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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

November 4, 2005

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, taken on November 4, 2005, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

This transcript has not been reviewed, corrected and edited and it may contain inaccuracies.

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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527TH MEETING

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FRIDAY,

NOVEMBER 4, 2005

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The Committee met in Room T2B3 of the U.S. Nuclear Regulatory Commission, Two White Flint North, 11545 Rockville Pike, Rockville, Maryland, at 8:30 a.m., Graham B. Wallis, Chair, presiding.

PRESENT:

- GRAHAM B. WALLIS, ACRS Chairman
- WILLIAM J. SHACK, ACRS Vice Chairman
- JOHN D. SIEBER, ACRS Member-At-Large
- GEORGE E. APOSTOLAKIS, ACRS Member
- MARIO V. BONACA, ACRS Member
- RICHARD S. DENNING, ACRS Member
- THOMAS S. KRESS, ACRS Member
- DANA A. POWERS, ACRS Member
- VICTOR H. RANSOM, ACRS Member

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## P R O C E E D I N G S

8:29 A.M.

CHAIRMAN WALLIS: This is the second day of the 527th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the Committee will consider the following: Digital Systems Research Plan; Status of Rulemaking on Post-Fire Operator Manual Actions; Future ACRS Activities/Report of the Planning Procedures Subcommittee; Reconciliation of ACRS Comments and Recommendations; Preparation for Meeting with the NRC Commissioners; and the Preparation of ACRS Reports.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Sam Duraiswamy is the Designated Federal Official for the initial portion of the meeting.

We have received no written comments from members of the public regarding today's session. We have received a request from Mr. Alex Marion of NEI for time to make oral statements regarding the rulemaking on post-fire operator actions.

A transcript of portions of the meeting is being kept and it is requested that the speakers use one of the microphones, identify themselves and speak

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1 with sufficient clarity and volume so that they can be  
2 readily heard.

3 During lunch time today, representatives  
4 of the Office of the Chief Financial Officer will  
5 provide a briefing to us regarding the revised policy  
6 for reporting labor hours.

7 That's all I have by way of introductory  
8 remarks. I will now hand over the chair to my  
9 esteemed colleague, George Apostolakis.

10 MEMBER APOSTOLAKIS: Thank you, Mr.  
11 Chairman. The Committee has been reviewing the  
12 Digital System Research Plan for more than a year now.  
13 We issued the first letter on June 2, 2004 in which we  
14 supported the efforts of the team that is developed  
15 the program and in that letter also there were several  
16 personal opinions written by me. Then the full  
17 Committee had an information meeting on May 6th of  
18 this year and then the Digital I&C Subcommittee met in  
19 June 14-15, 2005, and last month, October 20-21.

20 Today, we will be briefed on the plan by  
21 the staff and I believe they're requesting that we  
22 write a letter commenting on the plan. So to start  
23 the briefing by the staff, I will turn the  
24 presentation over to William Kemper, Chief of the  
25 Instrumentation and Control Section in the Office of

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1 Nuclear Regulatory Research.

2 Bill?

3 MR. KEMPER: Thank you, George. Before I  
4 start, Rich Barrett is here.

5 Rich, do you want to say anything?

6 MR. BARRETT: No, that's okay, go ahead.

7 MR. KEMPER: Great. Good morning. I'm  
8 Bill Kemper. As George said, I'm the Section Chief of  
9 the Instrumentation and Control Engineering Section in  
10 the Office of Research. And I have my colleagues  
11 Steve Arndt here with me, who is a senior I&C engineer  
12 in our section as well. And between the two of us we  
13 will present the research plan.

14 We're here today to present the final  
15 draft research plan which covers the period 2005 to  
16 2009. As George mentioned, we provided a fairly  
17 detailed overview of the research plan to the  
18 Committee back in May. Since that time we've  
19 continued to work proactively with our stakeholders,  
20 NRR, NMSS and NSIR to improve the research plan.

21 We've also, as George said, presented the  
22 plan to the I&C subcommittee through two different  
23 sessions which resulted really in three full days of  
24 interaction with the subcommittee and got a lot of  
25 very good insights from the subcommittee as well. We

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1 appreciate the interactions with that committee and  
2 look forward to continued interactions with you all.  
3 It's really helpful to us quite frankly.

4 So today's presentation is going to be a  
5 higher level overview, if you will, than the last time  
6 we were here. And it will include the results of  
7 those interactions with the subcommittee, as well as  
8 our internal stakeholders.

9 We hope that these briefings on the  
10 research plan will provide the ACRS with sufficient  
11 information for the Committee to endorse our program  
12 to the Executive Director of Operations.

13 And also, we have a lot information, as  
14 before, to cover, in a relatively short period of  
15 time, so we will make our best effort to stay on  
16 schedule.

17 In terms of background, the current  
18 digital safety system review guidance is really  
19 contained in Chapter 7 of the Standard Review Plan  
20 which is several years old. That plan was produced in  
21 1997. The SRP is adequate, but it's dated. We have  
22 already seen and anticipate receipt of more  
23 complicated and more extensive plant specific  
24 applications, thus the need to make the review process  
25 more effective, continues to grow.

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1                   The 2001 through 2004 research plan was  
2 primarily focused on NRR issues.

3                   CHAIRMAN WALLIS: Did that plan succeed?

4                   MR. KEMPER: We believe that we got a lot  
5 of good use from that plan, a lot of benefit to the  
6 Agency from that plan.

7                   CHAIRMAN WALLIS: This new plan gives no  
8 reference to sort of approaches which were successful  
9 previously or anything like that, so it doesn't give  
10 the idea that you're building on anything.

11                  MR. KEMPER: Well, it does indicate  
12 products that were produced through the efforts of the  
13 previous effort. There were various NUREGs that are  
14 mentioned throughout the various sections of the plan.

15                  I do not have a compiled list of those  
16 things, but we could produce that for you, if you'd  
17 like at some time in the future. I'll go over this in  
18 just a minute. The current plan builds on the old  
19 plan.

20                  CHAIRMAN WALLIS: You're going to tell us  
21 that, okay.

22                  MR. KEMPER: Yes. However, in the past  
23 few years, the need to provide support to NSIR and  
24 NMSS has grown.

25                  CHAIRMAN WALLIS: The output of this goes

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1 to -- is going to be a chance in the SRP or something?

2 MR. KEMPER: It should result in changes  
3 to the SRP.

4 CHAIRMAN WALLIS: So how can academic work  
5 in universities which this seems to be directed at do  
6 anything for an SRP which is a regulatory document  
7 that is extraordinary unfamiliar territory for most  
8 universities?

9 MR. KEMPER: Well, that's just one of the  
10 outputs. Also, we expect to produce review,  
11 regulatory guidelines which we issue to the industry,  
12 numerous NUREGs that will provide the biggest --

13 CHAIRMAN WALLIS: Who is going to do that  
14 connection between this research and the real need?

15 MR. ARNDT: Steve Arndt. That's going to  
16 be done by a number of different people. Some of it  
17 will be done by other contractors. Some of it will be  
18 done by the research staff and some of it will be done  
19 jointly in collaboration with our stakeholders. For  
20 example, we're working right now on how to improve the  
21 technical tools and acceptable criteria for some of  
22 the on-going areas that are coming up in the  
23 regulatory space, for example, the on-line monitoring  
24 program that's been an academic exercise primarily for  
25 10 or 15 years, but now is moving into the plants and

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1 we expect license amendment requests within the next  
2 year.

3 CHAIRMAN WALLIS: Sometimes that's the  
4 most difficult part of the work.

5 MR. ARNDT: Exactly.

6 CHAIRMAN WALLIS: To make that connection  
7 between academic work and the real world.

8 MR. ARNDT: That's exactly the most  
9 difficult going from what is theoretically the right  
10 way to do it, to what is the specific acceptance  
11 criteria that is necessary. And as Bill will mention  
12 in a minute, the research plan is more geared this  
13 time for development of specific acceptance criteria  
14 to assist in review and update of the regulatory  
15 guidance.

16 MR. WATERMAN: This is Mike Waterman.  
17 Just as an addendum. In addition to developing  
18 acceptance criteria, we want to develop review  
19 procedures, step-by-step procedures that we have  
20 consistent reviews of safety system applications.

21 And additionally, we want to develop  
22 training curriculums that we can train and support our  
23 staff on how to use the review procedures, the tools  
24 and methodologies to assess acceptance criteria  
25 appropriately. So that's -- it's more of a product-

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1 oriented function, where we want to put tools and  
2 procedures in the hands of our supported staff.

3 CHAIRMAN WALLIS: So the sequencing here  
4 is you first do the work in university and then  
5 someone looks at it and sees that it's suitable for  
6 your task and then tries to adapt it in some way to  
7 what you need?

8 MR. WATERMAN: Exactly. We want to  
9 develop --

10 CHAIRMAN WALLIS: I'd think you'd have to  
11 do it simultaneously, otherwise university may go off  
12 in some area which is very interesting, but doesn't  
13 really meet your needs.

14 MR. ARNDT: Professor Wallis, it's really  
15 a phrased approach and we'll get into this later in  
16 the presentation, but the 30-second version is we look  
17 out on the horizon, see what technologies might be  
18 important for us to understand. We develop the  
19 information or the technology or the tools. As that  
20 goes forward we will decide whether or not, if  
21 necessary, we have enough information, we have enough  
22 tools. If not, then we transition that into the tool  
23 development, the regulatory development, the Reg.  
24 Guide, whatever; then finally, the actual training and  
25 acceptance criteria and revision to the guidance.

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1 MR. KEMPER: But in the final analysis,  
2 our contracting process really will control the scope  
3 of the work that's done by universities. We use  
4 cooperative agreements which are pretty well-defined,  
5 in terms of the goals and objectives when we work at  
6 universities. We use statements of work when we  
7 contract with independent contractors or laboratories  
8 which are very definitive in terms of what our scope  
9 is, the expected outcomes and the level of effort that  
10 should transpire.

11 So as I was saying, we've also noticed  
12 that NRR is not the only internal stakeholder that we  
13 should provide support to. For example, at fuel cycle  
14 facilities, there are fuel cycle facilities right now  
15 going through the licensing process that depend  
16 heavily on digital I&C systems. So we're  
17 participating with NRR to provide support to that  
18 effort.

19 So our current situation really that NRC  
20 is facing is a number of issues which I'm going to  
21 cover here. We expect that licensing, excuse me, that  
22 licensees will replace analog systems with digital  
23 systems as the existing analog systems become  
24 obsolete. Obsolescence of analog I&C systems is a  
25 real problem within the nuclear industry, and

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1 routinely challenges the licensee staff in maintaining  
2 the maintenance of these systems. In some cases,  
3 licensees are having to resort to extraordinary  
4 measures to obtain replacement parts to keep these  
5 systems in operation. They're doing things such as  
6 mass procurements of RPSs and ESFASs, cabinets and all  
7 the peripherals associated with that; plants that have  
8 been shut down or where the construction was stopped  
9 at those plants. There's also somewhat emerging  
10 business with third party vendors to re-engineer these  
11 sector analog components such as pressure transmitters  
12 and nuclear instrumentation cabinets and modules and  
13 so forth, because the original OEMs or equipment  
14 manufacturers just won't support the equipment any  
15 more. They're either out of business or they shifted  
16 to the digital world because that's where the business  
17 interest is. And the rest of the sector process  
18 control is business.

19 So replacement of analog equipment with  
20 digital equipment is inevitable. There's no doubt  
21 about it. It's going to happen. Licensing these  
22 digital systems presents challenges to the NRC because  
23 of the increased complexity of the systems.  
24 Consolidation of discrete analog functions into a  
25 single digital process is typical. In the analog

1 world you have many things happening in parallel. All  
2 that is consolidated into one processor. It's all a  
3 sequential type of operation.

4 Also, potential consolidation of  
5 independent safety systems themselves into a single  
6 system such as combining RPSs and ESFASs on to one  
7 chip is something that we're seeing right now, being  
8 proposed to the Agency. And also, there's many new  
9 potential failure modes which we've discussed at  
10 length, involving digital equipment versus analog  
11 equipment.

12 There's also limited operating history of  
13 digital equipment in the nuclear safety-related  
14 applications. And to review licensee systems, it  
15 requires a significant amount of effort by the staff  
16 with specialized skills.

17 So current licensing guidelines provide  
18 information on what to review, but not necessarily how  
19 to review it or what the appropriate acceptance  
20 criteria should be. So that's really the angle that  
21 we're approaching here and the value that we're going  
22 to add to the regulatory process.

23 Also, there is a considerable industry  
24 interest in risk-informed digital safety system  
25 reviews, but the NRC does not yet have the needed

1 technical basis to support this kind of review.

2 MEMBER RANSOM: Does your definition of  
3 digital systems include wireless and optical  
4 transmission of data?

5 MR. KEMPER: Yes, it does. Also, in  
6 today's environment, cyber security safety-related  
7 digital systems is really important. And the staff is  
8 working, as we speak to develop regulatory guidance  
9 and we intend to assist them with acceptance criteria  
10 and some of the bases information needed to support  
11 that regulatory guidance in this area.

12 The operating history we have indicates  
13 that digital system failures may be of risk  
14 significance. For example, an analysis of the 1984  
15 through 1987 accident sequence precursor or data  
16 indicated that a large number of risk-significant  
17 events includes I&C failures and that both safety and  
18 nonsafety systems contributed to these events.

19 In fact, 30 percent of the events were  
20 initiated by I&C system failures and an additional 10  
21 percent of those events at least one I&C failure  
22 contributed to the progression of the event.

23 Also, an analysis of LER data show that  
24 many software system failures are context dependent,  
25 so it's not straight forward. In other words, it's

1 dependent upon the operational mode at the time, so  
2 the failure of digital systems various from one plant  
3 sequence to another and that many faults are  
4 introduced in testing and maintenance, as well as  
5 operations.

6 MEMBER APOSTOLAKIS: But that brings us  
7 back to a comment that was made some time ago  
8 regarding the distinction between a software-centric  
9 approach and a systems-centric approach. This is a  
10 very true statement, the failures are context  
11 dependent. However, in several places in the plan,  
12 you say, for example, that you will estimate the risk  
13 significance of the software. That is a little bit  
14 different than this because that implies that you are  
15 viewing the software as another component of the  
16 facility which, like a pump, will cover all or  
17 whatever. Whereas here, what you're saying is that  
18 really you can't do that because it's part of the  
19 integrated system, so I think it would be useful to  
20 recognize these things in the plan and make sure that  
21 the guys who are working on this issue are fully aware  
22 of it.

23 MR. ARNDT: The point here is that these  
24 are complicated systems that cannot be analyzed easily  
25 using the traditional methods we have available.

1 MEMBER APOSTOLAKIS: Right.

2 MR. ARNDT: And your point is well taken  
3 and in the areas which we'll talk about a little bit  
4 later in the presentation where we're looking at,  
5 particularly risk significance, but also other issues  
6 associated with software-driven systems, one of the  
7 big challenges for us is not only understanding the  
8 complexity, but also being able to differentiate which  
9 systems you need to analyze with very sophisticated  
10 methods and which ones you can get away with analyzing  
11 in a less significant way.

12 MEMBER APOSTOLAKIS: Which is an excellent  
13 idea and I'm not sure there is a section in the plan  
14 where this is addressed, the classification, in other  
15 words, because in some systems, you may, in fact, make  
16 sense to talk about the software as a separate  
17 component. In an actuation system, for example --

18 MR. ARNDT: Right. That is part of the  
19 research and we can go back and look at the plan  
20 before we finalize it and see if we can highlight that  
21 more specifically.

22 MEMBER APOSTOLAKIS: These two comment,  
23 these two issues that we just discussed I think are  
24 very important. The first one is classification.

25 MR. ARNDT: Right.

1 MEMBER APOSTOLAKIS: and the second one is  
2 to make sure that some of the items in the plan do  
3 reflect this context-dependence of the software,  
4 because if you read that section 3.3.4 or something  
5 like that, you clearly get the impression that you  
6 have a pump, you have a valve, you have the software.  
7 So what is the risk significance of the pump? What's  
8 the risk significance of the software? And that's not  
9 consistent with this.

10 MR. ARNDT: You're right.

11 MEMBER APOSTOLAKIS: It's obvious that  
12 you're appreciating the difficulty, but I think it  
13 should also be in the plan.

14 MR. ARNDT: Okay.

15 MEMBER APOSTOLAKIS: Because the guys who  
16 do the work may not appreciate it.

17 MR. KEMPER: Well, I believe and Steve  
18 will cover this in more detail during his portion of  
19 the presentation, but our risk element, I think,  
20 addresses that or attempts to address that as one  
21 total system. One concentric system, if you will.  
22 You can't really separate the software from the  
23 hardware. You have to treat it as a single system.

24 MEMBER APOSTOLAKIS: I noticed also at the  
25 subcommittee meetings, if one reads the plan without

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1 talking to anybody, one gets a certain impression as  
2 to what the authors had in mind, but then when one  
3 talks to you, that there is really a much better  
4 picture, okay?

5 You gentlemen have thought through a lot  
6 of these issues, but a lot of that thinking is not in  
7 the plan and maybe you can try, if you have another  
8 chance to go over it, to make it reflect this kind of  
9 thinking. I don't recall a single case, but we asked  
10 the question and you didn't have an answer, but if you  
11 go to the plan, it's not always there.

12 MR. ARNDT: Fair enough. Thank you.

13 MEMBER APOSTOLAKIS: Okay, let's move on.

14 MR. KEMPER: Also a member of our staff,  
15 Mike Waterman, did a study that evaluated some  
16 potential common mode failures that have occurred in  
17 systems that are currently licensed in the U.S. over  
18 the past 10 years. And he produced a report, 20 some  
19 odd different events that represent software failures  
20 which could be construed to become mode failures under  
21 certain plant conditions and it includes things like  
22 the most recent Palo Verde Core Protection Calculator  
23 software bug you all probably heard about that. Palo  
24 Verde modified their RPS software to allow a failed  
25 sensor input signal to be ignored and maintain the

1 value of the last good signal. The licensee didn't  
2 ask for that, so I've been led to believe, but it  
3 happened. In fact, it missed the licensee's review  
4 and it was only discovered during a maintenance  
5 activity. Operations was made aware of it. They  
6 declared all four channels inoperable conservatively  
7 and resulted in a plant shutdown.

8 Also, there was a soft testing bug in the  
9 software for the Turkey Point load sequencers. They  
10 were upgraded to a digital system about 10 years ago  
11 and the system has a self-testing routine that is  
12 invoked quite a bit, but it's supposed to be  
13 interrupted when a real signal comes in. As it turns  
14 out, due to a bug, the real signal could not interrupt  
15 the self-testing routine and therefore when called  
16 upon, the system wouldn't properly actuate.

17 So these are just examples --

18 CHAIRMAN WALLIS: So this gets to my  
19 original question. What they're talking about here is  
20 giving some advice on the practice of how you detect  
21 false and so on in a plant.

22 MR. KEMPER: Yes.

23 CHAIRMAN WALLIS: That's very different  
24 from some academic doing a study on digital system  
25 faults. That could be very esoteric.

1 MEMBER APOSTOLAKIS: Maybe you need both.

2 CHAIRMAN WALLIS: Maybe we need both.

3 MEMBER APOSTOLAKIS: The field is so new.

4 CHAIRMAN WALLIS: We need some structure,  
5 intellectual structure coming from academia, but we've  
6 got to get down to the plant level.

7 MEMBER APOSTOLAKIS: Exactly. Just out of  
8 curiosity, is it really a problem for a regulator to  
9 say anecdotal evidence? If there is some suspicion  
10 shouldn't you get the damn evidence?

11 (Laughter.)

12 MR. KEMPER: Well, we chose that word just  
13 to say we haven't -- this is not a report that we  
14 intend to issue. We haven't spent a great amount of  
15 time putting this in a format that we typically  
16 would issue to the public.

17 MEMBER APOSTOLAKIS: But you do what  
18 happened there?

19 MR. KEMPER: Oh yeah, we're very sure of  
20 the details that are in this table here.

21 MEMBER APOSTOLAKIS: Anecdotal evidence.

22 MR. KEMPER: I've got a copy of the table  
23 if anybody wants to take a look at it here.

24 MR. WATERMAN: This is Mike Waterman from  
25 Research. That isn't really a report. I was just

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1 curious about well how many common mode failures have  
2 we had since say like 1990 or 1991, so I simply did a  
3 key word search on it. I think I started with digital  
4 systems or something like that, something simple. And  
5 I thought well, I'll get a couple here and then I'll  
6 have to refine it. And I found over 20 events just on  
7 that one key word and I was just building up a table  
8 for myself, if you will. It wasn't issued as a report  
9 or anything like that, just for my own reference. But  
10 I was kind of surprised by how many events have  
11 actually happened. When I went back sort of  
12 remembering all the different things and started  
13 adding them up mentally, I thought, yeah, I guess  
14 there have been a lot.

15 It turns out just about all the digital  
16 systems we've licensed at one time or another have had  
17 one problem or another occur in them and it's just  
18 like hm, maybe we ought to pay more attention to this.

19 MEMBER APOSTOLAKIS: Yes, it's fine to do  
20 that, but when you decide that on several occasions  
21 there is something going on, I presume you're going to  
22 find out exactly what happened?

23 MR. WATERMAN: Oh sure, the licensees  
24 always do their root cause analysis.

25 MR. KEMPER: Most of these are the results

1 of LER. It's documented. It's on the record.

2 MR. WATERMAN: Yes, these are LERS and  
3 event reports and Part 21 notices.

4 MR. KEMPER: It's just not our formal  
5 report that you can look and --

6 MEMBER APOSTOLAKIS: No, I understand.

7 MR. KEMPER: But the bottom line here is  
8 these operational events involving failures of digital  
9 I&C equipment indicates why this research is so  
10 extremely important. It's really critical that we  
11 understand how these systems behave and that we have  
12 objective performance criteria to review in licensee  
13 systems.

14 So all these things prompted a development  
15 of digital safety system research plan. In 1997, a  
16 National Academy of Science's report "Digital  
17 Implementation and Control Systems in Nuclear Power  
18 Plants" was reviewed. The Committee identified a  
19 number of key areas that should be explored, including  
20 system aspects of digital instrumentation and control  
21 technology, software quality assurance, common mode  
22 software failure potential, safety and reliability  
23 assessment methods, human factors and human machine  
24 interfaces and dedication in commercial off-the-shelf  
25 hardware.

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1 In developing the previous research plan,  
2 the '01 to '04 plan, we research reviewed the NAS  
3 report recommendations and also I&C vendor-development  
4 efforts at the time and determined that the key areas  
5 for research really were in four areas: systems  
6 aspects of digital technology, software quality  
7 assurance, risk assessment of digital I&C systems and  
8 emerging I&C technology and applications.

9 CHAIRMAN WALLIS: And these four areas of  
10 research were actually carried out?

11 MR. KEMPER: They are in progress.

12 CHAIRMAN WALLIS: In progress?

13 MR. KEMPER: Yes. We haven't completed  
14 them. A research plan is a living document, if you  
15 will.

16 CHAIRMAN WALLIS: Whenever our review a  
17 research program, I want to know -- I usually look at  
18 the success of the previous one in order to evaluate  
19 my opinion of the second one.

20 MR. KEMPER: Right.

21 CHAIRMAN WALLIS: I don't want to get into  
22 that, except your written document gave me no clue as  
23 to whether or not the previous work was successful and  
24 where it was leading and all that kind of stuff.

25 MR. KEMPER: That's a good point. that

1 was pointed out also by the subcommittee and we intend  
2 to add a section to the research report that indicates  
3 the completed work.

4 MEMBER APOSTOLAKIS: Speaking of that,  
5 what is the plan? Are you planning to revise this  
6 document any time soon?

7 MR. KEMPER: Our plan is basically we're  
8 still looking at what came out of our last  
9 subcommittee meeting and any actionable items that  
10 came out of there we'll include that into the plan as  
11 quickly as we can and then we're hoping to wait until  
12 this Committee provides their letter to the  
13 Commission, excuse me, to the EDO and then we will  
14 issue that document under Carl Paperiello's signature  
15 to the other office directors with a copy to the  
16 Commission. That's the plan. And we intend to do  
17 that by the end of this year.

18 MEMBER APOSTOLAKIS: So that will be it?

19 MR. KEMPER: That will be it.

20 MEMBER APOSTOLAKIS: That's again for some  
21 period of time?

22 MR. KEMPER: Well, the plan is after that,  
23 I hope to update this on an annual basis. Rather than  
24 waiting another five years because it's such a dynamic  
25 world we live in. Things are going to change quickly

1 and so it makes more sense to me to update this on a  
2 shorter period.

3 MEMBER APOSTOLAKIS: Surely though some of  
4 the tasks of the previous plan will be completed soon  
5 and may have been completed already.

6 MR. KEMPER: That's right, they have been.  
7 For example, the Lightning Task. We talked to you all  
8 about that at the last committee meeting.

9 MEMBER APOSTOLAKIS: Yes.

10 MR. KEMPER: Many of the system --  
11 research on the system aspects of digital systems are  
12 being completed.

13 MEMBER APOSTOLAKIS: And you said earlier  
14 you plan to have relatively frequently interactions  
15 with the subcommittee?

16 MR. KEMPER: Right.

17 MEMBER APOSTOLAKIS: I think this is an  
18 important topic, as we said earlier. It's fairly new.  
19 We all are really learning in various degrees, of  
20 course, and especially in some key areas, I would urge  
21 you to come to us before you have a completed product.

22 MR. KEMPER: Okay.

23 MEMBER APOSTOLAKIS: While your work is in  
24 progress, you have some ideas how to proceed and I  
25 think it would be useful to inform us and maybe get

1 some feedback.

2 MR. KEMPER: Absolutely. That's precisely  
3 what we would like to do.

4 So in developing the new research plan, we  
5 continue the programs that are in progress and refocus  
6 the outcome of the research projects to provide  
7 improved technical guidance for review of digital  
8 systems, to provide technical support in areas where  
9 program offices need to improve acceptance criteria  
10 and develop assessment tools and methodologies to  
11 improve the reviews.

12 Input to the plan was solicited from NRR  
13 program offices, NRR, NSIR, and NMSS. The draft plan  
14 was sent to those offices and thoroughly vetted with  
15 the technical folks in the three offices and comments  
16 have been incorporated. In fact, we held numerous  
17 meetings with the program offices to disposition their  
18 comments.

19 We also presented the results of these  
20 reviews in comment resolutions to the ACRS I&C  
21 subcommittee during the June meeting.

22 And as I said, the research plan has been  
23 reviewed by the subcommittee and comments are being  
24 incorporated.

25 So in the final analysis, we believe this

1 plan provides a flexible, adaptable framework for  
2 identifying NRR, NMSS and NSIR research initiatives  
3 needed to meet the challenge of licensing digital I&C  
4 systems for safety-related applications at nuclear  
5 facilities.

6 The research plan is structured to include  
7 the most important areas needed to support the program  
8 office. We have six programs identified in the plan.  
9 Four of them are carry overs from the previous plan  
10 with two new areas.

11 CHAIRMAN WALLIS: There's something really  
12 wrong with your previous slide. A framework for  
13 identifying NRR, NMSS and NSIR research initiatives?  
14 I don't understand that at all. You identify needs of  
15 those people and then you construct initiatives to  
16 meet them. I don't understand how this framework  
17 identifies those folks' research. This is your  
18 research.

19 MR. KEMPER: This research program --

20 CHAIRMAN WALLIS: Framework for carrying  
21 out research to meet the needs of those people. It  
22 doesn't make sense, that sentence.

23 MR. KEMPER: The plan provides a flexible,  
24 adaptable framework for identifying research  
25 initiatives needed to meet the challenges of the other

1 program offices in licensing digital I&C systems.  
2 That's what we're trying to say. In other words,  
3 they're our customers.

4 CHAIRMAN WALLIS: You'll put it right,  
5 okay.

6 MR. KEMPER: This plan is driven by the  
7 regulatory use of the products.

8 CHAIRMAN WALLIS: I hope so.

9 MR. KEMPER: It's not research just for  
10 the sake of research.

11 So the plan is structured, as I say, it  
12 has six programs. Four of them are carry overs,  
13 although there's new elements associated with each of  
14 those four areas and we have two new elements,  
15 security aspects of digital systems and advanced  
16 nuclear power plant digital systems.

17 These six programs represent 27 research  
18 projects at this point. We expect more will be  
19 produced as time goes on.

20 CHAIRMAN WALLIS: Now another thing I  
21 missed in all of this, you've got this very nice  
22 sounding scheme, you're going to do all these things.  
23 I had no awareness of the capability of the  
24 professional world out there to deliver any of this  
25 stuff. This could be just a pipe dream. We'll put

1 out this RFP, or whatever, and someone will do the  
2 work and magically the research product will appear.  
3 My sense of the field is it isn't like that. This is  
4 a rather beginning sort of field, particularly in  
5 security aspects, that people are struggling to come  
6 up with the right way to do things.

7 MEMBER APOSTOLAKIS: I mean, do you expect  
8 the plan to say this research will be done at such and  
9 such a place?

10 CHAIRMAN WALLIS: There are some people  
11 out there who are capable of doing it, otherwise, the  
12 whole thing is a dream.

13 MEMBER APOSTOLAKIS: Well, how would the  
14 plan reflect that?

15 CHAIRMAN WALLIS: I think you might have  
16 to say something about the realism of the plan  
17 somewhere.

18 MEMBER APOSTOLAKIS: That's a different --

19 MR. KEMPER: Well, if I could, the tasks  
20 in the plan represent the needs of program offices.

21 CHAIRMAN WALLIS: I understand that. That  
22 makes sense there.

23 MR. KEMPER: If the expertise doesn't  
24 exist, then we're going to have to work hard to try to  
25 find where that expertise is or grow that expertise.

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1 CHAIRMAN WALLIS: Grow it, right.

2 MR. KEMPER: Within academia and --

3 CHAIRMAN WALLIS: Is there anything you  
4 can give us now? How far along are they in terms of  
5 meeting these needs?

6 MR. ARNDT: It depends a little bit on the  
7 particular area you're talking about and I'll  
8 highlight that a little bit when I talk about  
9 particular research programs.

10 To give you the 30-second answer, in some  
11 areas you're entirely correct, we have some real  
12 challenges associated with the ability to actually  
13 come up with enough specificity and techniques and  
14 methods and acceptance to get there. In some areas,  
15 we're surprisingly far along. There's been a lot of  
16 work either in various corners of the world or in  
17 various other safety critical applications that we  
18 hope to borrow from.

19 But as Bill mentioned, the idea is to work  
20 through those issues and improve the current  
21 regulatory process by providing the review procedures  
22 and the acceptance criteria. One of the biggest  
23 challenges associated with this, a lot of these  
24 technologies, is you can look at it, but frequently  
25 there's not the definitive acceptance criteria. How

1 good is good enough?

2 CHAIRMAN WALLIS: So there may be some  
3 areas where you simply figure out what you need to do  
4 in the next plan?

5 MR. ARNDT: Yes.

6 CHAIRMAN WALLIS: In order to get these  
7 research products that you want. I don't know if it's  
8 going to be all delivered at the end of this program.

9 MR. ARNDT: Right, and we'll highlight  
10 that issue.

11 MEMBER POWERS: Am I correct that you had  
12 prepared some fairly useful reviews of the field and  
13 indeed have presented that before the American Nuclear  
14 Society to kind of assess the field in this area?

15 MR. ARNDT: In several specific areas, one  
16 of the parts of the task is simply to understand the  
17 state-of-the-art and to know which areas we want to  
18 investigate further. The particular area that Dr.  
19 Powers is talking about is in the risk area. One of  
20 the areas we wanted to look at is what is the state-  
21 of-the-art? And we presented a paper in June at the  
22 ANS meeting, but that's true in several of the other  
23 areas as well. We have to understand where the state-  
24 of-the-art is and whether or not it is sufficiently  
25 well known to convert to the state-of-the-practice.

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1 It's really fortunately or unfortunately, depending on  
2 your perspective of research, what we do is we convert  
3 the state-of-the-art to a practical document or a  
4 practical procedure or practical set of acceptance  
5 criteria for our regulatory counterparts to use.

6 MEMBER POWERS: I would just comment that  
7 the paper in this particular area was excellent and I  
8 thought it was a real contribution made to the Society  
9 to present this review of the state-of-the-art. And  
10 solicit input from the Society members on what they  
11 thought. That represents what I think is a good  
12 practice for the research program to share what their  
13 thinking is on a subject.

14 MR. KEMPER: I was going to say that's  
15 very productive because as it turns out all of us in  
16 the world are trying to solve the same problems  
17 because everybody in the world, in the nuclear world  
18 anyway, is trying to deploy digital instrumentation  
19 and control systems in their plant.

20 MEMBER APOSTOLAKIS: Yes.

21 MR. KEMPER: So we're all grappling with  
22 the same issue. So as a result of that there's a lot  
23 of information, a lot of energy being expounded  
24 throughout the world. It really is productive for us  
25 to do just what you said.

1 MEMBER POWERS: I think it's -- I know for  
2 a fact the paper elicited lots of thinking and  
3 discussion and you get free peer review there. It  
4 maybe worth what you paid for it, but it's -- I may  
5 you may get a real nugget there.

6 MR. KEMPER: Absolutely.

7 MEMBER APOSTOLAKIS: But just as an  
8 example, talking about peer review, you don't seem to  
9 mention any peer review in the plan for individual  
10 projects. Are you the only reviewers?

11 MR. KEMPER: Well, we have a peer-review  
12 process within the Office of Research.

13 MEMBER APOSTOLAKIS: Okay.

14 MR. KEMPER: That can be invoked any time  
15 we choose to do it. We do internal peer reviews  
16 ourselves, but for example, Steven did a project,  
17 started a project on software metrics where he called  
18 upon a peer review by various industry experts, if you  
19 will, in this field and got formal input from them and  
20 included that into the report itself, actually. We do  
21 that when the need arises.

22 MEMBER APOSTOLAKIS: Do you remember when  
23 we had the presentation here some time ago of work  
24 that was done at the University of Maryland and at the  
25 University of Virginia where the committee members

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1 challenged several of the fundamental assumptions of  
2 the researchers who are, in my view, seemed to be  
3 surprised that they were challenged at such a  
4 fundamental level when they had used these approaches  
5 for railways and so on and nobody could challenge  
6 them.

7 Who is doing this challenging this time  
8 around? Is it you or the ACRS or somebody else?

9 MR. ARNDT: It depends on the particular  
10 project and the particular level of knowledge that  
11 exists in the industry and the particular level of  
12 controversy that exists, associated with particular  
13 concepts. In some cases, we try and get that input  
14 from knowledgeable sources, including the ACRS  
15 subcommittee, but also sources that are out there.  
16 For example, one of the peer reviews we did drew from  
17 members of the 1997 NAS Committee that were  
18 knowledgeable of both the general software, the  
19 general digital reliability community. In the case of  
20 the current digital system reliability program, we're  
21 drawing from people who are working digital system --  
22 general reliability, but have some expertise in  
23 digital systems, like some of the people at Idaho,  
24 some of the people like Nathan Smith, Siu, I'm sorry,  
25 things like that, who are both internal and external.

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1                   It's a challenge because we have both  
2 conflict of interest issues and the fact that these  
3 areas in most cases are very small set of people are  
4 working in them and there's some level of controversy  
5 associated with it.

6                   MEMBER APOSTOLAKIS: So what you're saying  
7 is that there some peer review, but you just didn't  
8 make it very formal in the plan?

9                   MR. KEMPER: That's correct. And also,  
10 I'll be frank with you, that's why we're very excited  
11 about your subcommittee's existence as well because  
12 you all serve a lot of help for us, quite honestly, in  
13 asking those questions and challenging those concepts.

14                   MEMBER APOSTOLAKIS: I'll tell you,  
15 flattery works with me. Let's move on.

16                   (Laughter.)

17                   MR. KEMPER: Okay, moving right along  
18 here.

19                   MEMBER RANSOM: I would hope that you've  
20 looked at Japan because 15 years ago when I visited  
21 Japan with Ken Hanson on an assessment mission there,  
22 the Japanese were at this stage, actually doing  
23 research with digital systems for what they called  
24 advanced nuclear plants. So I would guess they have  
25 quite a bit of experience in this area. I don't know,

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1 are you aware of that?

2 MR. KEMPER: Yes, yes, they do. Japan as  
3 well as Korea is another, and Taiwan as well. Many of  
4 the Asian nations are well along in a deployment of  
5 digital controls.

6 MEMBER APOSTOLAKIS: The Europeans have  
7 done a lot of work.

8 MR. KEMPER: That's true. I didn't mean  
9 to exclude the Europeans, but yes, specifically,  
10 you're right.

11 MEMBER POWERS: Koreans seem to be  
12 extremely aggressive in funding the universities to do  
13 particular studies and things like that.

14 I'm sure Steve is very aware of it, just  
15 his work for the ANS because we nearly always have a  
16 session on that particular area.

17 MR. KEMPER: That's correct.

18 MEMBER APOSTOLAKIS: I get a paper from  
19 Korea just about every other week on digital systems.  
20 They are extremely active.

21 MR. KEMPER: Yes, they are very much so.

22 MEMBER APOSTOLAKIS: They don't have an  
23 ACRS there, I don't think.

24 (Laughter.)

25 CHAIRMAN WALLIS: Regarding peer review,

1 I think you can expect the ACRS to give you a very  
2 high level review, but don't expect it to be the kind  
3 of peer review you really need.

4 MEMBER APOSTOLAKIS: The subcommittee gets  
5 into fair detail.

6 CHAIRMAN WALLIS: I think you need a peer  
7 review of experts in the field and real experts in the  
8 field.

9 MR. KEMPER: A fair comment, I appreciate  
10 that.

11 MEMBER POWERS: I thought you said there  
12 were no experts, only specialists.

13 CHAIRMAN WALLIS: I didn't say that. I  
14 don't know where you get that quote from.

15 MEMBER APOSTOLAKIS: From your long  
16 record.

17 (Laughter.)

18 MEMBER POWERS: You said everybody was  
19 struggling with how to proceed here.

20 (Laughter.)

21 CHAIRMAN WALLIS: No, I was asking --

22 MEMBER APOSTOLAKIS: We're still on Slide  
23 7.

24 MR. KEMPER: Yes, I'm trying to move on  
25 here as quickly as I can.

1                   In the final analysis, the research plan's  
2 broad base focusing on improving traditional review  
3 methods for reviewing existing digital technologies,  
4 analysis of emerging technologies and evaluation of  
5 issues arising from the application of digital  
6 technology. Also the plan focuses on improving the  
7 assurance of digital I&C system reliability which  
8 comprises many systems and components in the  
9 mitigating systems and security cornerstones of the  
10 reactor oversight process.

11                   So how do we prioritize these projects?  
12 Well, this is the plan here. Basically, the inputs  
13 used to determine the priority of the research  
14 included completing on-going work, program office  
15 inputs, and also a balance between current regulatory  
16 issues such as diversity and defense-in-depth  
17 security; issues that are anticipated to be regulatory  
18 issues in the short term, such as field programmable  
19 gate arrays, on-line monitoring.

20                   These are systems that are currently being  
21 -- they're over the horizon. They're almost right in  
22 front of us. We expect them to be deployed here soon  
23 and submitted for approval; and also following  
24 emerging technologies that might require future  
25 licensing reviews. Smart transmitters are examples.

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1           The projects also support the NRC  
2 strategic plan, as indicated in Section 4 of the  
3 research plan. Each program has strategies supported  
4 indicated by them and as indicated in Section 4 of the  
5 research plan, each project has a relative priority,  
6 high, medium and low. These priorities were  
7 determined based on operational experience, program  
8 office request, such as user needs, and likely  
9 application schedule for the specific issue involved.

10           The projects have been scheduled based on  
11 available budget as well and resources. So we have a  
12 certain budget in resource and a certain number of I&C  
13 engineers and of course, that has to be a part of this  
14 equation here. As a result, the research plan is very  
15 useful in supporting the RES budgeting process.

16           That concludes my portion of the  
17 presentation. At this point I'm going to turn it over  
18 to Steven t to provide an overview of the program  
19 areas of the research plan.

20           MR. ARNDT: Okay, this next part of the  
21 presentation is just to give you an overview of some  
22 of the projects that are in the program. What we're  
23 going to try and do is work through this part of the  
24 presentation rather quickly, just to give you an  
25 overview of what we're doing, why we're doing it, how

1 we came up with the particular programs in there and  
2 just a little bit of a flavor for what some of those  
3 programs are.

4 As Bill mentioned earlier, the program is  
5 specifically designed to balance between looking over  
6 the horizon, trying to see what new technologies are  
7 available, what's going to happen. As we get more and  
8 more information about the particular programs, then  
9 we can decide whether or not we need to do specific  
10 research programs to develop specific regulatory  
11 guidance.

12 Most of that work is in the emerging  
13 technologies applications program which is Section 3.5  
14 of the plan. Those programs will either be developed  
15 and worked in that particular section or moved into  
16 other parts of the program as they become more  
17 specific user needs.

18 The other parts of the plan are organized  
19 in a particular structure that just allows us to  
20 understand what we're doing and what we're trying to  
21 solve and issues like that.

22 I'm going to go through this. It's not in  
23 the order in which it's most convenient, 3.1, 3.2,  
24 3.3. I'm going to go through it in a slightly  
25 different order because we did not get to some of

1 these areas when we talked to them in May. So we  
2 re-ordered it a little bit to make sure we get to the  
3 issues that we didn't address at the May meeting.

4 VICE CHAIRMAN SHACK: What fraction of  
5 this work is sort of actually directed at specific  
6 user needs?

7 MR. KEMPER: If I could -- let's see. I'm  
8 going to have to take a guess here. I would say maybe  
9 20 percent has existing user needs. The rest of it  
10 was anticipatory research, although now that the  
11 research plan has been reviewed and we've collaborated  
12 with our offices, we no longer consider any of this  
13 work as anticipatory any more, although there may not  
14 be a specific user need number driving that, if it's  
15 an approved projects and research plan, we consider  
16 that the same as a user need.

17 MR. ARNDT: The first area I'm going to go  
18 over fairly briefly is the security aspects of digital  
19 systems. This is an area that if you go back to the  
20 earlier research plan, we had a very small little  
21 section and that was only added as part of ACRS  
22 discussions. Previously, this was an area that was  
23 covered in the regulatory review process in various  
24 areas of the standard review plan under some of the  
25 general design criteria, but we wanted to look

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1 generally at this issue to see if it was a major  
2 issue.

3 Obviously, since 9/11, that has been  
4 elevated both in the general agency concern and also  
5 in the research concern of the plan. Attention is not  
6 only to safety systems, but also non-safety systems  
7 associated with security aspects within the plant:  
8 security computers, access control and also the  
9 various risk-significance of non-safety system  
10 applications.

11 We're also looking at how security issues  
12 are going to play out in the era of upgrading to  
13 digital systems. The increased use of digital  
14 systems, particularly in safety systems, but also non-  
15 safety systems and security systems is an issue. The  
16 current regulation consists of the particular rules  
17 and regulations that are already in part 50 and other  
18 places in the regulation, as well as the specific  
19 orders that were issued after 9/11.

20 We are in the process of supporting the  
21 rule making associated with this in NSIR and that's  
22 one part of this program, but also we're looking at  
23 the particular programs that have been approved, and  
24 will be put into licensing processes in the near  
25 future to understand the cyber vulnerabilities.

1           Just for your information, the color  
2 coding scheme that I have here is the blocks that are  
3 in yellow are programs that we plan on doing, but have  
4 not yet started. The blocks in green are the parts of  
5 the plan that actually have on-going research. So  
6 that gives you just a general feel for how much of  
7 this is currently working and how much of it is going  
8 to be --

9           MEMBER APOSTOLAKIS:       So in future  
10 presentations, perhaps it would help if you had an  
11 extra box there with a different color saying work or  
12 part of the work here has been completed to satisfy  
13 Professor Wallis. Saying the previous plan for -- I  
14 know security was not done. In future, you can say  
15 the previous time we sponsored this kind of research  
16 and we have this product.

17                       That would be very useful to everyone.

18           MR. ARNDT:   Okay, and in this case this  
19 presentation is too high level to see that.

20           MEMBER APOSTOLAKIS:   I understand.

21           MR. ARNDT:   But there are certain projects  
22 under this general program that we have completed and  
23 --

24           VICE CHAIRMAN SHACK:   You can put a  
25 progress bar.

1 MR. ARNDT: Yes. We can find some kind of  
2 graphic to make it look a little bit more apparent.

3 MEMBER APOSTOLAKIS: Hot red.

4 MR. ARNDT: Hot pink or something. As I  
5 just mentioned under the previous program, and as part  
6 of the early part of this program, we've completed  
7 some research in this area, both with under the  
8 research plan by the Office of Research, as well as  
9 some work that has been conducted by NSIR to look at  
10 specific potential issues.

11 During the subcommittee meeting, we went  
12 into a fairly high level of detail, both in general  
13 and in proprietary and safeguards information, so I  
14 won't go into it in detail here, but the research we  
15 did led us to the conclusion that additional work  
16 needs to be done to more clearly identify particular  
17 issues that might present challenges in new digital  
18 systems, particularly in areas like the protocols that  
19 are necessary, the communications that go on in  
20 digital systems, how you need to ensure that improper  
21 communication is prohibited, things that are  
22 associated with how do you deal with permanently  
23 installed connections for maintenance and things like  
24 that to reduce the likelihood that you could have a  
25 cyber vulnerability.

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1           There's also been a lot of work associated  
2 with understanding what the criteria should be. The  
3 projects that are highlighted there, the power reactor  
4 pilot study and the licensee self-assessment  
5 methodology was work that was done with the industry  
6 and NSIR to develop a strategy for doing the analysis.

7           However, this is fairly high level  
8 information. Details of what is an acceptable  
9 methodology and what is an acceptable protocol and  
10 what is acceptable communication architecture is  
11 something that we're going to look at the future to  
12 try and understand and what the characteristics of  
13 these systems need to be to be acceptable.

14           One example of the work is the project  
15 that we'll focus on, the specific issues associated  
16 with communication protocol of assessments, evaluating  
17 safety/nonsafety interconnections, evaluating internal  
18 architecture of digital systems from the cyber  
19 security standpoint. These systems were originally  
20 designed to be interconnected and to be flexible and  
21 to have the capability to accomplish the protection  
22 and control function. The rules on which they were  
23 designed under never really looked at the concept of  
24 someone trying to hack into them as opposed to random  
25 failures or failures like that.

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1                   So we want to go back and look at it from  
2 a different perspective and look at much more detail  
3 into methodology that various people might use to  
4 attack these systems and what the appropriate  
5 methodologies would be to design architectures to  
6 prevent that and what the acceptance criteria would be  
7 and the policy associated with those.

8                   Next I'm going to go over again fairly  
9 briefly the risk assessment portion. This is an on-  
10 going area of research, very active. We had at the  
11 subcommittee meeting an extensive briefing by the EPRI  
12 on their methodology and their proposed methodology.  
13 We talked extensively about some of the research that  
14 we have on-going, both the development of analysis of  
15 what data there is out there, both nuclear data and  
16 non-nuclear data, as well as the programs that we have  
17 on-going to look at the issues that Professor  
18 Apostolakis was mentioning earlier. What are the  
19 methods that are necessary, what level detail does the  
20 model have to be, how do you integrate this into  
21 current risk methodologies?

22                   To briefly summarize the current  
23 situation, there's a lot of interest in doing this  
24 kind of work in the industry. There's a number of  
25 reasons why that is being driven. Some of the

1 traditional deterministic analyses drives the  
2 designers down a particular path that they would not  
3 necessarily like to go. So they're interested in  
4 understanding and looking at whether or not risk-  
5 informed or risk insights can get you to a different  
6 design concept.

7 EPRI has proposed a methodology. The NRC  
8 is also looking at various methodologies.

9 MEMBER APOSTOLAKIS: Have you reviewed the  
10 EPRI methodology?

11 MR. ARNDT: Yes.

12 MEMBER APOSTOLAKIS: Do you have an  
13 assessment of it?

14 MR. ARNDT: Let me be careful here. EPRI  
15 asked the Agency to do a review of the topical report.  
16 That is a specific regulatory act that looks at is it  
17 acceptable or not. That has not been done. The  
18 Agency has not done a formal review.

19 Now if you use the small case "R" review,  
20 have we reviewed what's in the document and assessed  
21 what we like and what we don't like about their  
22 proposed methodology, the answer is yes. And we did  
23 that for two reasons. One, as an input to NRR to  
24 determine if they're going to review it, if they  
25 consider it to be acceptable for review, enough

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1 information, details and things like that.

2 The other aspect was to look at is there  
3 something in what they're doing that could be used in  
4 our research program for the Agency. We've done both  
5 of those and there are certainly some aspects of what  
6 EPRI has proposed that we can integrate into our  
7 research and we're doing that. However, we do have  
8 some issues with the methodologies that they proposed  
9 as well as some of the data that they've proposed.

10 MR. KEMPER: And the results of that  
11 review has actually been documented and sent out to  
12 EPRI.

13 MEMBER APOSTOLAKIS: I'd like to see that.  
14 Can I see that?

15 MR. ARNDT: Sure.

16 MEMBER APOSTOLAKIS: It looked to me like  
17 it was just a sensitivity study.

18 MR. ARNDT: There are some significant  
19 information that needs to be looked at and gone  
20 through.

21 We've also looked at a number of other  
22 things that have been proposed both in the nuclear  
23 industry and the non-nuclear industry. That third  
24 bullet there, there's a lack of generally accepted  
25 methodology to predict digital systems, failure

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1 probability is, of course, almost a motherhood  
2 statement, but the converse to that is also true.  
3 There's a lot of methodologies out there with varying  
4 levels of pedigree and varying levels of  
5 implementation success that we're trying to use and  
6 understand and build on.

7 MEMBER APOSTOLAKIS: This is again an  
8 example of when you really have to be careful with the  
9 language.

10 MR. ARNDT: Yes.

11 MEMBER APOSTOLAKIS: This again presumes  
12 that there is such a thing as a failure probability of  
13 the software.

14 MR. ARNDT: Yes.

15 MEMBER APOSTOLAKIS: You might say there  
16 is a lack of generally accepted methodology to  
17 evaluate, to estimate the failure probability of a  
18 system that has in it digital software.

19 MR. ARNDT: Right.

20 MEMBER APOSTOLAKIS: That's really the  
21 correct way of saying it because after all, what we're  
22 interested in is a system performance.

23 MR. ARNDT: Right.

24 MEMBER APOSTOLAKIS: This presumes again  
25 there is such a thing as a failure probability of the

1 software.

2 If you recall, since you mentioned it in  
3 the National Academy report, there was a strong  
4 disagreement among the members as to what is the  
5 appropriate way. So that is coming back to you?

6 MR. ARNDT: Yes, and that is still an open  
7 technical issue and I suspect it will be for the  
8 foreseeable future. And really, the issue we have is  
9 there currently does not, in our opinion, there  
10 currently is not a sufficient level of acceptance to  
11 use this in the regulatory process, but it is rapidly  
12 coming to that, I think, in some areas technically,  
13 but more importantly directly coming to that in the  
14 regulatory process as licensees want to use this. We  
15 need one, either to have a good technical basis for  
16 saying no, you can't; or two, have a good technical  
17 basis for saying yes, you can, but if you do so you  
18 have these limitations on the use of this  
19 implementation of risk-informed or risk insights in  
20 digital systems.

21 MEMBER APOSTOLAKIS: As you know, what  
22 makes this whole field very difficult is that it deals  
23 with issues that are not dealt with in traditional  
24 reliability and risk assessment.

25 MR. ARNDT: Right.

1 MEMBER APOSTOLAKIS: Namely, to design a  
2 specific case analysis. And if you look at the PRA,  
3 we never really say the probability that this thing  
4 was manufactured incorrectly. We always assume it  
5 starts correctly and then we have some time dependence  
6 and so and that's what makes this extremely difficult.  
7 There are no methods out there.

8 MR. ARNDT: And point of fact, it's even  
9 more complicated than that because if you look at what  
10 data we have, it's actually a rather complicated  
11 convolution of specification issues, design issues,  
12 maintenance issues, actual coding issues and other  
13 things, some of which can be relatively straight  
14 forwardly modeled, some of which can't and some of  
15 which have different aspects to it.

16 The real issue is how much of this can we  
17 do and how much of it do we need to do. One of the  
18 issues that has been raised several times, including  
19 in the subcommittee is, as more and more systems  
20 include digital controls and digital protection  
21 systems, the plant PRAs, in essence, are becoming  
22 outdated, simply because they're not trying to address  
23 them, not only for the digital systems themselves, but  
24 of the embedded controls in a lot of the other large  
25 spinning parts and valves and things like that.

1                   So the research program is designed as Dr.  
2 Powers pointed out, to look at the known capability of  
3 available models, both academic research level as well  
4 as actual implemented models in other technologies and  
5 what available technologies and data that are out  
6 there and use these methodologies to examine the most  
7 promising ones to see whether or not we can develop  
8 both regulatory guidance in this area, what's  
9 necessary, what the limitations are, what the  
10 specifics are, as well as internal check tools and  
11 methodologies to examine the analysis ourselves.

12                   CHAIRMAN WALLIS: Do you have an idea of  
13 how adequate this information is that you're going to  
14 look at? Is it very sparse or is there a huge amount  
15 of it or is it of the right sort and that kind of  
16 thing?

17                   MR. ARNDT: We've done several analyses of  
18 the methodologies, both looking from the traditional  
19 -- if we were to do this in a traditional PRA, using  
20 traditional methods, how would we do it and what are  
21 the limitations.

22                   We've also looked at it from the opposite  
23 way, saying all right, if you take the most  
24 sophisticated methods that have been proposed, the  
25 most exotic stuff that's out there in the research

1 area, what are the ones that one, been used --

2 CHAIRMAN WALLIS: I was talking about the  
3 data rather than method. Is there a base -- in other  
4 areas of research you say we don't have enough data,  
5 so we have to do an experiment or we have to do  
6 something. Are you at the point where you put all the  
7 data in and you just have to analyze it or do you have  
8 to create it somehow?

9 MR. ARNDT: We have two issues with  
10 respect to data. We don't have a whole lot of data.  
11 There's two reasons for that. One, the systems have  
12 not been deployed all that long and two, many cases  
13 detailed root cause analysis is not done. The card  
14 doesn't work, throw it over your shoulder, put a new  
15 card in.

16 The other part of it is even if you have  
17 the data, you have to structure in such a way that you  
18 can actually use it. That is in some ways an even  
19 worse problem than the lack of data itself because  
20 some of the data analysis you can steal from other  
21 industries and you can build up data sources from  
22 cards and components and other things. The problem is  
23 the models frequently don't have the sophistication to  
24 get down to the point where you can use that built up  
25 data and you can't structure the data bases in such a

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1 way that they support the models that we have.

2 So we're trying to do -- attack this on a  
3 number of areas. We have a couple of on-going data  
4 analyses and data-gathering projects. One is the  
5 International Database Program that's run out of OECD  
6 which is the Computer System Important to Safety  
7 database, the COMPSIS database which is gathering  
8 nuclear plant-specific data. Another is the on-going  
9 work we have at Brookhaven National Lab to gather  
10 generic component-type data.

11 Implicit in both of those is also looking  
12 at how do you structure this data and how do you put  
13 it together in a rational way to deal with it. The  
14 other part of that is in the analysis methodology,  
15 we're looking at how do you build experiments or tests  
16 or how do you write the analysis software or analysis  
17 methods to support testing information or analysis  
18 information instead of completely doing it on data.  
19 For example, if you want to understand how systems  
20 fail, you can look at mutation testing, or fault  
21 injection testing and things like that. Can you use  
22 that data to predict what you're actually going to get  
23 in a reliability kind of standpoint.

24 MEMBER APOSTOLAKIS: But it seems to me,  
25 Steve, that one of the true tests of a proposed

1 methodology is to take a piece of software, analyze  
2 it, find the fault which then the designer of the  
3 software admits it's a fault. Because just having  
4 data, you know, I don't know you can always do things  
5 and say well, my methodology caught this. And that  
6 was the first paper back in 1984, I think it was, in  
7 a master's thesis when they took a piece of software  
8 that was developed by Berkeley for one of their  
9 rockets experiments and they just did a simple 403  
10 analysis and my goodness, they found an error.

11 We did the same thing at MIT and the  
12 designer was one of our guys. He finally admitted  
13 that there was an error there. He would have divided  
14 by zero under certain conditions, but his counter  
15 argument was that the probability that you would ever  
16 need to do that was so small that it really didn't  
17 matter.

18 I think that's a true test of a  
19 methodology. Now of course, most of the time you  
20 don't find anything because these systems are tested  
21 and reviewed and so on, so is that proof that it's not  
22 a good methodology? I don't know. It probably isn't  
23 because if there is no error there, you're not going  
24 to find it.

25 MR. ARNDT: One of the primary issues

1 we're trying to deal with in the supporting analysis  
2 part of the digital system risk area, as you know, you  
3 can't just have a risk model with reliability. We  
4 need something to support the reliability numbers, be  
5 it data analysis or whatever, is looking at those  
6 particular methodologies and for example, one of the  
7 methodologies is fault injection testing and there's  
8 been several examples of them finding these kind of  
9 issues. Another one is looking at state space  
10 analysis methods. They're basically a much more  
11 sophisticated software fault tree, to see if you can  
12 gain that kind of information.

13 MEMBER APOSTOLAKIS: But we're still on  
14 slide 17.

15 MR. ARNDT: Yes, I'm going to start  
16 working on it. Let me just recap this quickly.

17 MEMBER APOSTOLAKIS: No, Dr. Kress.

18 MEMBER KRESS: Eventually, you will want  
19 to take a piece of software and associated hardware  
20 and come up with -- you look at where it shows up in  
21 an event tree, for example, where it's called upon to  
22 do something to create some change in the system and  
23 what you want is the probability that this  
24 software/hardware combination will or will not screw  
25 up this event. You want to know, yes or no,

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1 probability.

2 That's how you would use it in a PRA.

3 MR. ARNDT: Right.

4 MEMBER KRESS: Now the starting is  
5 starting from that is what your need is. I can see how  
6 you can get a probability of a hardware failure.  
7 That's just like other components, but you also need  
8 to add that probability that the software will fail,  
9 will fail to give the right output that would be  
10 needed to create this event.

11 MR. ARNDT: That's correct.

12 MEMBER KRESS: This seems to me like you  
13 ought to be able to take a simulator and you look at  
14 the exercise input space that this thing is going to  
15 see during sequences, severe accident sequences and  
16 you have uncertainties in that input space. You have  
17 uncertainties in the models that create the evolution  
18 of the sequence, up to the point where the event is  
19 taken.

20 Now you could Monte Carlo sample all that  
21 uncertainty and your problem is with a simulator you  
22 could actually look and see if there was a faulty  
23 output, but that's not all of it because no matter  
24 what you do, you're not going to sample all of the  
25 input space. But it seems to me like you could make

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1 some judgment like what fraction of the input space  
2 did I sample and the fraction I didn't sample then you  
3 could say -- let's assume that fraction has an error  
4 in it and that ratio gives you the probability. Now  
5 is that one of your approaches?

6 MR. ARNDT: That is, believe it or not, a  
7 very simplistic way of looking at some of the  
8 methodologies that are out there.

9 MEMBER KRESS: Okay.

10 MR. ARNDT: And that's basically a concept  
11 of what is known as coverage that is to say how much  
12 of the model did you look at and you can make certain  
13 predictions on the amount of reliability or the bound  
14 of the reliability based on how much of the --

15 MEMBER KRESS: So that is one of the  
16 methods you're investigating?

17 MR. ARNDT: Yes. It's actually a little  
18 bit more complicated than that, but I won't go into  
19 that.

20 MEMBER KRESS: I was simplifying it, but  
21 I just now thought of it.

22 MR. ARNDT: The other issue really is how  
23 do these things interact with the rest of the PRA?

24 MEMBER KRESS: Yes.

25 MR. ARNDT: And that's really a major

1 challenge and when we talk about developing and  
2 testing methods, we're looking at how do you not only  
3 develop the methods, but how do you integrate it with  
4 the real PRA and that's very challenging because of  
5 the relative sophistication of traditional PRAs and  
6 what's necessary here.

7 But what we're trying to do is as the last  
8 bullets talk about is pilots and methods come up with  
9 issues and as Professor Apostolakis mentioned earlier,  
10 one of the big issues is to make a determination of  
11 what level modeling is necessary for what kinds of  
12 systems.

13 At the risk of truncating this  
14 prematurely, I really have to go on.

15 Another major area is software quality  
16 assurance and this is primarily an issue associated  
17 with how do we do our job of assessing the software in  
18 terms of the actual assessment methodologies, as well  
19 as how do you credit the various internal processes of  
20 the software and the hardware such as self-testing  
21 methods and things like that.

22 As Professor Wallis mentioned earlier, one  
23 of the big issues is there's a lot of stuff out there  
24 that has been done in the theoretical area, but very  
25 little of that is found practical application in

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1 reviews. The way we currently review is we look at  
2 the system in the software specifications. We look at  
3 the development process. And we do some audits and  
4 thread analysis of the software products, the  
5 specification, the test plans, the coding and things  
6 like that.

7 The problem is, of course, that this can  
8 never be complete because of the complexity of these  
9 systems. It's very time consuming. It requires a  
10 high level of skill for the reviewers, not only the  
11 actual software analysis methodologies, but also how  
12 this thing is going to be used in the plant. And  
13 that's not something we find in every individual. As  
14 a matter of fact, we have a very limited set of people  
15 who can do that.

16 And in most cases, acceptance criteria is  
17 not quantitative. How many thread reviews do you have  
18 to do to have a good understanding that you're  
19 probably not going to have a problem. It's not  
20 something that easily quantifiable.

21 The current state-of-the-art in software  
22 system safety assessment, there's a lot of different  
23 methodologies that have been proposed and many of them  
24 have been just esoteric lab bench type things and some  
25 of them have been exercised in fairly sophisticated

1 systems in the aviation business, the transportation  
2 business and in NASA and other things. But the level  
3 of detail for real time safety critical applications  
4 in the nuclear business in most cases is very low or  
5 none. These include various software system analysis  
6 methods, Markov analysis, dynamic flow modeling and  
7 things like that.

8 MEMBER APOSTOLAKIS: Anyway, the latter,  
9 Tom, has a lot of the elements you mentioned.

10 MEMBER KRESS: Yes.

11 MR. ARNDT: Software metrics analysis, if  
12 you look at how the system is built and how the  
13 software is developed and what particular things they  
14 do, you can get a feel for are you getting all the  
15 bugs out? Are you testing it properly? Have you  
16 added bugs during the system? You can understand in  
17 a more quantitative way how good the software is  
18 likely to be.

19 There's a number of formal methods  
20 analyses which is basically the concept of formal  
21 proving of the software coding. This was something  
22 that was very, very popular about 10 to 15 years ago,  
23 fell out of favor because of the limitations  
24 associated with it. There are a lot of things you  
25 can't do very well with formal proof methods,

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1 particularly in sequential time systems. That is  
2 starting to become a big deal now again, particularly  
3 in Europe. EDF has a major program in this area.

4 You can learn a lot and add a lot of  
5 additional insights by looking at formal provers, and  
6 then various testing techniques, data flow testing,  
7 mutation testing, fault injection testing. Some  
8 nuclear industry vendors are starting to look at these  
9 kinds of techniques to not only understand what  
10 they're going to find, but the potential  
11 vulnerabilities for particular places in the software.

12 CHAIRMAN WALLIS: You have to move on.  
13 You're putting a fault in, unless you find a fault  
14 that's already there. So a fault to catch a fault  
15 doesn't sound quite right. Can you explain that to  
16 me?

17 MR. ARNDT: There's a whole theory behind  
18 it. I'd be happy to do that.

19 The research in this area is basically  
20 focused on looking at the various methods and seeing  
21 whether or not there's any short-term applications to  
22 these methodologies that could be used to improve the  
23 review process.

24 We're currently looking at three of these  
25 areas: fault injection testing, the formal methods

1 analysis and the software metrics. And the idea again  
2 is to find ways to improve the criteria and the  
3 procedures that we use to make it more reliable and  
4 increase the probability that we're going to find  
5 things, if they're there, or understand the structure  
6 of the software better, so we can make a more  
7 quantitative consistent judgment of the software.  
8 And that's basically what this slide says.

9 MEMBER APOSTOLAKIS: Do you really need to  
10 address this issue?

11 MR. ARNDT: Say again?

12 MEMBER APOSTOLAKIS: Do you need to  
13 address the system aspects? Maybe you can go to the  
14 emerging digital technology?

15 CHAIRMAN WALLIS: I think you've got to  
16 jump ahead. There's an awful lot of material.

17 MR. ARNDT: Okay, I'll give you the two  
18 second version. There's a number of different  
19 projects in this area. The only one we're currently  
20 working on is the environmental stressors, however,  
21 there's a number of issues, particularly the defense-  
22 in-depth and diversity issues that we need to work on  
23 proactively. So that will be the next one that we  
24 start.

25 In the emerging technologies area, these

1 are the things that are over the horizon that we're  
2 trying to get smart about so we know whether or not we  
3 need to do more detailed analysis.

4 VICE CHAIRMAN SHACK: What is the time  
5 scale for starting these areas where you haven't --  
6 we've seen an awful lot of yellow boxes here.

7 MR. KEMPER: That's laid out in actually  
8 Section 4 of the plan. We have scheduled first  
9 quarter like FY07, FY08, that sort of thing.

10 MR. ARNDT: To be in this plan it has to  
11 at least start within the time frame of 05 to 09, so  
12 it's anywhere from going on now which is a green box  
13 to starting in 07, 08 or 09.

14 MR. KEMPER: And obviously, these time  
15 lines will change. As priorities change, new projects  
16 come up and resources change as well.

17 MR. ARNDT: Basically, as the owners and  
18 the licensees and things continue to improve, we need  
19 to keep an eye on what's going on. We have both the  
20 specific projects. We also have a catch-all project  
21 that specifically goes out every two or three years  
22 and looks at the wide variety of what's going on in  
23 the digital system industry and looks at specific  
24 things that might work their way into specific  
25 applications. For example, we did the first one about

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1 three years ago and one of the things that it  
2 highlighted was field programmable gate arrays which  
3 is now part of the research program.

4 So the on-going projects include the  
5 emerging technology evaluations which I just  
6 mentioned, the on-line monitoring which is something  
7 that we expect an actual application later this year  
8 and getting smart about tomorrow's technology.

9 This is just a basic overview of field  
10 programmable gate arrays which is starting to become  
11 a very big issue, as I mentioned earlier. It's one of  
12 the areas that EPRI -- I'm sorry, EDF is looking at  
13 very highly. Toshiba is also looking at this very  
14 highly. So it's something that we expect to have to  
15 deal with very soon and the big issue there is these  
16 things shift the complexity that might otherwise be in  
17 software to hardware designs and the tools that are  
18 necessary to design the hardware. And that's  
19 something that our review process really aren't geared  
20 toward.

21 MR. KEMPER: Now these FPGAs appear to be  
22 the next generation, if you will, of computer control  
23 systems and the benefit is that it has a way of  
24 eliminating software reliability issues. It's hard  
25 program, like a sea of gates that a program wants and

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1 once that happens, you don't have to consider software  
2 failures if you will.

3 MR. ARNDT: We gave a last area which is  
4 the advanced nuclear power plant digital systems.  
5 This was originally put in the plan to be a catch-all  
6 for that research we're going to need to do to support  
7 the kind of advanced control rooms and advanced  
8 digital systems we expect to see in the next  
9 generation of reactors.

10 MEMBER APOSTOLAKIS: Shouldn't one of  
11 these at least be green? I mean we're already in the  
12 process of reviewing the ESBWR.

13 MR. KEMPER: You would think --

14 MEMBER APOSTOLAKIS: Can you help us with  
15 that?

16 MR. KEMPER: You would think that they  
17 would be.

18 MEMBER APOSTOLAKIS: I'm sorry?

19 MR. KEMPER: You would think so, but as it  
20 turns out, each one has a different story. The AP  
21 1000 design, for example, has already been certified.  
22 ESBWR, we've been told by the vendor that they intend  
23 to use the ABWR process control system for that  
24 design. ACR 700, we don't have a design certification  
25 on the table yet. And pebble bed is too far out into

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1 the future to know really what's going on.

2 EPR is probably the next best hope we've  
3 got of really getting meaningful process controls,  
4 research work started on that.

5 MEMBER APOSTOLAKIS: But your research  
6 here is participatory so you should start something  
7 before the EPR comes --

8 MR. ARNDT: Yes. We're in a bit of a bind  
9 right now because the designers and the vendors are  
10 telling us that they're planning on using current  
11 generation technology in these plants. At the same  
12 time, our gut feel says this is a first time we're  
13 going to have an opportunity to design a new glass  
14 cockpit time of system and we would really expect them  
15 to use the new technology that's becoming available to  
16 them to do more sophisticated protection and control  
17 systems.

18 So our kind of gut feel is telling us one  
19 thing and the vendors are telling us something else.  
20 So we're in a bit of a box here.

21 EPR is certainly going to be using some of  
22 the things they've learned from the N4 reactor  
23 development as well as some of the things that they've  
24 learned from their application of their standard  
25 platform which is the Teleperm platform in Europe.

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1 But we haven't really got any insight on that.

2 MEMBER APOSTOLAKIS: Well, the PRA  
3 subcommittee is supposed to review the PRA of the  
4 ASBWR and I understand we're going to have a problem  
5 with the digital part.

6 MR. KEMPER: Very likely.

7 MEMBER APOSTOLAKIS: That is a user need.  
8 We're not a user, are we?

9 MR. KEMPER: You could be.

10 MEMBER KRESS: Let us know where we can  
11 help.

12 MR. KEMPER: Accuser.

13 (Laughter.)

14 MR. ARNDT: The areas, depending upon what  
15 actually comes in, we hope to look at, things like  
16 more use of artificial intelligence, autonomous  
17 controls and new instruments and things like that.  
18 And because of that, we've broken the research into  
19 instruments controls and risk issues associated with  
20 -- like you just mentioned, but we currently don't  
21 have a research plan in these areas.

22 So what we plan on doing is basically  
23 watch this area and trying to build into these  
24 programs.

25 At this point, I'm going to summarize and

1 turn it back over to George. We've developed this  
2 plan based on what we've learned over the last few  
3 years the research of the previous plan. It's based  
4 on a broad program, more consistent processes for  
5 regulating the applications. We particularly designed  
6 the program to look at bringing the technology into  
7 review guidance and acceptance criteria. We look  
8 forward to working with ACRS not only the  
9 implementation of the plan, but also the particular  
10 research areas as Professor Apostolakis has mentioned.  
11 We want to come back and vet some of these things,  
12 both as they come to conclusion, but also as  
13 intermediate milestones are achieved. And we also  
14 want to have the ACRS provide us input on how the plan  
15 can be better.

16 MEMBER APOSTOLAKIS: In fact, that's a  
17 very important point and maybe we can have a meeting  
18 or maybe meet with Mr. Thornsbury to give us some idea  
19 of what you see in the next year or two, where you  
20 would seem some subcommittee meetings or whatever.

21 MR. ARNDT: Okay.

22 MEMBER APOSTOLAKIS: It's really  
23 important. This is a very new area for everyone, so  
24 we should try to do it the way we did the Regulatory  
25 Guide 1174.

1 MR. KEMPER: Right, there you go.

2 MEMBER APOSTOLAKIS: And the participatory  
3 mode.

4 MR. KEMPER: Yes.

5 MR. ARNDT: Absolutely.

6 MEMBER APOSTOLAKIS: Any questions for the  
7 gentlemen presenters?

8 CHAIRMAN WALLIS: It seems to me you're  
9 going to have very carefully monitor the work. We  
10 find some examples in other areas which are much more  
11 dimensional and a contractor has gone off and done  
12 something and fields a report and it's a bad report.  
13 Well, it doesn't have to be a bad report. If it's  
14 properly monitored along the way, it's going to be  
15 caught early. And I think particularly in this area  
16 where I think you can take all kinds of paths, really  
17 close to what they're doing and help steer them. Give  
18 them enough freedom of thought, of course, but not let  
19 them go off and produce something which isn't what you  
20 need.

21 MR. KEMPER: That's a very high priority  
22 of ours, quite honestly. It's a point very well made.

23 MEMBER APOSTOLAKIS: Mr. Thadani will say  
24 a few words.

25 MR. THADANI: Yes. Early on in the review

1 of fuel reactor designs, the staff had utilized a  
2 design acceptance criteria process approach to approve  
3 digital-based systems such as protection system and so  
4 on. The motivation then certainly was that these  
5 reactors probably are not going to come on line for 15  
6 to 20 years and the technology will have advanced  
7 significantly. And so there was a sense that perhaps  
8 we don't need to expend a lot of energy on this issue.

9           However, the environment seems to have  
10 changed. I'm a little bit surprised that you said  
11 that there's no research going on in terms of new  
12 reactors, given the people are talking about coming in  
13 with COLs in a couple of years. That surprises me  
14 quite a bit.

15           We're using an approach that was conceived  
16 probably 10 years ago.

17           MR. KEMPER: You're right. I find it hard  
18 to believe that a vendor will propose a brand-new  
19 advanced design with 10-year-old process control  
20 technology, but that's -- when we engaged them, that's  
21 what we've been told on a couple of occasions.

22           MEMBER APOSTOLAKIS: That's certainly an  
23 issue that needs further exploration.

24           CHAIRMAN WALLIS: One reason they might do  
25 that is because they don't have to review anything

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1 that's more modern, on a scale that you wouldn't know  
2 how to review anything more modern. Therefore, they  
3 would be very conservative in their choice of  
4 equipment. So there's this problem of how far do you  
5 have to stay ahead of the vendors or you'd have to  
6 anticipate or do you have to just follow them all of  
7 the time.

8 MR. CAIRAMAZ: This is Matt Cairamaz, NRR.  
9 We were using the same process that we used for the  
10 advanced reactors back in 1999 for these new advance  
11 reactors also because for example, the EPR is going to  
12 be using the Teleperm XS platform which we already  
13 approved. And the AP 1000 and the COMMON Q platform  
14 which we approved. And the latest IEEE standard on  
15 the acceptance criteria for digital systems is we're  
16 going to issue the Reg. Guide 1.1.2 which has been  
17 through the ACRS already.

18 MEMBER APOSTOLAKIS: Which again, brings  
19 up the perennial problem. Since NRR can make all  
20 these decisions and be happy, why do we need this?  
21 We're going to go back to 1999? So if we're happy  
22 with what we did in 1999, there is no reason to do any  
23 of this.

24 Matt, it's not just your problem.

25 MR. CAIRAMAZ: One of the user needs that

1 we did, we did request our researchers to keep an eye  
2 for the advance technology that we used in nuclear  
3 plants and come up with guidance for us to review and  
4 that's what this is about.

5 MEMBER APOSTOLAKIS: Any other comments or  
6 questions to the presenters, the staff?

7 MR. KEMPER: I noticed Mike Mayfield  
8 joined us. Mike, did you want to make any comments?

9 MEMBER APOSTOLAKIS: Do you have any  
10 questions to the presenters, Mike?

11 (Laughter.)

12 MEMBER APOSTOLAKIS: You had your question  
13 in the past already.

14 MR. MAYFIELD: When you put it that way,  
15 I guess the one point that NRR wanted to make and I  
16 was hoping to be able to sit next to Rich when we were  
17 making it, a couple of times the staff has been before  
18 the Committee and there plainly were disagreements and  
19 differences of opinion.

20 Over the last few months we, both offices,  
21 have worked hard, staff and both offices have worked  
22 hard to communicate better, to work through areas  
23 where there was misunderstanding.

24 We're not 100 percent there, but we're a  
25 long ways further down that road than we were four or

1 five months ago and I think that's a tribute actually  
2 to the staff on both sides, from both offices to have  
3 gone into an open dialogue and have gotten us to a  
4 point where there is very strong agreement, not  
5 complete, but strong agreement on the vast majority of  
6 the work. So I think that's something that I've been  
7 very happy to see. I think Rich is similarly pleased  
8 with the progress we've made.

9 MEMBER APOSTOLAKIS: I am very pleased to  
10 hear that too.

11 Okay, thank you very much, gentlemen.  
12 This was very informative as usual and we will try to  
13 get your letter by the end of tomorrow.

14 MR. KEMPER: Thank you very much.

15 MEMBER APOSTOLAKIS: Mr. Chairman, back to  
16 you.

17 CHAIRMAN WALLIS: George, you'd made it  
18 almost exactly on time. Congratulations. We'll take  
19 a break until 10:15.

20 (Whereupon, the foregoing matter went off  
21 the record at 10:00 a.m. and went back on the record  
22 at 10:17 a.m.)

23 MEMBER DENNING: Thank you.

24 We are now going to hear from the staff  
25 regarding their recommendations to withdraw the draft

1 final rule regarding post fire operator manual  
2 actions.

3 In addition, Mr. Alex Marion of Nuclear  
4 Energy Institute has requested five minutes to share  
5 the NEI perspective after the staff's presentation.

6 The ACRS has previously reviewed this  
7 subject during a fire protection subcommittee meeting  
8 in October of 2004. And then a full committee  
9 meeting, the 517th full committee meeting in November  
10 of 2004.

11 In a letter dated November 19th, 2004, the  
12 ACRS recommended that the staff proposed rule on post  
13 fire operator manual actions be published for public  
14 comment. There were 14 sets of comments that were  
15 received.

16 After reviewing the public comments, the  
17 staff concluded that the rule would not result in a  
18 reduction in exemption requests and decided that the  
19 draft rule should be withdrawn. And that's what  
20 they're for with us today is to discuss that.

21 The principle issue that is involved is  
22 the requirement for automatic fire suppression systems  
23 as a prerequisite for the acceptability of manual  
24 actions regardless of fire hazard in the area. And I  
25 think that what faces us today is the decision as to

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1 whether to accept the recommendation for withdrawal or  
2 whether to make a recommendation that the staff try to  
3 work a little bit harder to come to accommodation on  
4 a rule that would work.

5 And I think Senil Weerakkody, Chief of the  
6 Fire Protection Branch, will start off the discussion.

7 MR. WEERAKKODY: Yes. I'm Senil  
8 Weerakkody, Chief of the Fire Protection Branch.

9 Alex, could you go to Slide No. 2 please?  
10 What I'm here for is first I want to introduce Alex  
11 Klein. He's in my branch. He has been leading the  
12 manual action rulemaking effort for the last two  
13 years. So he's going to be providing you the  
14 presentation as to what public comments we got and why  
15 we chose to make the recommendation after reviewing  
16 the public comments.

17 Then Dave Diec -- he's from the Rulemaking  
18 Branch. He's been the rulemaking lead for the manual  
19 action rule.

20 The purpose of today's meeting is to  
21 inform the ACRS as to why after reviewing the public  
22 comment we are planning to recommend to the  
23 Commissioners that we withdraw the manual action  
24 rulemaking. And our objective is to get your  
25 endorsement for that action.

1 With that, I'm going to hand over to Dave.

2 MEMBER APOSTOLAKIS: So that's it? You're  
3 just withdrawing? No plans for anything else?

4 CHAIRMAN WALLIS: That surprise me. I  
5 mean there was a problem that the rule addressed. Are  
6 you just simply going to forget it?

7 MR. WEERAKKODY: No, there are -- we have  
8 a closure plan.

9 CHAIRMAN WALLIS: You have an alternative  
10 plan?

11 MR. WEERAKKODY: Yes.

12 CHAIRMAN WALLIS: Are you going to tell us  
13 anything about that?

14 MR. WEERAKKODY: Yes, we can.

15 CHAIRMAN WALLIS: Oh, okay.

16 MR. WEERAKKODY: I don't know whether this  
17 was part of our presentation but we have a closure  
18 plan in terms of bringing the whole issue to a  
19 conclusion through enforcement. And if you need, we  
20 can go into details of that. We prepared the  
21 presentation more focused on the detection and  
22 suppression issue.

23 MEMBER DENNING: I don't think we'll have  
24 to go into that in detail but we definitely would like  
25 to hear at a high level what that plan is.

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1 MR. WEERAKKODY: We could do that.

2 MR. DIEC: Thank you. Thank you, Senil.

3 I guess I don't have to introduce myself  
4 again. Let me go directly into the background of the  
5 issue a little bit.

6 Back in November of 2004, we came forward  
7 and presented our proposed rule to the committee and  
8 asked for endorsement to have the proposal published  
9 for public comment.

10 Shortly after that, we received the  
11 endorsement letter from the committee, you know,  
12 agreeing with our recommendation to publish the rule  
13 for public comments. Also in that letter one of the  
14 committee members did raise a number of issues of  
15 which Alex will discuss in detail regarding the role  
16 of the suppression system and risk informed,  
17 performance-based opportunities.

18 W the staff published a rule back in March  
19 2005 with the comment period ending in May 2005.  
20 During the opening comment period, the staff held a  
21 Category 3 public meeting to discuss the issue  
22 regarding about what the rule means and clarify to our  
23 best opportunity to make the rule more transparent and  
24 also receive a number of comments and feedback from  
25 the industry early in the process regarding about

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1 their position about the proposed rule.

2 And the comment from the industry echoed  
3 mostly of which the ACRS member raised about the --  
4 they wrote up a suppression system. And in September  
5 of this year, we also had a Category 2 meeting to  
6 convey to the public and stakeholders of our proposed  
7 recommendation to the Commission to withdraw the  
8 operating manual action rulemaking.

9 MEMBER APOSTOLAKIS: What category is the  
10 Category 2? Can you explain?

11 MR. DIEC: Category 3 is pretty much an  
12 interactive meeting of which we make more availability  
13 to ourselves to answer questions with the public  
14 involvement. Category 2 basically allows us an  
15 opportunity to present our case. And also affords the  
16 public appropriate time to make their comment as well.  
17 But not the interactive.

18 Our next step is to consolidate all the  
19 insights from reviewing of the public comments after  
20 May 2005 and developing our disposition to such  
21 comments. Our plan, of which you alluded to earlier,  
22 is a policy paper that lays out the staff proposed  
23 recommendation and direction moving forward.

24 With that, I'm going to transfer over to  
25 Alex. His presentation will go into greater detail.

1 MR. KLEIN: Thank you. My name is Alex  
2 Klein. I'm a Senior Fire Protection Engineer. I work  
3 in the office of NRR. I report directly to Senil  
4 Weerakkody.

5 Next slide please. We were actually here  
6 a year ago exactly to the day briefing you folks on  
7 the proposed rule. And what I'd like to do is just  
8 give you idea of what the key topics are that I'm  
9 going to spend some time on. I'll go through these  
10 very quickly and then we'll get into some detail as I  
11 get into the subsequent slides.

12 The first two bullets on safety and  
13 compliance and the purpose of the rule I'll discuss  
14 very, very briefly. I think most of you folks are  
15 already aware of what's going on there.

16 I'll spend time -- actually more time on  
17 the third bullet on the major stakeholder comments  
18 because it is, I believe, what the committee is  
19 interested in most. And furthermore, it's the area  
20 that the staff has received comments on and questions  
21 both from the ACRS and comments from the public.

22 And then the last couple of bullets I'll  
23 discuss the closure plan which, I think, has some  
24 interest on here at this committee. And then a brief  
25 discussion on our scheduling conclusion.

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1                   Next slide please?    With regard to  
2 maintaining safety and compliance, as you all know,  
3 when we started this rulemaking, we did state that  
4 feasible and reliable GII operator manual actions are  
5 safety in spite of them being in noncompliance.

6                   We've been continuing inspections and we  
7 have enforced our regulations whenever we found non-  
8 feasible operator manual actions. When we found  
9 feasible manual actions, we have cited these manual  
10 actions as non-compliances. And request that the  
11 licensee include those items in their corrective  
12 action program.

13                   We plan to continue this inspection  
14 activity with a focus on any manual actions that are  
15 risk significant.

16                   Next slide please.

17                   CHAIRMAN WALLIS: Now is this a major  
18 burden going all this inspection and handling everyone  
19 of these manual actions individually?

20                   MR. KLEIN: This -- the inspections are  
21 part of our reactor oversight process under the  
22 Triangle Fire Protection Inspections. Inspectors go  
23 through that process and if they come across any non-  
24 complaint operator manual actions, then we'll  
25 determine the significance.

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1 CHAIRMAN WALLIS: But how much of a  
2 burden? I thought part of the rule was to clarify  
3 things and remove the burden of having to decide on  
4 each one of these manual actions.

5 MR. KLEIN: Part of the rule, if it had  
6 gone through, part of the proposed rule would have  
7 removed that part of the burden. However, as part of  
8 the inspection process, if the proposed rule had moved  
9 forward, inspectors would still determine and inspect  
10 the licensee's feasibility and reliability  
11 determinations of that operator.

12 CHAIRMAN WALLIS: They still do much the  
13 same work?

14 MR. KLEIN: I'm sorry.

15 CHAIRMAN WALLIS: They still do much the  
16 same work if the rule had gone forward?

17 MR. KLEIN: It may very well be, yes,  
18 sir.

19 VICE CHAIRMAN SHACK: But if you find it  
20 is feasible, do you still have to go through a  
21 significance determination process for the finding?

22 MR. KLEIN: Today yes.

23 VICE CHAIRMAN SHACK: Today? How about --  
24 okay, I mean and that will continue to be true?

25 MR. KLEIN: Under -- if the proposed

1 rulemaking is withdrawn, yes.

2 CHAIRMAN WALLIS: If it went in -- if the  
3 proposed rule went through, would it reduce this  
4 burden of the significance determination?

5 MR. KLEIN: If a licensee implements an  
6 operator manual action under the proposed rule that is  
7 determined to be feasible and reliable, then we do not  
8 go through that process. However, if an inspector  
9 determines that or questions the determination of  
10 feasibility and reliability by the licensee, then we  
11 may very well reenter the SDP, yes.

12 MEMBER DENNING: But if the rule went  
13 through, then he could very well be in compliance with  
14 the rule depending on what the conditions of the rule  
15 are.

16 MR. KLEIN: That's correct, yes.

17 MEMBER APOSTOLAKIS: Could you say a few  
18 words about what you mean by feasible?

19 MR. KLEIN: We talked about this last  
20 year. And yes, I can address that. We have a set of  
21 criteria that we have in the proposed rule to  
22 establish the feasible of an operator manual action.  
23 That basically establishes that the operator manual  
24 action can be done.

25 And, of course, with your input initially

1 in the development of this rulemaking, we also  
2 developed reliability criteria to establish and to  
3 ensure that the action can be done on a more likely  
4 basis with high probability of success.

5 With respect to the purpose of rulemaking,  
6 I'll spend a very brief amount of time on this slide  
7 because we're all very well aware. The primary  
8 purpose of the rulemaking was listed in SECY-03-0100.  
9 And two of the primary purposes of that rulemaking was  
10 one, to codify the use of manual actions and its  
11 acceptance criteria, which we did under the proposed  
12 rule.

13 And the primary purpose was to avoid the  
14 need for numerous exemption requests. And that, I  
15 think, is one of the things that we're going to talk  
16 about in some level of detail. And I'll talk about it  
17 in some subsequent slides.

18 I want to point out to you the staff  
19 requirements memorandum that the Commission issued to  
20 the staff in January of this year that approved  
21 publishing the proposed rule.

22 The Commission directed the staff to  
23 engage stakeholders to get a clear understanding that  
24 the proposed rule would indeed achieve its underlying  
25 purpose of avoiding the need to process numerous

1 exemption requests. We received written comments from  
2 a variety of stakeholders at the close of that comment  
3 period.

4 The SRMs also directed the staff to add a  
5 statement to the proposed rule, supporting language,  
6 a statement of consideration that clearly pointed out  
7 the Commission's view with regard to exemption  
8 requests. And what I've done is I've placed a quote  
9 on there.

10 And what we believe is that the  
11 Commission's statement makes clear their view  
12 regarding exemption requests and the options available  
13 to licensees with respect to operator manual actions.

14 Next slide. As the ACRS member indicated  
15 after the close of the public comment period on May  
16 23rd, 2005, we received 14 sets of comments. Of the  
17 14 sets of comments that we received, five were from  
18 individuals of which four opposed the rule outright  
19 and one provided detailed technical comments.

20 Detailed technical comments were also  
21 received from the Nuclear Information and Resource  
22 Services, NIRS, a public interest group who also  
23 opposed the rule. But they advocated codifying  
24 acceptance criteria of the proposed rule Section 3(p).

25 We also received -- the majority of the

1 comments that we did receive were from industry,  
2 industry consultants, and from NEI. And I'll go over  
3 those major comments in detail in a couple more  
4 slides.

5 In addition to the comments received to  
6 the proposed rule, the NRC had previously received  
7 comments from several hundred people, individuals  
8 opposing our plan to issue the operator manual action  
9 rulemaking. These comments were received under our  
10 Federal Register notice to publish an enforcement  
11 discretion policy back in November of 2003.

12 In terms of the rulemaking process, the  
13 staff analyzed the comments, considered the comments  
14 made by the stakeholders. Many of the comments were  
15 the same or similar in nature so you'll see that I've  
16 grouped them together in a couple more slides. And  
17 I'll highlight some of these.

18 MEMBER APOSTOLAKIS: Is it common to have  
19 several hundred individuals comment on anything? Or  
20 was it a campaign behind it?

21 MS. MCKENNA: This is Eileen McKenna. I'm  
22 the Branch Chief in Financial and Policy in NRR. We  
23 have -- I think you're right. Many of these comments  
24 were almost form letters and repetitive-types of  
25 things. And we do see, on occasion, campaigns if you

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1 will, websites where people can find proposed comments  
2 to submit, and we will get repetitive comments.

3 So I don't think it is unusual in that  
4 regard. We had one on one of our rulemakings. It was  
5 petition on design basis threat where we had that  
6 experience as well.

7 CHAIRMAN WALLIS: I think these comments  
8 from industry and from NEI were the same, weren't  
9 they, as had already been made at our meeting here a  
10 year ago. So we didn't really need to go out for  
11 public comment to know what their response was. Isn't  
12 that true?

13 MR. KLEIN: That's true to some extent.

14 CHAIRMAN WALLIS: So but you still put the  
15 rule out and then getting the same comments again, you  
16 decided to back off.

17 MR. KLEIN: Yes, sir.

18 CHAIRMAN WALLIS: You didn't back off  
19 before. But nothing had changed.

20 MR. KLEIN: I'll ask the rulemaking branch  
21 folks to respond to that. But what I can say is that  
22 the comments that we did receive from the industry  
23 were in public meetings and were verbal. I think that  
24 there is a process that the staff needs to go through  
25 when we go through proposed rulemaking.

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1 CHAIRMAN WALLIS: Yes, I understand that.  
2 I understand.

3 MS. McKENNA: I think that's correct.

4 MR. KLEIN: Right.

5 MS. McKENNA: And also that by putting the  
6 notice in the Register, we can solicit comments from  
7 any stakeholder who chooses to comment, not just those  
8 who are participating in the meetings.

9 CHAIRMAN WALLIS: Yes, but it still means  
10 that it changed your mind. And you already had the  
11 information before. I'm a bit surprised that just  
12 getting it written down changed your mind when getting  
13 it orally didn't.

14 MEMBER DENNING: You can proceed.

15 CHAIRMAN WALLIS: But anyway, go ahead.

16 MR. KLEIN: Next slide please. This slide  
17 lists the major stakeholder comments. The comments  
18 that are bolded, if you'll note at the top, are those  
19 that I'll go into more detail in the next few slides.  
20 And those bolder comments are also those that this  
21 Committee had some recent questions and comments on.  
22 And to which I'd like to address individually.

23 If you'll allow, I would just like to  
24 briefly go over each of these comments with the intent  
25 of addressing each of the bolded comments in some

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1 subsequent slides.

2 With respect to the requirement for  
3 automatic suppression, the comment was made by the  
4 industry and by NEI that that requirement is  
5 unnecessary. The comments were primarily directed,  
6 however, at the requirement -- even though the  
7 comments were made, the requirement includes fire  
8 detection and suppression. The comments were  
9 primarily made with respect to automatic fire  
10 suppression. And again, I'll get back to that in a  
11 little more detail.

12 With respect to the comment made that  
13 numerous exemptions will still be needed, as you are  
14 aware, one of the primary purposes for the rulemaking  
15 was to avoid the need for licensees to prepare  
16 exemption requests. And, however, many industry  
17 comments were made stating that numerous exemptions or  
18 costly modifications will be necessary in that the  
19 proposed rule would not achieve its intended purpose.

20 With respect to the alternative rule  
21 language, alternative rule language was proposed by  
22 NEI in their comment letter.

23 CHAIRMAN WALLIS: I think you're on Slide  
24 14 now?

25 MR. KLEIN: No, sir.

1 CHAIRMAN WALLIS: Well, I'm following you.  
2 And you seem to be --

3 MEMBER DENNING: He's going to go over  
4 them again.

5 CHAIRMAN WALLIS: Oh, you're going to go  
6 over them again. I see.

7 MR. KLEIN: In very brief detail. I just  
8 wanted to give you a flavor for each of these if I  
9 may.

10 CHAIRMAN WALLIS: Excuse me.

11 MR. KLEIN: The alternative rule language  
12 that NEI proposed basically defined certain terms in  
13 3(g) (1) and proposes no changes to existing wording in  
14 3(g) (2). And stated that the criteria that's in the  
15 proposed Rule 3(p) is not necessary.

16 With respect to the inspection procedure,  
17 there was a comment made by NEI that their position is  
18 that the inspection procedure criteria that is listed  
19 in the back of that inspection procedure provides  
20 sufficient criteria for determining the feasibility of  
21 operator manual actions. And again, I'll get back  
22 into that in a little more detail.

23 The next four I'll discuss fairly quickly.  
24 Even though the time margin and time margin factor was  
25 an issue that we discussed last year in some great

1 detail, there were a number of comments that were made  
2 from the industry with respect to time margin and the  
3 time margin factor that is contained in the draft  
4 regulatory guide.

5 With respect to time margin requirement,  
6 a number of commenters indicated that the licensee's  
7 thermal hydraulic analysis and calculations and other  
8 types of analyses have inherent conservatisms that  
9 accounts for the time margin.

10 The comments also objected to the time  
11 margin factor of two stating that it is arbitrary, it  
12 is unprecedented, and not consistent with requirements  
13 for other plan programs such as emergency operating  
14 procedures.

15 The staff has taken this comment into  
16 consideration in the treatment of any criteria that  
17 may be issued for internal staff guidance. However,  
18 we would retain the concept of time margin. We  
19 believe that that's a very important concept to  
20 retain.

21 With respect to comments on the proposed  
22 rules of backfit, some commenters continue to state  
23 that the proposed rules of backfit and that the use of  
24 operator manual actions is within the regulations.  
25 The staff disagrees with these assertions.

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1           As stated in the past -- and as supported  
2 by CRGR, the regulations do not identify the use of an  
3 operator manual action as one of the three means of  
4 compliance in Section 3(g)(2) of Appendix R.

5           There was a comment made with respect to  
6 missing an opportunity to risk inform and performance  
7 base this rule. The NRC disagrees with this  
8 contention in that we've already promulgated a risk  
9 informed performance-based rule under 10 CFR 50.48(c)  
10 that addresses fire protection as a complete program.

11           There were comments made by the public  
12 interest groups that asserted that the proposed rule  
13 abandons defense-in-depth. And that it would  
14 undermine the Agency's safety oversight and abandon  
15 its enforcement responsibility.

16           It was further asserted that the proposed  
17 rule would overlook security-related fires.

18           The staff does not agree with these  
19 assertions. We believe that we've provided the bases  
20 for the proposed rule and that it adequately addresses  
21 defense-in-depth.

22           The reactor oversight process and our  
23 inspection of plants continue to be done in accordance  
24 with our processes and policies. Enforcement would  
25 also continue in accordance with our procedures and

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1 policies.

2 With respect to security-related fires,  
3 the staff recognized this when we wrote the proposed  
4 rule. We decided during the proposed rulemaking  
5 process during the proposed rulemaking period, that  
6 the security-related fires needed to be addressed on  
7 a more global and comprehensive basis rather than  
8 piecemeal through individual rules.

9 Next slide please. Industry stated that  
10 the requirement for an automatic fire suppression  
11 system is not necessary and that the installation of  
12 such systems would be costly without a clear safety  
13 enhancement and will likely result in more exemption  
14 requests. They also stated that existing fire hazards  
15 analyses have already determined where an automatic  
16 fire suppression system is required in the plant.

17 The staff has considered the comments and  
18 continues to maintain that the fire detectors and  
19 automatic fire suppression system requirement in the  
20 proposed rule is essential to ensure defense-in-depth  
21 and is fundamental to fire protection regulations.  
22 And we discussed this with you folks in great depth a  
23 year ago. And the same with the fire protection  
24 subcommittee.

25 Under the proposed rule, licensees would

1 be allowed to implement operator manual actions as a  
2 fourth compliance option to the requirements of  
3 3(g)(2) where redundant trains are located in the same  
4 fire area. This fourth compliance option relies on  
5 the success of the operator manual action to safely  
6 shut down the plant in the event of a fire.

7 Because of the relatively high failure  
8 probability of an operator manual action, the staff  
9 believes that the defense-in-depth provided by  
10 automatic suppression is essential.

11 With respect to fire hazards analysis,  
12 fire hazards analysis is a deterministic type analysis  
13 and is done by considering items such as, you know,  
14 the type and quantity of combustibles, the location of  
15 the hazards, the geometry of the area, and other  
16 factors such as ventilation and available manual  
17 firefighting capability. However, a fire hazards  
18 analysis does not account for the failure of the  
19 manual action.

20 For these reasons, the staff included the  
21 requirement for automatic fire suppression in the  
22 proposed rule.

23 MEMBER DENNING: Let's spend a few minutes  
24 on this --

25 MR. KLEIN: Yes.

1 MEMBER DENNING: -- because I think this  
2 is the essence of whether we can -- how you proceed.

3 The one alternative that the industry now  
4 has is to go through the risk-informed process. And  
5 if one looks at how manual actions are going to be  
6 taken into account in that process, and it is somewhat  
7 speculative, but basically we can almost be assured  
8 that based upon risk assessment and the risk  
9 significance of an area that the arguments will be  
10 made that manual actions should be approved without  
11 the requirement for fire suppression systems based  
12 upon the low risk from that area. There will be  
13 arguments about the low risk from that area.

14 And the way the process is set up, I  
15 suspect that those arguments will be accepted. I mean  
16 the process isn't critical of that. So that I see for  
17 areas that have this low-risk significance, that  
18 they'll be allowed to have manual actions without fire  
19 suppression systems.

20 The industry argument about the fire  
21 hazards analysis is pretty similar. That is, they say  
22 that we go through a fire hazards analysis and we  
23 determined that combustible loading is not high enough  
24 to really sustain fires in an area. And it doesn't  
25 need sprinkler systems.

1           So they've already gone through that  
2 analysis for an area. And based upon that, they said  
3 we don't need a fire sprinkler for that area.

4           But with the rule you now have it, it  
5 would be required, that even though the fire hazard  
6 analysis said it didn't need a sprinkler, you would  
7 need a sprinkler because you have the manual action.  
8 So that I think that what we wind up with is quite an  
9 inconsistency between how the same room would be  
10 treated in Plant A that goes through risk-informed  
11 analysis and Plant B that is identical but goes  
12 through the deterministic analysis.

13           And they really would wind up in the same  
14 place, then I don't see why we would be so sticky  
15 about this question of do we really have to have the  
16 sprinkler system in addition to the manual action when  
17 we do have some evidence that fire isn't at the same  
18 level of concerns as those areas where there are  
19 sprinklers.

20           So again I raise the question along those  
21 lines.

22           MR. KLEIN: Let me respond with respect to  
23 the 805 process. Yes, I agree, it is a risk-informed  
24 method of establishing a new fire protection licensing  
25 basis. And perhaps there may be situations where it

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1 may very well be appropriate to implement an operator  
2 manual action.

3 With respect to whether a suppression  
4 system is required or not, when you look at the risk,  
5 one other aspect that an 805 licensee would have to  
6 make a determination on is the effect that say removal  
7 or not putting in place a suppression system is their  
8 determination of adequacy of defense-in-depth.

9 So a licensee under the 805 process would  
10 not simply look at the risk numbers. They would also  
11 make that determination of whether or not a  
12 suppression system is required --

13 MEMBER DENNING: Yes.

14 MR. KLEIN: -- with the defense-in-depth.

15 MEMBER DENNING: Yes. But I would be  
16 willing to make a little bet as to how that answer  
17 comes out for the majority of those cases. There's  
18 one other thing I'd like to pursue and that is the  
19 inspection guide that is used now which determines  
20 whether -- in the inspection process whether a  
21 noncompliance is really a serious noncompliance or a  
22 not serious non-compliance.

23 And it says in the inspection guide that  
24 in those cases, it is okay that you don't have to shut  
25 the plant down and fix something because the safety --

1 because these are low safety concerns.

2 I didn't see anywhere in the inspection  
3 guide where the requirement would exist for fire  
4 suppression in that determination. Am I wrong? Is  
5 there a requirement? In order to be found to be a low  
6 safety significance for a manual action, in that  
7 inspection guide, do you have to have a fire  
8 suppression system operable? Automatic?

9 MR. KLEIN: Yes. Let me respond to that.  
10 If I can go to Slide 15 please?

11 The inspection procedure was written and  
12 had attached to it the criteria. And the acceptance  
13 criteria in the inspection procedure was provided back  
14 in March of 2003. And that was provided for  
15 inspectors to determine whether or not an operator  
16 manual action is feasible with respect to a licensee  
17 being able to take credit for that operator manual  
18 action as a temporary compensatory measure.

19 So with respect to how we use the criteria  
20 in the inspection procedure, it was done under that  
21 type of consideration with respect to an interim  
22 compensatory measure.

23 With respect to whether or not suppression  
24 was actually listed as a requirement as one of the  
25 criteria, the criteria were provided to establish the

1 feasibility of the operator manual action. The  
2 requirement for automatic suppression or detection is  
3 part of the rule under 3(g)(2).

4 So an inspector would come in and make  
5 that determine that judgment and determine the risk  
6 when they go through the STP process considering  
7 wither or not automatic suppression would provide that  
8 level of defense-in-depth and safety required.

9 So in terms of it not being listed in the  
10 criteria, I think it was because we listed the  
11 criteria only to establish the feasibility of the  
12 operator manual action. Now I'll ask any of the staff  
13 to clarify what I've said because I wasn't here when  
14 they issued the inspection procedure back in March of  
15 2003. But, however, I believe that's the basis for  
16 it.

17 And I don't know of Senil has any  
18 additional comments to make.

19 MR. WEERAKKODY: The criteria that they  
20 put together in the inspection guidance -- obviously  
21 the inspection guidance doesn't go through the same  
22 rigorous review process the rule criteria goes through  
23 was a tentative mission for us to move forward with  
24 this issue by a rulemaking or any other means and then  
25 keep the plant safe during that time.

1                   There is a big difference between what  
2                   were existing under inspection guidance, which is an  
3                   internal document. When we entered the rulemaking  
4                   process, rightfully so, we come to you, we go to all  
5                   the stakeholders and we get feedback. And one of the  
6                   things we learned was that feasibility was just not  
7                   sufficient.

8                   We need to have feasibility and  
9                   reliability for these manual actions for a self-  
10                  implementing rule because once the rule is approved,  
11                  the licensees could, on their own, approve these  
12                  manual actions. So the quality or the objective of  
13                  the criteria is going to be a step up in a rule as  
14                  opposed to inspection criteria.

15                  MEMBER DENNING: I understand your  
16                  position.

17                  MR. KLEIN: Okay. Let me add something  
18                  about the fire hazards analysis aspect of it also.  
19                  And maybe we can go to Slide 13 because I think that  
20                  has some connection to it.

21                  With respect to the comments that were  
22                  made with the numerous exemptions, when we try to  
23                  write a rule, we try to write the rule, as Senil  
24                  indicated, we try to write a rule that is objective,  
25                  that's clear, and is such that it is inspectible and

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1 enforceable.

2 And if we try to put a rule in place where  
3 we provide a licensee exceptions to where, for  
4 example, a suppression system may not be required  
5 because there are no combustibles at all in their fire  
6 area, I believe.

7 And I believe that it is the position of  
8 the Agency that it may not necessarily cover all  
9 situations out there in the plant because each case of  
10 an operator manual action in a specific location in a  
11 plant is specific to that configuration and the  
12 plant's ability to have suppression in that area.

13 We further believe that if we provide  
14 language, rule language, that would provide exceptions  
15 that we would not be contributing to clarity in our  
16 regulations again because of the specificity of the  
17 situations. And that's basically why we have the  
18 requirement for automatic suppression as part of the  
19 rule.

20 MR. WEERAKKODY: One thing I'd really like  
21 to add to this important topic based on the questions  
22 you asked Dr. Denning, with respect to suppression, if  
23 you -- we are in no way holding 805 and non-805 plants  
24 with different safety standards with respect to manual  
25 actions. If you go to the 805 code document and the

1 main rule, all licensees who go to 805, unless their  
2 manual action already is approved, they have to re-  
3 analyze each of those manual actions using  
4 performance-based/risk-informed methods.

5 And as you can recall with our discussions  
6 on the reg guide and the number of questions you had  
7 on MEFS, LFS, you found out how much analysis the  
8 licensee has to do and document in order to use manual  
9 actions in an area without suppression.

10 So you are correct. And 805 plant can  
11 have situations of manual actions without suppression  
12 but they will do it after following a very deliberate,  
13 very thorough process with five PRAs and, you know,  
14 they are using money to do all that analysis.

15 MEMBER DENNING: You can return to your --

16 MR. KLEIN: Thank you. Let's stay on  
17 Slide 13 then. And I think we covered most of these  
18 items.

19 The staff understands that numerous  
20 exemptions would be submitted. And I think that we're  
21 talking about -- the crux of the matter is the fact  
22 that we have the requirement for automatic suppression  
23 in the proposed rule.

24 And I discussed with you previously in a  
25 couple of slides the bases for why we believe

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1 automatic suppression is appropriate for ensuring  
2 defense-in-depth.

3 So if I could just go on to the next  
4 slide, Slide 14 with respect to the alternative rule  
5 language proposed by NEI. As I indicated, NEI did  
6 submit some proposed alternative rule language. The  
7 staff did consider this alternative rule language but  
8 we did conclude that the language would not ensure  
9 defense-in-depth.

10 Basically the language would allow the use  
11 of manual actions in areas with redundant trains under  
12 the assumption that the manual action is successful in  
13 ensuring that one train remains free of fire damage.  
14 Aside from the conflict that this would impose with  
15 Section 3(g)(2) and 3(g)(3), the alternative language  
16 does not ensure feasibility and reliability of the  
17 operator manual action absent acceptance criteria as  
18 part of the rule which was not proposed in the NEI  
19 rule language.

20 Furthermore, we believe that the lack of  
21 again, the automatic fire suppression system is  
22 essential to defense-in-depth as we previously  
23 discussed. So it is for those reasons that the NRC --  
24 that the staff concluded that the alternative rule  
25 language would not adequately address our concerns.

1                   Let me skip over Slide 15 I think. Unless  
2 the Committee has some further questions with respect  
3 to the inspection procedure, I'll skip over that one.

4                   CHAIRMAN WALLIS: Well, all your slides so  
5 far seem to reap up the public comments and support  
6 issuing the rule. I don't have any rationale yet for  
7 withdrawing it.

8                   MR. KLEIN: I'll get to that if I may.

9                   This slide basically states the  
10 recommendation that the staff will make to the  
11 Commission to withdraw the proposed rule.

12                   CHAIRMAN WALLIS: It doesn't follow from  
13 what you just said though.

14                   MR. KLEIN: I'm sorry?

15                   CHAIRMAN WALLIS: Okay. You're going to  
16 tell us the rationale after that?

17                   MR. KLEIN: Yes, sir. Slide 17, if I may.

18                   Okay, the industry certainly was very  
19 clear in their response stating that a substantial  
20 number of exemptions would still be needed under the  
21 proposed rule. Given the industry's positions and  
22 assertions, the primary purpose of the rulemaking  
23 certainly would not be achieved.

24                   The assertion of the large number of  
25 exemption requests would also not meet the

1 Commission's staff requirements memorandum view of  
2 exemption requests. That's the slide that I had up  
3 there previously.

4 The SRM provided the Commission's view  
5 that although the exemption process is available, the  
6 Commission considers the rulemaking or 10 CFR  
7 50.48(c), which is NFP 805, more desirable in order to  
8 minimize the need for future exemption requests.

9 Since a substantial number of exemptions  
10 would still be needed, it's clear that the  
11 Commission's view and direction would not be met. 10  
12 CFR 50148(c) is available to licensees as a risk-  
13 informed alternative to minimize exemption requests  
14 and solve the kinds of issues being addressed in this  
15 proposed rule.

16 This alternative also meets the  
17 Commission's SRM view and direction without a new  
18 rule. Furthermore, the majority of the comments from  
19 the industry and the public clearly did not support  
20 the proposed rule as written.

21 And I've got some quotes here which I'll  
22 just skip over with respect to time.

23 And so basically, based on the above  
24 reasoning, the staff will make a recommendation to the  
25 Commission to withdraw the proposed rule.

1 CHAIRMAN WALLIS: Well, I'm not sure  
2 you've been deterred by stakeholder comments in the  
3 past. And that's not the real reason for voiding a  
4 rule.

5 MR. KLEIN: Well, it is -- I mean part of  
6 the reason is the Commission in its SRM really does  
7 say if you determine that it isn't going to reduce the  
8 number of exemptions --

9 CHAIRMAN WALLIS: I understand -- I can  
10 understand that rationale. But the fact that a few  
11 comments from industry object isn't really a good  
12 reason for backing off since all your previous  
13 rationale supported the rule.

14 MR. WEERAKKODY: Can I add something Dr.  
15 Wallis?

16 One of the things that I think Alex is  
17 going to mention or has not mentioned yet is that when  
18 we issued Appendix R, the old fire protection rule,  
19 and we turn around and issued about a thousand  
20 exemptions, and that's kind of like backdooring or  
21 circumventing the rule. So with that background, you  
22 know, we can't issue a rule with the full knowledge  
23 that the only way to comply with the rule is by  
24 pursuing another hundreds of exemptions. That's  
25 unacceptable to how we do business.

1 We had to do it for Appendix R because the  
2 courts asked that we do so.

3 MEMBER DENNING: But isn't there a set of  
4 problems out there where there actually are fixed  
5 suppression systems. And by including this, they will  
6 not have to ask for exemptions for those?

7 MR. KLEIN: That's correct. If you look  
8 under the requirements for Section 3(g)(2),  
9 3(g)(2)(b), which is a 20-foot separation requires a  
10 licensee to have installed automatic suppression and  
11 detection. Section 3(g)(2)(c) with a one-hour fire  
12 barrier also requires detection and suppression.

13 So really what it comes down to is Section  
14 3(g)(2)(a) which is the three-hour fire barrier which  
15 was deemed adequate enough for train separation at the  
16 time Appendix R was written without automatic  
17 suppression.

18 MEMBER DENNING: Okay. Continue.

19 MR. KLEIN: Okay. So are we on Slide 18,  
20 yes, our closure plan, which I think that you'd like  
21 some discussion on. Of course we're developing a  
22 policy paper that will recommend withdrawal of the  
23 proposed rule. That's ongoing right now as we speak.

24 The staff also plans to issue a regulatory  
25 issue summary that will communicate our regulatory

1 compliance expectations.

2 CHAIRMAN WALLIS: If they look something  
3 like the rule you are withdrawing, nothing much will  
4 change except it won't be a rule. It will just be a  
5 somewhat weaker document. You still seem to have the  
6 same expectations.

7 MR. KLEIN: What we will reiterate, Dr.  
8 Wallis, in the risks is our compliance expectations  
9 with regard to the fact that the use of operator  
10 manual actions under 3(g)(2) is prohibited by  
11 regulation unless a licensee has an exemption to that  
12 effect.

13 CHAIRMAN WALLIS: So it's just status quo  
14 then?

15 MR. KLEIN: Yes, it is. In effect it is,  
16 yes, sir.

17 CHAIRMAN WALLIS: You know you haven't  
18 cured the problem.

19 MEMBER DENNING: In actuality --

20 MR. KLEIN: Well, with respect to curing  
21 a problem with numerous exemption requests, if that's  
22 characterized as the problem, as Senil indicated, if  
23 we do issue the proposed rule as written, and if  
24 licensee do come in with exemption requests, then we  
25 are not providing a good regulatory practice.

1 CHAIRMAN WALLIS: The rule doesn't solve  
2 the problem. But the problem is still there. And  
3 you're going to solve it in the traditional way  
4 essentially.

5 MR. KLEIN: That's one way of solving it.  
6 The other option, of course, is for a licensee to come  
7 in under 50.48(c).

8 CHAIRMAN WALLIS: Right.

9 MR. KLEIN: So there is that option  
10 available to a licensee.

11 Senil?

12 MR. WEERAKKODY: And when we -- if the  
13 Committee approves and then if we withdraw the rule,  
14 we have plans to -- and, you know, I can't go to the  
15 details because these are pre-decisional at this  
16 point, we have current enforcement disciplines in  
17 place for manual actions and circuits. We have plans  
18 to give the licensees a reasonable time frame to  
19 develop plans and come into compliance.

20 MR. KLEIN: Okay, the last bullet I think  
21 I talked to you about already. That the staff  
22 continues to inspect operator manual actions through  
23 the reactor oversight process.

24 My last slide basically is a -- with  
25 respect to schedule, the policy paper is scheduled to

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1 go to the Commission by the end of calendar 2005. And  
2 we plan to issue the risks in the spring of 2006  
3 assuming that the Commission favorably approves our  
4 recommendation to withdraw the rule.

5 In conclusion, the staff believes that the  
6 proposed rule should be withdrawn and we are asking  
7 ACRS endorsement of our recommendation.

8 That concludes my presentation.

9 MEMBER DENNING: Does anybody have any  
10 questions for the staff? We are going to have a few  
11 minutes to a presentation by Mr. Marion following our  
12 discussion.

13 CHAIRMAN WALLIS: After Mr. Marion's  
14 presentation we may have some questions for the staff  
15 --

16 MEMBER DENNING: Staff still.

17 CHAIRMAN WALLIS: I'm not quite sure how  
18 that will work out.

19 MEMBER DENNING: Sure. Any questions now?  
20 Dana?

21 MEMBER POWERS: Somewhat off the subject  
22 but just a little bit on philosophy. In thinking  
23 about your proposed rule, you have given some emphasis  
24 to automatic suppression yet we never credit automatic  
25 suppression with extinguishing a fire. Is that true?

1 MR. KLEIN: I'm trying to understand your  
2 question. Are you saying --

3 MEMBER POWERS: I haven't asked one really  
4 yet.

5 (Laughter.)

6 MR. KLEIN: All right. Well, you asked me  
7 if that's true.

8 MR. WEERAKKODY: No, that's not. I heard  
9 the question. I think that's not true depending on  
10 the suppression system. Some we rely on to suppress  
11 fire. Some we rely on to extinguish fires.

12 MEMBER POWERS: Can you point me to  
13 something where we credit an automatic system of  
14 extinguishing a fire.

15 MR. FRUMKIN: Well, this is Dan Frumkin of  
16 the staff. One of the nuances in automatic suppress  
17 systems is the gaseous versus the water suppression  
18 systems. And gaseous suppression systems are, by  
19 definition, extinguishing systems.

20 And the water suppression systems, we have  
21 deluge what are, I think, extinguishing systems and  
22 the automatic sprinkler systems which most people are  
23 familiar with are the control systems.

24 And that's where NFPA comes in and says  
25 some of these are extinguishing and some of them are

1 control systems. From a regulatory standpoint in the  
2 fire protection significance determination process,  
3 for example, a large amount of credit is given for  
4 automatic systems to extinguish fires.

5 If they operate in enough time, you can  
6 get one or two orders of magnitude of credit for  
7 extinguishing a credit from an automatic system or if  
8 you don't extinguish it you do make the scenario go  
9 away. It could be a very small fire after that. So  
10 there's a lot of credit in practicality space at NFPA  
11 and also in risk space in our significance processes.

12 MEMBER POWERS: Are these probabilities  
13 that you would ascribe to extinguishing based on  
14 experiment?

15 MR. FRUMKIN: Are they based on  
16 experiment? I think that they're based on statistics  
17 and this history of fires and how many fires had, you  
18 know, gone past that point. But that was developed  
19 during the fire SDP and the NUREG 6850 statistical  
20 machinations with the fire events database, EPRI's and  
21 Sandia's.

22 MEMBER DENNING: It would be useful to see  
23 what the statistics are for gaseous systems actually  
24 extinguishing.

25 MEMBER DENNING: Other questions Dan?

1 MEMBER POWERS: I'm too off the topic to  
2 pursue this.

3 MEMBER DENNING: Okay. Well, thank you  
4 very much. And now, Mr. Marion, would you step up  
5 front and guide us?

6 MR. MARION: Good morning. My name is  
7 Alex Marion, Senior Director of Engineering at the  
8 Nuclear Energy Institute. And I appreciate the  
9 opportunity to offer a few perspectives from the  
10 industry relative to this particular rulemaking.

11 The industry essentially supports  
12 rulemaking in this area. We think it is important to  
13 establish acceptance criteria but which licensees can  
14 demonstrate their ability to execute an operator  
15 manual action if there is a fire in a nuclear power  
16 plant.

17 And approximately three years ago, we  
18 reached an agreement with the NRC on that concept and  
19 we also reached an agreement that rulemaking was the  
20 appropriate vehicle to use to provide some stability  
21 in the process going forward.

22 Now prior to any stability in this  
23 particular area, there have been two processes that  
24 have been involved over the last 25, 30 years relative  
25 to the treatment of manual actions. One was the NRC

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1 expectation that utilities who wanted to credit manual  
2 actions for 3(g)(2) areas would issue a formal  
3 exception request to the NRC.

4 However, that has not been written  
5 anywhere. It is not explicitly stated in NRC  
6 regulations nor is it explicitly stated in NRC  
7 regulatory guidance.

8 The second practice has been one where the  
9 NRC has reviewed and approved operator manual actions  
10 in a more informal manner. And it has been documented  
11 in safety evaluation reports and inspection reports.

12 We provided that kind of information to  
13 the NRC approximately three years ago. That was the  
14 basis of the recognition, I think, on their part that  
15 there were these dual approaches and we needed to  
16 provide some consistent process going forward.

17 And that's why fundamentally we supported  
18 th rulemaking. We still support the rulemaking. The  
19 only provisions of the rulemaking that we took issue  
20 with was the requirement or proposed requirement for  
21 automatic suppression. And our basic argument in that  
22 regard was that it was arbitrary.

23 But more importantly from a practical  
24 sense, the utility fire hazards analysis and utility  
25 actions for demonstrating compliance with 10 CFR 4058

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1 as well as Appendix R had already identified that  
2 particular areas of the plan that have significant  
3 fire hazards such that automatic suppression is  
4 necessary.

5 So to add it as an additional requirements  
6 in areas where you're you are going to execute  
7 operator manual actions makes no sense from a fire  
8 protection point of view.

9 And the second provision of the proposed  
10 rulemaking that we took issue with was this time  
11 margin which was effectively a penalty on the use of  
12 operator manual actions. And we still believe that  
13 there is need for stability in this process going  
14 forward. We support the inspection procedure  
15 acceptance criteria that has been in place now for  
16 approximately two-and-a-half years.

17 We, as a matter of fact, had an appendix  
18 to NEI 001 that identified similar acceptance  
19 criteria. And we removed that appendix when NRC  
20 published the inspection procedure. Because it didn't  
21 make any sense to have redundant information in an  
22 industry document as well as an NRC document.

23 We intend to submit --

24 MEMBER POWERS: There are no major cases--

25 MR. MARION: Pardon?

1 MEMBER POWERS: -- of where there is that  
2 redundant information?

3 MR. MARION: I'm sorry.

4 MEMBER POWERS: No -- we don't have any  
5 major situations where there is that kind of redundant  
6 information?

7 (Laughter.)

8 MEMBER POWERS: I think it is actually  
9 fairly common.

10 MR. MARION: Yes, it is. It is. But, you  
11 know, we wanted to basically quite frankly give credit  
12 to the NRC for articulating the acceptance criteria in  
13 their inspection procedure. So operator manual  
14 actions for the past couple of years have been  
15 reviewed against that acceptance criteria.

16 And as I mentioned before, the regulations  
17 aren't explicit in this area in terms of requiring an  
18 exemption request. It's an interpretation but it is  
19 more fundamental than that.

20 There are two sets that are referred to as  
21 Appendix R plants and those that are referred to as  
22 NUREG 0800 plants. And the timeline for the  
23 differentiation between the two categories of  
24 facilities of 1979 -- those licensed before '79 and  
25 those after.

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1                   And for the plants that have been licensed  
2 under 0800, they have a standard license condition  
3 that allows them to do an evaluation of changes to  
4 their fire protection program. And if that evaluation  
5 doesn't reduce the effectiveness of the fire  
6 protection feature. And they are allowed to proceed  
7 with making that change.

8                   And a lot of utilities that have received  
9 informal, if you will, non-exemption type of approval  
10 for the use of operator manual actions fall into the  
11 category.

12                   So the problem still exists. This is the  
13 same problem we've had for the last 25, 30 years today.  
14 You still have two approaches that are being used.

15                   We support the rulemaking. We don't  
16 support those two provisions. We intend to submit  
17 acceptance criteria to the NRC for review and approval  
18 hopefully the first week of December.

19                   Let me just say a word about fire hazards  
20 analysis. It is deterministic but it is fundamental  
21 to evaluating the fire hazard you have in a given area  
22 so that a licensee can identify the appropriate fire  
23 protection features to deal effectively with that  
24 hazard.

25                   And I don't believe the staff was trying

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1 to downplay the significance of fire hazards analysis  
2 in the comments this morning. But I just wanted to  
3 point out that it is deterministic. But it is the  
4 only means you have now to do that kind of an  
5 evaluation.

6 And let me just indicate that it is also  
7 one of the key aspects to the defense-in-depth  
8 concept. In defense-in-depth are four elements, if  
9 you will, prevention, detection, mitigation, and  
10 recovery.

11 Operator manual actions identify what kind  
12 of features you need to put in place to detect a fire,  
13 based upon the hazards again. What kind of features  
14 do you need to put in place to prevent a fire, again  
15 based upon the hazards in a given area.

16 And then what you need to do to mitigate.  
17 And then from the standpoint of recovery, you are  
18 relying on operator manual actions to get the plant in  
19 a safe condition.

20 And lastly I'd like to say that I'm quite  
21 frankly disappointed as to where we are now. We were  
22 under the impression that we were on a success path to  
23 provide some predictability and stability to the  
24 process going forward. And if the staff recommends,  
25 and I suspect that they will continue to do so as they

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1 presented this morning, that the rulemaking activity  
2 be ceased, we're back to where we were three years  
3 ago.

4 We're back to an unpredictable process.  
5 We're back to a licensing basis at plants that  
6 represents two approaches, one with formal exemption  
7 requests and another with informal acceptance by the  
8 NRC. And we haven't solved anything.

9 I'm hoping that the staff can review and  
10 approve our acceptance criteria that we intend to  
11 submit. That criteria will be consistent with what is  
12 in the inspection procedure that was referred to  
13 earlier.

14 We have done a review against other NRC  
15 guidance documents and the only aspect that we are not  
16 considering is this time margin factor penalty. And  
17 we are not including the proposed requirement for  
18 automatic suppression.

19 And that concludes my comments. And I  
20 thank you for the opportunity. And I'll be more than  
21 happy to answer any questions.

22 MEMBER DENNING: Yes. A couple quick  
23 questions. First, you say that you are still  
24 supportive of the rulemaking process. But if the rule  
25 went forward as it exists today are you just

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1 indifferent? Or would you prefer not to see the rule  
2 as it is being proposed today?

3 MR. MARION: If the rule was issued today  
4 as proposed, and this includes the two provisions that  
5 we are fundamentally against, it will require an  
6 increased number of exemptions basically to do with  
7 those two provisions.

8 As I think Senil indicated, there are  
9 approximately a thousand exemptions that have been  
10 issued on Appendix R already. You'll probably get as  
11 many, all right, based upon the automatic suppression  
12 provision in that regulation.

13 CHAIRMAN WALLIS: Did you answer his  
14 question? Would you be in favor of this rule going  
15 forward --

16 MEMBER DENNING: As it is today.

17 MR. MARION: With those two --

18 CHAIRMAN WALLIS: The question we face is  
19 to recommend whether it goes forward or not.

20 MR. MARION: Yes. The rule, as proposed,  
21 we do not support.

22 MEMBER DENNING: You don't support it --

23 MR. MARION: No.

24 MEMBER DENNING: -- as proposed.

25 MR. MARION: Primarily because of those

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1 two provisions.

2 CHAIRMAN WALLIS: So you support a rule  
3 but not this rule.

4 MR. MARION: We propose a rule that  
5 focuses on acceptance criteria to demonstrate the  
6 feasibility of manual action.

7 CHAIRMAN WALLIS: So you're not opposed to  
8 a withdrawal of this rule?

9 MR. MARION: Not opposed to withdrawing  
10 this rule --

11 CHAIRMAN WALLIS: Thank you --

12 MR. MARION: -- as proposed.

13 CHAIRMAN WALLIS: -- for clarifying  
14 things.

15 MEMBER DENNING: Yes. Okay? Any other  
16 questions?

17 (No response.)

18 MEMBER DENNING: If not, then thank you  
19 very much. And I turn it back to you, Graham.

20 CHAIRMAN WALLIS: Thank you. I think  
21 we've done very well.

22 Now we have another item on the agenda.  
23 And we look forward to that. If the staff will come  
24 forward, we have a meeting on the report of the  
25 Planning and Procedures Subcommittee. And we'll move

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1 right to that.

2 We don't need the transcript. Thank you  
3 very much for the transcript. We don't need it any  
4 more.

5 (Whereupon, the above-entitled meeting was  
6 concluded at 11:18 a.m.)

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CERTIFICATE

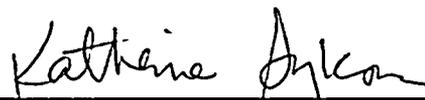
This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on  
Reactor Safeguards  
527<sup>th</sup> Meeting

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.



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Katherine Sykora  
Official Reporter  
Neal R. Gross & Co., Inc.



# NRC DIGITAL SYSTEM RESEARCH PLAN FY 2005 THROUGH FY 2009

Advisory Committee on Reactor Safeguards  
November 4, 2005

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## BACKGROUND

- The current digital system review guidance (SRP Chapter 7) is several years old (1997)
- We have already seen and anticipate receipt of more complicated and more extensive plant specific applications, thus the need to make the review process more effective continues to grow
- The FY2001-2004 NRC digital system research program plan was primarily focused on NRR issues
- In the past few years the need to provide support to NSIR and NMSS issues has grown



# CURRENT SITUATION

- Issues facing NRC
  - We expect that licensees will replace analog systems with digital systems as the existing analog systems become obsolete
  - Licensing these digital systems presents challenges to NRC because of the
    - Increased complexity of the systems
      - Consolidation of discrete analog functions into a single digital system
      - Potential consolidation of independent safety systems into a single digital system
      - Potential new failure modes
    - Limited operating history of digital equipment in nuclear safety related applications
    - Significant effort required by staff with specialized skills
  - Current licensing guidelines provide information on what to review, but not necessarily how to review it, or what the appropriate acceptance criteria should be
  - There is industry interest in risk-informed digital system reviews, but the NRC does not yet have the needed technical bases to support this kind of review



## CURRENT SITUATION

- In today's environment, cyber security of safety related digital systems is essential, and staff is working to develop regulatory guidance and acceptance criteria
- The operating history we have indicates digital systems failures may be risk significant
  - An analysis of 1984-1997 ASP data indicated that a large number of risk significant events includes I&C failures and that both safety and non-safety systems contributed to these events
  - An analysis of LER data showed that many software system failures are context-dependent (e.g. dependent upon the operational mode at the time of failure) and that many faults are introduced in testing, operations and maintenance
  - Anecdotal evidence shows potential issues (Palo Verde's Core Protection Calculator and Turkey Point's load sequencers)



## DEVELOPMENT OF THE NEW PLAN

- In the 1997 NAS report “Digital Instrumentation and Control Systems in Nuclear Power Plants: Safety and Reliability Issues” the review committee identified a number of key areas that should be explored including;
  - Systems Aspects of Digital Instrumentation and Control Technology
  - Software Quality Assurance
  - Common-Mode Software Failure Potential
  - Safety and Reliability Assessment Methods
  - Human Factors and Human-Machine Interfaces
  - Dedication of Commercial Off-the Shelf Hardware
- In developing the “NRC Research Plan for Digital I&C for FY 2001-2004” RES reviewed the 1997 NAS report recommendations and I&C vendor development efforts at that time and determined that the key areas for research were
  - Systems Aspects of Digital Technology
  - Software Quality Assurance
  - Risk Assessment of Digital I&C Systems
  - Emerging I&C Technology and Applications



# DEVELOPMENT OF THE DIGITAL SAFETY SYSTEM RESEARCH PLAN FY 2005-2009

- The new research plan was developed to
  - Provide improved technical guidance for review of digital systems
  - Provide technical support in areas where program offices need improved acceptance criteria
  - Develop assessment tools and methodologies to improve reviews
- Input was solicited from NRC program offices (NRR, NSIR and NMSS)
- Draft plan was vetted with program offices and comments have been incorporated
- The new research plan has been reviewed by the ACRS Digital I&C Subcommittee and comments are being incorporated
- Provides a flexible, adaptable framework for identifying NRR, NMSS, and NSIR research initiatives needed to meet the challenges of licensing digital I&C systems for safety related applications at nuclear facilities



## RESEARCH FOCUS

- Structured to include the most important research areas needed to support the program offices
  - Systems Aspects of Digital Technology
  - Software Quality Assurance
  - Risk Assessment of Digital I&C Systems
  - Security Aspects of Digital Systems
  - Emerging Digital Technology and Applications
  - Advanced Nuclear Power Plant Digital Systems
- Broad-based, focusing on improving traditional review methods for
  - Review of existing digital technologies
  - Analysis of emergent technologies
  - Evaluation of issues arising from the application of digital technologies
  - Focus is on improving the assurance of digital I&C system reliability

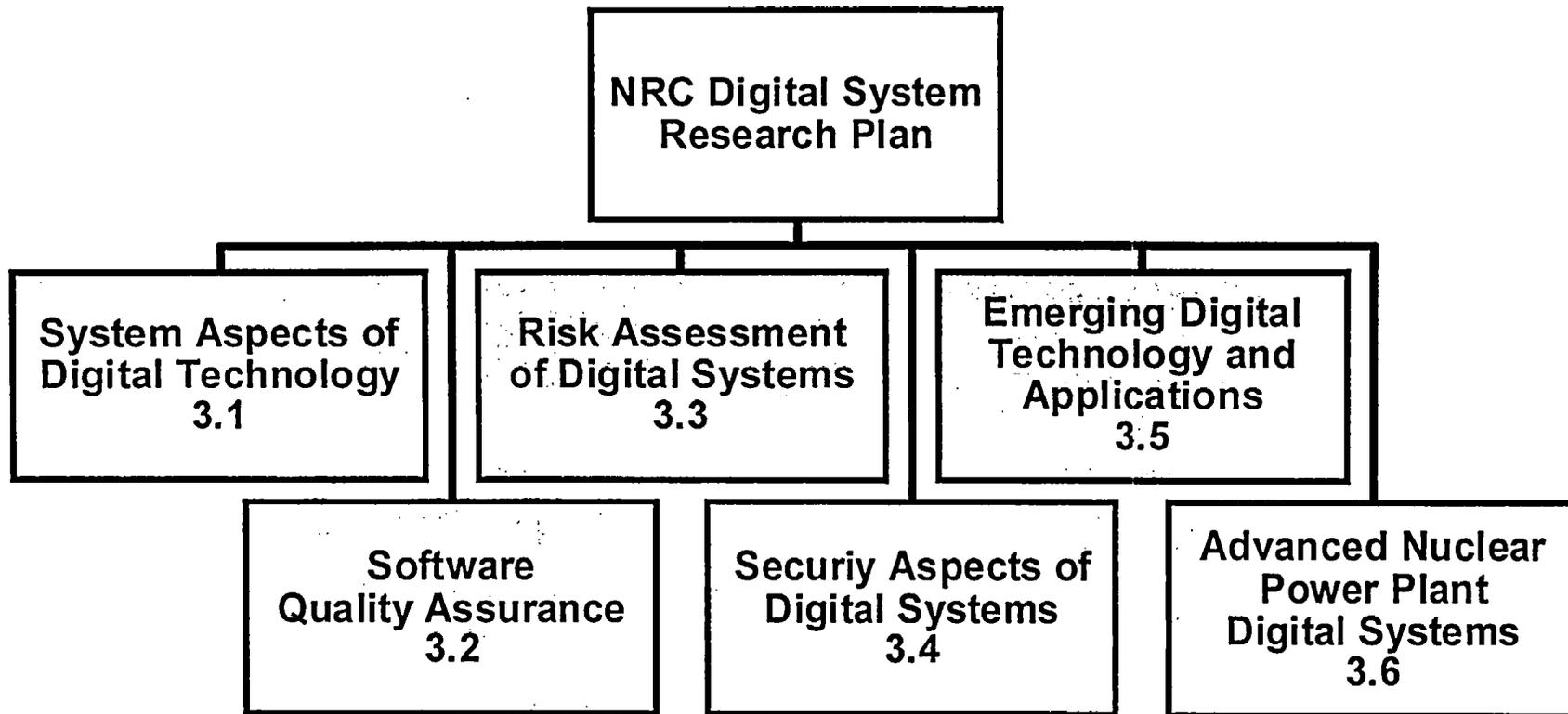


# PRIORITIES FOR CONDUCTING THE RESEARCH

- Inputs included
  - Completing ongoing work
  - Program office inputs
  - Balanced between
    - Current regulatory issues (EMI/RFI, D3, Security)
    - Issues that are anticipated to be regulatory issues in the short term (FPGAs, OLM, digital system risk)
    - Following emerging technology that might require future licensing reviews (smart transmitters, self testing methods)
- Supports NRC strategic plan strategies
- Incorporated in the Plan (in Section 4) as
  - Relative priority (high, medium and low)
  - Determined based on operational experience, program office requests and likely application schedule
  - Projects scheduled based on priority and available resources
- Used to support RES budget process

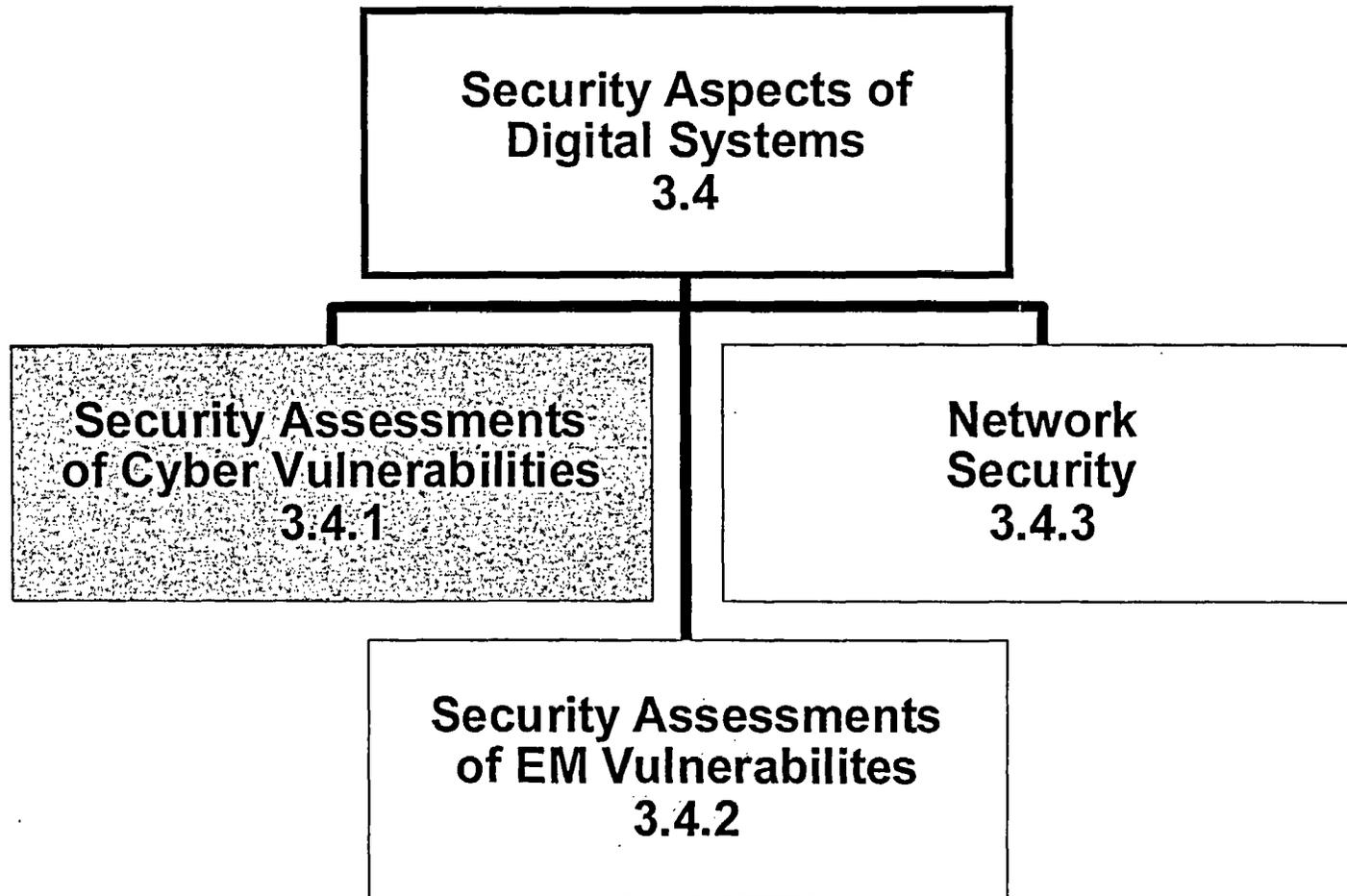


# RESEARCH PROGRAMS





# SECURITY ASPECTS OF DIGITAL SYSTEMS





# SECURITY ASPECTS OF DIGITAL SYSTEMS

- Cyber security is an NRC concern that has been heightened since the events on 9/11
  - Attention to non-safety as well as safety systems
  - New look at safety systems
- Digital system security requires addressing potential vulnerabilities during system development and after installation
- Current regulation, orders and guidance establishes security criteria for the use of digital systems



# SECURITY ASPECTS OF DIGITAL SYSTEMS

- Additional guidance is needed to develop detailed acceptance criteria and review procedures, and training for reviewers
- Past research indicates that additional information is needed
  - Safety System Isolation Study
  - Protocol Robustness Analyses
  - Network Security Tool Vulnerability Case Study
  - NSIR projects
    - Power Reactor Pilot Study
    - Licensee Self-Assessment Methodology
- This program includes three project areas
  - Security Assessments of Cyber Vulnerabilities
  - Security Assessments of EM Vulnerabilities
  - Network Security

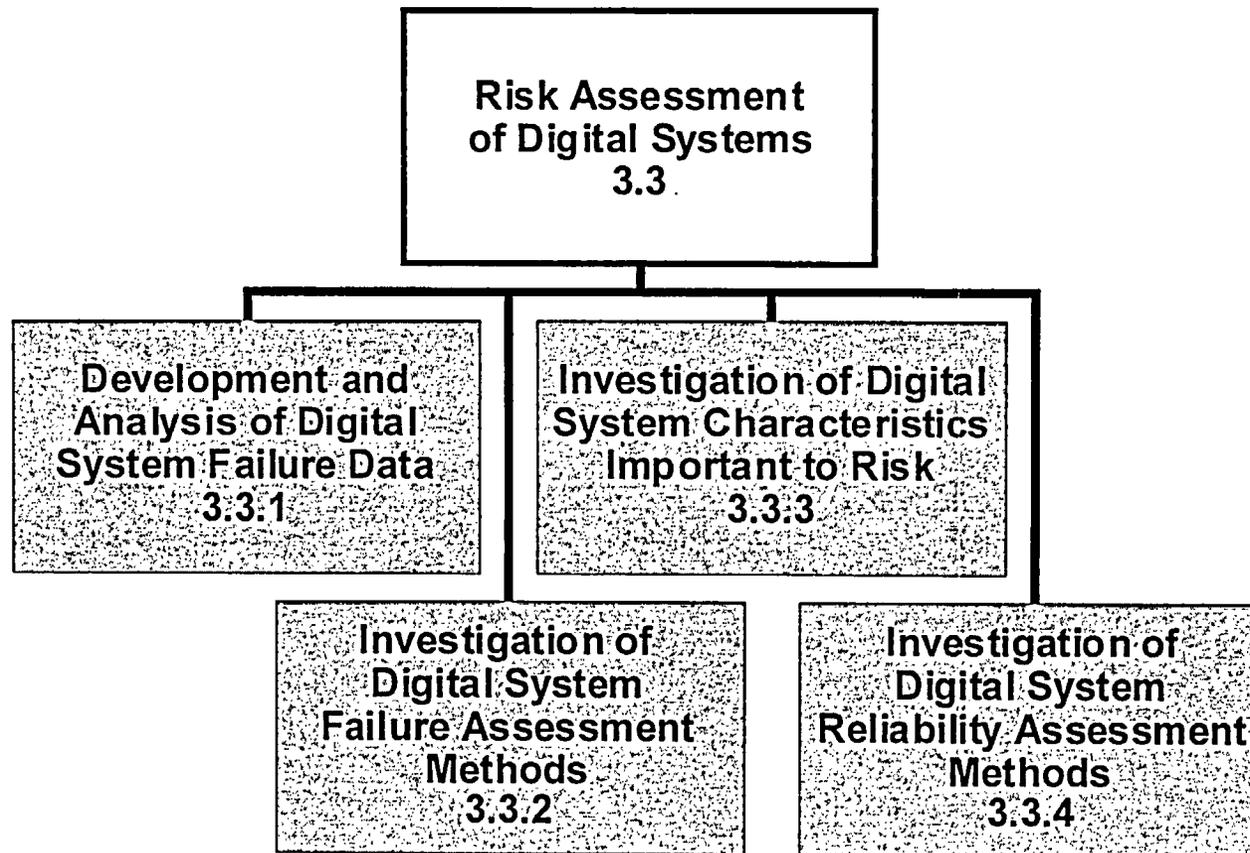


# SECURITY ASPECTS OF DIGITAL SYSTEMS

- As an example the security assessments of cyber vulnerabilities research project will conduct detailed
  - Safety System Assessments,
  - Communication Protocol Assessments and
  - Evaluations of safety  $\leftrightarrow$  non-safety system interconnections
- This research will produce
  - Test reports, including mitigation measures
  - Taxonomy of potential vulnerabilities
  - Methodologies (including procedures and tools) for reviews and inspections
  - Acceptance criteria
  - Policy and regulatory recommendations



# RISK ASSESSMENT OF DIGITAL SYSTEMS





# DIGITAL SYSTEM RISK PROGRAM

- Licensees are replacing analog systems with digital systems
- Licensing these digital systems presents challenges to NRC
  - Consolidation of many analog functions in one digital system challenges traditional diversity and defense-in-depth methods
  - Industry has expressed interest in incorporating risk insights in the reviews of these systems or using risk-informed regulation as an alternate method for licensing these systems (EPRI)
  - Lack of a generally accepted methodology to predict digital system (software) failure probability
  - Research into the limitations of digital systems reliability modeling to support the needed analysis does not currently support expanded use of risk information in licensing digital systems
- As the NRC licensees replace analog systems with digital systems, the current PRAs are not keeping up with these changes
- NRC risk analysis tools and data do not currently support this kind of analysis. NRC risk guidelines currently do not provide acceptance criteria for digital system reviews



## DIGITAL SYSTEM RISK PROGRAM

- The research program is designed to use available information, including failure data and known capabilities of available methods to develop the review methodology
- Available methods and tools for including digital system models will be examined and the most promising ones will be investigated in detail
- Review of current data and development of application-specific databases is on-going and will be used to support methods development

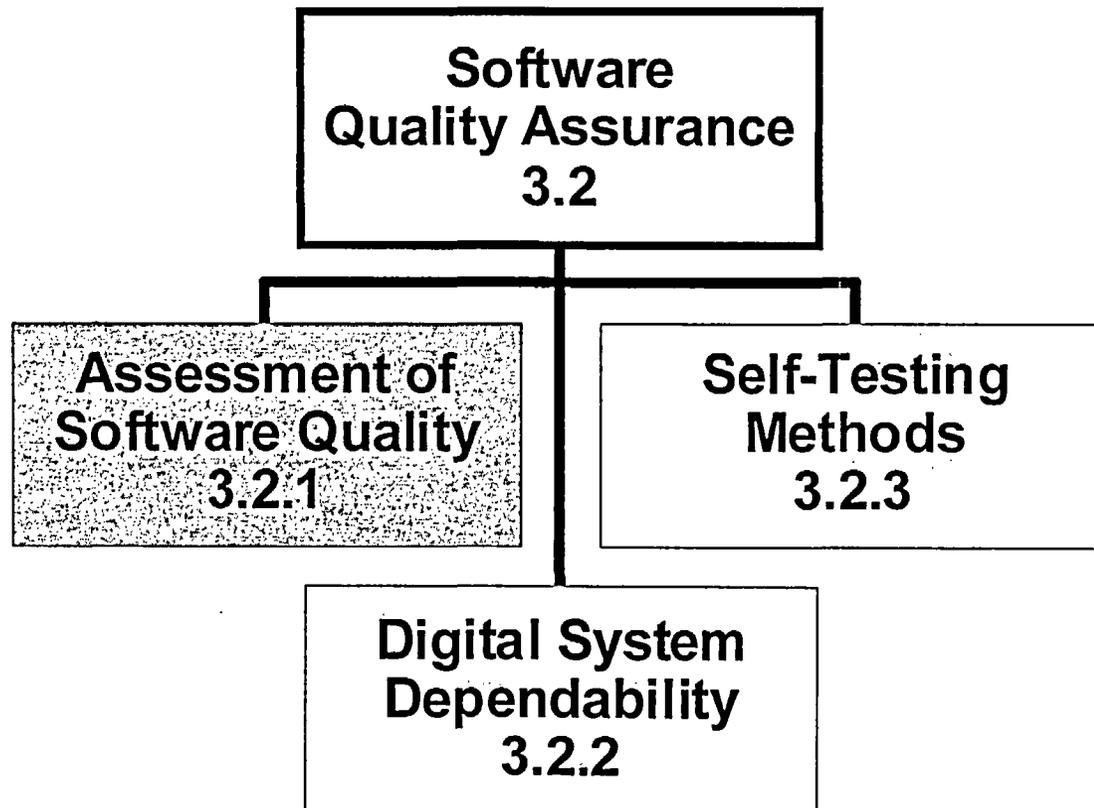


# DIGITAL SYSTEM RISK PROGRAM

- Research is oriented toward developing regulator guidance and providing consistent processes for assessing risk based digital safety system applications
  - Gathering, understanding and using failure data
  - Assessing what modeling methods might be acceptable
  - Determining which systems need to be modeled and at what level of detail
  - Developing and testing methods
  - Developing regulatory acceptance criteria
- New methods for integrating current digital system models into PRAs will be developed
  - Pilot methods using both traditional methods and dynamic methods using models
  - Benchmarks of the capabilities of several methods will be completed
  - Uses and limitations of methods will be explored



# SOFTWARE QUALITY ASSURANCE





# SOFTWARE QUALITY ASSURANCE

- NRC SRP Chapter 7, Rev. 4, June 1997 provides regulatory guidance for reviewing digital safety systems
- NRC SRP Chapter 7 BTP HICB-14 identifies digital system development attributes that should be reviewed, but does not provide detailed guidance on the process for confirming that the software conforms to acceptance criteria
- As part of its review of digital safety systems, NRC evaluates safety related software quality by reviewing
  - System and software specifications
  - Development processes (e.g., V&V, CM) and
  - Software development products (e.g., SRS, SDD, Test plans, Code listings, RTM)
- SQA evaluations are performed manually, since assessment tools or other means of obtaining quantitative measures of software quality are not available
  - Time consuming
  - Highly dependent on the skill and experience of the individual reviewer
  - Acceptance criteria is not quantitative



## SOFTWARE QUALITY ASSURANCE

- The current state-of-the-art in software system safety assessment includes a number of methods and tools for quantitatively assessing the quality of software:
  - Software system analysis techniques (e.g., Petri-net analysis, Markov Analysis, Dynamic Flow Modeling)
  - Software metrics
  - Formal verification methods
  - Testing Techniques (e.g., Data Flow Testing, Fault Injection, and Mutation Testing)
- None of the these methods have found wide-spread uses in the nuclear industry



# SOFTWARE QUALITY ASSURANCE

- Given the complexity and sophistication of current digital safety systems, the goal of research in this area is to provide independent assessment methods and specific acceptance criteria that can supplement and augment the existing guidance in Chapter 7 of the SRP
- Research in this area will focus on methods that have likely short term application without the need to do extensive development and apply these to nuclear industry applications
  - Fault injection testing has been used by a number of industries including some nuclear platform suppliers
  - Formal methods have been used in several industries to support safety critical applications
  - Software metrics are currently used for software quality control and continuous improvement (e.g., for programs at CMM level 4 and 5 respectively)

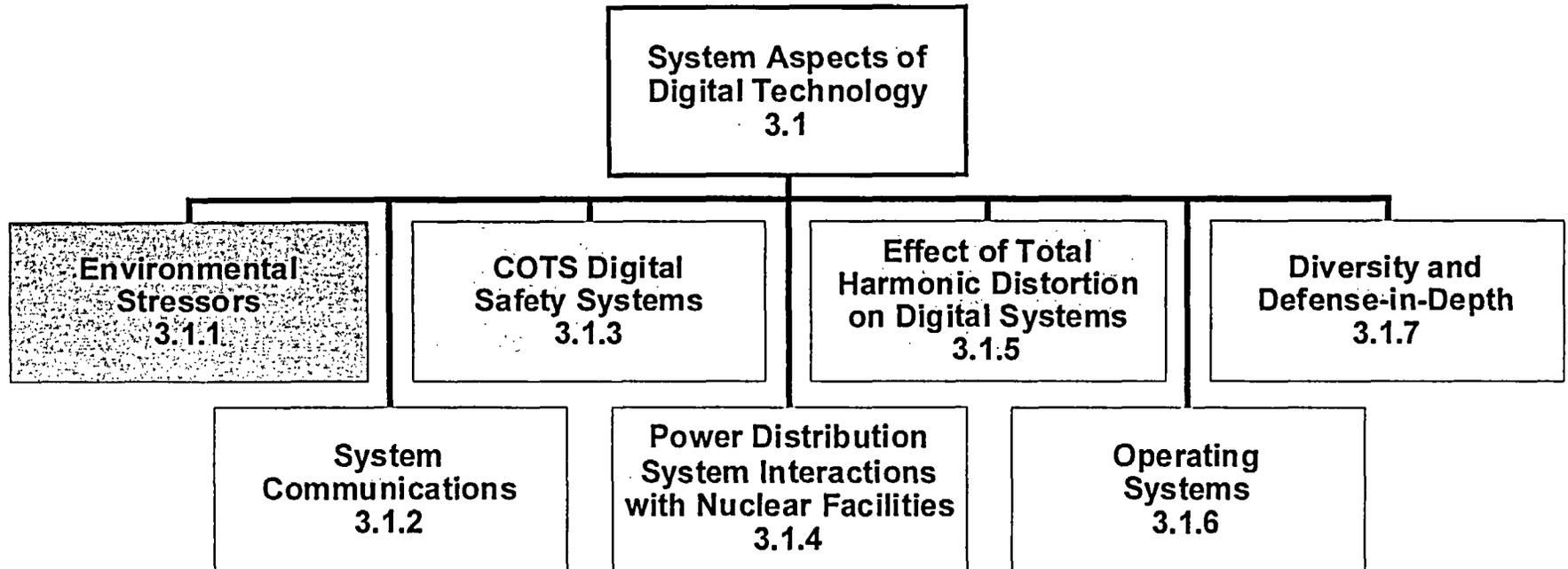


# SOFTWARE QUALITY ASSURANCE

- As an example, there have been a number of software errors in nuclear applications, like the Turkey Point 3 load sequencer failure that would be very difficult to find using the current review process that focuses primarily on a review of the software development process and a limited number of thread audits
- This research area currently focuses on developing methods to help assess software quality and reliability using tools and analysis methods that
  - Permit the reviewer to review more of the code with the same amount of effort
  - Assess the added benefits of self testing and improved development processes
  - Provide objective acceptance criteria and review procedures that augment and supplement existing SRP guidance for approving (or denying) digital safety system license applications



# SYSTEM ASPECTS OF DIGITAL TECHNOLOGY





# SYSTEM ASPECTS OF DIGITAL TECHNOLOGY

- System aspects of digital technology involve factors, both internal and external, that affect the performance of a digital system as a whole
- This research will address aspects of digital systems that can adversely affect safety due to
  - Environmental stressors
  - Systems interactions associated with power distribution and total harmonic distortion effects
  - Operating systems and system communications
  - Diversity and defense-in-depth analysis

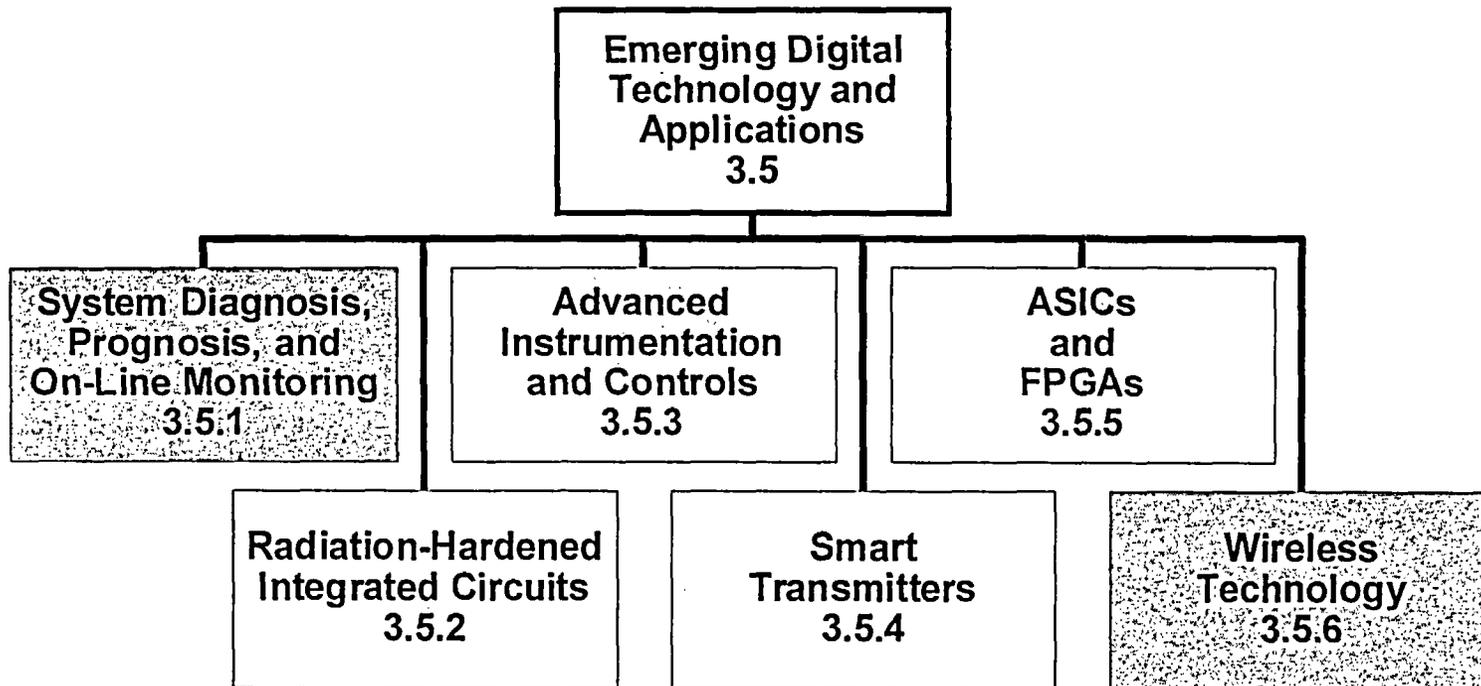


# SYSTEM ASPECTS OF DIGITAL TECHNOLOGY

- As an example, systems interactions associated with power distribution and total harmonic distortion effects are safety issues because newer digital components are more sensitive to power quality and power distribution
  - Higher IC circuit densities
  - Lower voltage requirements for memory states
  - Non-linear loading that can effect power quality
- Current criteria adequate for current designs, but as above increases new criteria may be needed
- There have been several events in which these effects have caused a digital system failures
- The goal of the research is to provide detailed acceptance criteria (IC density and/or power quality) to support regulatory reviews



# EMERGING DIGITAL TECHNOLOGY AND APPLICATIONS





# EMERGING DIGITAL TECHNOLOGY AND APPLICATIONS

- Vendors, licensees, owners groups, and nuclear industry will continue to develop and propose new technologies for nuclear facilities
- A detailed understanding of these emerging technologies is critical for NMSS, NRR, and NSIR staff to license these technologies in safety related applications in an effective and consistent manner
- This part of the research program will include an effort to identify important emerging technology, investigate technologies that may have a regulatory impact and develop the needed information and regulatory guidance before a licensee submits an application



# EMERGING DIGITAL TECHNOLOGY AND APPLICATIONS

- The research program in this area includes
  - Developing technology specific information on the potential application
  - Developing assessment tools and review methodologies
  - Revising regulatory guidance to support unique features of each new technology and establish acceptance criteria
  - Adopting the SRP for unique technologies
  - Developing the supporting training curricula
- Ongoing projects include
  - Emerging technology evaluations (every 2-4 years)
  - On-line monitoring
  - Wireless technology
- Future projects include
  - System diagnosis and prognosis
  - Advanced instrumentation and controls
  - Radiation-hardened integrated circuits
  - ASICs and FPGAs
  - Smart transmitters

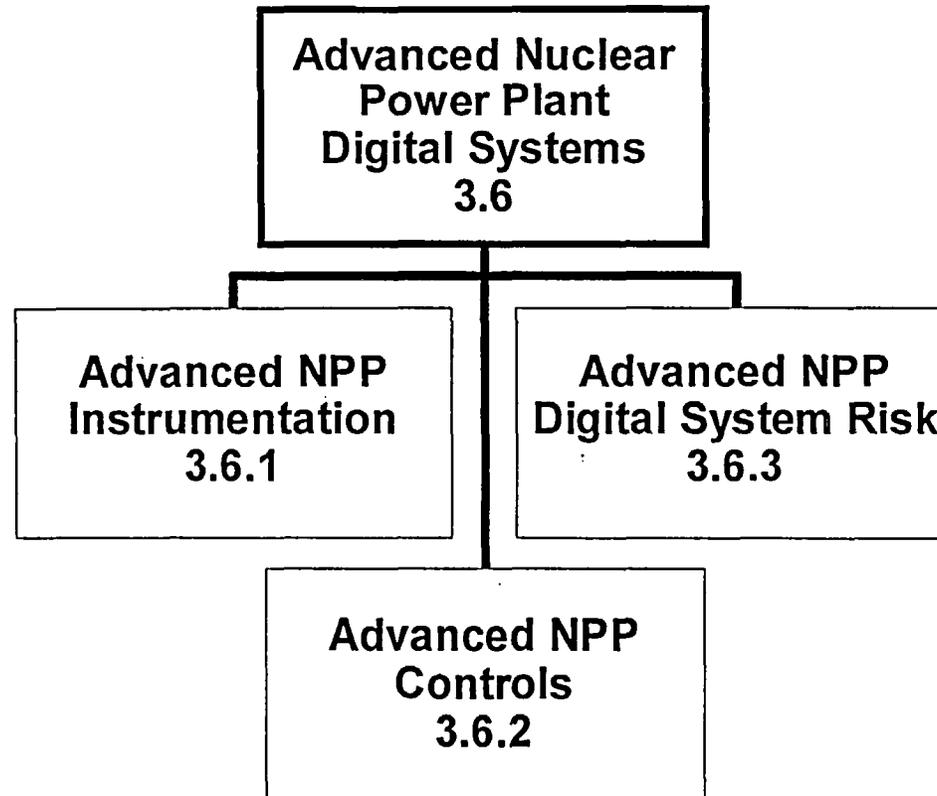


# EMERGING DIGITAL TECHNOLOGY AND APPLICATIONS

- As an example, application specific integrated circuits (ASICs) and field programmable gate arrays (FPGAs) are now starting to be used in safety applications
- FPGAs are currently being used by Toshiba in safety systems for international nuclear applications
- FPGAs shift the complexity that might otherwise be in software to the hardware and design tools
- Current review guidance is based on software driven systems
- This research will
  - Evaluate the safety aspects (design, V&V, etc.) of ASICs and FPGAs
  - Develop safety assessment techniques and acceptance criteria for these devices
  - Support modifications of current regulatory guidance (SRP) to include this emerging technology



# ADVANCED NPP DIGITAL SYSTEMS





# ADVANCED NPP DIGITAL SYSTEMS

- Advanced reactor designs could result in new instrumentation and control technologies, and might present new regulatory challenges
- To date, new reactor vendors have not identified any new technologies, however as the actual implementation come closer, advanced I&C designs are expected to be incorporated
- Research projects are dependent on advanced reactor design pre-application reviews and COL applications
  - EPR
  - AP1000
  - ESBWR
  - ACR-700
  - PBMR



## ADVANCED NPP DIGITAL SYSTEMS

- Advanced reactor designs may apply new I&C technologies in safety, important to safety and non-safety systems
  - Robotics, artificial intelligence, autonomous controls, fully integrated DCS, new instrumentation, etc.
  - Research is organized into three basic areas
    - Advanced nuclear power plant instrumentation
    - Advanced nuclear power plant controls
    - Advanced nuclear power plant digital system risk
- No research in progress at this time



## SUMMARY

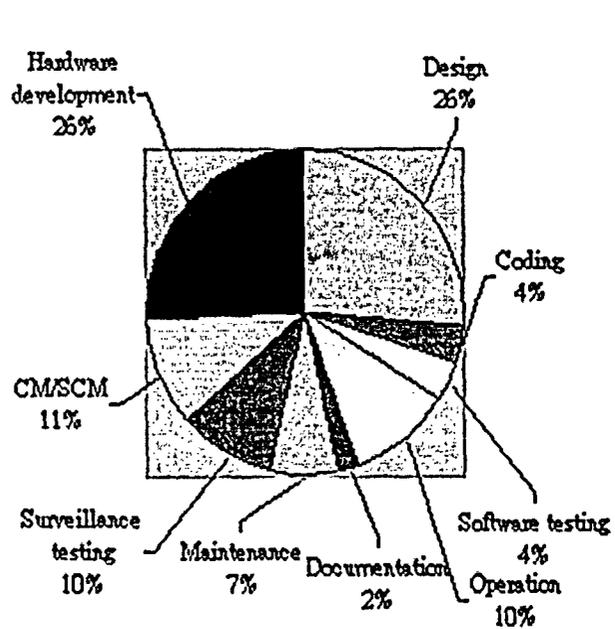
- NRC Digital System Research Plan FY 2005-2009  
Provides a flexible, adaptable framework for supporting NRR, NMSS and NSIR regulatory requirements
  - Broad-based program oriented toward providing more consistent processes for regulating nuclear applications
  - improving review methods for new applications of existing technologies, advanced technologies and new issues
  - developing regulatory acceptance criteria
- The staff requests that the ACRS endorse the plan and continue to provide inputs on how to improve the research program
- RES is looking forward to working closely with the ACRS as the research is implemented



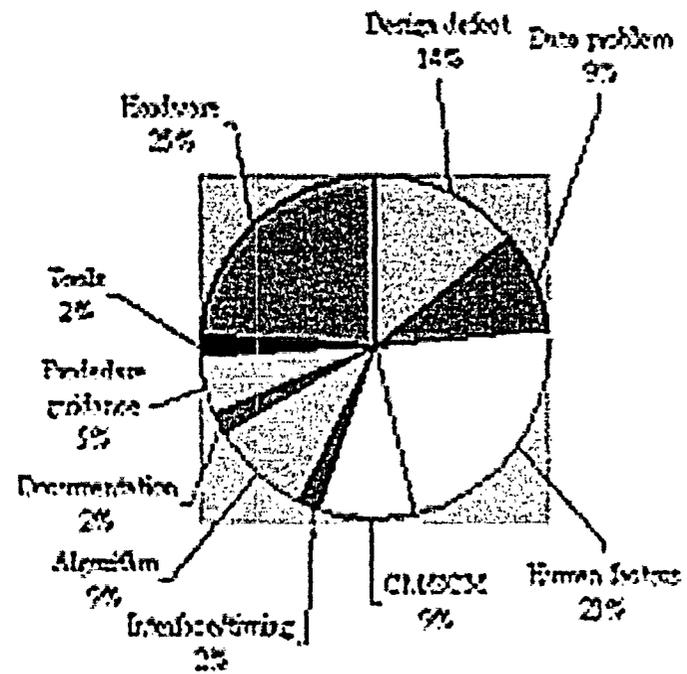
# BACK-UP SLIDES



# CURRENT SITUATION



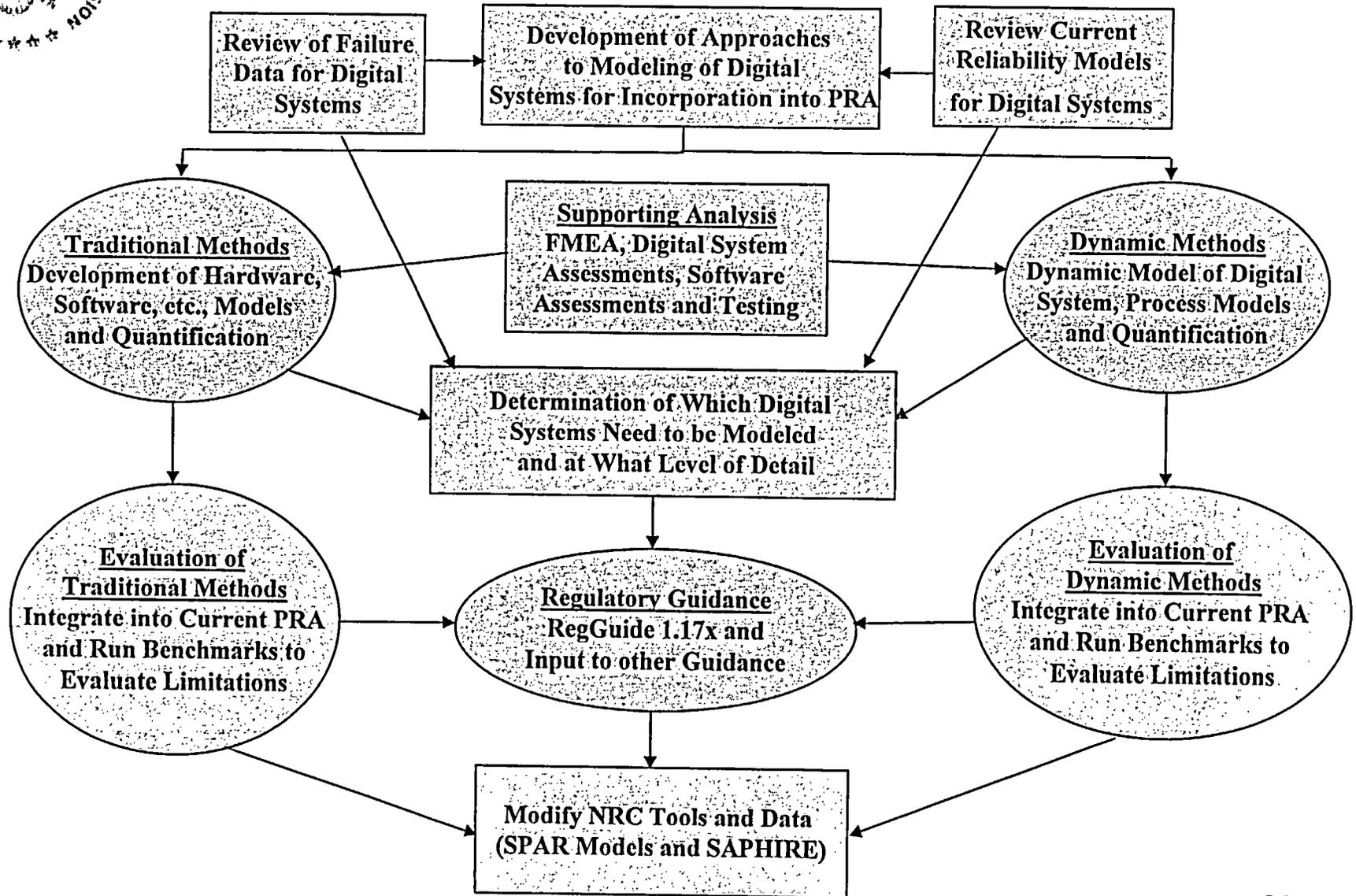
Stage where fault was inserted



Type of fault

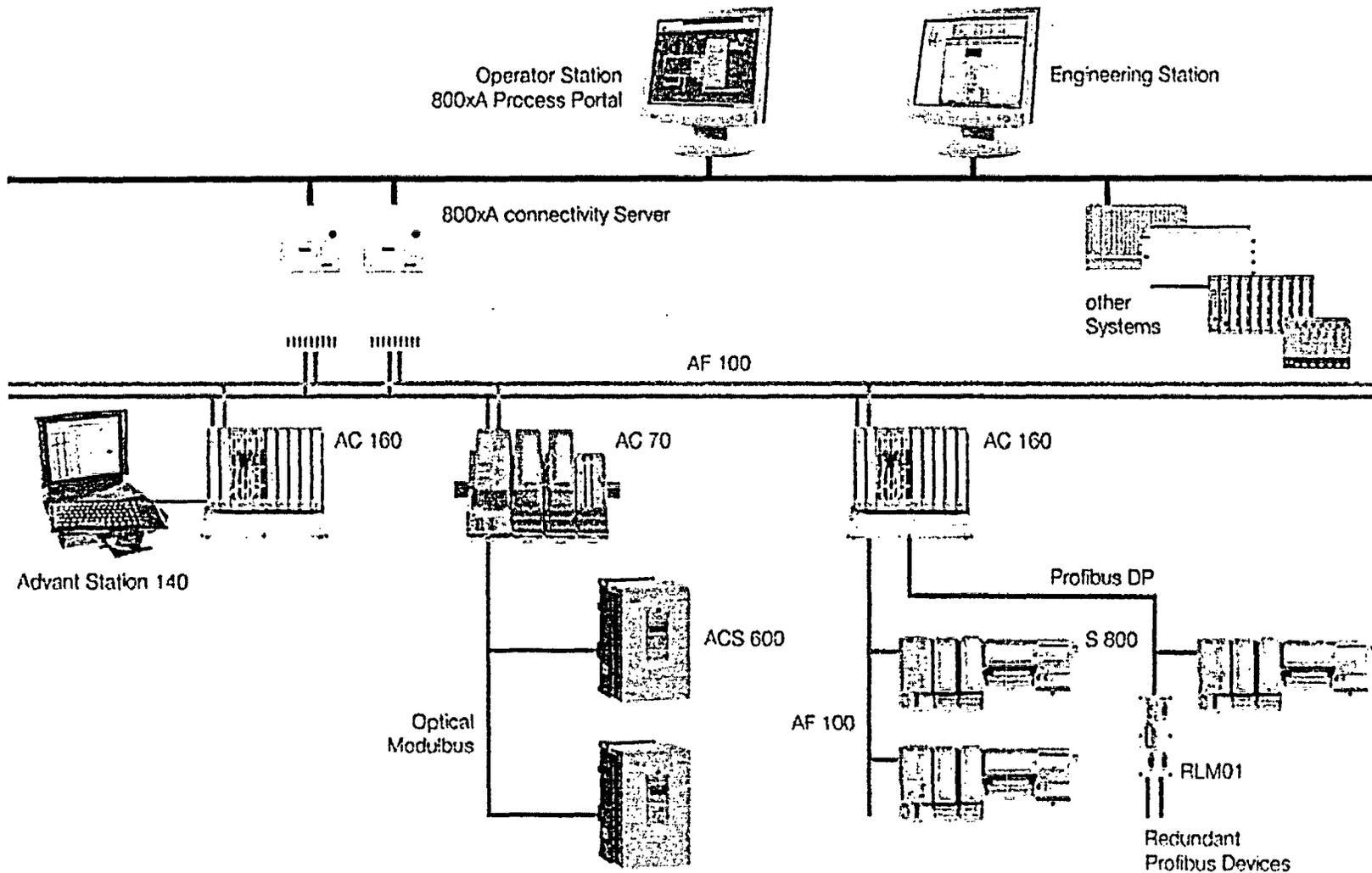


# NRC Digital System Risk Program





# SECURITY ASPECTS OF DIGITAL SYSTEMS





NRC's Overall Safety Mission

# Building on the Reactor Oversight Process

Public Health and Safety (as a Result of Civilian Nuclear Reactor Operation)

Strategic Performance Areas

Reactor Safety

Radiation Safety

Safeguards

NMSS

Cornerstones

Initiating Events

Mitigating Systems

Barrier Integrity

Emergency Preparedness

Occupational Radiation Safety

Public Radiation Safety

Physical Protection

Digital I&C

- Function and Unique Characteristics
- How are they reviewed now?
- What evidence is there that improvement is needed?
- Is improvement related to Effectiveness? Efficiency? Regulatory Burden? Other?
- Are there any metrics to measure success of a project?



# Operator Manual Actions Rulemaking

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**Sunil Weerakkody, Chief**  
Fire Protection Branch  
Division of Risk Assessment  
Office of Nuclear Reactor Regulation



# Operator Manual Actions Rulemaking

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- Staff introductions
- Purpose



# Operator Manual Actions Rulemaking

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**David Diec, Project Manager**  
Financial, Policy and Rulemaking Branch  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation



# Operator Manual Actions Rulemaking

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- **Background:**
  - Staff briefed ACRS in November 2004
  - Staff published proposed rule in March 2005  
Proposed rule comment period ended in May 2005
  - Staff received early feedback on proposed rule in a Category 3 public meeting in April 2005
  - Staff held Category 2 public meeting in September 2005



# Next Steps in Rulemaking Process

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- Incorporate insights from public comments
- Develop dispositions of public comments
- Develop policy paper with Staff recommendation



# Operator Manual Actions Rulemaking

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Alexander Klein,  
Sr. Fire Protection Engineer  
Fire Protection Branch  
Division of Risk Assessment  
Office of Nuclear Reactor Regulation



# Key Topics

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- Maintaining Safety and Compliance
- Purposes of Rulemaking
- Major Stakeholder Comments
  - ACRS questions
- Staff Recommendation
  - Basis for recommendation
- Closure Plan
- Schedule and Conclusion



# Maintaining Safety and Compliance

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- Continue Inspections of Manual Actions
- Issue Violations Against Non-Feasible Manual Actions



# Purposes of Rulemaking

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- Primary purposes of the proposed rule SECY-03-0100
  - Codify the use of manual actions and its acceptance criteria
  - Avoid the need to process numerous exemption requests
- SRM dated January 18, 2005 stated:
  - “the staff should engage stakeholders to get a clear understanding...the proposed rule would achieve its underlying purpose”
  - “although the exemption process is available...the Commission considers the...rulemaking...or 10 CFR 50.48(c) more desirable in order to minimize the need for future exemption requests”



# Major Stakeholder Comments

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- Public Comments
  - Staff received 14 sets of comments
  - Several hundred individuals commented on November 2003 Federal Register Notice
  - The staff analyzed and considered the comments



# Major Stakeholder Comments

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- Major comments
  - Requirement for automatic suppression is unnecessary [Industry, NEI], [ACRS question]
  - Numerous exemptions will still be needed [Industry], [ACRS question]
  - Alternative rule language proposed [NEI], [ACRS question]
  - IP71111.05T criteria endorsed [NEI], [ACRS question]
  
  - Objected to the time margin and factor [Industry, NEI]
  - Proposed rule is a backfit [Industry, NEI]
  - Missing an opportunity to risk-inform, performance-base the rule [Industry]
  - Proposed rule abandons defense-in-depth; overlooks security related fires; undermines safety oversight [Public Interest Group]



# Major Stakeholder Comment

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- Requirement for automatic suppression is unnecessary
  - Industry and NEI object to the requirement
    - Fire hazards analysis
  
  - Staff concludes that the requirement for automatic suppression is essential to maintain defense-in-depth
    - One success path with an operator manual action
    - Relatively high failure probability of an operator manual action
    - Fire hazards analyses are deterministic



# Major Stakeholder Comment

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- Numerous exemptions will be needed
  - Industry comment based primarily on requirement for automatic suppression
- Staff position
  - Staff concludes that this would require writing exceptions to the rule to cover all situations
    - Poses a challenge to ensuring safety
    - Each situation is case-specific
    - 10CFR50.48(c), NFPA 805 approach is available



# Major Stakeholder Comment

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- Alternative rule language proposed by NEI
  - Defines several terms in III.G.1
  - Does not change III.G.2
  - Eliminates III.P
- Staff position
  - Staff considered the alternative rule language
  - Staff concluded that alternative language could lead to operator manual actions in areas where there are redundant trains
  - Some operator manual actions may have high probability of failure resulting in an unsafe plant condition
  - Alternative rule language does not ensure defense-in-depth



# Major Stakeholder Comment

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- IP71111.05T criteria endorsed by NEI
  - NEI claims IP71111.05T provides criteria for determining feasibility of manual actions
- Staff position
  - Staff developed the proposed rule acceptance criteria as part of a self-implementing rule
    - Staff wrote the acceptance criteria to be objective, inspectable and enforceable
    - Staff wrote the criteria to also ensure reliability



# Staff Recommendation

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- The staff will recommend to the Commission that the proposed rule on operator manual actions be withdrawn



# Bases for Recommendation

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- Industry comments stating that numerous exemptions will still be needed
  - Does not achieve a primary purpose
  - Does not meet the Commission SRM view
- Option of 10 CFR 50.48(c) is available to industry
  - Addresses Commission SRM direction
- Comments from stakeholders did not support the proposed rule
  - Industry
  - Public



# Closure Plan

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- Staff is developing a Policy Paper that will recommend withdrawal of the proposed rule
- Staff plans to issue a Regulatory Issue Summary (RIS) that will communicate our regulatory compliance expectations
- Staff continues inspecting operator manual actions through the Reactor Oversight Process



# Schedule and Conclusion

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- Schedule
  - Staff plans to submit the policy paper to the Commission by the end of calendar 2005
  - Staff plans to issue a RIS Spring 2006
- Conclusion
  - Staff believes the proposed rule should be withdrawn
  - Staff requests ACRS endorsement of our recommendation