UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Title: BRIEFING ON EVOLUTIONARY AND ADVANCED LIGHT-WATER REACTOR DESIGN ISSUES

Location: ROCKVILLE, MARYLAND

Date: MAY 14, 1993

Pages: 79 PAGES

SECRETARIAT RECORD COPY

NEAL R. GROSS AND CO., INC.

COURT REPORTERS AND TRANSCRIBERS
1323 Rhode Island Avenue, Northwest
Washington, D.C. 20005
(202) 234-4433

DISCLAIMER

This is an unofficial transcript of a meeting of the United States Nuclear Regulatory Commission held on May 14, 1993, in the Commission's office at One White Flint North, Rockville, Maryland. The meeting was open to public attendance and observation. This transcript has not been reviewed, corrected or edited, and it may contain inaccuracies.

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

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

- - - -

BRIEFING ON EVOLUTIONARY AND ADVANCED
LIGHT-WATER REACTOR DESIGN ISSUES

- - - -

PUBLIC MEETING

Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland

Friday, May 14, 1993

The Commission met in open session, pursuant to notice, at 2:30 p.m., Ivan Selin, Chairman, presiding.

COMMISSIONERS PRESENT:

IVAN SELIN, Chairman of the Commission
KENNETH C. ROGERS, Commissioner
JAMES R. CURTISS, Commissioner
FORREST J. REMICK, Commissioner
E. GAIL de PLANQUE, Commissioner

STAFF SEATED AT THE COMMISSION TABLE:

SAMUEL J. CHILK, Secretary

WILLIAM C. PARLER, General Counsel

JAMES TAYLOR, Executive Director for Operations

THOMAS MURLEY, Director, NRR

WILLIAM RUSSELL, Associate Director for Inspections and Tech. Assessment, NRR

ASHOK THADANI, Director, Division of Systems Technology, NRR

BILL BORCHARDT, Section Chief, Division of Advanced Reactors, NRR

1 P-R-O-C-E-E-D-I-N-G-S

2 2:30 p.m.

3 CHAIRMAN SELIN: Well, good afternoon,
4 ladies and gentlemen.

5 We're very pleased to welcome the members
6 of the staff to brief the Commission on several
7 policy, technical and licensing issues pertaining to
8 the evolutionary and advanced light water reactor
9 designs. The Commission has received numerous
10 briefings on these issues in the past, but SECY-93-087
11 represents the culmination of the many papers to the
12 Commission on these policy issues, issues affecting
13 the evolutionary and passive light water reactors.
14 This SECY also provides status on the policy issues as
15 well as the final staff recommendation on some 20
16 issues.

17 I'm sure that the briefing charts -- the
18 briefing today will focus on a certain number -- I've
19 been told that the briefing itself will concentrate on
20 eight issues, but of course you'll be available to
21 answer questions on any of the issues that might come
22 up.

23 I understand that copies of the viewgraphs
24 are available at the entrances to this room.

25 I would like to call your attention to the

1 fact that today is Friday and we could easily go the
2 whole weekend on these issues, but let's try to keep
3 to the schedule. There really is too much material
4 for one briefing. So let's try to keep to the
5 schedule and if it goes into other things, we'll
6 schedule sequels as appropriate.
7 Commissioners, do you have any opening
8 comments?
9 Mr. Taylor?
10 MR. TAYLOR: Good afternoon. With me at
11 the table are Bill Borchardt, Tom Murley, Bill Russell
12 and Ashok Thadani from NRR.
13 As you mentioned, Mr. Chairman, we did
14 pick eight issues to elaborate on today, but are
15 prepared to answer questions on any of the topics that
16 the Commission cares to explore.
17 Tom Murley does have some additional
18 opening remarks.
19 DOCTOR MURLEY: Yes. I wanted to take a
20 word and talk about some of the comments that came
21 from the ACRS in their meeting with you this morning.
22 First we have had several meetings with the
23 Subcommittee on ABWR; eight meetings in calendar year
24 '92, for example, one this calendar year and there's
25 one planned next month in San Jose. So, we have had

1 many interactions. Our commitment to them, my
2 commitment to them and the staff's is that we will
3 work with them early on issues and not wait for our
4 final position in the SER. We have not been waiting.
5 Other than the mere fact that they're meeting on these
6 issues that we talked about, that we're going to talk
7 with you today, is I think an indication of the kind
8 of interactions that we've been having with them.
9 With regard to their final review, I've
10 agreed to give them early drafts of SER chapters as we
11 write them and not wait for the final SER. So,
12 they'll have more than just the six weeks to look at
13 material. They've got six weeks after we finish
14 wrapping up the FSER and send it to the Commission,
15 but they will have had interactions long before then.
16 With regard to your comments on digital
17 INC systems, I am concerned. I think they're giving
18 you a distorted picture of a situation there and I
19 don't know the reason for that, but it is troubling to
20 me and to the staff. We are not blindly applying the
21 concepts of diversity and redundancy that we use to
22 mechanical and electrical systems. We have had -- in
23 addition to our reviews and meetings with General
24 Electric and CE and Westinghouse, the staff has had
25 detailed technical meetings, and not just attended

1 conferences, but detailed one on one technical
2 meetings with Siemens, Electricity de France, AECL,
3 Toshiba, Hitachi, Nuclear Electric in the U.K., and
4 regulatory authorities from France, the U.K. and
5 Canada. We have a four party discussion with
6 regulatory authorities from France, U.K., and Canada
7 and I believe the next one is next month.
8 MR. RUSSELL: Next week.
9 DOCTOR MURLEY: Next week.
10 The nature and the depth of these
11 interactions are well documented in trip reports and
12 meeting reports. We believe we are quite familiar
13 with the status of application of digital I&C in
14 nuclear plants throughout the world and I am quite
15 confident we're not out of step with what is being
16 done and going on in the rest of the world.
17 Now, I think the real question is, is the
18 ACRS out of step. But we're doing all we can. We'll
19 be glad to talk with whoever anyone would suggest.
20 But I think there's more going on here than just
21 technical issues and technical disagreements. This
22 steady drumbeat of ad hominem attacks seems to be
23 aimed at discrediting the qualifications and the
24 competence of the staff in this area. I think we're
25 quite concerned and I'm quite concerned about it.

1 We're prepared to talk about these issues and get into
2 the technical matters today in the briefing.
3 COMMISSIONER ROGERS: Just before you drop
4 by that, Tom, how many of your staff were involved
5 with these meetings with people overseas and others?
6 I think the comment was made, "Well, maybe one person
7 has done that."
8 DOCTOR MURLEY: Yes. I have sat in on all
9 day meetings myself with Siemens and Nuclear Electric,
10 for example.
11 Bill, would you care to estimate?
12 MR. RUSSELL: I would say that I
13 personally have been involved in on the order of
14 between a half a dozen and a dozen meetings. The more
15 detailed ones we have had division director, branch
16 chief, section leader in technical reviewer
17 involvement. Tom mentioned the four party agreements.
18 We typically send four staff to those and they get
19 into very detailed technical discussion about design
20 and regulatory approaches and the rationale behind
21 approvals.
22 I need to comment for the record that that
23 information is provided under our international
24 agreements and is not publicly available. So, while
25 we have sent it to the Commission and we have provided

1 the information to the ACRS, it has not been discussed
2 publicly because of the requests of the foreign
3 governments that are involved. Also because it
4 involves proprietary design information from reactors
5 overseas. We've had very detailed technical
6 discussions in Switzerland and other countries, down
7 to and including the point where we've now signed
8 agreements for exchange of information on those,
9 including results during testing. We meet frequently
10 with them and we have consciously increased our
11 overseas contacts basically through bilaterals, but we
12 also participate in standards development activities,
13 including having a member on the staff who is the
14 chairman of the international committee developing
15 standards in this area.
16 So, I would say that the majority of the
17 staff have been involved. It is not one person and
18 there has been extensive management involvement such
19 that management can hear directly from the other
20 countries and the regulators as to what the approaches
21 are. So, we're trying to make sure it is a balanced
22 view.
23 CHAIRMAN SELIN: Well, what I'll do is
24 I'll say to you the same thing I said to the ACRS this
25 morning. I don't understand and I don't appreciate

1 all of this discussion about yes, people are doing the
2 right thing, but do they really believe it or what is
3 the reason for this. I would like to keep this
4 discussion -- I don't mean just this afternoon, but in
5 general, as much as we can on the facts of this is the
6 standard review plan, this is the review, this is the
7 design, these are the steps that are taken, and to
8 avoid what I assume you're saying, Doctor Murley, and
9 I agree with you, on just needless speculation as to
10 what people really believe and what their motivations
11 are. It's not really fruitful. What is important is
12 the work that's done and whether it's appropriate
13 work.
14 DOCTOR MURLEY: I'll just close saying I
15 believe we're on the right path. We'll take technical
16 comments from any source, any direction. We're always
17 willing to amend our views and to learn and I'll just
18 leave it there.
19 COMMISSIONER de PLANQUE: Could I just ask
20 a question here?
21 I sense that maybe there's discussion of
22 apples and oranges. I didn't sense so much that the
23 criticism was in the interaction within the nuclear
24 regulatory community internationally but just in the
25 general computer expert community. I don't know if

1 anybody else sensed that, but I saw it as them talking
2 about interactions beyond regulators or beyond the
3 nuclear business. Is there any flavor of that?
4 DOCTOR MURLEY: There was that theme as
5 well. That's almost a secondary theme, but it is
6 there. The real question gets as to what is NRC's
7 role in turning around the whole world? That's an
8 issue for the Commission, but it's far more than my
9 staff or I can do.
10 CHAIRMAN SELIN: Your job is very
11 straightforward. It's not to give signals in advance
12 that certain otherwise acceptable approaches would not
13 be welcome, and then to review from a health and
14 safety point of view the designs that do come on. I
15 think you appreciate that and I think that's what has
16 to be looked at. As I said this morning, we're not
17 designing the reactors, but if we tell people that
18 certain designs would be acceptable and certain won't,
19 then we have to make sure that there are good health
20 and safety reasons.
21 DOCTOR MURLEY: Yes. We do have
22 legitimate concerns about redundancy and diversity in
23 common mode failures. There's no question about that.
24 But we're willing to listen. We have changed our
25 views. We're willing to always listen on a technical

1 and a safety matter.

2 CHAIRMAN SELIN: I think it's clear that

3 the staff's views have, in fact, evolved enormously in

4 the last couple of years, in my own personal opinion,

5 in the right direction.

6 MR. TAYLOR: We'll continue then.

7 Tom? Bill?

8 DOCTOR MURLEY: Bill?

9 MR. RUSSELL: Bill Borchardt will cover

10 the introduction and then I'll go into the specific

11 eight issues.

12 MR. BORCHARDT: SECY-93-089 is a follow-on

13 to the Commission paper 90-016 which addressed issues

14 for evolutionary designs and is the result of over

15 three years of effort by the staff with active

16 interaction with the ACRS and the industry. Fourteen

17 branches from all of the technical divisions within

18 NRR participated in the development of the staff

19 positions and recommendations presented in this paper.

20 Some of the issues in this paper were

21 addressed and resolved for the evolutionary designs in

22 SECY-90-016. Two draft Commission papers were

23 published last year which were the subject of four

24 ACRS meetings and several meetings with the industry.

25 There's 42 issues covered in this

1 Commission paper and they can be broken down into
2 three basic categories; the first being the 20 where
3 the staff is requesting Commission approval of its
4 proposed position. Second are 13 issues that will be
5 the subject of future Commission papers, and third are
6 the issues such as level of detail and ITAAC that the
7 staff has discussed for the Commission's information
8 but does not believe that there's a policy issue.
9 (Slide) Can I have slide 3, please?
10 This slide shows the 20 issues where the
11 staff has provided recommended final positions for the
12 Commission's consideration. The final positions are
13 underlined in the Commission paper and are the result
14 of significant interaction with the ACRS, the industry
15 and individual vendors. The recommended positions are
16 currently being used in the ongoing evolutionary and
17 passive design reviews.
18 Because of the time constraints today,
19 we've selected eight issues to discuss in detail and
20 those are marked with an asterisk.
21 (Slide) Can I have slide 5, please.
22 There are 13 issues discussed in the
23 Commission paper relating primarily to the passive
24 designs that will be the subject of future Commission
25 papers. Final staff recommendations have not been

1 developed yet, but a discussion of the issues is
2 provided for the Commission's information and to serve
3 as a starting point for further ACRS interaction and
4 interaction with the individual vendors.
5 There's four Commission papers in various
6 forms of development right now, the first being
7 regulatory treatment of non-safety systems for the
8 passive designs, a source term paper that discusses
9 the use of the revised source term, an emergency
10 preparedness paper, and the staff on April 1st issued
11 a draft of the combined license form and content paper
12 which we briefed the ACRS on this morning.
13 (Slide) May I have slide 6, please?
14 COMMISSIONER REMICK: The proposed
15 schedules of those four are in 087? I'm trying to
16 recall where I saw proposed schedules. For example,
17 emergency planning. If I recall you were going to
18 have a draft in May.
19 MR. BORCHARDT: I believe the last time we
20 really provided a schedule publicly was in the last
21 semi-annual Commission meeting that we had. It's not
22 discussed in the scheduled paper specifically.
23 COMMISSIONER REMICK: Am I dreaming? I
24 thought I just read recently the proposed schedule in
25 several of these.

1 Well, let me be specific. On emergency
2 planning, when will we get a draft of that?
3 DOCTOR MURLEY: We will be coming to brief
4 the Commission on June the 2nd with regard to
5 schedules in general. Why don't we fill you in at
6 that time?
7 COMMISSIONER REMICK: Okay. All right.
8 Fine.
9 DOCTOR MURLEY: We do not have agreement
10 yet with EPRI. We're still waiting -- to give you a
11 short answer on this one, still waiting for a proposal
12 from EPRI on emergency planning.
13 MR. RUSSELL: What you're thinking about,
14 I believe, is that there was information due in from
15 EPRI on what their overall approach was going to be.
16 Information did come in, but it was in the context of
17 changes to the EPRI requirements document to preserve
18 an option for consideration of changes related to
19 emergency preparedness. We believe that their paper
20 is not going to be in now until close to the end of
21 the year, so we don't see a basis for changing the
22 positions regarding emergency preparedness between
23 evolutionary and passive reactors. There may be some
24 fine tuning related to emergency action guidelines or
25 other issues which are design specific, but broadly

1 the approach would be consistent with what we're doing
2 now in evolutionary plants.
3 COMMISSIONER REMICK: Okay.
4 MR. BORCHARDT: Slide 6 shows nine
5 additional issues that are provided for the
6 Commission's information, but the staff does not
7 believe there are currently policy questions that need
8 to be resolved. The staff's activities relating to
9 these issues are within the current regulations and
10 previously approved Commission positions. The staff
11 doesn't intend to discuss these in any future
12 Commission papers unless new information becomes
13 available that require Commission decision.
14 Now I'll turn the presentation over to
15 Bill Russell for a discussion of the eight topics.
16 MR. RUSSELL: (Slide) Could I have slide
17 number 10?
18 The first issue I'll discuss will be
19 hydrogen control and the issue here is that we require
20 containments be designed for control of hydrogen
21 generation following an accident. The position we're
22 proposing is that 100 percent active cladding
23 oxidation, which is currently in the regulations, be
24 continued. We look at a ten percent global, but
25 because of uncertainties associated with

1 concentrations of hydrogen, the potential for
2 stratification and local effects, we believe that it's
3 appropriate to have physical methods in the
4 containment to mitigate the consequences of high
5 concentrations and the potential for local combustible
6 concentrations.
7 Based upon the discussion with the ACRS
8 this morning, I do not believe there is a disagreement
9 as it relates to the broad policy issues of providing
10 the capability to effectively control hydrogen or that
11 some means may be needed to do that. The issue really
12 revolves around how many igniters and what is the
13 appropriate placement of igniters to ensure that local
14 concentrations do not build up. We agree that that is
15 an issue. It's one that is still under discussion and
16 that we believe there are technical approaches to
17 addressing that. So, we do not see that as an issue
18 which would impact the ability of the Commission to
19 make a decision on the broader issues of the need to
20 be able to address that because of the uncertainties
21 in distribution of hydrogen within containment.
22 That's really the policy issue that we're
23 asking for a Commission decision.
24 COMMISSIONER REMICK: And based on --
25 MR. RUSSELL: If there are no questions on

1 hydrogen, we move to the next one.

2 COMMISSIONER REMICK: Just one and it goes

3 back to the briefing that I had a week or so ago,

4 prebriefing for this. If I recall, the staff has not

5 precluded the concept of catalytic converters if

6 proposed. Is that correct?

7 DOCTOR THADANI: Commissioner Remick, as

8 a matter of fact, most recently, the last few days, we

9 just received a report from EPRI and what they

10 indicate is that they are going to very likely go with

11 these passive autocatalytic devices that were

12 developed in Germany and have been tested in Germany.

13 If, in fact -- and they have proposed, in fact,

14 location of these devices in both the System 80+ as

15 well as AP600 designs.

16 If that is the decision of the designers,

17 it takes care of some of the concerns that have been

18 raised about performance of igniters in presence of

19 steam and so on. But we will plan to review these

20 very carefully in case they introduce some other

21 issues. But it appears that that's the direction that

22 they are going in actually.

23 MR. RUSSELL: But the simple answer to

24 that question is we have not ruled out the potential

25 for passive devices. What we do feel is that some

1 type of device is needed to be able to address the
2 uncertainties associated with hydrogen distribution
3 within the containment.
4 (Slide) Slide number 11, please.
5 This is what I will characterize as the
6 practical engineering approach to core debris. We
7 believe that the subcompartment under the vessel
8 should have adequate spreading area to spread the
9 debris. The design should provide for a means to
10 flood that area after the debris has been deposited
11 and to provide means for protecting important
12 structural members such as the containment liner or
13 structural components associated with vessel supports,
14 et cetera, or to show that the loss of those materials
15 does not impact structural integrity and lead to
16 undesirable effects.
17 This level of approach, the approach I've
18 just described, is being implemented now in fairly
19 significant detail in the evolutionary plants, looking
20 at the details of the design of the subcompartment
21 areas, looking at the structural capability to
22 withstand loss of concrete or structural materials.
23 In general this is an area where I would characterize
24 that reasonable progress is being made.
25 In this morning's discussion, the ACRS

1 commented on the rationale for the change from
2 quenching that was described earlier to coolable in
3 this context. I would characterize that there is
4 certain uncertainty in the phenomena, that some of the
5 testing has raised questions about whether a crust
6 would be formed and whether something would indeed be
7 quenchable or not. We believe that the fundamental
8 issue of concern is that the core, the corium in fact
9 be able to be cooled, that you can remove that, and we
10 are also looking at this in combination with the
11 position we've taken on containment performance. That
12 is essentially that containment be able to withstand
13 these type of phenomena for essentially a period of
14 approximately 24 hours based upon strength and
15 robustness of the containment design.
16 So, we don't see these issues in
17 isolation. We do believe that there is some
18 uncertainty as to the phenomena and we did address the
19 issue that we are interested in coolability in the
20 longer term.
21 COMMISSIONER ROGERS: There was an issue
22 raised about the floor space, the floor area.
23 MR. RUSSELL: Yes.
24 COMMISSIONER ROGERS: A factor of two
25 difference there apparently between what somebody

1 calculates and what someone else calculates. The
2 question or the comment was made that the calculation
3 should be sharpened up to try to define that better.
4 What is your opinion?
5 MR. RUSSELL: Our opinion is that we do
6 not wish to get into numerical calculation to
7 establish an acceptance criteria. We neither endorse
8 nor reject the .02 meter squared per megawatt thermal.
9 We believe that this is an issue that should be looked
10 at from the standpoint of practicality of the design,
11 provide features to ensure retention of structural
12 integrity, to be able to spread it to the extent it's
13 practical, to be able to flood it, but we do not wish
14 to get into an analytical basis for the design and to
15 convert this into something like a quasi-design basis
16 accident where you have to have conservatism and
17 analysis, et cetera.
18 So, we are intentionally staying away from
19 the use of a numerical value to determine
20 acceptability or non-acceptability of a design.
21 DOCTOR MURLEY: We're not against
22 additional calculations. Bill said it exactly right.
23 This is an area that is, even in spite of all the
24 years of research, it's not -- as you know, we don't
25 have the certainty that we do with ECC systems. So,

1 we would continue to follow the research, continue to
2 do calculations, but we think this approach here is a
3 solid one where the designers take prudent and
4 reasonable steps to deal with debris, but we do not
5 want to make it a design basis.
6 DOCTOR THADANI: And I might just note
7 that we are looking at calculations, a reasonable set
8 of calculations with a reasonable set of assumptions.
9 One can always come up with "what if" type questions
10 and go to some bounding calculations. The issue is
11 no, you ought to really understand what's going on,
12 both in terms of containment performance, core
13 concrete interactions and so on, as well as oblation
14 and support structures and so on. We are looking at
15 those, but not in the context of so-called design
16 basis type accidents, conservative analyses and so on.
17 COMMISSIONER REMICK: Your position on the
18 .02 is consistent with what it was in 90-016.
19 DOCTOR MURLEY: Yes.
20 MR. RUSSELL: Yes, it is. It is
21 unchanged.
22 (Slide) Could I have slide number 12,
23 please?
24 The issue here is essentially one about
25 providing a highly reliable depressurization system to

1 ensure that high pressure melt events are of low
2 probability, but at the same time recognizing that
3 because you're relying on devices it is potential that
4 you could have a scenario that did involve a high-
5 pressure melt. What can you do from a practical
6 standpoint to provide a tortuous path in the cavity
7 area such that you not have a direct ejection into the
8 upper portions of the drywell such that you would be
9 concerned about direct containment heating and the
10 potential for over pressure?
11 So, again, it's similar to the last one.
12 We are interested in providing design features that
13 would be able to mitigate this event were it to occur,
14 even though we also believe that it's very important
15 to have highly reliable depressurization systems. We
16 believe in doing this in a new design before you have
17 poured concrete, et cetera, is something which is
18 practical to do and it does not significantly increase
19 the cost. So, this is again an approach which I would
20 characterize as a practical engineering approach to an
21 issue which has a certain degree of uncertainty, both
22 from the standpoint of the phenomena and its
23 probability, and it's one that we feel we can deal
24 with with a hardware type solution.
25 COMMISSIONER REMICK: Is there a possible

1 trade-off here with the concept of the cavity design
2 to preclude the ejected corium from affecting
3 containment and hydrogen concentration? Will the
4 staff look at that from both standpoints when they
5 review?
6 MR. RUSSELL: Basically at this point in
7 time we're looking at the pathway by which the debris
8 under a high-pressure scenario would be vented and
9 going up into the upper cavity area. That could
10 create areas where you would have potential for
11 hydrogen concentrations. But we'd need to look at
12 that. I know we've been looking at it in the vent
13 lines and off to the stack and capability of valves
14 for their high local concentrations and worrying about
15 the potential for detonation.
16 DOCTOR THADANI: We have been looking and
17 first of all in terms of depressurization approach,
18 that ought to really prevent this kind of scenario
19 from taking place. But we are looking at the loads
20 that are created and have some understanding in terms
21 of what the hydrogen loads would be as well as the
22 pressurization effects.
23 But really the key here is -- that's
24 mostly to make sure we have understanding and so on,
25 but the key here is to focus attention on making sure

1 that the design of the depressurization system would
2 be able to do what it's -- to get the pressure low
3 enough.
4 MR. RUSSELL: (Slide) If I could have
5 slide number 13.
6 This is where I want to pull together all
7 of the issues. The four are very similar in their
8 approach. Then I'll also discuss where we currently
9 are on the ABWR design review.
10 There are some slight changes to the
11 recommendation in this case from what we had in 90-
12 016. We have reached agreement with EPRI and we have
13 described it in the paper as to what we believe are
14 the likely challenge which need to be addressed.
15 We've agreed with the set of 23 for analysis and we
16 are essentially stepping through those, each where
17 applicable and then addressing the capability of the
18 containment to adequately perform. We're using a test
19 that is essentially deterministic to maintain a
20 reliable lead-type barrier for approximately 24 hours
21 under these challenges which we've agreed upon, and
22 essentially after that to provide a barrier against an
23 uncontrolled release of fission products.
24 Previously, in 90-016 for the evolutionary
25 plants, we also had a conditional containment failure

1 probability of .1. We do expect-- and this is
2 somewhat leaning forward in the trenches, so if it
3 turns out to not be the case, don't hold me to it. We
4 believe at this point in time that both the CE
5 evolutionary design and the ABWR design will be able
6 to show a .1 conditional containment failure
7 probability and they will likely also be able to show
8 that they meet the more deterministic requirements for
9 holding level C for approximately 24 hours for these
10 challenges.
11 There is some question on the timing for
12 the ABWR. There is analyses that's been done by the
13 applicant. The staff is doing some independent
14 analyses with Melcor to look at those, to see what the
15 trends are and to really understand the analyses, not
16 necessarily to say both have to be greater than 24
17 hours, but more to probe an understanding of the
18 phenomena.
19 The reason that we dropped the earlier
20 recommendation on .1 is that as you drive the core
21 damage probability down, there are fewer challenges or
22 the challenges remaining have higher uncertainty and
23 so the potential exists that the containment failure
24 probability would be higher. What we're not
25 interested in doing is backing away and adding some

1 challenges in from a core damage standpoint in order
2 to get a conditional containment failure probability
3 of less than one.
4 It's in that context that we felt it was
5 more appropriate to use the deterministic approach
6 rather than the conditional containment failure
7 probability approach to obtain the balance between
8 mitigation and prevention, and not to focus on the
9 probabilistic alone. There is significant uncertainty
10 in the probabilistic approach, particularly as you get
11 to very small probabilities, both from the standpoint
12 of challenge and performance, and that we think the
13 deterministic approach balanced with some
14 understanding of their probability, is the more
15 appropriate way to proceed.
16 DOCTOR MURLEY: Bill, may I add a comment?
17 Nonetheless, the .1 conditional containment failure
18 probability has served us well, I think. It is the
19 goal that's out there. It just turns out that it's
20 not a totally practical thing to use. So, we've
21 changed to a deterministic which we think is
22 comparable to it, but it's more useful to use in
23 regulation. I think in the future, as we move toward
24 more performance-based regulations, we'll find that
25 maybe the performance base has to stand out there as

1 a goal while we still have a deterministic
2 requirement.
3 DOCTOR THADANI: In fact, you can
4 illustrate that point even with this deterministic
5 approach that we're using for a number of challenges.
6 If you have to, let's say, have a system in place, the
7 natural question is does that system have to be
8 redundant, safety grade, et cetera? The answer is no
9 because what kind of level of safety are you after?
10 In that context, it helps you decide should it be a
11 single train, is that good enough or not?
12 So, implicitly, in a way, you are using
13 these probabilistic thought processes and the .1 is a
14 good guidance that helps you decide should you have
15 two systems or one system. So, in that sense, I
16 think -- and we've been saying this, that these are
17 relatively comparable approaches. One is just
18 explicitly and totally probabilistic one. The other
19 one is using probabilistic thinking but having
20 deterministic set of criteria. That's really what
21 we're doing.
22 COMMISSIONER REMICK: As I indicated at
23 the earlier briefing, this is an area where I do have
24 some concern. Not that I differ with anything you
25 said and not that I have any problem with

1 deterministic, but in 90-016 you had the two options,
2 you're either probabilistic and you're saying that you
3 don't want to rely on probabilistic alone. You're
4 saying that they're comparable. Let me make my
5 coherence and consistency approach are arguments.
6 After a decade of arguing about whether a conditional
7 containment failure probability could be devised,
8 you're proposing it in 90-016 and the Commission
9 endorsing it, although having the deterministic
10 backup. Where the evolutionary plants, now we're
11 swinging to just deterministic. There's some lack of
12 coherence and it seems to me if you're making the
13 argument that I hope that could be said, that the
14 probabilistic of ten percent or a tenth could be a
15 goal and the deterministic approach could be a way of
16 demonstrating that you think you've met it.
17 Personally, I much prefer that approach,
18 particularly in light of the fact that I see that the
19 staff has proposed to ACRS that you no longer pursue
20 the large release. Part of that argument is that you
21 now have a core damage frequency and you have a CCDF
22 or -- as surrogates to that. So, just purely from a
23 coherence, people understanding what we do in this
24 agency, if it's possible I sure would like to see the
25 dual approach continue.

1 DOCTOR MURLEY: Yes. I think we would not
2 object. The .1 goal is still there and it's not as
3 firm as we had proposed in 90-016 as a requirement.
4 We've tilted -- okay.
5 COMMISSIONER REMICK: Yes.
6 DOCTOR MURLEY: I think we probably will -
7 - if we haven't made that clear, we should.
8 COMMISSIONER REMICK: No, it comes across
9 that you're now proposing just deterministic.
10 COMMISSIONER ROGERS: Yes. I think Mr.
11 Thadani's comments would cover that, if you'd be more
12 explicit.
13 DOCTOR THADANI: Yes, it would. In fact,
14 it came up at an ACRS meeting and Mr. Ward, who is a
15 consultant to the ACRS, turned around and said, "If
16 you write it that way, we have no problems."
17 COMMISSIONER REMICK: I see.
18 COMMISSIONER ROGERS: Just a question.
19 Where does 24 hours come from?
20 MR. RUSSELL: Judgment.
21 COMMISSIONER ROGERS: Is there anything
22 that says that 24 hours is really a --
23 MR. RUSSELL: Well, we know from our
24 experience with current plants we have a concern for
25 early failure. If it's on less than two hours, you

1 really can't affect much, but really was a judgment
2 for approximately 24 hours.
3 DOCTOR THADANI: If I may, there was a bit
4 more. Two factors went into that thinking and I know
5 Tom remembers it well, I suspect. One was long enough
6 time such that you can actually take some special
7 actions and measures and so on. You may have to --
8 example being if you have to actuate venting system.
9 You have to get a lot of parties together before you
10 make that decision. Timing was important. Reasonable
11 period of time was a key issue.
12 Second part, we did some calculations with
13 available tools to see what the source term might be
14 under certain conditions and we convinced ourselves
15 that within about 12 hours the source term would be
16 low enough that you would probably not even exceed
17 Part 100 guideline values. So, those were the two key
18 factors.
19 COMMISSIONER ROGERS: Well, that was what
20 I was trying to get at, whether you had some
21 considerations such as that.
22 DOCTOR MURLEY: Plus, our thinking of the
23 time needed to take emergency preparedness actions.
24 COMMISSIONER ROGERS: It would be rather
25 nice, I think, to see just a little summary of these--

1 DOCTOR THADANI: We can get that.

2 COMMISSIONER ROGERS: Without making a big
3 project of it, but just the backup for 24 hours. Why
4 24 hours is a good number by itself.

5 DOCTOR THADANI: Yes, we can do that.

6 MR. RUSSELL: But the precision of that,
7 we say about 24 hours and while the factors we've just
8 discussed, there is considerable uncertainty as to how
9 much time you were need to carry those out. So, in
10 the context of whether it's 12 hours that the source
11 term gets down, it wasn't as sophisticated as we want
12 to put a factor of two on 12 hours in a deterministic
13 way and say about 24. We considered a number of
14 factors and then came up with a judgment that about 24
15 hours was correct.

16 COMMISSIONER CURTISS: Bill, before you go
17 on, while you're on this subject, could you expand
18 upon what your current thinking is and where you may
19 be headed with the advanced notice of proposed
20 rulemaking on severe accident? Or Tom, I guess.

21 MR. RUSSELL: Yes. Tom and I spent a lot
22 of time on this.

23 DOCTOR MURLEY: We had a discussion of
24 that today. What we propose to do is continue our
25 analysis of the comments, continue our dialogue with

1 the ACRS on this and in parallel with the reviews that
2 are going on here, follow the activities that are
3 being done in our last stages of ABWR and System 80+
4 review. When we wrap up our final safety evaluation
5 report and the FDA so the staff is firmly locked into
6 those positions, then we would propose -- having kept
7 in parallel the activity, that we would then propose
8 moving ahead with advanced notice of proposed rule
9 that would be consistent with the positions we've
10 taken in the ABWR and the CE 80+.
11 COMMISSIONER CURTISS: The approach would
12 be to use the design reviews as the vehicle for
13 flushing out all the implications of the individual
14 severe accident issues.
15 DOCTOR MURLEY: Yes.
16 COMMISSIONER CURTISS: But do I infer from
17 what you've just said that you have reached the
18 position and you currently believe that having done
19 that, first you still believe that it's appropriate to
20 codify those in a rulemaking and hence would proceed
21 with a notice of proposed rulemaking?
22 DOCTOR MURLEY: Yes.
23 MR. RUSSELL: We're beyond the proposed
24 notice stage. We'd actually be at the drafting of a
25 proposed rule stage. But we do believe that we need

1 to complete our in-depth understanding of the
2 implications of it because even at this point I have
3 three fairly significant issues still open on the ABWR
4 review that we're trying to close as it relates to the
5 issues we just discussed, the cavity design details.
6 There are some issues associated with the hydrogen --
7 not the hydrogen, but the venting for high-pressure
8 melt scenarios, and we have not completed our own
9 Melcor runs. So, we have additional technical
10 meetings scheduled for the second week in June and
11 hope to bring these to closure. But until we have
12 done so, taken it through the ACRS and understand the
13 implications, we think it would be premature to get a
14 rulemaking in advance of that.
15 So, we're proposing that we go a little
16 bit slower in the rulemaking until such time as we've
17 completed the technical work. Then when we've done
18 that and we're confident in the rulemaking language,
19 then go proposed rule, final rule.
20 COMMISSIONER CURTISS: Based upon that
21 schedule, are you completing something later this year
22 or early next for the rulemaking?
23 DOCTOR MURLEY: Early next year.
24 COMMISSIONER CURTISS: Early next year?
25 MR. RUSSELL: It would be early next year.

1 COMMISSIONER CURTISS: Okay. Thank you.
2 DOCTOR MURLEY: And I think your question
3 is we do see some benefit. It's not overriding, but
4 we do see some benefit in codifying all these
5 positions that we've taken.
6 COMMISSIONER CURTISS: In addition to the
7 design certification rule?
8 DOCTOR MURLEY: Yes.
9 COMMISSIONER CURTISS: Okay. Thank you.
10 MR. RUSSELL: (Slide) If I could have
11 slide number 18, please.
12 My reason for choosing this one is not
13 because it's new or a unique approach. In fact, it's
14 basically the approach we've been taking on currently
15 operating reactors. It's just that it's being
16 expanded potentially to other areas and it is an area
17 that was identified by the industry as an optimization
18 issue. We have proceeded with the technical work to
19 support leak before break.
20 There are some caveats, however. That is
21 we believe that for certain types of materials or
22 application it's not appropriate. For example, if you
23 have carbon steel piping and you're worried about
24 erosion corrosion, or if it's a piping system which
25 could be susceptible to water hammer or other more

1 serious loads, that it would not be appropriate.
2 There could be things done with design, either
3 cladding the piping or using materials which are not
4 susceptible to erosion corrosion.
5 We believe that this would provide a
6 benefit from the standpoint that it would reduce the
7 number of local restraints, pipe whip restraints,
8 things like this that may be in the design which would
9 provide access for performing maintenance, in-service
10 inspection, et cetera. But we do not propose to use
11 this as a vehicle for reducing what is called the
12 global effects associated with postulated pipe breaks
13 for equipment qualification or other features. So,
14 it's really addressing the issue of pipe whip, pipe
15 jet restraints, shields, those types of things for
16 local effects and the benefit is that it would improve
17 accessibility and the ability to perform in-service
18 inspection.
19 It is an area where we would be going
20 further in application, but it's not different in
21 approach from what we've done on current reactors.
22 (Slide) The next slide, if there are no
23 questions on that one, is number 24.
24 This is really an issue which relates to
25 marrying a standard design to a specific site. Let me

1 start out that the issue that we see is that there is
2 a potential that a particular design may be acceptable
3 for a site, even though a site external parameter
4 exceeds the design basis which the designer originally
5 intended.
6 For example, there could be a seismic
7 spectrum which is developed through the siting
8 procedure which may have some period of exceedence
9 beyond that of the design spectrum at .3 G. There may
10 be some particular frequency range. We would envision
11 that that could be addressed on a site-specific, case-
12 specific basis with additional justification as to why
13 that is acceptable. We do not see additional work
14 being required or necessary, and this is not proposing
15 additional work, if the site parameters are bounded by
16 the design parameters which were considered. So, if
17 the seismic hazard is less than .3 Gs, there would be
18 no further review that would be done. If the wind
19 speed is less than 300 miles per hour equivalent in
20 kilometers per hour, there would be no further work
21 done.
22 There are some areas where the tornado
23 wind speed and tornado missile spectrum has been a
24 surrogate for other site-specific hazards such as
25 aircraft crash or other areas. There may be some need

1 to address those local aspects.

2 Where that is done, we feel that that

3 should be integrated in its treatment and should be

4 done through the vehicle of a probabilistic risk

5 assessment such that you are not giving undue weight

6 to areas, you are looking at them in context. So, we

7 see that as an integrating approach. But in essence,

8 if the site is less severe than the certified design,

9 there would not be additional work that would be

10 required.

11 COMMISSIONER REMICK: This is one where in

12 our previous briefing, Bill, I thought that the SECY

13 document's help was not clear because I got the

14 impression that regardless if they were inside the

15 design envelope or not, that they were going to have

16 to do analysis.

17 MR. RUSSELL: That's why I picked this

18 one, because of your questions at the briefing. That

19 is not our intent. Our intent is only for those cases

20 where the site would exceed the design envelope for

21 which the standard design has been reviewed and

22 approved.

23 COMMISSIONER REMICK: And the other thing

24 from this, future PRAs following this would not have

25 a seismic PRA, you'd have a margins --

1 MR. RUSSELL: That's correct. That's
2 actually another --
3 COMMISSIONER REMICK: Essentially a margin
4 study and you would not have fire probabilities
5 associated with core damage frequency.
6 MR. RUSSELL: That is correct. That's
7 actually in another issue, but the approach for
8 internal events -- and I use internal and external
9 events broadly. Fires, we've endorsed the five
10 methodology or a more deterministic approach. For
11 internal events such as flooding, we believe that the
12 classic PRA approach to addressing internal events is
13 appropriate. For seismic, we do not want to get into
14 the areas where there's significant uncertainty in the
15 return period.
16 For the event itself, that is the seismic
17 hazard curve, what we believe is appropriate is to
18 look at the robustness of the design through a
19 margins-type analysis and the staff believes that the
20 margins analysis should show approximately a factor of
21 two between the design basis and those features in the
22 design which are necessary to achieve shutdown based
23 upon the insight from the PRAs, which we call the high
24 confidence, low probability of failure or the seismic
25 fragilities, what are the components. We do not

1 believe that there will be large numbers of them.

2 This is an area where there has been some

3 disagreement with EPRI. They believe that we should

4 limit this for the basic design to a HCLPF of

5 approximately .5 Gs where the design is at .3. They

6 argue that principally based upon what is being done

7 for operating reactors. We believe that since this is

8 a design that has not yet been built, that we should

9 not be as constrained and we believe that

10 systematically looking for the weaknesses can be

11 accomplished and that a good design should have on the

12 order of a factor of two margin. We saw that with the

13 early work that was done on the ABWR where it was more

14 a fullblown seismic PRA, but the HCLPF values were on

15 the order of .6 and above. So, we don't see this as

16 a significant issue and we have taken that position.

17 COMMISSIONER REMICK: Just a comment. One

18 of the problems I've had in international discussions

19 of PRAs or PSAs, people put up a core damage frequency

20 and you always have to ask is that just for internal

21 initiators or external initiators. I think in the

22 U.S. we do a little better job than some countries in

23 that respect, but I don't think we're perfect. I just

24 urge the staff, if we do have this, if we are now

25 taking out the seismic and we're taking out the fire,

1 that when we use the term "external initiators," that
2 we have a footnote or something so that people know
3 what is in and what isn't.
4 You find that ABB/Combustion people do, I
5 think, a better job of specifying what is in their
6 PRAs. Just a minor point in trying to understand
7 international presentations because it's a lack of
8 consistency in what's included and what isn't. You
9 always have to ask. So, my only comment is that
10 whenever we do something, I hope the staff will
11 adequately identify what's in the PRA and what isn't.
12 MR. RUSSELL: I'd also comment related to
13 the HCLPF value that we are closing the gap that
14 existed between the Livermore-NRC estimate of hazard
15 and the EPRI estimation of hazard. For some sites it
16 was -- if you looked at it in return period, it could
17 be as much as two orders of magnitude in difference.
18 We believe that the differences for most sites are now
19 down within about a factor of 2. We also generally
20 believe that a factor of 2 change in peak ground
21 acceleration is about a decade in return period or a
22 probability of occurrence. So, when we weigh all
23 those things together, we believe that a factor of 2
24 between your design and what the HCLPF would be would
25 be approximately the right value to ensure robustness

1 in design from the standpoint of the hardware.

2 For siting, such a standard design in a

3 plant which has, in fact, a site hazard less than .3,

4 it is probably excessive. But again, that's coming

5 from the standardization approach of trying to

6 envelope a number of sites.

7 COMMISSIONER ROGERS: How did that coming

8 together come about? What led to that?

9 MR. RUSSELL: Let me see if I can do it

10 shortly, since it's a Friday afternoon.

11 COMMISSIONER ROGERS: Yes.

12 MR. RUSSELL: Essentially, we identified

13 some approaches in our handling of expert opinion and

14 in how we statistically handled both the intercept and

15 slope on the curves that were used for ground motion

16 attenuation and return period. We found that when we

17 did it originally we treated them as independent

18 variables. They're not necessarily independent and we

19 did not go back and resolicit from the experts how we

20 treated their views. So, when we used a more formal

21 method for handling expert opinion and statistically

22 treated them in a consistent manner, we found that the

23 results came down and it was principally because the

24 tails of the distribution were driving it and when you

25 treated them independently they got some rather large

1 values.

2 That's about a short discussion.

3 COMMISSIONER ROGERS: That's good enough.

4 MR. RUSSELL: We have some long meetings

5 on it. It did come down significantly and it's to the

6 point now where we're questioning whether there's a

7 need to do further work to try and refine the

8 differences and close them even --

9 COMMISSIONER ROGERS: Thank you.

10 COMMISSIONER CURTISS: Bill, before you go

11 on, just one other question on this subject. It's

12 really a process question that arises out of the

13 discussion in the enclosure on page 51. In the event

14 that a site-specific PRA points to a generic design

15 flaw, the enclosure indicates that the staff can

16 initiate a rulemaking to amend the design

17 certification rule itself, is it -- what is the

18 likelihood that after the PRA that's prepared on the

19 design itself at the time of certification, that you

20 might have a site-specific PRA that as you've

21 indicated would be a vehicle for accommodating certain

22 parameters, pointing to a generic design flaw that

23 would require amending the design certification rule

24 itself?

25 MR. RUSSELL: Well, there are two ways

1 that that could come up. One, since we are making
2 assumptions about equipment reliability and
3 extrapolating from our current knowledge that goes
4 into the database that's used, if it turns out that
5 assumptions about equipment reliability or
6 availability which are key assumptions of the design
7 cannot be achieved and through passage of time, when
8 you get to a site-specific review, you use real data
9 instead of generic data. If you find that that aspect
10 of the design is questionable, it's conceivable that
11 you could identify the need for a design modification.
12 That would have to clearly pass a test and the issue
13 is whether that would be an adequate protection issue
14 or whether cost benefit could be applied. That's an
15 issue that's pending before the Commission.
16 COMMISSIONER CURTISS: But that wouldn't
17 necessarily arise out of a site-specific external
18 event, would it?
19 MR. RUSSELL: Not necessarily an external
20 event.
21 DOCTOR MURLEY: Could I give an example,
22 Commissioner? For example, there may be some unique
23 soil conditions that would lead to certain frequency
24 band accelerations that could call into question the
25 integrity of the design. It could be that it's

1 relatively simple to fix with some design changes.
2 They may choose to do that, but they'd have to go
3 through an amendment process. I think that's what
4 we're saying.
5 We think that the design has enveloped
6 most soil and site conditions, but there could very
7 well be an example where that's not the case, where it
8 can be fixed relatively simply with some design
9 changes. But it would need an amendment.
10 MR. RUSSELL: This was intended more from
11 a completeness. I don't think it's because we have
12 any concept that there is something that's missing.
13 In fact, in the soil siting area, we've identified
14 that in the DAC process they could consider actual
15 properties at the site rather than the generic
16 envelope and you get very high amplitude
17 accelerations.
18 DOCTOR MURLEY: I'm advised that this may
19 be an exemption rather than the rule.
20 MR. RUSSELL: It could be an exemption or
21 it could be a rulemaking.
22 COMMISSIONER CURTISS: It looks like there
23 are two separate circumstances here and there one that
24 I've focused on in the first part of my question is a
25 case where site-specific PRA points to what you call

1 a serious generic design flaw that in turn meets the
2 adequate protection threshold. NRC can initiate a
3 rulemaking. That probably should be the NRC will or
4 must --
5 MR. RUSSELL: Correct.
6 COMMISSIONER CURTISS: -- if that's in
7 fact the case, to amend the design certification rule.
8 Of course, the Part 52 allows that to be done. They
9 will apply then, I guess, to all reactors referencing
10 that design.
11 The second circumstance that you have here
12 is if the site-specific PRA identifies a site specific
13 design weakness, presumably not one that involves a
14 serious generic design flaw, as you've described it
15 here, the COL applicant could request an exemption --
16 DOCTOR MURLEY: I was referring to that
17 case.
18 COMMISSIONER CURTISS: Yes. Okay.
19 Bill, do you have anything else? I saw
20 you clicking over there.
21 MR. PARLER: Everything is in order now.
22 The paper is correct, the subsequent explanation is
23 correct, generic problem you do something with the
24 design. The site-specific problem you go the
25 exemption route.

1 COMMISSIONER CURTISS: Okay. Thank you.
2 MR. RUSSELL: (Slide) Let's shift and
3 we'll take 27 next because it's an easy one and I'll
4 save the digital I&C for last. Could I have slide 27,
5 please?
6 The staff position on steam generator tube
7 ruptures really is addressing two separate issues.
8 The first one -- and I'm now focusing on the passive
9 reactor issue. The facility response to multiple
10 steam generator tube ruptures and what may be
11 occurring with flow potentially back from a steam
12 generator into the primary loop as the reactor is
13 depressurizing we feel is an issue that needs to be
14 explored and understood because of the passive design.
15 That's fundamentally the reason for addressing
16 multiple steam generator tube ruptures in the passive
17 design.
18 The second issue which actually applies
19 equally well to the evolutionary plants is that there
20 is a containment bypass potential with a steam
21 generator tube rupture. The issue here is that a
22 rupture, if you've had either a failure, for example,
23 of the safety valve on the steam generator, if it
24 sticks open as a result of the transient, or if water
25 level control is lost in a steam generator as a result

1 of the break and the generator fills up and the relief
2 valve lifts, or if there's been a line break of some
3 type, the tube rupture itself provides a bypass of
4 containment. This is an issue that we feel we need to
5 look at. We are looking at it now and, in fact,
6 raising issues related to operating reactors. That's
7 essentially the view.
8 We are looking at the potential for design
9 features which would mitigate or preclude this from
10 being a concern. Some of them may not be practicable
11 at this point in design development, such as raising
12 the secondary side design pressure in the steam
13 generator for the evolutionary plant such that it
14 would be above the shutoff pressure of the high
15 pressure injection pumps so that you would not be
16 challenging the relief valves or the barrier. Other
17 approaches might be to direct the safety valve
18 discharge back into containment. That has other
19 adverse affects such as the need for suppression and
20 it might result in additional energy being delivered
21 to the containment.
22 We have not completed our reviews of these
23 issues, but we think they're important issues to be
24 addressed and should be addressed in the review.
25 DOCTOR MURLEY: Bill, can I add a point?

1 I've asked the staff to look at one other possibility.
2 It turns out that some foreign reactors today, current
3 reactors, have a system where they use nitrogen 16
4 detectors on the steam lines to detect incipient
5 breaks. They actually have a control system that runs
6 back power and actually causes trip. They believe
7 that this can significantly reduce the core melt
8 probability given single or multiple steam generator
9 tube ruptures. We have to look at that and see
10 whether there are some positive or any negative
11 affects to that. But that is an option that we may
12 decide to require on BWRs and, if so, we'll come back
13 to the Commission because that does go beyond the
14 current requirement.
15 COMMISSIONER CURTISS: There are some U.S.
16 plants that have those too.
17 MR. RUSSELL: Yes. They have N-16
18 monitors, but they do not have automatic systems to
19 reduce pressure, run back, et cetera, which would
20 mitigate by reducing the primary/secondary
21 differential pressure.
22 COMMISSIONER CURTISS: Right. Correct.
23 COMMISSIONER ROGERS: Before you leave
24 that, your analysis includes two to five tubes.
25 What's the basis of limiting it to five tubes? My

1 understanding is that some of the fuel designs suggest
2 that more than five tubes could easily be involved.
3 DOCTOR THADANI: We are really looking at
4 the issue of the number of tubes. Two to five was
5 purely judgmental. The real thrust of this position
6 was that for the passive design we really must
7 understand -- if you have multiple tube failures, we
8 must understand at what point do you get primary
9 pressure below secondary so this unborated water gets
10 into the primary system and not only that, it may
11 cause some other types of difficulties. We're looking
12 to see what number of tube ruptures might get you
13 there. There are two ways, X number of tube ruptures
14 or tube rupture with operator actuating the ADS
15 system.
16 ACRS made a comment to us that they
17 thought a reasonable approach, in fact, would be to
18 pick seven tubes with the hex design. The one in the
19 middle and the six around seemed like a reasonable way
20 to address this issue. But we're still looking at it.
21 Our motivation really is to make sure we
22 understand where the potential serious problems might
23 be and make a conscious decision, where do we go, how
24 do we deal with it. That was why we, in fact, raised
25 this issue in the first place.

1 COMMISSIONER ROGERS: Well, are the
2 studies of how many tubes might be involved, most
3 likely to be involved, do they involve any
4 considerations other than just close physical
5 proximity?
6 DOCTOR THADANI: Mostly close physical
7 proximity, yes.
8 COMMISSIONER ROGERS: Because it's
9 conceivable that there could be --
10 DOCTOR THADANI: Yes. Yes.
11 COMMISSIONER ROGERS: -- situations in
12 which the ruptures take place not close to each other
13 at all.
14 DOCTOR THADANI: Yes, indeed. That is
15 possible. But the thing we're concerned about is that
16 this -- I think Bill kind of touched on some of the
17 issues that make it very complex. If the primary
18 pressure is above secondary, do you fill up to the
19 steam lines? If not, if you do, then that causes the
20 operators to do certain things too. So, our sense
21 right now is a very important part of it is not
22 necessarily the number of tubes, but the phenomenon.
23 COMMISSIONER ROGERS: Right.
24 DOCTOR THADANI: Could things change
25 radically? Then let's understand and go forward.

1 MR. RUSSELL: This issue does not appear
2 to be in dispute with Westinghouse. In fact, they
3 have modified their high-pressure test program to
4 address this so that they would gather data on
5 multiple tube ruptures to be able to develop
6 appropriate models to be able to explore this with a
7 better understanding. So, that's really, I think, the
8 key issue.
9 DOCTOR THADANI: I think we're going to
10 get there. I just would caution that -- I would be a
11 little less optimistic in that statement.
12 DOCTOR MURLEY: For sure I'm going to try
13 to make sure that we explore it in ROSA, this full
14 range of tubes and so we know where the cliffs are.
15 If there are some cliffs, we may ask Westinghouse to
16 go back, but we haven't yet asked them to explore the
17 full range, Bill. That's the only point --
18 DOCTOR THADANI: And that's right.
19 MR. RUSSELL: Tom and Ashok were in Italy
20 discussing this with them, so things may have changed
21 since they got back.
22 DOCTOR THADANI: No, no, no. We are going
23 to ask them to do it. I just wanted to say that the
24 agreement hadn't been reached yet.
25 MR. RUSSELL: So the agreement hasn't been

1 fully finalized yet.

2 COMMISSIONER CURTISS: It wasn't clear --

3 one final question -- from the wording of your

4 recommendation where you say that we should require

5 the analysis of multiple steam generator tube ruptures

6 up to five be included in the application. If the

7 Commission endorses this recommendation, are we

8 endorsing including up to five steam generator tube

9 ruptures as part of the DBA? Would this be

10 commensurate with saying that the DBA from this point

11 forward for the passive will include five ruptures?

12 DOCTOR THADANI: One of the things, I

13 guess, we would like to clarify -- two, as a matter of

14 fact. As I said, the ACRS indicated that the number

15 chosen might be different than what we have suggested.

16 The second part is we should be careful whether it's

17 a design base accident in the traditional sense.

18 Traditionally when we call something design base

19 accident, we tack on a lot of conservative factors

20 both in terms of conditions and in terms of models.

21 Here our motivation, in fact, is to get realistic

22 understanding of response because we are afraid of

23 interactions, both hardware and human interactions.

24 COMMISSIONER CURTISS: Yes. My question

25 really --

1 DOCTOR THADANI: So, our goal really is to
2 do realistic assessment, but it is part of the design
3 of the AP600.
4 COMMISSIONER CURTISS: That's the key,
5 because the analytical methodologies differ depending
6 upon how you classify it. From what you've just
7 described, it sounds to me like you're classifying it
8 as a severe accident rather than a part of the DBA.
9 DOCTOR THADANI: That thought process, as
10 a matter of fact.
11 COMMISSIONER CURTISS: Permitting best
12 estimates rather than conservative analyses. Is that
13 your --
14 MR. RUSSELL: Our intent is not to require
15 conservative analyses for multiple tube ruptures.
16 COMMISSIONER CURTISS: So this would not
17 be part of the DBA then?
18 DOCTOR THADANI: We would call it
19 something else. It will be part of the design, but
20 not the classical design basis accident, conservative
21 bounding, et cetera.
22 COMMISSIONER CURTISS: Okay. Thank you.
23 MR. RUSSELL: (Slide) If I could have
24 slide 25.
25 DOCTOR MURLEY: Bill, are you on digital

1 I&C?

2 MR. RUSSELL: I'm ready to go into digital

3 I&C.

4 DOCTOR MURLEY: I need to say at the

5 beginning the staff's view is that we -- unless

6 there's any doubt, we are in favor of digital control

7 systems. It is a good technology and I harken back to

8 a year ago when someone asked me why I was so negative

9 about passive reactors, just because we were finding

10 all these problems and asking questions. It's our job

11 to dig and find problems and ask questions, but if

12 anyone should infer from that that we're against

13 digital control systems, no.

14 CHAIRMAN SELIN: But you are against

15 common mode failures.

16 DOCTOR MURLEY: We are very much against

17 common mode failures that could lead to core melt

18 accidents.

19 CHAIRMAN SELIN: I'm glad we have that out

20 of the way. Is there anything else you'd like to say

21 about the --

22 MR. RUSSELL: I guess I would like to just

23 comment. The issues here we do not disagree with the

24 ACRS on. Digital, software design systems are

25 different from analog systems. They have different

1 potential failure modes, as was discussed earlier with
2 you today. We agree that they cannot be treated in
3 the classic PRA sense. In fact, it's an area where we
4 don't have a lot of information. It's for some of
5 these reasons that the staff felt that there needed to
6 be some diversity or some alternative because we could
7 not rule out the potential that a common mode failure
8 exists. We can do the best job that we can through
9 the process of design acceptance criteria to ensure
10 that the original specification is complete, addresses
11 what the system is to do, that we do subject it to V&V
12 and that that gives us confidence in quality, but we
13 cannot put a number on it or a reliability number to
14 associate with it. Because of that, we think that it
15 is appropriate to systematically search for potentials
16 for common mode failure and where they are identified
17 to evaluate the system response if one were to occur.
18 The area, I think, that we're focusing on
19 is that we do allow credit for manual action or credit
20 for non-safety systems. We don't think this is a high
21 probability occurrence, so we have built that into our
22 approach. That's essentially the first three points
23 of the staff's position, is a systematic search such
24 that you have some alternative approach should there
25 be a processor lock-up or a common mode failure

1 associated with software.

2 The final position is the one that has

3 been the most controversial.

4 COMMISSIONER ROGERS: Excuse me. When

5 you're talking about software, you're really talking

6 about common mode error, aren't you really?

7 MR. RUSSELL: It's really or it could be

8 something that was unanticipated. If the

9 specification is wrong and the system behaves in a

10 manner that is outside what the specification had, you

11 could get inputs that cause you to go into a mode that

12 was unanticipated. But it really is an error in

13 programming to implement the specification under the

14 assumption that the specification is correct. So, we

15 are putting emphasis on the specification. That's the

16 first step in the DAC process. But then we do look at

17 later steps.

18 The fourth point is the one that I would

19 characterize has been the greatest movement on the

20 part of the staff. That is the safety grade backup

21 for system-level actuation manually from the control

22 room for a minimum set of features that are needed to

23 affect emergency response. This is one that we have

24 been reviewing the designs and this is not an issue on

25 either the ABWR or the CE 80+. We have reached

1 agreement on how to implement in words which appeared
2 to be somewhat soft or impractical to the lowest level
3 achievable in the architecture. We've been able to
4 resolve those with practical reviews of the actual
5 designs being proposed. That is not an issue in
6 dispute for either of those two reviews and there are
7 changes that are being proposed even by Westinghouse
8 to address this issue.
9 The issue that becomes difficult is the
10 aspect of the operator response using those manual
11 systems. Even though you have system-level actuation,
12 you now rely upon the operator actuating that and for
13 some events the time for operator action is very
14 critical. In the case of the ABWR review, the
15 limiting event is a LOCA. In this case, the action
16 that needs to be taken is the starting of a second
17 control rod drive pump. They believe that they can
18 complete analyses to show that with two CRD pumps,
19 because of the smaller piping associated in removing
20 of some of the research piping, et cetera, from
21 design, they'll be able to show under a realistic
22 analysis that that provides sufficient cooling for an
23 excess of one hour, at which time they would be able
24 to man and actuate the remote shutdown location and
25 turn on additional emergency core cooling systems.

1 In the case of the CE 80+ design, the
2 limiting event is associated with a streamline break
3 or a feedline break or a large break LOCA. There they
4 have ECCS capability from the control room, but it's
5 manual. So, the issue is is there sufficient time for
6 that manual action based upon a realistic analysis or
7 would that need to be automated. At this point in
8 time we have not closed on either of those, but the
9 issues are not with respect to the details of what the
10 design looks like. They have proposed simple digital,
11 which is at a low level in the architecture and we
12 have found that generally to be acceptable.
13 So, the issue now is back into reactor
14 system response and how much time is available for
15 operator action. We are getting close to closing on
16 those. We've agreed on a path to closure and it may
17 very well be for the CE design that there's not
18 sufficient time and we may look at other alternatives
19 such as enhanced leakage detection or something else
20 which would provide assurance that you are minimizing
21 the potential for large break LOCA and/or steam or
22 feedline break for the areas which are of critical
23 concern.
24 So, it's not necessarily the case that we
25 would require automatic ECCS redundancy for the CE 80+

1 design. So, that's where we stand on both of those
2 reviews as it relates to this position.
3 CHAIRMAN SELIN: If you'll just bear with
4 me for a minute. There are three different dimensions
5 in which one is talking about backup and it's what I'm
6 having a little bit of problem with.
7 MR. RUSSELL: Yes, sir.
8 CHAIRMAN SELIN: The first is that if you
9 have one set of displays and controls, these are
10 hardware, circuits. They could fail and you want to
11 make sure you have another set of displays and
12 controls. They might even be identical design.
13 There's no reason at the first level they have to be
14 even different, let alone manual. You just want to
15 make sure you're not completely critically dependent
16 on a single --
17 MR. RUSSELL: That there would not be
18 behind the display the same software that could
19 cause --
20 CHAIRMAN SELIN: No, I'm just talking
21 about the display itself, to start off with. If
22 you're critically dependent --
23 MR. RUSSELL: Oh, yes, sir.
24 CHAIRMAN SELIN: -- on display, you need
25 another display in case the first one fails.

1 MR. RUSSELL: That's correct.

2 CHAIRMAN SELIN: Then the second point,
3 you say, okay, we have a single set of codes that's
4 driving all of these pieces. There's always the
5 possibility that the code hasn't been completely
6 tested in all the situations. You don't want to be
7 completely dependent on that code. You need a backup
8 approach. It could also be automatic, but it would
9 have to be a different set of codes. Not only a
10 different set of codes, but unless you had
11 extraordinary confidence in your program, you wouldn't
12 even like to use too many of the same modules in the
13 code. Probably different timing modules, et cetera,
14 if you're really dependent on it.

15 The third is a question of whether it's
16 manual or not. Frankly, I don't see where manual
17 comes in at all, unless you're worried about a power
18 supply failure. If you had a different set of
19 displays with a different set of software, there's a
20 backup to the first set and they have separate power
21 supplies. I don't see what difference it makes
22 whether the backup is manual or not. The fact that
23 they're digital doesn't really make them any less
24 reliable than any other --

25 What difference does it make whether the

1 backup is manual or hardwired or what have you, as
2 long as it's a different piece of equipment and one
3 way or another, either through different software or
4 really thorough IV&V program, you're sure that the
5 software is properly programmed.
6 MR. RUSSELL: In the -- to put it in the
7 context that you've just described for the first
8 point, our typical single failure analysis which has
9 been done for this design would address the issue of
10 failure of a piece of hardware, whether it be a
11 display or be a control or some other device. For the
12 second level, which is really the first three elements
13 of the diversity position, we are looking
14 systematically for the potential for common mode
15 failure.
16 CHAIRMAN SELIN: Right.
17 MR. RUSSELL: We believe that that
18 position does provide defense against common mode
19 failure, but from a regulatory standpoint we felt that
20 there should be, in addition to that systematic
21 search, a capability within the control room for
22 system-level actuation in a rather clear unambiguous
23 way that would allow an operator to start emergency
24 core cooling, for example, or other components that
25 are necessary and bypass most of the architecture

1 associated with a safety-related system.

2 CHAIRMAN SELIN: I could accept that in

3 the sense it would be foolish not to give the operator

4 that capability unless you thought that the

5 probability that the operator would make a mistake is

6 higher than the probability that the system -- which

7 is not true. If the logic were really complex, you

8 might decide not to give the operator that authority,

9 but setting that aside. But if it turns out that the

10 timing is such or the number of decisions that have to

11 be made are complex enough, you don't want to rely on

12 the operator, why can't the backup system be an

13 automated system as well, just a different automated

14 system from the --

15 MR. RUSSELL: It could very well be. At

16 this point in time, in fact, that's the approach that

17 some of our fellow regulators have taken and have

18 essentially required where it is an automatic system

19 and it's essential and there's not sufficient time for

20 operator action that it be a safety grade and diverse

21 and they take it from diverse hardware, diverse

22 software, extensive diversity all the way through.

23 We have chosen to not do that. We do give

24 credit for non-safety system, including software,

25 regular work station that would be used day in and day

1 out for operating the facility, but there's some
2 potential that that non-safety system may not be
3 functioning. The screen could go dark, you may be
4 getting back information on that system from inputs
5 from other parts of the system. So, we felt that even
6 though it is diverse and you wouldn't have the same
7 concerns, we felt it was prudent to have a manual
8 capability that would be independent in going to a low
9 level in the architecture to get a system level
10 actuation. Not component actuation, but system-level
11 actuation, so that if the operator really wanted to
12 have emergency core cooling, he could in a clear,
13 unambiguous way go over and actuate emergency core
14 cooling.
15 The issue we're looking at is whether
16 there is sufficient time available for some of the
17 non-safety systems. The example I gave, for example,
18 for starting the second CRD pump, that would be non-
19 safety system would typically be through the normal
20 non-safety controls to show that an additional CRD
21 pump starting is sufficient to perform the function.
22 We're not proposing to put CRD pump starting as a part
23 of the dedicated system-level actuation safety grade
24 in the control room. So, if I misled with that,
25 that's not our approach.

1 CHAIRMAN SELIN: No, no. What I'm asking
2 is the vendor came back and said, "No, I'd rather put
3 it in a dedicated system, independent system," you'd
4 accept that.
5 MR. RUSSELL: Oh, absolutely, if they
6 chose to.
7 CHAIRMAN SELIN: So you're not requiring
8 the system to be a manual system-level actuation
9 display, but you would be satisfied with a manual
10 system-level actuation?
11 MR. RUSSELL: That's correct. Thus far,
12 they've not proposed to go automatic for the dedicated
13 systems.
14 COMMISSIONER REMICK: On that topic, since
15 you're not going to cover slide 28, I guess, but your
16 second bullet leads me into -- I assume you heard the
17 discussion with ACRS in which I didn't understand
18 their comment and they said their comment was one they
19 didn't understand what the staff was proposing on the
20 enunciators for manual action where it's not backed up
21 by automatic. Could you clarify?
22 MR. RUSSELL: Probably the best way to
23 clarify is with some examples. The situation we have
24 is where the condition is alerted to the operator and
25 it is of safety concern, but the operator then has to

1 take action to respond to that concern. Some examples
2 are we have alarms that indicate that deboration is
3 occurring during shutdown such that the operator can
4 take action to terminate deboration. Some designs
5 overseas are going to automatic termination of
6 deboration. In this case, we would propose that the
7 alarm and the qualification of the alarm would meet
8 safety standards that would basically be a 1E alarm.
9 There are other examples. We have a
10 letter that we are sending back to the ACRS that
11 addresses this more completely and identifies three or
12 four examples where this would be applicable. The one
13 that applies to digital I&C, we have questions about
14 how does the operator know which system to use. That
15 is, you've got one that may be erroneous. We're
16 basically looking at, for example, a deviation
17 monitor. If you have two inputs that are being
18 processed by different modes and you get a difference
19 between the two of them, then an alarm would occur and
20 would alert the operator to then compare that to
21 instrumentation that may be available that's a part of
22 this dedicated system-level actuation such that they
23 can make a judgment as to which one to rely on and
24 which one to use.
25 So, in that case, since it's alerting them

1 to a potential for a system failure that could cause
2 them to take inappropriate actions, we would say that
3 that would be an alarm which should be a safety-
4 related alarm and go through the QA and the other
5 aspects to ensure it, rather than -- it would be, in
6 fact, subjected to the DAC process if it were
7 digitally driven, as compared to non-safety which we
8 are not imposing those same requirements for
9 development of V&V, et cetera.
10 So, that's really the difference. It's a
11 few alarms beyond those which are identified in Reg
12 Guide 197.
13 COMMISSIONER REMICK: The thing that I was
14 trying to get out of ACRS, were they differing with
15 your position that that should be Class 1E equipment
16 or not? I was surprised when they said, "Well, they
17 didn't understand what you were proposing and where it
18 would exist."
19 MR. RUSSELL: I think that's because we
20 did not give them a sufficient set of examples and
21 clarify, in fact, the details which we're proposing to
22 do in the letter back to them.
23 COMMISSIONER REMICK: So you don't know if
24 they're differing with your position on the --
25 MR. RUSSELL: In fact broadly I would say

1 in most cases we do not disagree with the positions
2 that they identified on 93-087. We have prepared a
3 response back. We want to work with the ACRS. In
4 fact, we want to identify the details of the design to
5 show how these positions are being implemented. I
6 find that when you talk about things generically
7 without having an understanding of what the actual
8 implication is, you can conjure up a lot of different
9 concerns and problems. So, what we want to do is go
10 through and illustrate with specific examples and do
11 that through the vehicle of the ABWR review and the CE
12 80+ review.
13 That completes our presentation.
14 CHAIRMAN SELIN: Commissioners, any
15 comments or questions?
16 COMMISSIONER ROGERS: Well, I had just one
17 or two brief comments.
18 I wanted to say that I thought the
19 presentation was excellent, as was the general
20 completeness of the paper. I had a question though of
21 a very general nature, and that is when you've decided
22 on what is not a policy issue, can you give me an
23 indication of what your thinking is that guides you
24 there? When I look at the list, for instance, I don't
25 necessarily differ with you, but of those issues on

1 page 6, I don't know which slide that is, it's
2 probably slide 7, the ones that you didn't feel were
3 policy issues, there is a question of prototyping, for
4 example, II.K. To me that might be a policy issue.
5 I don't know.
6 What's the general -- I've asked this
7 question before. This is not the first time I've
8 asked this question of staff. But as you came at
9 these, what was the guidance that you used, things
10 that have been written down as Commission positions or
11 how do you decide whether you think there's a policy
12 issue involved here?
13 DOCTOR MURLEY: Yes, Commissioner.
14 Generally if it's in our regulations or if it is a
15 position that the Commission has approved before in
16 some SRM or some other guidance, then we did not
17 believe that that is a new policy issue. But if we go
18 beyond anything that the Commission has approved or
19 any staff position that has been used on past designs,
20 generally I think we're fairly rigorous, including
21 that as a policy issue.
22 COMMISSIONER ROGERS: Does prototyping
23 fall into that?
24 MR. RUSSELL: We have had papers that
25 we've sent to the Commission before and there were

1 SRMs that came back on prototyping broadly. The issue
2 here, I think we've come to the Commission on a
3 separate issue of prototyping as it relates to the
4 control room, and particularly for the passive plants.
5 We identified that as a policy issue that we wanted a
6 decision on. That's one of the 20. But broadly, we
7 did not see issues because the guidance was if it's
8 new or different and it's not an extension of current
9 technology, the Commission has said that we should
10 consider prototyping.
11 CHAIRMAN SELIN: So, it's not that it's --
12 the question isn't policy, the question is issue.
13 MR. RUSSELL: The question is issue and
14 application and where there was an application we
15 brought that issue to you for decision.
16 CHAIRMAN SELIN: I thought you were going
17 to say that a policy, should there be nuclear power
18 and whether we should approve the particular reactor
19 is just operations.
20 MR. RUSSELL: I think our level of detail
21 is lower than that.
22 DOCTOR MURLEY: Slightly.
23 COMMISSIONER ROGERS: That's all I have.
24 COMMISSIONER REMICK: Jerry wanted to --
25 MR. WILSON: Jerry Wilson, NRR.

1 CHAIRMAN SELIN: Your microphone is not
2 working. Are you the I&C?
3 MR. WILSON: Is it working now? No, I'm
4 unfortunately not an I&C.
5 I was just going to add that what we had
6 in the discussion on prototyping is implementing our
7 existing requirements on prototyping that are in Part
8 52.
9 CHAIRMAN SELIN: Commissioner Curtiss?
10 COMMISSIONER CURTISS: Just one quick
11 question. Aside from what we've already discussed on
12 I&C, digital I&C, are there any notable discrepancies
13 between the approach that you've recommended here and
14 where you see other international efforts going?
15 MR. RUSSELL: I'd like to address that in
16 either a closed meeting or meet with you separately
17 because the information we've gotten from other
18 countries is subject to non-disclosure in our
19 international agreements.
20 COMMISSIONER CURTISS: Okay. We'll set
21 that up. I'd like to go through that. We'll do that
22 separately.
23 MR. RUSSELL: In fact, I believe I've sent
24 up the earlier trip reports from our meetings. Have
25 one the end of this month and I'd be pleased to brief

1 you when we come back. We're basically on a six month
2 meeting schedule.
3 COMMISSIONER CURTISS: I can't wait six
4 months, but I'll --
5 DOCTOR MURLEY: Commissioner, did you ask
6 in the digital I&C area or other than that?
7 COMMISSIONER CURTISS: No, other than --
8 MR. RUSSELL: Oh, other than digital I&C?
9 COMMISSIONER CURTISS: Yes.
10 DOCTOR MURLEY: There are some differences
11 in philosophy that have not really hardened yet into
12 differences in regulatory changes, but let me give you
13 a flavor. In certain European countries, they think
14 that any advanced designs should be such that the
15 likelihood of offsite releases that could lead to
16 emergency actions, emergency preparedness actions, are
17 so low that they can be excluded practically. That
18 means then that that feeds back into containment
19 design requirements. It's a profound policy question
20 as to whether you can get containments that reliable
21 and designs that reliable that you don't need to have
22 sirens, you don't need to have plans even for
23 immediate action.
24 But that is one difference where I see, in
25 my discussions at least with colleagues overseas, a

1 potential difference.

2 COMMISSIONER CURTISS: And that would

3 manifest itself in formal things like hydrogen and the

4 control mechanisms?

5 DOCTOR MURLEY: Much more of an impact on

6 containment designs across the board, hydrogen, steam

7 explosion, core debris containment features, and just

8 general toughness --

9 COMMISSIONER CURTISS: Depressurization

10 systems, that kind of thing?

11 MR. RUSSELL: Filter vents.

12 DOCTOR THADANI: In spite of the designs,

13 the containment still has to be able to deal with

14 these challenges over and above design features and

15 that's really the significant issue there.

16 DOCTOR MURLEY: I suspect that this will

17 come to the Commission in the context of the passive

18 utility requirements document, some stage. I mean

19 they had wanted us to be able to relax emergency

20 preparedness requirements. To do that, they were

21 going to make the case the reliability of the design

22 and on the containment. They have not done that yet.

23 But we're still expecting something from them in this

24 area.

25 COMMISSIONER CURTISS: Okay.

1 MR. RUSSELL: We did, I believe it was
2 last June in our trip, we explored this issue
3 specifically as it related to severe accidents and we
4 discussed it fairly significantly and I can get you a
5 copy of that trip report.
6 COMMISSIONER CURTISS: Okay.
7 MR. RUSSELL: I was referring to it in my
8 earlier comments on the extensive interaction in the
9 digital I&C area, but we've also interacted on
10 requirements at the regulatory level broadly in the
11 area of severe accidents with a number of foreign
12 countries and regulators.
13 COMMISSIONER CURTISS: Okay. I don't have
14 any other questions. I thought the paper and the
15 presentation were both very well done. Thank you.
16 CHAIRMAN SELIN: Of course, if I might
17 just follow-up Commissioner Curtiss' comment, the
18 other corollary is that there can't be an accident and
19 you don't need such siting requirements as we need and
20 therefore you can put the reactor much closer to
21 populated areas.
22 MR. RUSSELL: That's becoming a very
23 significant international issue.
24 CHAIRMAN SELIN: Yes.
25 Commissioner Remick?

1 COMMISSIONER REMICK: One item you didn't
2 cover, but on page 53 of the document, you don't have
3 to go to it, under Item P, generic rulemaking related
4 to design certification, the staff indicated that the
5 staff has not yet received Commission guidance on
6 SECY-91-262. At the prebriefing, I gave you a copy of
7 that SRM. Are you now satisfied that the Commission
8 has responded? Okay.
9 MR. RUSSELL: Yes, sir.
10 COMMISSIONER REMICK: My question, and it
11 could be to the staff, it could be to the Secretary or
12 the Chairman, since I've been out has there been any
13 request for the public to address this SECY document
14 before the Commission votes? Do we know of anybody
15 who is responding?
16 MR. BORCHARDT: We have gotten comments
17 from EPRI. I think two days ago we got a letter from
18 them, which the staff has just begun reviewing. Those
19 are the only comments that I'm aware of.
20 COMMISSIONER REMICK: Has the Commission
21 received a copy yet? My mail has piled up, so I don't
22 know what's there.
23 MR. RUSSELL: It's dated May 11th from
24 EPRI.
25 DOCTOR MURLEY: We will make sure the

1 Commission --

2 MR. RUSSELL: We'll make sure you get it.

3 COMMISSIONER REMICK: Okay. Please.

4 MR. RUSSELL: It identifies those

5 positions for which they have no common degree and

6 some positions for which they have taken exceptions.

7 I've tried to identify, at least as it related to the

8 eight, where there were differences between the

9 approach EPRI felt was appropriate and the staff

10 recommendations.

11 DOCTOR THADANI: It's a pretty short

12 letter.

13 COMMISSIONER REMICK: Any other public

14 comments that have come in or we know are coming in

15 that the Commission should see before voting?

16 MR. BORCHARDT: None that we're aware of.

17 COMMISSIONER REMICK: Okay. All right.

18 CHAIRMAN SELIN: Commissioner Remick, were

19 you satisfied on the other topics that were not

20 briefed?

21 COMMISSIONER REMICK: Yes, since I had my

22 briefing with the staff before I went on this trip.

23 CHAIRMAN SELIN: You're not of the opinion

24 that we should have a second session on it?

25 COMMISSIONER REMICK: I personally don't

1 need it, no. I don't know if others do.

2 And I would also like to add my

3 compliments to the staff. I thought it was a very

4 well written, concise document and I might hedge a

5 little bit on the OBE and so forth. The seismic

6 issues were a little complex, but maybe that's because

7 of my knowledge. But really I thought the staff did

8 a fine job in preparing this document and 092 also.

9 CHAIRMAN SELIN: Commissioner?

10 COMMISSIONER de PLANQUE: Well, lest you

11 be disappointed at not having to give Commissioner

12 Curtiss that briefing on digital I&C, I would like

13 some more information on that. We can discuss that.

14 But maybe you can answer this general

15 question without getting into information that you

16 don't want to disclose here. With the foreign

17 countries that you deal with in this area, is there

18 anyone who's really out there setting the state-of-

19 the-art, anyone in particular?

20 MR. RUSSELL: Most of the dealing has been

21 with the regulatory authorities and how they are

22 reviewing designs, and it turns out that U.S. vendors

23 are proposing designs, the same designs in a number of

24 countries. So, the exchange has been along the lines

25 of how do you review those designs.

1 COMMISSIONER de PLANQUE: Okay.

2 MR. RUSSELL: Some of them are being
3 backfit into existing reactors. Others are being
4 proposed for reactors under construction. There is a
5 much closer relationship in this area. I'm trying to
6 be careful with the words, so I don't --

7 DOCTOR MURLEY: Could I just add a point?

8 MR. RUSSELL: Maybe it would be best if I
9 briefed you separately or if the Commission wanted to
10 go into closed session, I could brief it.

11 DOCTOR MURLEY: We could say, Bill, for
12 example, Canada has used --

13 MR. RUSSELL: Yes.

14 DOCTOR MURLEY: -- digital control systems
15 in their safety systems for years.

16 DOCTOR THADANI: That's right.

17 DOCTOR MURLEY: So they're way ahead of
18 us, there's no question, in the application and the
19 regulation of this and we're learning from this. If
20 the question is today is anyone clearly way out in
21 front, my own view is we're kind of pretty much
22 together. That is, we're learning from what the
23 Canadians have done and our vendors are -- they know
24 what the rest of the world is doing. I think we're
25 probably coalesced into a fairly coherent --

1 MR. RUSSELL: The information exchange has
2 been going both ways. They've been learning from us
3 and we've been learning from them and it's been very
4 valuable.
5 COMMISSIONER de PLANQUE: Then let me just
6 carry it one step farther to a really general
7 question. Do any of you see any other industry as
8 being much farther ahead in this type of application,
9 regulating in this area?
10 CHAIRMAN SELIN: Oh, yes. Aviation is
11 much further ahead. Absolutely.
12 DOCTOR MURLEY: Yes. The Airbus --
13 MR. RUSSELL: Well, there are technologies
14 in other industries that are further along in their
15 use. As it relates to how that is being regulated by
16 the safety authorities and the degree to which the
17 safety authorities are probing it, I'm not able to
18 answer that part of the question. There have been
19 some questions. So, I just don't know firsthand the
20 degree to which FAA looks into quality, et cetera. I
21 just don't know the answer to that at this point in
22 time.
23 COMMISSIONER de PLANQUE: Okay.
24 MR. RUSSELL: We've been looking for those
25 parallels --

1 CHAIRMAN SELIN: It's clearly far ahead in
2 aviation, but the cost of verifying a flight control
3 system is just a completely different order of
4 magnitude from what you have in a reactor.
5 COMMISSIONER de PLANQUE: Okay. That's
6 it. Thank you.
7 CHAIRMAN SELIN: I'd like to thank you.
8 I thought it was very good.
9 I do have to tell you that I have a -- I
10 find in a couple places that some of the suggested
11 answers are a little more prescriptive than I would
12 have expected at this point. I need to think about
13 what my reaction is to that. It's not that I don't
14 agree with the recommendations in principle, but when
15 you get down to the detail, some of them are more
16 prescriptive and I may suggest that my contributions
17 to the SRM, we'll see if they can't be made broader in
18 a couple of points.
19 Thank you very much.
20 (Whereupon, at 4:08 p.m., the above-
21 entitled matter was concluded.)
22
23
24
25

CERTIFICATE OF TRANSCRIBER

This is to certify that the attached events of a meeting of the United States Nuclear Regulatory Commission entitled:

TITLE OF MEETING: BRIEFING ON EVOLUTIONARY AND ADVANCED LIGHT-WATER REACTOR DESIGN ISSUES

PLACE OF MEETING: ROCKVILLE, MARYLAND

DATE OF MEETING: MAY 14, 1993

were transcribed by me. I further certify that said transcription is accurate and complete, to the best of my ability, and that the transcript is a true and accurate record of the foregoing events.

Carol Lynch

Reporter's name: Peter Lynch

SECY-93-087 POLICY, TECHNICAL, AND LICENSING ISSUES PERTAINING TO EVOLUTIONARY AND ADVANCED LIGHT WATER REACTOR DESIGNS

NRR BRIEFING TO COMMISSION
MAY 14, 1993

ISSUE SUMMARY

- SECY-93-087 discusses 42 policy, technical, and licensing issues pertaining to evolutionary and passive designs

- Issues can be divided into three general categories

  - Issues where the staff requests Commission approval of its proposed position (20 issues)

  - Issues where staff resolution will be discussed in future Commission papers (13 issues)

  - Issues provided for information only and the staff has determined that no current policy issue exists (9 issues)

ISSUES FOR COMMISSION APPROVAL
(20 Issues)

- Contain <u>underlined</u> staff positions for Commission approval

- Significant ACRS, industry, and vendor comments from the two draft Commission papers on ALWR issues addressed in final positions

- Approval would enable the staff to
  - complete design certification review of ABWR and System 80+
  - proceed more effectively with AP600 and SBWR design reviews

ISSUES FOR COMMISSION APPROVAL

- The 20 issues containing underlined staff positions for Commission approval are:

	Issue I.E	Fire Protection
	Issue I.F	Intersystem Loss-of-Coolant Accident
*	Issue I.G	Hydrogen Control
*	Issue I.H	Core Debris Coolability
*	Issue I.I	High-Pressure Core Melt Ejection
*	Issue I.J	Containment Performance
	Issue I.K	Dedicated Containment Vent Penetration
	Issue I.L	Equipment Survivability
	Issue I.M	Elimination of Operating-Basis Earthquake
	Issue II.A	Industry Codes and Standards
*	Issue II.D	Leak-Before-Break
	Issue II.E	Classification of Main Steamlines in BWRs
	Issue II.F	Tornado Design Basis
	Issue II.H	Containment Leak Rate Testing
	Issue II.I	Post-Accident Sampling System
*	Issue II.N	Site-Specific PRA and Analysis of External Events
*	Issue II.Q	Defense Against Common-Mode Failures in Digital I&C Systems
*	Issue II.R	Steam Generator Tube Ruptures
	Issue II.T	Control Room Annunciator (Alarm) Reliability
	Issue III.H	Role of the Passive Plant Control Room Operator

STAFF PRESENTATION WILL BE ON ISSUES MARKED WITH AN ASTERICK.

ISSUES TO BE RESOLVED IN FUTURE COMMISSION PAPERS (13 Issues)

- SECY-93-087 identifies 13 issues where a final staff position is not proposed but will be addressed in future Commission papers

- Primarily passive plant design issues

- Commission papers being prepared to address these issues in the following topic areas:

  - Regulatory treatment of non-safety systems
  - Source term
  - Emergency planning
  - Combined license (COL) form and content

ISSUES TO BE RESOLVED IN FUTURE COMMISSION PAPERS

- The 13 issues to be resolved in future Commission papers are:

Issue I.A	Use of a Physically Based Source Term
Issue I.D	Station Blackout
Issue I.N	Inservice Testing of Pumps and Valves*
Issue II.B	Electrical Distribution
Issue II.G	Containment Bypass
Issue II.M	Reliability Assurance Program
Issue II.S	PRA Beyond Design Certification
Issue III.A	Regulatory Treatment of Non-Safety Systems in Passive Designs
Issue III.B	Definition of Passive Failures
Issue III.D	Safe Shutdown Requirements
Issue III.E	Control Room Habitability
Issue III.F	Radionuclide Attenuation
Issue III.G	Simplification of Offsite Emergency Planning

*This issue also requests that the Commission approve inservice testing requirements for passive designs that were previously recommended for evolutionary designs

ISSUES FOR INFORMATION ONLY
(9 Issues)

- SECY-93-087 provided an information discussion of nine issues in order to provide a more complete picture of the issues affecting evolutionary and passive design reviews

- Staff did not request additional Commission policy guidance on these issues

- Issues include:

I.B	ATWS
I.C	Mid-Loop Operation
II.C	Seismic Hazard Curves and Design Parameters
II.J	Level of Detail
II.K	Prototyping
II.L	ITAAC
II.O	SAMDAs
II.P	Generic Rulemaking Related to Design Certification
III.C	SBWR Stability

ISSUES FOR COMMISSION APPROVAL

FIRE PROTECTION

ISSUE

Contribution of fire to the likelihood of severe accidents for advanced plants should be minimized

STAFF POSITION

Passive plants should also be reviewed against the enhanced fire protection criteria approved by the Commission for evolutionary designs in its staff requirements memorandum on SECY-90-016

RATIONALE

Fire protection requirements should reflect experience from operating reactors and the greater understanding of severe accidents that has been acquired since Appendix R was promulgated in 1979

INTERSYSTEM LOSS-OF-COOLANT ACCIDENT

ISSUE

Possibility of a loss-of-coolant accident (LOCA) outside containment in advanced plants should be reduced.

STAFF POSITION

Passive plants should also be reviewed for compliance with the intersystem LOCA criteria approved by the Commission for evolutionary designs in its staff requirements memorandum on SECY-90-016

RATIONALE

- Intersystem LOCAs minimized by designing all systems and subsystems (including all elements of low-pressure system) connected to the reactor coolant system (RCS) to preclude rupture due to full RCS pressure
- When not practicable, systems should include:
  - Leak testing capability for the pressure isolation valves
  - Leak testing of all pressure isolation valves
  - Control room valve position indication
  - High-pressure alarms

HYDROGEN CONTROL

ISSUE

Containments are required to be designed for control of hydrogen generation following an accident

STAFF POSITION

Passive plants should also be designed to the hydrogen control criteria approved by the Commission for evolutionary designs in its staff requirements memorandum on SECY-90-016

RATIONALE

- An equivalent 100-percent active cladding oxidation reaction is a reasonable surrogate for expected in-vessel and ex-vessel hydrogen generation

- Due to uncertainties in the phenomenological knowledge of hydrogen generation and combustion, limits on containment hydrogen concentration and methods for containment-wide hydrogen control are necessary

CORE DEBRIS COOLABILITY

ISSUE

In a severe accident scenario where the core melts through the reactor vessel, containment integrity could be breached if the molten core is not sufficiently cooled

STAFF POSITION

Evolutionary and passive light-water reactor (LWR) designs meet criteria to

- provide floor space to enhance debris spreading
- provide means to flood the reactor cavity to assist cooling process
- protect the containment liner and structural members with concrete
- ensure containment capability for environmental conditions resulting from core-concrete interactions

RATIONALE

Incorporation of mitigative measures and assurance of containment integrity for approximately 24 hours will provide

- defense-in-depth in the containment design
- an appropriate degree of robustness in the containment design

HIGH-PRESSURE MELT EJECTION

ISSUE

Molten core debris ejected from the reactor vessel under high-pressure could potentially fail the containment as a result of direct containment heating

STAFF POSITION

Evolutionary and passive LWR designs provide

- a reliable depressurization system; and
- cavity design features to decrease the amount of ejected core debris that reaches the upper containment

RATIONALE

- A reliable depressurization system reduces the probability of a high-pressure molten-core ejection from the reactor vessel

- Reasonable cavity design features provide a degree of consequence mitigation to offset uncertainties associated with a depressurization system

CONTAINMENT PERFORMANCE

ISSUE

Containment function faced with distinct challenges from severe accidents

STAFF POSITION

Use the following deterministic containment performance goal to evaluate passive LWRs:

- Maintain reliable, leak-tight barrier for approximately 24 hours under the more likely severe accident challenges
- Provide a barrier against the uncontrolled release of fission products following this period

RATIONALE

- Provide final check as well as defense-in-depth to ensure design is adequate to mitigate a severe accident
- Ensures containment will perform function for credible severe accident challenges
- Maintains balanced approach between accident prevention and consequence mitigation

DEDICATED CONTAINMENT VENT PENETRATION

ISSUE

Use of a containment overpressure protection system to avoid gross containment failure resulting from postulated slow rising overpressure scenarios

STAFF POSITION

Need for a containment vent for passive plant designs should be evaluated on a design-specific basis

RATIONALE

- Containment vent is one of many systems that could be used to mitigate accident consequences

- Vent may not be necessary if analyses show that severe accident criteria such as the containment performance goal are met

EQUIPMENT SURVIVABILITY

ISSUE

Measures to ensure that systems and equipment required only to mitigate severe accidents are available to perform their intended function

STAFF POSITION

Passive plant severe accident design features need not be subject to:

- environmental requirements of 10 CFR Section 50.49
- quality assurance requirements of 10 CFR Part 50, Appendix B
- redundancy/diversity requirements of 10 CFR Part 50, Appendix A

RATIONALE

- Significant differences exist in the likelihood of occurrence between severe core damage accidents and design basis accidents

- Design-specific reviews will consider the severe accident conditions under which these mitigative systems operate

ELIMINATION OF OPERATING-BASIS EARTHQUAKE

ISSUE

Eliminate OBE from design in both evolutionary and passive advanced reactors

STAFF POSITION

- Facility should be shutdown and inspection performed for damage for earthquake which exceeds one-third SSE

- Licensee may choose higher shutdown and inspection level earthquake using predetermined plan with additional analysis

RATIONALE

- OBE should not control design of safety systems
- Overall design of structures conservative
- SSE generally controls piping design
- Pipe breaks more likely under normal operating conditions

INDUSTRY CODES AND STANDARDS

ISSUE

Revisions to industry codes and standards have not been reviewed and approved by the staff

STAFF POSITION

- Staff will use the newest codes and standards endorsed by the NRC in its review of evolutionary and passive plant design applications

- Unapproved revisions to codes and standards proposed by applicants will be reviewed on a case-by-case basis as part of the application

RATIONALE

Approach is consistent with past practice and the efficient use of resources

LEAK-BEFORE-BREAK

ISSUE

Acceptability of the use of leak-before-break (LBB) considerations in the advanced LWR designs

STAFF POSITION

- Approve the application of the LBB approach to both evolutionary and passive LWR designs
- Approval limited to instances where
  - bounding limits are established using preliminary analysis results during the design certification phase
  - implementation is verified by performing the appropriate ITAAC

RATIONALE

- GDC 4 permits elimination of the dynamic effects of postulated high-energy pipe ruptures from the design basis using advanced fracture mechanics analyses
- Limitations and acceptance criteria for LBB in advanced LWRs are the same as current operating plants

BWR MAIN STEAM LINE CLASSIFICATION

ISSUE

Alternative approach to ensuring that doses associated with leakage through the main steam isolation valves (MSIVs) is acceptably low involving:

- Elimination of leakage control system
- Higher leakage limits through MSIVs
- Alternate MSIV leakage treatment method

STAFF POSITION

- Preventing gross structural failure of the piping and hotwell downstream of the MSIVs would provide assurance that leakage from the MSIVs would not exceed 10 CFR Part 100 guidelines
- Design requirements for main steam drain line, bypass piping, and the condenser specified to ensure their pressure and structural integrity under SSE loading

RATIONALE

- Reduction in man-rem exposure anticipated from less maintenance required when compared to present systems
- Satisfies dose limits of 10 CFR Part 100

TORNADO DESIGN-BASIS

ISSUE

Tornado design-basis requirements to be used in establishing structural requirements to protect nuclear plant safety-related structures, systems, and components (SSCs)

STAFF POSITION

Maximum tornado wind speed of 482 km/hr (300 mph) be used in the design-basis tornado employed in the design of evolutionary and passive plants

RATIONALE

- Based on updated tornado data and the analysis provided in NUREG/CR-4661

- Other external impact hazards reviewed on a site-specific basis

CONTAINMENT LEAK RATE TESTING

ISSUE

Extension of the maximum interval between Type C leakage rate tests from 24 months to 30 months

STAFF POSITION

Maximum interval between Type C leakage rate tests for both evolutionary and passive plant designs should be 30 months

RATIONALE

- Consistent with proposed changes to Appendix J under evaluation for operating reactors

- Case-by-case extension of the time interval for performing Type C leakage rate tests utilized on currently operating plants

POST-ACCIDENT SAMPLING SYSTEM

ISSUE

Proposed deviations from several aspects of the post-accident sampling system (PASS) design requirements

STAFF POSITION

- Safety-grade hydrogen instrumentation provides adequate monitoring for post-accident containment hydrogen

- PASS design for pressurized water reactors (PWRs) should provide capability to analyze dissolved gases and chloride with the time for taking these samples extended to 24 hours

- PASS capability for boiling water reactors to analyze dissolved gases is not needed

- PASS capability required to take boron concentration 8 hours following an accident and activity measurements 24 hours following an accident

POST-ACCIDENT SAMPLING SYSTEM

RATIONALE

- Installed instrumentation can provide similar accident assessment information

- For PWRs, postulated accidents not involving early reactor depressurization (like TMI-2) warrant retention of certain sampling capabilities

SITE-SPECIFIC PROBABILISTIC RISK ASSESSMENT (PRA) AND ANALYSIS OF EXTERNAL EVENTS

ISSUE

External events can be important contributors to core damage and warrant consideration at the certification and combined license (COL) stages

STAFF POSITION

- Use design-specific PRA or alternative methods to assess both internal and external events
- Margins approach or other simplified methodologies acceptable when uncertainties in methods are very large
- Advanced LWR vendors should perform bounding analysis of site-specific external events likely to be a challenge to the plant
- Review site-specific characteristics at COL stage if site parameter exceeds bounding vendor analysis

RATIONALE

Ensure risk from external events is consistent with safety goals

DEFENSE AGAINST COMMON-MODE FAILURE IN DIGITAL I&C SYSTEMS

ISSUE

Design or software programming error in digital instrumentation and control (I&C) systems could result in a common-mode failure of redundant safety equipment

STAFF POSITION

- Assess the defense-in-depth and diversity of I&C systems and demonstrate adequate defense against common-mode failures

- Provide a set of independent safety-grade displays and controls in the main control room for manual system-level actuation and display

DEFENSE AGAINST COMMON-MODE FAILURE IN DIGITAL I&C SYSTEMS

RATIONALE

- Principle factors for defense against common-mode failures is quality and diversity
  - In assigned function
  - In equipment
  - In hardware
  - In software

- Hardwired backup system is added level of defense against common-mode failure that would provide operators with unambiguous information and control capabilities
  - Analog components, or
  - Simple, dedicated, and diverse digital equipment

STEAM GENERATOR TUBE RUPTURES (SGTRs)

ISSUE

Two issues related to SGTRs are:

- multiple SGTRs in the passive PWR
- containment bypass potential from SGTR in evolutionary and passive PWRs

STAFF POSITION

- Include analysis of multiple SGTRs involving two to five tubes in the application for design certification for passive PWRs
- Evolutionary and passive LWR applicants assess design features to minimize the potential for bypass from SGTRs

RATIONALE

- Multiple SGTR pose a substantial challenge to passive safety systems
- No current requirement to analyze multiple SGTRs
- Experimental data needed to validate plant performance (e.g., AP600)
- SGTRs can lead to a loss of containment integrity

CONTROL ROOM ANNUNCIATOR (ALARM) RELIABILITY

ISSUE

Operating experience has revealed vulnerabilities to losses of annunciator systems that can impact the operators' ability to monitor and mitigate a plant transient

STAFF POSITION

- Advanced LWR alarm systems should meet the applicable EPRI requirements for redundancy, independence, and separation

- Alarms provided for manually controlled safety functions shall meet requirements for Class 1E equipment and circuits

TECHNICAL RATIONALE

Additional requirements for alarm systems necessary to minimize problems experienced by operating plants

ROLE OF THE PASSIVE PLANT CONTROL ROOM OPERATOR

ISSUE

Passive plant operators will be required to perform functions and tasks unlike those of evolutionary plants such as those associated with:

- new operational philosophy with passive systems
- increased automation
- greater use of advanced technology

STAFF POSITION

- Extensive man-in-the-loop test and evaluation be performed for passive plant control room design
- Fully functional integrated control room prototype is likely to be necessary

RATIONALE

Needed to ensure that the passive designs properly consider the operator's role in ensuring plant safety