PRAs, however, will be needed in the long run to move toward a coherent risk-informed regulatory system.

Sincerely,

T. S. Kress

T. S. Kress
Chairman

REFERENCES:
1. Memorandum dated September 20, 1994, from John C. Hoyle, Acting Secretary, NRC, to John T. Larkins, Executive Director, ACRS, Subject: Staff Requirements - Periodic Meeting with ACRS, Thursday, September 8, 1994
2. Richard Sherry, ACRS Senior Fellow, "A Simplified Approach to Estimation of Seismic Core Damage Frequencies from a Seismic Margins Methods Analysis"
3. U. S. Nuclear Regulatory Commission, NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," Office of Nuclear Regulatory Research, December 1990
4. U. S. Nuclear Regulatory Commission, NUREG-XXXX, "Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance," Draft for Comment dated April 1996
5. U.S. Nuclear Regulatory Commission, NUREG/CR-6144, "Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Surry, Unit 1," Brookhaven National Laboratory, July 1994

6. U. S. Nuclear Regulatory Commission, NUREG/CR-6143, "Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Grand Gulf, Unit 1," Sandia National Laboratories, March 1995

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

July 18, 1996

Dr. T. S. Kress, Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Dr. Kress:

SUBJECT: POTENTIAL USE OF IPE/IPEEE RESULTS TO COMPARE THE RISK OF THE CURRENT POPULATION OF PLANTS WITH THE SAFETY GOALS

This is in response to the ACRS letter to Chairman Jackson dated June 6, 1996, regarding potential use of IPE/IPEEE results to compare the risk of the current population of plants with the Commission's Safety Goals. As discussed during the ACRS meeting, the results presented from the study comparing the IPE results with the Safety Goals were preliminary. Since very few IPEs were based on level 3 PRAs, the comparisons to the goals (i.e., the two quantitative health objectives) were made through the use of IPE level 1 and 2 information and NUREG-1150 level 3 information. Comparisons were also made with two subsidiary objectives, core damage frequency and the conditional probability of early containment failure. No comparisons were made with the one-in-one-million frequency of large release subsidiary objective proposed in the Safety Goal Policy Statement. This proposed objective was found several years ago to be impractical to implement (as discussed with and agreed to by the Committee at that time). As noted in your letter the staff agrees and recognizes that this study does not include all the relevant risk such as the risk from seismic and fire and the risk from other modes of operation (e.g., shutdown). This work has progressed since that time and will be documented in the upcoming IPE Insights report (NUREG-1560) to be published in October 1996 for public comment. The ACRS will be provided a copy of this report.

The staff agrees with the ACRS conclusion "that, on average, the population of plants meets the safety goals [i.e., quantitative health objectives] [but that] a definitive determination of this...will only be possible when acceptable, full-scope Level 3 PRAs are available for all the plants." The staff also agrees with the ACRS conclusion that "the required effort to develop such comprehensive PRAs cannot be justified for the sole purpose of

comparison with the safety goals." The extent to which such PRA's will be needed in the long run to move toward a coherent risk-informed regulatory system, as suggested by the ACRS, will be a subject of the continuing interactions between the staff and the Committee on risk-informed regulation.

Sincerely,

James M. Taylor
Executive Director
for Operations

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
SECY

ITEM B.5:

USE OF SAFETY GOALS
ON A PLANT-SPECIFIC BASIS

(DR. KRESS)

ITEM B.5: USE OF SAFETY GOALS ON A PLANT-SPECIFIC BASIS

In an April 23, 1996 report to the Commission on "Probabilistic Risk Assessment Framework, Pilot Applications, and Next Steps to Expanding the Use of PRA in the Regulatory Decision-Making Process," the ACRS stated that a restatement of the Commission's safety goal policy is needed, which would allow the use of safety goals on a plant-specific basis. In the June 11, 1996 Staff Requirements Memorandum (SRM), resulting from the meeting between the ACRS and the Commission on May 24, 1996, the Commission stated that:

> "The ACRS should provide recommendations on how the Commission's safety goals and safety goal policy should be revised to make them acceptable for use on a plant-specific basis."

The ACRS Subcommittee on Probabilistic Risk Assessment met with representatives of the staff and industry on July 18 and August 7, 1996, to gather information on the pilot applications for risk-informed, performance-based regulation. Based on the information gathered and discussions held during the August 8-10, 1996 ACRS meeting, the ACRS issued a report "Risk-Informed, Performance-Based Regulation and Related Matters," dated August 15, 1996, which included the following paragraph:

> "We believe the safety goals and subsidiary objectives can and should be used to derive guidelines for plant-specific applications. It is, however, impractical to rely exclusively on the Quantitative Health Objectives (QHOs) for routine use on an individual plant basis. Criteria based on core damage frequency (CDF) and large, early release frequency (LERF) focus more sharply on safety issues and can provide assurance that the QHOs are met. They should be used in developing detailed guidelines."

The Committee also noted in the report that it would discuss the larger question of the application of the safety goals on a plant-specific basis at a later time.

On November 18, 1996, the Committee provided a report to the Commission on "Plant-Specific Application of Safety Goals," which contained several observations and recommendations including the following:

- The Safety Goals quantified "how safe is safe enough" for the population of U. S. plants. For an individual plant, however, the acceptable level of risk is determined by the concept of "adequate protection," which in the final analysis means compliance with the body of regulations. Risk-informed analyses would provide a more rational basis for making regulatory decisions regarding plant-specific requests for exemptions from the rules or for changes to the licensing basis, and the acceptability of new regulations."

- An evolutionary and pragmatic approach for using Safety Goals on a plant-specific basis would be to use the CDF as the primary criterion for evaluating proposed changes along with a qualitative or quantitative evaluation of the possible Level 2 and Level 3 PRA issues raised by these changes. For a quantitative analysis, the following two options are offered:

  1) A full-scope Level 2 PRA (with fission product transport capability).

  To use this option, a conservative value for LERF criterion must be determined. This value, along with the CDF criterion, will provide an acceptable basis for decisionmaking. We note that both the NRC staff and the Electric Power Research Institute, in its, "PSA Application Guide," are proposing the use of LERF as an acceptable criterion.

  2) A full-scope Level 2 PRA (without fission product transport capability).

  To use this option, conservative values for early containment failure frequency criteria for different reactor designs must be determined. These values, along with the CDF criterion, will provide an acceptable basis for decisionmaking.

- In the longer term, the agency should move beyond the evaluation of risk associated with proposed changes to individual plant licenses and apply the Safety Goals to assess the acceptability of plant-specific risk. This could be done in terms of the QHOs, along with the CDF, or in terms of the CDF and LERF. To use the QHOs directly, it would be necessary to have full-scope Level 3 PRAs. The use of Level 3 PRAs in the future should be encouraged.

Attachments:

- Staff Requirements Memorandum, dated June 11, 1996, from John C. Hoyle, Office of SECY, to John T. Larkins, ACRS Executive Director (pp. 69-70)

- Report dated August 15, 1996, from T. S. Kress, ACRS Chairman, to Shirley Ann Jackson, NRC Chairman, Subject: Risk-Informed, Risk-Based Regulation and Related Matters (pp. 71-74)

- Letter dated November 18, 1996, from T. S. Kress, ACRS Chairman, to Shirley Ann Jackson, NRC Chairman, Subject: Plant-Specific Application of Safety Goals (pp. 75-77)

REFER TO: M960524

June 11, 1996

MEMORANDUM TO: John T. Larkins, Executive Director
Advisory Committee on Reactor Safeguards

FROM: John C. Hoyle, Secretary /s/

SUBJECT: STAFF REQUIREMENTS - MEETING WITH ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS), FRIDAY, MAY 24, 1996, COMMISSIONERS' CONFERENCE ROOM, ONE WHITE FLINT NORTH, ROCKVILLE, MARYLAND (OPEN TO PUBLIC ATTENDANCE)

The Commission was briefed by the ACRS on the following topics:

1. Use of IPEs in the regulatory process, PRA framework document, pilot applications, and the next steps to expand the use of PRA in the regulatory decision-making process

2. Fire protection issues, including fire PRA models and PRA-based scoping analysis of degraded fire barriers

3. Proposed final revisions to 10 CFR Parts 50 and 100

4. Status of ACRS review of Regulatory Guidance documents related to digital instrumentation and control systems

5. Status of ACRS review of standard plant designs:
   - ABWR and System 80+ design certification rules
   - AP600 design
   - Test and analysis programs associated with the AP600 and SBWR designs

6. Conformance of operating plants with NRC safety goals

The Commission requested ACRS input on GE's recent submittal containing safety significant design changes prior to the Commission briefing on the design certification rulemakings scheduled for late August.

(ACRS) (SECY Suspense: 8/22/96)

The ACRS should continue their review efforts, as noted in the meeting, in the digital instrumentation and controls area.

The ACRS should continue to interact with the staff in the development of regulatory guidance and a standard review plan for the performance and review of PRAs. In particular, the ACRS should advise the staff regarding appropriate methods for judging the acceptability and unacceptability of assumptions and models to be used when performing PRAs.

The ACRS should provide recommendations on how the Commission's safety goals and safety goal policy should be revised to make them acceptable for use on a plant-specific basis.

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
EDO
OGC
OCA
OIG
Office Directors, Regions, ACRS, ACNW, ASLBP (via E-Mail)
PDR - Advance
DCS - P1-24

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

August 15, 1996

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Jackson:

SUBJECT: RISK-INFORMED, PERFORMANCE-BASED REGULATION AND RELATED MATTERS

During the 433rd meeting of the Advisory Committee on Reactor Safeguards, August 8-10, 1996, we discussed the issues identified in the Staff Requirements Memorandum dated May 15, 1996. We also discussed the pilot applications for risk-informed, performance-based regulation. Our Subcommittee on Probabilistic Risk Assessment (PRA) met with representatives of the NRC staff and the nuclear industry on July 18 and August 7, 1996. We also had the benefit of the documents referenced.

The staff presentations dealt only with the development of guidelines from the Commission's safety goals to be used as an element of the evaluation of licensee-initiated changes to licensing commitments. All of our comments address the application of risk-informed regulation in that context. At a later time, we will discuss the larger question of the application of the safety goals on a plant-specific basis.

CONCLUSIONS

Issue 1: *Should the Commission's safety goals and subsidiary objectives be referenced or used to derive guidelines for plant-specific applications and, if so, how?*

We believe the safety goals and subsidiary objectives can and should be used to derive guidelines for plant-specific applications. It is, however, impractical to rely exclusively on the Quantitative Health Objectives (QHOs) for routine use on an individual plant basis. Criteria based on core damage frequency (CDF) and large, early release frequency (LERF) focus more sharply on safety issues and can provide assurance that the QHOs are met. They should be used in developing detailed guidelines.

<u>Issue 2</u>: *How are uncertainties to be accounted for?*

This is a difficult issue. There are models and formal methods to account explicitly for a large number of uncertainties. However, other uncertainties are unquantifiable. The staff proposes to explore a number of options, such as establishing margins in the acceptance guidelines, placing more importance on defense-in-depth, and others, to deal with such uncertainties. Such approaches seem appropriate, although much work remains to be done.

<u>Issue 3</u>: *Should requested changes to the current licensing basis be risk-neutral or should increases be permitted?*

We agree with the staff and industry that increases in risk should be permitted in some situations. Acceptance guidelines expressed in terms of the proposed change in risk and the current risk estimates should have three regions: a region in which some increase in risk is acceptable, one in which it is unacceptable, and one in which further analysis and evaluation would be required.

<u>Issue 4</u>: *How should performance-based regulation be implemented in the context of risk-informed regulation?*

We agree with the staff that, where practical, performance-based strategies should be included in the implementation and monitoring step of the risk-informed decision-making process. The pilot programs may provide an opportunity for a more concrete definition and development of performance-based strategies.

DISCUSSION

<u>Issue 1</u>

Even though a CDF could be derived from the QHOs that could be greater than 10^{-3} per reactor-year, the current subsidiary goal of 10^{-4} per reactor-year should be maintained and should be stated as a fundamental safety goal, along with the QHO. Accident sequences that have a high probability of leading to severe consequences could be controlled by the QHOs, but a more workable measure would be a subsidiary goal on the LERF. The definition of the latter needs to be improved. Whether the LERF should be a fixed value or derived from the QHOs, which would allow the LERF goal to include site-specific characteristics, needs to be investigated.

We recommend that the staff develop guidance for handling situations in which high values of the CDF occur for short periods of time (for example, 10^{-2} per reactor-year for a day).

Issue 2

In accounting for uncertainties, it is important to distinguish between those plant characteristics or phenomena that are modeled in the PRA and those that are not modeled (e.g., the actual layout of components and organizational factors). For those that are modeled, parameter and model uncertainties should be explicitly quantified and propagated through the PRA. The resulting distributions should be an input to the decision-making process along with other qualitative input.

Mean values of distributions should, in general, be used for comparison with goals or criteria, although the sensitivity of the mean value to the high tail of a distribution should not be overlooked. For very broad distributions, such as those that typically result when significant model uncertainty is present, reliance on the mean values may not be appropriate and a more detailed investigation of the reasons for this large uncertainty should be undertaken. This could possibly lead to decisions to conduct additional research or to take other measures.

Accounting for uncertainty in the case of plant characteristics or phenomena that are not currently modeled at all is much more difficult. The staff proposes to explore a number of options, such as establishing margins in the acceptance guidelines, placing more importance on defense-in-depth, and others. We agree and encourage the staff to actively pursue the resolution of this issue.

Issue 3

The concept of a "three-region" approach is consistent with the Electric Power Research Institute's PSA Applications Guide (PSAAG), although the boundaries of the regions used in the PSAAG are not necessarily the ones that the staff will adopt.

The staff has raised the issue of how "packaged" requests are to be handled. Packaging is the process by which risk trade-offs can be accomplished. It is a significant benefit of risk-informed regulation. We believe that it is the overall impact on plant risk that is important, and related changes should be handled as a package. Such changes should be consistent with the current philosophy of risk management; i.e., that the "bottom-line" numbers should not be the only input to the decision-making process, and other concepts such as defense-in-depth must be maintained.

We will continue to monitor the progress of the staff on these issues.

Sincerely,

T. S. Kress

T. S. Kress
Chairman

<u>References</u>:

1. Staff Requirements Memorandum dated May 15, 1996, from John C. Hoyle, Secretary, NRC, to James M. Taylor, Executive Director for Operations, NRC, regarding Briefing on PRA Implementation Plan on April 4, 1996
2. Memorandum dated June 20, 1996, from James M. Taylor, Executive Director for Operations, NRC, to the Commission, Subject: Status Update of the Agency-Wide Implementation Plan for Probabilistic Risk Assessment (PRA) (from March 1, 1996 to May 31, 1996)
3. Electric Power Research Institute, EPRI TR-105396, Final Report dated August 1995, "PSA Applications Guide"

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

November 18, 1996

The Honorable Shirley Ann Jackson
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Jackson:

SUBJECT: PLANT-SPECIFIC APPLICATION OF SAFETY GOALS

During the 436th meeting of the Advisory Committee on Reactor Safeguards, November 7-9, 1996, we discussed the application of Safety Goals on a plant-specific basis. This subject was also discussed at meetings of our Joint Subcommittees on Probabilistic Risk Assessment and Plant Operations on July 17-18, 1996, and of our Subcommittee on Probabilistic Risk Assessment on August 7, 1996. We also had the benefit of the documents referenced.

In a Staff Requirements Memorandum dated June 11, 1996, we were requested to provide recommendations on how the Commission's Safety Goals and Safety Goal Policy should be revised to make them acceptable for use on a plant-specific basis.

The Safety Goal Policy Statement made it clear that the Quantitative Health Objectives (QHOs) and the subsidiary Core Damage Frequency (CDF) goal were to provide standards for the NRC staff to judge the overall effectiveness of the regulatory system. That is, if the risk posed by the population of plants on the average proved to be less than the Safety Goals, then the staff (and presumably the public) would deem that the regulatory system had functioned appropriately to protect the health and safety of the public.

The Safety Goals quantified "how safe is safe enough" for the population of U. S. plants. For an individual plant, however, the acceptable level of risk is determined by the concept of "adequate protection," which in the final analysis means compliance with the body of regulations. Risk-informed analyses would provide a more rational basis for making regulatory decisions regarding plant-specific requests for exemptions from the rules or for changes to the licensing basis, and the acceptability of new regulations.

In our August 15, 1996 report, we stated: "the safety goals and subsidiary objectives can and should be used to derive guidelines for plant-specific applications. It is, however, impractical to rely exclusively on the Quantitative Health Objectives (QHOs) for routine use on an individual plant basis. Criteria based on core

damage frequency (CDF) and large, early release frequency (LERF) focus more sharply on safety issues and can provide assurance that the QHOs are met."

In developing plant-specific criteria, it is important to consider the regulatory needs in the near future and to ensure that the process will be evolutionary rather than so revolutionary that it might discourage the licensees from using this approach. It appears that most of the anticipated licensee requests for changes to their current licensing basis will deal with Level 1 probabilistic risk assessment (PRA) issues, e.g., inservice inspection, extension of allowed outage times. Furthermore, most licensees have only recently familiarized themselves with Level 1 PRA methodology for the narrow regime of power operations. They are just beginning to integrate findings of such Level 1 risk assessments with the safe operation of their plants. Even the NRC staff is still coming to grips with the implications of Level 1 risk assessment results for regulation of nuclear plants. Many licensees do not have access to the technologies for facile conduct of full-scope Level 2 or Level 3 PRAs that treat power operations, low power/shutdown operations, as well as accidents initiated by external events. Commonly accepted standards for such extensive, in-depth analyses do not exist.

An evolutionary and pragmatic approach for using Safety Goals on a plant-specific basis would be to use the CDF as the primary criterion for evaluating proposed changes along with a qualitative or quantitative evaluation of the possible Level 2 and Level 3 PRA issues raised by these changes. For a quantitative analysis, the following two options are offered:

1) Full-scope Level 2 PRA (with fission product transport capability).

To use this option, a conservative value for a LERF criterion must be determined. This value, along with the CDF criterion, will provide an acceptable basis for decisionmaking. We note that both the NRC staff and the Electric Power Research Institute, in its, "PSA Application Guide," are proposing the use of LERF as an acceptance criterion.

2) Full-scope Level 2 PRA (without fission product transport capability).

To use this option, conservative values for early containment failure frequency criteria for different reactor designs must be determined. These values, along with the CDF criterion, will provide an acceptable basis for decisionmaking.

In the longer term, we believe the agency should move beyond the evaluation of risk associated with proposed changes to individual plant licenses and apply the Safety Goals to assess the

acceptability of plant-specific risk. This could be done in terms of the QHOs, along with the CDF, or in terms of the CDF and LERF. To use the QHOs directly, it would be necessary to have full-scope Level 3 PRAs. We believe that the use of Level 3 PRAs in the future should be encouraged.

Sincerely,

T. S. Kress

T. S. Kress
Chairman

<u>References</u>:

1. Staff Requirements Memorandum dated June 11, 1996, from John Hoyle, Secretary, NRC, to John T. Larkins, Executive Director, ACRS, Subject: Meeting with ACRS, Friday, May 24, 1996
2. ACRS report dated August 15, 1996, from T. S. Kress, Chairman, ACRS, to Shirley Ann Jackson, Chairman, NRC, Subject: Risk-Informed, Performance-Based Regulation and Related Matters
3. Electric Power Research Institute Report TR-105396, "PSA Application Guide," prepared by ERIN Engineering and Research, Inc., August 1995

B.6

ITEM B.6:

USE OF RULENET IN THE REGULATORY PROCESS

(DR. SHACK)

ITEM B.6: USE OF RULENET IN THE REGULATORY PROCESS

- Use of RULENET in the Regulatory Process

In the December 22, 1995 Staff Requirements Memorandum (SRM), resulting from the meeting between the ACRS and the Commission on December 8, 1995, the Commission requested,

> "feedback from the ACRS on the use of RuleNet" in the rulemaking process.

The NRC undertook a project called RuleNet, designed to use state-of-the-art computer technology to maximize communication between the NRC and the public on important nuclear power plant safety issues. The project was intended not only to provide the NRC and the public with valuable information, but also to test the usefulness of computer-based communication as a tool in the rulemaking process. The Nuclear Energy Institute (NEI) petition for rulemaking to amend 10 CFR 50.48, Fire Protection, was chosen as the pilot RuleNet action.

The RuleNet process was broken into three phases. Phase I was the issue identification and discussion phase. Phase II was the alternative identification phase. In this phase, proposed solutions to the challenges and/or issues identified in Phase I were solicited. The analysis of alternatives and final comment phase was Phase III. This phase was intended to solicit more concrete proposals on how to deal with the issues or challenges.

During the 430th ACRS meeting, the Committee heard presentations by and held discussions with representatives of NEI and the NRC staff.

NEI provided the following comments regarding the RuleNet program:

- RuleNet may have merit and can improve communications between the NRC and the public if it is properly managed, is cost effective, and adds value to the regulatory process. The pilot project has demonstrated that computer technology can be used in soliciting public input on regulatory issues, and in identifying areas of common understanding as well as differing opinions.

- NEI supports the use of computer technologies to improve the regulatory process if they are cost-effective and add value. However, NEI believes there are a number of significant questions that need to be resolved in the RuleNet effort. For example, NRC's disposition of communications among participants, qualification of participants, potential influence by special interests, conduct of private versus open caucuses among participants, and representation by organizations versus individuals, etc., have not been addressed by the RuleNet procedures. Until these questions can be fully addressed, RuleNet should be considered only as a tool to assist the NRC in achieving better communication on regulatory issues.

The NRC staff stated that the use of electronic communication in licensing poses problems because the information that used to consist of hard copies, which became part of the public record, is now transmitted between computers.

The NRC sought to use RuleNet to reach agreement with the public on the statement of the issues associated with the fire protection rulemaking. On August 29, 1996, the staff issued SECY-96-188, "RULENET," which provided the staff's evaluation of the RuleNet process. It concluded that the RuleNet pilot program accomplished its two principal objectives, which were to add to the NRC's information base about fire protection issues and to serve as a demonstration of the use of electronic communications in the regulatory sphere.

In SECY-96-178, "Action Plan to Address Outstanding LSS Issues," the staff advised the Commission of issues pertaining to the Licensing Support System (LSS) and its proposed use in the Department of Energy's license application for a high-level radioactive waste repository. As described in SECY-96-178, the staff intends to conduct an electronic discussion with the LSS Advisory Panel to identify issues related to the future direction of the LSS. This discussion will use many of the tools and processes developed for NRC's RuleNet. The NRC is posting this phase as LSSNET.

ACRS OBSERVATIONS:

- The use of computer technology can enhance the communications between the public and the nuclear industry and can be cost effective and add value to the regulatory process. However, because a significant portion of the general public either does not have access to the needed computer technology or is not familiar with its use, other avenues for participating in the rulemaking process will have to be maintained.

- Much of the discussion was in the form of open caucuses among the participants. It was difficult for the staff to determine whether comments were addressed to the NRC or to the other participants in the caucuses.

- More guidelines should be provided to the participants with regard to proper format for providing comments.

- RuleNet was a useful first step in the development of procedures and guidelines for using computer technology in the regulatory process in the future. This development should continue.

Attachments:

- RuleNet pages from Internet, including NEI views (pp. 80-82)

- Licensing Support System (LSS) Rulemaking Issues (pp. 83-84)

- Letter dated December 1, 1995, from William H. Rasin, NEI, to NEI Nuclear Strategic Issues Advisory Committee, Subject: "NRC RuleNet Program" (pp. 85-86)

United States
Nuclear Regulatory Commission

About NRC Rulemaking

- NRC Rulemaking Process
- Petitioning NRC to Initiate, Modify or Terminate a Rule
- NRC Regulatory Agenda

Rulemaking and Petitions for Rulemaking on Fedworld

- Information about the Rulemaking Bulletin Board System
- News, Information, and Contacts for Current Rulemakings *(table format)*
- News, Information, and Contacts for Current Rulemakings *(non-table format)*

Interactive Rulemaking Pilot

The U.S. Nuclear Regulatory Commission conducted an interactive rulemaking pilot known as "Rulenet." The pilot allowed for interactive rule development through use of World-Wide Web browsers and associated software tools. Using fire protection rules, the pilot focused on changes that would make the rules more performanced based and less prescriptive. The public was able to access RuleNet from January 5, 1996 to February 9, 1996. While RuleNet is closed for comment, the description and discussions which occured in each of the three phases of RuleNet is available for browsing.

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ruletop.html last updated on Tuesday, March 5, 1996 by clh1@nrc.gov.

Forum

Choose this for a textual representation of this page.

To provide participants with an overview of discussions in **RuleNet**, news pages were published daily. These pages included a summary and a detailed news story for each discussion. These News stories have been maintained in the News archive.

RuleNet was open from January 5, 1996 throught February 9, 1996. It proceeded through 3 phases. The description and discussions which occurred in each of these phases are accessable below. Please feel free to browse the discussions space.

Phase I Discussions

The first phase of the process was a "virtual kickoff" in which all participants were able to communicate in a simultaneous discussion via computer. This was followed by a period of five days for any caucuses; for the posting of questions and requests for clarification, directed either to the NRC or to other participants, and for the posting of answers to those questions; and for the identification of any further issues to be addressed, or challenges to be met, in the rulemaking.

Phase II Discussions

The second phase of the process comprised approximately 10 days. The NRC solicited proposed solutions to the challenges and issues identified in the first phase. It was also an opportunity for participants to respond to comments and suggestions made during the first phase.

Phase III Discussions

During the third phase of the process, the NRC technical staff, acting with the assistance of staff supplied by the contractor, consolidated and synthesized the challenges and the proposed solutions, using them to develop more concrete proposals, which were posted electronically. The participants were then allowed to respond to the proposals. As before, there was the opportunity for participants to caucus.

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Nuclear Regulatory Commission

RuleNet Discussion Group - Comment_On_Rulenet

Subject: NEI Views

From: *gcw@nei.org*
Date: *Fri, 9 Feb 1996 19:04:27 GMT*
Message-Id: *199602091858.SAA28305@nssc.llnl.gov*

Name: George Wu

NEI believes that RuleNet may have merit in enhancing communications between the public and the NRC if properly managed, is cost-effective, and adds value. We believe that the pilot project has demonstrated that computer technology can be used in soliciting public input on regulatory issues. and in identifying areas of common understanding as well as differing opinions. We also believe that information exchanges on RuleNet can promote a better understanding at the NRC and among interested individuals of issues that need to be addressed.

We note. however, that procedural questions remain with how the communications on RuleNet will be used to supplement information developed through traditional rulemaking approaches. For example, NRC's disposition of communications among participants, conduct of private versus open caucuses among participants, and what constitutes the formal record, are some questions that can be identified. Until these questions can be fully addressed, we believe that RuleNet should be considered only as a tool to assist the NRC in achieving better communication on regulatory issues.

We note also that the benefits of RuleNet to rulemaking must be determined based on an assessment of the cost-effectiveness of the program and value added in the regulatory process. both from the perspective of managing the RuleNet process as well as the resource expenditures of participants. (As the NRC stated: "Before the type of electronic exchange being demonstrated in the RuleNet project became a part of the agency's usual process for the development of rules, it would have to be shown to be cost-effective." 60FR57372) Pending this demonstration of cost-effectiveness and value added, we believe that the use of computer-based technology to improve communications should not be considered for other regulatory activities of the NRC. We also believe, based on lessons learned from this demonstration, that the NRC should publish more detailed guidance on how RuleNet and the end results will be used. The NRC's determination regarding the cost-effectiveness and overall value of RuleNet also should be published in the Federal Register for public review and comment.

- **Messages sorted by:** [date][thread][subject][author] [subject-abstract]
- **Next message:** gcw@nei.org: "Re: Direct Licensee and Public Access"
- **Previous message:** devonrue1@aol.com: "Re: Direct Licensee and Public Access"
- **Next in thread:** devonrue1@aol.com: "Re: NEI Views"

References | Help & Info | Feedback
News & Updates | Forum | Home

Forum

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LSS Rulemaking Issues

The Licensing Support System (LSS) concept grew out of the Nuclear Regulatory Commission's concern regarding how best to review the DOE license application for a high-level radioactive waste (HLW) repository. A centralized, electronic database, accessible by all parties appeared to offer the opportunity for significant time savings in conducting the licensing proceeding for the repository and, simultaneously, for the enhancement of any party's opportunity for effective participation. Plans for the LSS were first initiated in 1986 and were based on computer technology available in that time frame. It was intended to provide a central, shared, federally funded database of licensing information beginning in 1995. Budgetary shortfalls, however, and the unanticipated length of time that it would take to develop the licensing application for the repository, not only delayed the development of the LSS, but also resulted in the accumulation of a tremendous amount of potential licensing information, much of which may no longer be relevant to a licensing proceeding which may not begin until about 2002. In addition, since document capture may now involve much larger backlogs than originally contemplated, the risk of failing to capture **all** relevant material in the LSS is substantially larger than originally assumed. While the development of the LSS remained stalled, the state of technology in document automation and retrieval overtook the technology of 1986 on which the original LSS was to be based. With the widespread and common place use of computers to generate and maintain the documents of a party to the HLW licensing proceeding, the universal availability of the Internet to tie disparate and geographically dispersed systems together, and the availability of commercially available software applications relevant to LSS functionalities, the centralized LSS envisioned at the time the LSS rule was developed may be obsolete. Consequently, the Commission intends to evaluate how these new technologies can be integrated into the LSS rule while still maintaining the primary functions of the LSS:

1. A mechanism for the discovery of documents before the license application is filed;
2. Electronic transmission of filings by the parties during the proceeding;
3. Electronic transmission of orders and decisions related to the proceeding; and
4. Access to an electronic version of the docket.

It is the intent of the NRC staff to focus this rulemaking on how best to address changes in technology in regard to the LSS. There is no intent to re-visit the basic functionalities of the LSS that are reflected in the current 10 CFR Part 2, Subpart J.

To attempt to address these issues, the NRC is posting the following "topics" to guide the discussion during this phase of LSSNet:

<u>Topic 1</u> - What are the costs and benefits of moving from a dedicated, centralized system to a distributed system based on the Internet?

<u>Topic 2</u> - How should other improvements in computer technology be incorporated into the LSS?

<u>Topic 3</u> - What provisions of the LSS rule will need to be changed to reflect the incorporation of new technologies?

<u>Topic 4</u> - How should the backlog of "uncaptured", and possibly irrelevant, repository-related information be

addressed?

Topic 5 - What would the role of the LSS Administrator be under a distributed system?

Topic 6 - How should advice from potential users of the LSS be provided for?

References | Help & Info | Feedback
News & Updates | Forum | Home

References | News | Help & Info | Forum | Feedback | Home

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NEI

NUCLEAR ENERGY INSTITUTE

Bill Olmstead

December 1, 1995

TO: NEI Nuclear Strategic Issues Advisory Committee

SUBJECT: NRC RuleNet Program

On November 15, 1995, the NRC published in the *Federal Register* (60 *Fed. Reg.* 57370) a notice of availability of a computer-based pilot program called "RuleNet." The intent of RuleNet is to maximize communication between the NRC and the public on rulemaking issues, and it is the first time that such a program has been implemented by any federal agency. The program is being applied by the NRC specifically to the fire protection regulatory improvement area as a pilot effort. A copy of the notice is enclosed for your information.

In summary, the RuleNet program will allow interested individuals to participate in discussions on fire protection rulemaking issues through the use of computer networks, such as the World Wide Web. The RuleNet program is in progress with participant registration, and electronic discussions among participants will occur between January 2 and February 9, 1996. Procedures for the program are not clearly defined; however, and the NRC indicates that they can be developed and communicated through implementation of the pilot effort.

Discussions with the NRC staff indicate that RuleNet was developed by the NRC in conjunction with activities related to the National Performance Review, and will be observed by other federal agencies for potential adaptation. In addition, the NRC expects to apply this program to other rulemaking actions should the pilot effort be successful for the issue of fire protection.

NEI supports the use of computer technologies to improve the regulatory process if it is cost-effective and adds value. However, we believe that there are a number of significant questions that need to be resolved in the RuleNet pilot effort. For example, NRC's disposition of communications among participants, qualification of participants, potential influence by special interests, conduct of private versus open caucuses among participants, and representation by organizations versus individuals, etc., are some of the questions that have not been addressed by the

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RuleNet procedures. We intend to pursue discussions with the Commission to clarify the RuleNet program.

Pending clarification of the process, NEI is registering to participate in RuleNet on behalf of the industry. Because fire protection rulemaking is the issue for the pilot effort, we intend to focus direct participation through the NEI Fire Protection Working Group. Accordingly, we do not encourage direct participation in RuleNet by individual licensees or other industry organizations. However, we note that interaction among participants on RuleNet may be observed by others, and we believe that your representatives should periodically observe RuleNet discussions. We request that you provide any feedback directly to us so that we may reflect your views in our input to RuleNet.

We recommend that you forward this material to your staff responsible for licensing issues and individuals responsible for your fire protection program, as well as your legal support staff. Please contact me (202-739-8088) or George Wu (202-739-8086) of the NEI staff should you have any questions.

Sincerely,

William H. Rasin

WHR/GCW/ead
Enclosure

c: Administrative Points of Contact
Fire Protection Working Group
Chairmen, NSSS Owners Groups