ORIGINAL

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NUCLEAR REGULATORY COMMISSION

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2 NUCLEAR REGULATORY COMMISSION

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4 MEETING WITH

5 THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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7 PUBLIC MEETING

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9 Nuclear Regulatory Commission

10 One White Flint North

11 Rockville, MD

12 Wednesday, February 3, 1999

13 The Commission met in open session, pursuant to

14 notice, at 1:05 p.m., Shirley A. Jackson, Chairman,

15 presiding.

16 COMMISSIONERS PRESENT:

17 SHIRLEY A. JACKSON, Chairman of the Commission

18 NILS J. DIAZ, Commissioner

19 GRETA J. DICUS, Commissioner

20 EDWARD McGAFFIGAN, JR., Commissioner

21 JEFFREY S. MERRIFIELD, Commissioner

22 STAFF PRESENT:

23 ANNETTE L. VIETTI-COOK, Secretary of the

24 Commission

25 KAREN D. CYR, General Counsel

1 ACRS MEMBERS PRESENT:

2 DANA POWERS, Chairman, ACRS

3 GEORGE APOSTOLAKIS, Member, ACRS

4 JOHN BARTON, Member, ACRS

5 MARIO BONACA, Member, ACRS

6 MARIO FONTANA, Member, ACRS

7 THOMAS KRESS, Member, ACRS

8 DON W. MILLER, Member, ACRS

9 ROBERT L. SEALE, Member, ACRS

10 WILLIAM SHACK, Member, ACRS

11 ROBERT E. UHRIG, Member, ACRS

12 GRAHAM B. WALLIS, Member, ACRS

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

2 [1:05 p.m.]

3 CHAIRMAN JACKSON: Good afternoon, ladies and
4 gentlemen. It is a pleasure to meet once again with the
5 members of the NRC's Advisory Committee on Reactor
6 Safeguards, who plan to discuss a number of topics of
7 interest to the Commission at today's session.
8 First, I would like to welcome Dr. Powers in his
9 new role as chairman of the ACRS. You join a long list of
10 distinguished individuals who have held that post, certainly
11 not the least of whom was your esteemed colleague and
12 predecessor as chair, Dr. Seale. Dr. Seale, why don't you
13 stand up for our --
14 [Applause.]
15 CHAIRMAN JACKSON: The Commission is appreciative
16 of Dr. Seale's contributions during his two years as NR --
17 ACRS chairman. Freudian slip.
18 [Laughter.]
19 CHAIRMAN JACKSON: In addition, I welcome Dr.
20 Mario Bonaca to the Commission's Advisory Committee on
21 Reactor Safeguards. Welcome. We are pleased to have you on
22 board.
23 Over the years, as you know, the ARCS has provided
24 the Commission with very valuable and timely advice on the
25 safety aspects of nuclear power plants as well as on related

1 policy matters, rules and regulations, and the Commission
2 feels very fortunate -- I always say this because I think
3 it's important always to take note of that -- fortunate to
4 be able to draw upon the views, experiences and technical
5 expertise of this select group as we try to solve and
6 address many technical concerns in licensing and regulation.
7 For the record, I would like to express the
8 Commission's appreciation for the significant contributions
9 the ACRS made to the review and approval of the Westinghouse
10 AP600 design in accordance with their duties in 10 CFR 52.53
11 entitled Referral to the ACRS.
12 During today's briefing, the ACRS will cover the
13 following topics, and you were probably going to say this
14 anyway, Dr. Powers: proposed revisions to 10 CFR 50.59;
15 development of a risk-informed 10 CFR 50.59; options to make
16 Part 50 risk-informed; proposed rulemaking on the revised
17 source term; ACRS activities associated with license
18 renewal; impact of PRA results and insights on the
19 regulatory system; elevation of core damage frequency to a
20 fundamental safety goal and possible revision to the
21 Commission's safety goal policy; and finally, the NRC's
22 safety research programs.
23 My fellow Commissioners and I welcome you to this
24 meeting and anticipate another candid and informative
25 discussion on some of the agency's highest priorities.

1 As we progress through today's briefing, I would
2 ask that each ACRS member presenter highlight the key points
3 for each of the issues in as succinct a manner as possible.
4 This will allow the Commission more time to engage the
5 committee on these important issues. And so you can assume
6 that the Commission is familiar with the background
7 associated with them and with the information that you have
8 provided.
9 I understand that copies of the briefing material
10 are available at the entrances to the room, and so unless my
11 colleagues have any comments they wish to make, Dr. Powers,
12 please proceed.
13 DR. POWERS: Thank you, Chairman Jackson, and I
14 understand congratulations are in order for you for this
15 prestigious appointment to RPI. I know that members of the
16 ACRS are familiar with some outstanding technical work that
17 is done in the nuclear fields at that institution, and quite
18 frankly, some of us are very envious.
19 CHAIRMAN JACKSON: Well, eat your heart out.
20 [Laughter.]
21 CHAIRMAN JACKSON: Thank you.
22 DR. POWERS: And the ACRS, of course, is delighted
23 to see Commissioner Dicus back in the fold.
24 COMMISSIONER DICUS: Thank you very much.
25 DR. POWERS: We actually missed you at our

1 Christmas party and hope that you can attend in the future.
2 And we certainly hope Commissioner Merrifield has not found
3 any cause to doubt his decision to come to the ACRS.
4 COMMISSIONER MERRIFIELD: Not at all. Thank you.
5 DR. POWERS: And you have introduced our new
6 member, who may well have found reasons to doubt his
7 decision.
8 [Laughter.]
9 DR. POWERS: Let me turn now immediately to the
10 technical work, and my first comment is, wow. The
11 groundwork that this Commission has laid with its PRA policy
12 statement and the PRA research that the NRC has fostered
13 over the years is really beginning to bear fruit. We see an
14 absolute outpouring of work from the staff, beginning with
15 Reg Guide 1.174, now going on even to inspection and
16 assessment and enforcement. We're applying risk to
17 regulations in a real sense nowadays.
18 The ACRS, as you noted, has historically spoken to
19 the possibility of using risk more actively in the
20 regulatory practices. Quite frankly, this outpouring of
21 work has been breathtaking. In fact, speaking as one
22 member, it may be more accurate to say it's taking our
23 breath away or leaving us breathless because it is a
24 monumental amount of work.
25 Progress is clearly being made in what I think

1 amounts to a revolution in the way we do regulation that may
2 well stand as an example to regulatory agencies throughout
3 the federal government. Still, I think it's important that
4 we remember that there is a culture of conservatism within
5 the nuclear community. At this point, it's really important
6 that we not let conservatism be an excuse for being timid in
7 what I think is a major step in the way we regulate nuclear
8 power.
9 We also have pointed out in our research work that
10 the fundamental technical foundations for risk-informed
11 regulation are not complete, and we pointed out areas that
12 need to be continued to understand and develop the
13 technologies we'll have to have to completely use risk, and
14 I do acknowledge the Chairman's recent paper in which she
15 made essentially the same point.
16 I think our feeling is that it's important that
17 this experiment, if you will, in using risk is an active
18 tool for regulation succeed because it has implications that
19 go beyond just the nuclear industry.
20 At the same time, the ACRS recognizes the
21 Commission's need to have demonstrable progress in this
22 area. To facilitate this progress, the ACRS has been
23 working in much more of a participatory role in its reviews;
24 that is, we're working much more with the staff in real time
25 as they develop their products rather than waiting until

1 things are completed.

2 In that respect, the questions you've asked us to
3 address, you're catching us very much at mid-stride in some
4 of them. The products are still working. One of the most
5 important issues that we'll discuss is 50.59, and we've just
6 had another interim briefing literally hours ago, so you're
7 going to get our current thinking, and probably not our
8 final positions, on a lot of these issues.

9 Fifty-fifty-nine is one of the most urgent issues
10 being faced by the nuclear industry right now because it's
11 key to the stable operation of nuclear power plants. The
12 ACRS has advocated a two-phase approach, a first phase to
13 stabilize the 50.59 process; the second stage that would
14 take it on to a more completely risk-informed status. We're
15 going to be discussing primarily the phase one approach and
16 our current thinking on that.

17 In phase two, we have actually begun to work on
18 that and we have suggested a possible framework for making
19 50.59 completely risk-informed. Our thinking on that is in
20 connection with frequency consequence curves.

21 We have discussed those primarily in their
22 integral formulation. We have not had a chance to discuss
23 them in what I would call the differential formulation that
24 I think would be the one that you would actually use for
25 small changes in plans associated with 50.59. This integral

1 formulation may in fact be more appropriate for the bolder
2 step of trying to make all of Part 50 risk-informed.
3 Professor Apostolakis will shall I say proselytize
4 you a bit on this technology.
5 CHAIRMAN JACKSON: So his name is really Dr.
6 Aprostylakis.
7 [Laughter.]
8 DR. APOSTOLAKIS: I will present a balanced view.
9 [Laughter.]
10 DR. POWERS: As he always does.
11 We will also discuss with you some of our early
12 thinking on the strategies for approaching this bold step of
13 making all of Part 50 risk-informed.
14 It's important to remember not all of the progress
15 that we see the Commission making in reforming regulation
16 stems from this current intense activity that's coming from
17 the staff. Some of that progress actually comes from
18 prolonged development of technology that the NRC has
19 fostered.
20 A primary example of that is that prolonged
21 development of severe accident research that was done to get
22 a more realistic assessment of the magnitude and nature of
23 radionuclide source terms associated with reactor accidents,
24 and we're going to give you some thoughts on this step that
25 has been long in the making and really represents a

1 revolution in the way we look at severe accidents over what
2 was done in the past.
3 Finally, we're going to discuss license renewal,
4 which quite frankly I think this committee is beginning to
5 look upon as, if not its highest priority, a very high
6 priority. Because it's a very new activity, it looks very
7 complicated to us. We've confronted complications --
8 complicated activities in the past. We're drawing upon our
9 experience we've had with things like the certification of
10 evolutionary and advanced reactors to develop a strategy for
11 approaching this new activity.
12 Clearly it's an activity of some importance
13 because we anticipate many, many plants will be looking for
14 license renewal, and it will become a major activity for the
15 NRC in the future. The pilots we're conducting with Calvert
16 Cliffs and Oconee then are crucial for the establishment of
17 precedence. In other words, we want to do this one as best
18 we possibly can.
19 We're certainly looking to assure that the ACRS
20 does not introduce any unnecessary delays in the process,
21 and quite frankly, I think we're a bit more ambitious.
22 We're looking for chances to accelerate the process by
23 culling out the issues that may not require such careful
24 resolution at the beginning and focus on those that are
25 really most important to safety.

1 Unless you have any questions, I propose that we
2 move right on to the discussion of what's becoming
3 everybody's favorite topic lately: 50.59. I call upon Mr.
4 Barton to lead that discussion.
5 MR. BARTON: Good afternoon.
6 CHAIRMAN JACKSON: Good afternoon.
7 MR. BARTON: As Dr. Powers said, the topic has
8 been moving along at a fairly brisk pace over the past six
9 months. The last report we sent was July 16, 1998, to the
10 Commission. Basically, that's history at this time because
11 of the pace that this rulemaking has taken place.
12 I would call your attention to the third and
13 fourth bullets from that report. The Committee continues to
14 believe that the 50.59 can accommodate risk-informed
15 decisionmaking, and Dr. Apostolakis will be discussing that
16 subject in a few moments.
17 The Committee also believes that the issuance of
18 the regulatory guide is an important task in ensuring
19 stability in the 50.59 process, and we continue to discuss
20 the status of that effort with the staff.
21 The committee did have discussions with the staff
22 this morning regarding the status of the proposed revisions
23 and to discuss the comments that have come back in from the
24 public comment period. However, we have not had, as a
25 committee, the opportunity to deliberate on all the matters

1 and to reach any conclusions regarding the comments and the
2 -- to reach a final position on which to come to a
3 conclusion and recommendation to the Commission on the final
4 rule.
5 We do continue to discuss this issue. We are
6 supposed to meet with the staff the first week in March. I
7 believe we owe the Commission a report from our meeting in
8 March which would lay out our conclusions and
9 recommendations regarding the final rule on 50.59.
10 We are also continuing to discuss with the staff
11 as they consider options to include risk-informed approach
12 to 50.59. At this point, we have not reached as a committee
13 any conclusions regarding the final rule.
14 COMMISSIONER McGAFFIGAN: Madam Chairman?
15 CHAIRMAN JACKSON: Let's let him --
16 COMMISSIONER McGAFFIGAN: Okay.
17 CHAIRMAN JACKSON: And then whatever you'd like.
18 MR. BARTON: That's --
19 CHAIRMAN JACKSON: You're done? Okay.
20 COMMISSIONER McGAFFIGAN: I just was going to
21 encourage them to give us any preliminary conclusions
22 because I think there are two issues that have been called
23 to our attention that are the heart of the matter in a
24 recent staff briefing, and that's the definition of change
25 and how to deal with margin of safety. So if you have any

1 preliminary views, you may want to give them to us because I
2 think the goal at the moment, if I recall, is that the
3 Commission still vote in the early March time frame on
4 concept and then let the staff finalize by April. Isn't
5 that right, Madam Chairman, approximately?
6 CHAIRMAN JACKSON: Yes. Exactly.
7 In fact, let me just piggyback on that. I mean,
8 you have a, you know, a comment, and it was in a letter
9 having to do with the ANSE standard. It's in appropriate
10 for determining minimal increase and probability of
11 malfunction. So, of course, you know I'm going to press you
12 in terms of what you think would provide a better basis for
13 that.
14 And then if you, as part of your presentation, Dr.
15 Apostolakis, you know, talk about the differential approach,
16 differential use of frequency consequence curves or whatever
17 would allow us to talk about definition of change.
18 DR. APOSTOLAKIS: Sure.
19 CHAIRMAN JACKSON: And so -- but Dr. Barton, if
20 you could speak to that issue.
21 MR. BARTON: I wish I were a doctor.
22 CHAIRMAN JACKSON: Okay.
23 MR. BARTON: I'm the only non-doctor. I think I'm
24 the nurse on this committee.
25 [Laughter.]

1 CHAIRMAN JACKSON: Let's put it this way: I
2 confer upon you an honorary degree, so I'm going to call you
3 Dr. Barton today.
4 [Laughter.]
5 MR. BARTON: We have done some discussion on the
6 minimal increase. The reason for the ANSE is there was no
7 technical basis, we felt, in the letter in 1995 for using
8 the study that was in the ANSE as a justifiable reason for a
9 minimal increase.
10 I think the definition of minimal, where the
11 committee comes out is they would like to see qualitative
12 decisions -- qualitative definition of minimal so licensees
13 can employ PRA methods to show change has a minimal impact.
14 But currently, that is not the definition of minimal. I
15 think that's where we would like to see it come out, and
16 maybe George would discuss that as part of the --
17 CHAIRMAN JACKSON: So let me make sure I
18 understand. First of all, you want the language, you're
19 saying, to be qualitative.
20 MR. BARTON: Quantitative.
21 CHAIRMAN JACKSON: Quantitative. I see. And then
22 you want to be able to have PRA methodology be used from an
23 impact point of view.
24 MR. BARTON: Yes.
25 CHAIRMAN JACKSON: To be able to define minimal.

1 DR. APOSTOLAKIS: Can I say something?

2 CHAIRMAN JACKSON: Please.

3 DR. APOSTOLAKIS: Again, we have to distinguish
4 between short-term and long-term.

5 CHAIRMAN JACKSON: Right.

6 DR. APOSTOLAKIS: For the short-term, if we could
7 go back to the SECY and go line by line and delete the word
8 probability, we would be in much better shape. You are
9 giving a definition of minimal change in the probability of
10 malfunction. You explicitly state if there is a new failure
11 mode that is identified, then the change is more than
12 minimal, the change in probability is more than minimal.
13 Why don't we change that and say if there is a new failure
14 mode, you are not allowed to make the change. Drop the
15 probability.

16 Now, I was told this morning -- by the way, these
17 are my personal views, they are not the committee's views.
18 They were formed a few hours ago.

19 [Laughter.]

20 DR. APOSTOLAKIS: But I was told that it may not
21 be possible to eliminate the word probability from
22 everywhere. I think it's causing a lot of headaches because
23 it has to be unquantified at this point. It has to be --
24 the judgment -- what is minimal has to be the judgment. So
25 let's call it that. The idea is to preserve the integrity

1 of the licensing basis. That's what we were told. I like
2 these words. The original licensing basis was deterministic
3 based on judgment; the minimal change should be based on
4 judgment. We should not invoke terms that are not
5 quantified or ill-defined in that context as probability.
6 So if that could be done, I think the document would be much
7 better off.
8 Now, in the long term, of course, then it's a
9 different story. You go to PRA, you use probabilities and
10 so on. But for the short term, that would make me much
11 happier.
12 COMMISSIONER McGAFFIGAN: Madam Chairman?
13 CHAIRMAN JACKSON: Please.
14 COMMISSIONER McGAFFIGAN: The problem with that is
15 that it's in the original rule, the use of the word
16 probability, and the goal is stability. In the original
17 rule is deterministic use of the word probability. And so I
18 suspect what you're suggesting would require re-noticing and
19 not getting the stability that people want. We have to do a
20 better -- that's why the second step is important, I think
21 we all agree.
22 DR. APOSTOLAKIS: I notice, though, that you are
23 changing some of the words in the original rule, aren't you?
24 COMMISSIONER McGAFFIGAN: Yes, we are, but --
25 DR. APOSTOLAKIS: Yes.

1 COMMISSIONER McGAFFIGAN: Right. But have you
2 noticed these changes adequately that you might consider
3 making them this late in the process?
4 DR. POWERS: I think it's my impression that we're
5 struggling to find the right way to explain what probability
6 is. We're quite frankly dealing with two scales of
7 probability. There was probability considered in the
8 deterministic days, those dark old days. The probability
9 scale there was measured in units of two decades; that is,
10 things of nominally one to ten to the minus two per year was
11 high probability; things in the ten to the minus two to ten
12 to the minus four was a possible outcome; ten to the minus
13 four, ten to the minus six was very unlikely. That's a very
14 coarse scale.
15 Now I think when people use the word probability,
16 they're saying, gee, is it four times ten to the minus four?
17 Is it two times ten to the minus four? They're comfortable
18 with making that kind of distinction, whereas in the past,
19 they were uncomfortable making distinctions within the
20 decades.
21 It is, I think, because of that radical difference
22 in scale, Professor Apostolakis rightly calls, there's a
23 confusion now because we've gone to a much finer resolution
24 here. And if we can find words that eliminate that scale
25 and return to the qualitative influence Mr. Barton was

1 speaking of of, is it very likely, is it moderate likely,
2 and are you making a transition between those two regimes an
3 the scale, that we would be much better off.
4 CHAIRMAN JACKSON: Well, let me just ask a
5 follow-on question. I mean, a criticism has been that when
6 one has kind of words like that -- likely, moderately likely
7 -- that that leaves open a door for a degree of
8 arbitrariness that people would like to get away from.
9 That's number one.
10 Now then you say, well, you have that, and in
11 order to give definition to it, perhaps, you know, you have
12 to have the guidance. But I note that your first bullet is
13 that you feel that the revised guidance already is overly
14 prescriptive, then that relates to the definition of margin
15 of safety. We're talking, you know, minimal at this stage,
16 but they're all tied up. I mean, these things, these are --
17 DR. POWERS: They are very closely tied together.
18 CHAIRMAN JACKSON: Right. And so my question is,
19 how do we get there from here? I mean, if, on the one hand,
20 you feel that we're not at a point of being able to have
21 quantitative definitions in the rule as it is, you want to
22 get to a point to finish this rulemaking so we can have
23 stability. But if you leave open kind of very descriptive
24 language, the question becomes, how do you give enough
25 meaning to it to really allow it to be implemented in a way

1 where it doesn't appear that there would be arbitrariness.
2 DR. POWERS: I think you have hit upon the
3 critical juncture, and that is between the margin of safety
4 and the definition of minimal.
5 CHAIRMAN JACKSON: Exactly.
6 DR. POWERS: And quite frankly, as an example, not
7 to express a position, but an example that one can tolerate,
8 if one said that the margin of safety subject to regulation
9 is that margin that exists between the current tech specs
10 and where actual damage to the core occurs, then the
11 question of minimal resolves itself and can be eliminated
12 actually from the regulation because you can say anything
13 that does not affect the tech specs obviously has made a
14 minimal change in the margin of safety, and it has made none
15 at all. Okay. That's one clear-cut example.
16 If you take the other definitions of margin of
17 safety, then you have other kinds of definitions of where
18 minimal -- if we resolve this question of which margin --
19 and there are multiple margins, and that's one of the
20 biggest problems that we have in the debate. We need to
21 have margin sub-one, sub-two, sub-three, and all agree what
22 those mean. This issue of what minimal will resolve itself.
23 And you can see I perhaps telegraph some of the debate that
24 goes on within the committee.
25 DR. KRESS: I don't think the minimal will

1 completely resolve itself when you resolve the margins issue
2 because the changes that are normally made under Part 50.59
3 involve more than tech specs usually, and the margins issue
4 I think is a tech spec issue.
5 So you will still have to be faced with some sort
6 of definition of minimal even though you fixed the margins
7 problem, even though -- that could be part of the
8 definition. Once you fix the margins, that could be part of
9 the definition of minimal, but you'll need to go further.
10 DR. POWERS: I think it only serves as a standard
11 by which you can judge the other changes.
12 DR. APOSTOLAKIS: Yes. Coming back to the point
13 you made, Chairman Jackson, regarding the subjective nature
14 of these things, it's a trade-off. If we want stability, we
15 want something out on the street as soon as possible, that's
16 the price we have to pay. We have to live with subjective
17 judgment for a while. If we want something more
18 quantitative, well, it takes a little time to do this. And
19 it's already -- I mean, the use of the word probability
20 right now does not make it quantitative anyway.
21 CHAIRMAN JACKSON: That's true.
22 DR. APOSTOLAKIS: So it seems to me, by deleting
23 it if possible, we're avoiding a lot of the headaches we're
24 having now. That's not the committee position.
25 MR. BARTON: I think where the committee is on

1 this, and the bullet that you referred to on the overly
2 prescriptive had to do with option -- the staff's proposed
3 option one, which is, in fact, the inputs to the tech specs.
4 I think where the committee is, is between option two and
5 three, but we haven't really explored option three and the
6 industry's approach that goes along with that. So that's
7 where we are with respect to the minimum -- I mean the
8 margin of safety issue.
9 CHAIRMAN JACKSON: Have you been able to -- we are
10 not able to identify a list of key questions, such that in
11 answering them in a structured way, one would be led to
12 closure, even if you yourselves haven't answered those
13 questions?
14 I mean I'm really looking for a path through the
15 forest here, because we have been talking around this for a
16 long time, and this rule itself stayed with the Commission
17 for six months last year. And the real issue is, is there a
18 defined path with key questions or decision-making points so
19 that if those got answered, if not by through resolution
20 between the Staff and the industry, and other stakeholders,
21 then the Commission answered them, but that would lead you
22 to some resolution.
23 MR. BARTON: We do not have that currently, but we
24 are working on that. It was an item that we discussed in
25 our meeting last week planning programs meetings to develop

1 such a list, and that will be available, we will have that
2 shortly, so we will be ready for the March meeting.
3 CHAIRMAN JACKSON: Well, what I would just ask
4 then, you know, jumping ahead, that as soon as you have such
5 a list -- I mean I encourage you to develop that -- that you
6 promulgate it -- you propagate it, rather, to the Commission
7 even as it may be being discussed, once you have settled on
8 it as a committee, that you propagate that to the
9 Commission. Because it may be that the Commission has to
10 walk through these steps and answer the questions and,
11 therefore, come out at the end with where we are going to be
12 on 50.59 at this stage of the game, because we have got to
13 come to closure here, and if you or others can't come to
14 agreement on it, then that's where the Commission has to
15 step in and make a series of decisions.
16 COMMISSIONER McGAFFIGAN: And the only additional
17 -- I think a little bit of this discussion is confused, step
18 B with step A. The risk-informed part, which we are about
19 to listen to Dr. Apostolakis on, is something we want to get
20 to, something that you all in your December 11th letter say
21 is going to take some time, but on part A, I think our
22 options are limited, legally, based on what we noticed, and
23 we can't invent a lot of stuff at the end of the game. It
24 has to be basically -- unless we are going to re-notice and
25 not bring the short term stability, there is a constrained

1 set of issues that are -- that we can work on in step A.
2 CHAIRMAN JACKSON: Karen, what do you have to say
3 about that?
4 MS. CYR: Well, we clearly have to look at that
5 issue, but it depends on whether you could go back and
6 legitimately make an argument that given what you did
7 notice, that you were really talking about fundamentally
8 changing the way you went about that particular aspect of
9 the rule. And if you went and did something like delete the
10 word probability, that that is still within the scope of
11 what you were doing because you were talking about really
12 trying to come at it from a different perspective than you
13 had ever used before.
14 Now I mean we haven't done that, and we'd have to
15 do that, depending on what the Staff might come up with as a
16 possible approach, to see whether in fact we believe it had
17 really been noticed.
18 COMMISSIONER McGAFFIGAN: But the margin of safety
19 and the definition of change issue, those are fair, totally
20 fair, because we noticed multiple options and basically
21 asked for a large dialogue, but some of what you are saying
22 may well be for the second phase, I think.
23 CHAIRMAN JACKSON: What I'm talking about, in
24 terms of defining a set of questions or key issues, that if
25 answered would lead to a result. I'm talking about within

1 the context of what has already been noticed, within the
2 context of focusing on margin of safety and definition of
3 minimum. But I think that, in and of itself, would be a big
4 help, that if you could lay out such a pathway, that, you
5 know, you decide this or this, you decide this or this, and
6 then that allows the Commission to walk through and in the
7 end a lot of this is policy, public policy, and that's what
8 the Commission is here for, and if we are not going to come
9 to closure in terms of going down a quantitative path now,
10 based on PRA and risk assessment methodologies, then we just
11 have to identify those key questions that have to be
12 answered and move it along that way.
13 DR. POWERS: Again, I think the question that you
14 are talking about, we might know better as our strategy to
15 resolution, and Mr. Barton has a draft of it, and it will
16 get its fair share of debate in itself.
17 On the other hand, we are moving the direction,
18 and we don't want development of those questions to become
19 yet another --
20 CHAIRMAN JACKSON: Yes, long term project.
21 DR. POWERS: -- long term project itself.
22 COMMISSIONER DIAZ: But if dealing with the term
23 probability provides clarity to the rule, you know, in the
24 first phase, I certainly would like to see what the
25 rationale behind it is.

1 CHAIRMAN JACKSON: Well, and also, I mean if we
2 are going to do that, then you need to be able to give us a
3 quick legal opinion in that regard.
4 DR. APOSTOLAKIS: So my argument was that it does
5 not, but --
6 CHAIRMAN JACKSON: We'll have to get a legal
7 opinion also.
8 DR. APOSTOLAKIS: Yes, but I mean somebody else
9 may argue that it does, and that would be an interesting
10 argument.
11 COMMISSIONER DIAZ: And we'd like to hear both
12 sides.
13 DR. POWERS: Why don't we move on to the
14 discussion of the interesting frequency consequence curves,
15 and Professor Apostolakis will outline some of the things
16 that we have found out about them and whether they may or
17 may not be useful.
18 DR. APOSTOLAKIS: The emphasis, by the way, has
19 been on the frequency consequence curves, but there was more
20 to that attachment, and I will point that out as we go.
21 Since last July, when I wrote the attachment to
22 the letter, we have discussed it, these curves, among
23 ourselves, and there were many questions raised, and last
24 week we had a very useful and thorough subcommittee meeting
25 with Dr. Barr, who is the president of Energy Research,

1 Incorporated, and this company, which is in Rockville, has
2 been working with the Swiss nuclear regulatory inspector, I
3 believe is the name, to come up with risk-based, they call
4 it, regulatory system using curves like these, using cesium
5 as the consequences, equivalent grams of cesium, and the
6 frequency, of course. So that gave us a good opportunity to
7 discuss these things.
8 By the way, these have not been adopted by the
9 Swiss regulatory body.
10 And also I am happy to say that the frequency
11 consequence curves are one of the options that the Staff is
12 considering in their long term effort to risk informed
13 50.59, so I am sure that there will be more to it.
14 So, as the Chairman said earlier, you already have
15 the background material, so I think we should focus on slide
16 6-A, which will help us understand a few things or discuss a
17 few things that are, as Dr. Powers said earlier, that are
18 really relevant to the larger effort of informing Part 50.
19 What we see in the boxes with the heavy lines
20 there is the basic steps in the PRA. You start from the
21 left, where we identify a set of initiating events. Then we
22 do a plant model, that's a Level 1 PRA, whether the various
23 cooling systems would work and so on, and we end up with the
24 so-called plant damage states, and the frequency of the
25 number of them -- some of the frequencies of a number of

1 these plant damage phases is what we call core damage
2 frequency.
3 Then we proceed to Level 2, which looks at
4 containment performance, and we expand the accident
5 sequences to include failures of the containment systems and
6 we end up with the accident progression bins. And again,
7 the sum of the frequencies of a number of these accident
8 bins is what we call large early release frequency.
9 Then if we include the fission product transport
10 and removal, we end up with release states, with release
11 categories, where now we are saying we are releasing cesium,
12 we are releasing iodine with this frequency.
13 And then if we go to the side model, which is 11-3
14 PRA, in other words, we take into account weather conditions
15 and so on, and population distribution, we end up with what
16 most people commonly understand as risk and probability of
17 individual death and so on.
18 An important point here is that as we move from
19 left to right, the uncertainties increase. It is a very
20 important point. I have uncertainties of the plant damage
21 state. As I move to the accident progression bins, I have
22 to include accident phenomena that occurred in the
23 containment, their probability that their containment
24 functions fail, so my uncertainties are compounded.
25 The Commission right now has a safety goal policy

1 statement out that refers to individual risk at the
2 right-most part of the figure, the risk matrix. Now since
3 the uncertainties increase, it becomes impractical to set
4 criteria that are very far to the right, especially for
5 something like 50.59, which really deals with very little
6 changes, maybe you can think of them as changes in the
7 system model of the containment performance.
8 You would like to have criteria that are as close
9 to those actions as possible, okay. Now what do you lose
10 that way? Well, if you look at the release states, you will
11 have a contribution from the reactor itself, but also from
12 other sources. So that's what you lose. Now you are
13 dealing only with the reactor as you go into it.
14 On the other hand, one can make a very good
15 argument that the overwhelming contribution to the release
16 states does indeed come from the reactor. So that's really
17 where you should focus your attention.
18 Another argument that was raised is that it took
19 us a while to issue 1.174 and the other risk-informed
20 guides, where we use a CDF curve as the matrix, so now by
21 going to the right and go to the F-C curves, you are
22 changing the paradigm again before we even had the chance to
23 use the other one, and that's a good point as well.
24 So that's why I propose the F-C curves at the
25 release state, because I felt that that would help us have a

1 coherent set of regulations, including 50.59. But I do
2 recognize that there are all these problems.
3 Another major contribution, in my opinion, of
4 these curves, is that we will have to think in terms of
5 sequences, not individual changes in initiating events and
6 the malfunction of equipment.
7 This is a bad legacy of the previous system. It's
8 too intrusive, too prescriptive. What really matters is the
9 sequences, the accident sequence.
10 Now, of course, it's not only the F-C curves where
11 you have sequences. You can have sequences one step to the
12 left at the accident progression bin, or at the plant damage
13 state. So that is something for the future. In fact, the
14 Chairman noted that the consequences can be defined any
15 place you would like, and that's something that I did not
16 address, and in fact, a lot of people thought that I was
17 really arguing very strongly for the use of the F-C curves
18 themselves.
19 Well, these are the starting point, in my opinion.
20 You have to make it practical, so you have to devise or
21 derive subsidiary criteria from these curves that will move
22 to the left, and they will become much more practical.
23 Another thing that created panic was that this
24 academic is asking us now to do all these calculations for
25 50.59 things. That assumes that the benefits are the same.

1 The 50.59 I envision is not the 50.59 the industry is used
2 to. The industry will get much more flexibility, depending
3 on where we set the definitional criteria.
4 For example, people are saying, well, the F-C
5 curves are so insensitive to 50.59 changes, so they are
6 useless. Well, that's one conclusion. Another conclusion
7 is if they are insensitive to these changes, why should the
8 NRC review these changes. So you can change the argument
9 there.
10 In other words, we want to have performance-based
11 regulation. An essential element of performance-based
12 regulation is licensee flexibility. Okay. So if my risk
13 curves, if my risk method does not change in a significant
14 way, well, then I don't have to review it.
15 CHAIRMAN JACKSON: What if you remove the
16 containment?
17 DR. APOSTOLAKIS: Pardon?
18 CHAIRMAN JACKSON: Nothing.
19 [Laughter.]
20 DR. APOSTOLAKIS: By the way, this is
21 risk-informed in the spirit of 1.174. Decisions will not be
22 made only on this.
23 CHAIRMAN JACKSON: Right. I just thought, you
24 know, I'd bring it up. It's an interesting discussion.
25 DR. POWERS: Let me interject that one of the ACRS

1 initiatives is in fact to find the appropriate relationship
2 between defense-in-depth and risk-informed regulation, and I
3 hope that in the near future, you will get a communication
4 from us on exactly that issue, and whether you can remove
5 the containment or not.
6 CHAIRMAN JACKSON: Well, I just thought I'd check.
7 DR. APOSTOLAKIS: So the current effort to
8 risk-informed inspection and enforcement process has
9 proposed these cornerstones which are one way of
10 implementing defense-in-depth. You have initiating events,
11 mitigation systems, barrier integrity, and then on the right
12 emergency preparedness.
13 Well, we could set the criteria there, working
14 backwards from the F-C curves, so it will be easier to work,
15 plus we are implementing defense-in-depth.
16 So but the important point really is that people
17 should realize that if we do this, it will take extra
18 calculations, but the benefits will be there. It will not
19 be just preserving the current 50.59.
20 Now if we go with CDF and LERF that is the
21 paradigm that people like now -- well, on slide 7 you see a
22 set of frequency consequence curves, and we really
23 scrutinized them. It turns out that the flat part that you
24 see there is controlled by the core damage frequency, and
25 then the other part, the steep decline there, is LERF, so

1 there is a real question really whether you need the whole
2 curve if you have already controlled CDF and LERF. That's
3 something we are investigating.
4 But if we decide to go that way, then we already
5 have 1.174, and if we go to slide 10, I have taken figure 4
6 from 1.174 and added the fourth region which was not there,
7 that would be the 50.59 region. In other words, if -- and
8 again, this is just a proposal. I mean some of my
9 colleagues feel that region 4 should include region 3, the
10 current region 3, in other words, should go all the way to
11 the right, so that 50.59 changes would not depend on the
12 current status of the plant. That's something that I
13 consider a minor point to be discussed.
14 The idea is to have a region 4 that would say as
15 long as your delta CDF or your delta LERF is in that region,
16 then we will not review it, we will not review it. That
17 would be a risk-informed -- assuming, of course, that there
18 are adequate defense-in-depth and safety modules are also
19 satisfied, as stated in Regulatory Guide 1.174.
20 So --
21 CHAIRMAN JACKSON: So that could be done today?
22 DR. APOSTOLAKIS: You would revolutionize the
23 system if you adopted this today because that would allow
24 many more changes without prior approval. So I guess the
25 implications would have to be investigated, but it certainly

1 wouldn't take five years; along today, let's put it that
2 way, today is --
3 DR. POWERS: In truth, you'd have to say that
4 there is some groundwork that has to be laid as far as what
5 are the standards of the PRA that you are going to do the
6 evaluation. But have we got a first step that you have to
7 have? The first step is 1.174, and Professor Apostolakis is
8 adding to that, rather than creating a revolution by
9 himself.
10 Now I understand there is still this very
11 legitimate debate of 50.59 or its descendant still should be
12 applicable to all plants, regardless of their risk status.
13 Now it would still be possible to make changes in plants
14 that are of minimal regulatory interest, even if the plant
15 is up in a region that 1.174 would require lots of
16 regulatory attention.
17 COMMISSIONER DIAZ: I think a year ago
18 Commissioner McGaffigan and I were, say, not fighting, but
19 arguing with the Staff why couldn't we do just this then.
20 Now we were beaten to a pulp. You know, they had to drive
21 us out of the room, you know, bloody, because the Staff said
22 absolutely you cannot mix the two processes. But I always
23 wondered if that was the right --
24 DR. KRESS: I think the problem, the debate we
25 have had among ourselves, is that when you get down to that

1 level of delta LERF, you are reaching an area at which the
2 PRAs are insensitive.
3 CHAIRMAN JACKSON: That's right.
4 DR. KRESS: And that is the crux of the problem.
5 CHAIRMAN JACKSON: That is the crux of the
6 problem.
7 DR. KRESS: How do you really know whether -- how
8 do you believe the PRA.
9 COMMISSIONER McGAFFIGAN: But at some point --
10 maybe it doesn't matter if it's 10 to the minus 7 or 10 to
11 the minus 7, if they are below that threshold.
12 The other point I will make, though, that -- and
13 the reason that Commissioner Diaz and I were having this
14 discussion with the Staff, is this viewgraph as originally
15 proposed had a negligible region, which is essentially your
16 region 4 and region 3, I believe. And the negligible
17 region, or maybe it was one order of magnitude below, one of
18 the Staff commented to us that the license amendments in
19 that range would be approved in a nanosecond with the second
20 nanosecond for OGC concurrence.
21 So if they are indeed -- that then raises the
22 question why are we even looking at them, but the
23 fundamental issue is how this risk-informed regime marries
24 up with the deterministic regime, and we never could square
25 that, because --

1 CHAIRMAN JACKSON: I think they called them
2 different things --
3 DR. POWERS: Right.
4 CHAIRMAN JACKSON: -- that we insist upon, that I
5 don't want to go over. But all of us have been stuck -- not
6 all of us, all of everybody else, that somehow 50.59 has to
7 -- the issue is how do you preserve the design basis, but
8 not have us stuck in design basis, what we call design basis
9 space. Okay. Can one overlay cornerstones that relate to
10 design basis integrity onto this and then around those apply
11 something like this?
12 DR. POWERS: Let me make a prognostication,
13 without having much support, that when we go to this step of
14 risk-informed, we will find our biggest debates having to do
15 with how do we marry this negligible and sensitive risk with
16 the preservation of the defense-in-depth philosophy. And we
17 will continuously run into a problem of defense-in-depth
18 trumping all risk analyses, and we will have to resolve that
19 marriage in some more definitive fashion in saying where is
20 the appropriate for these defense-in-depth concepts which in
21 some respects are your design basis concepts appropriate to
22 preserve, and where is appropriate to defer to the new
23 technology of risk assessment to make the decisions.
24 CHAIRMAN JACKSON: That's right.
25 DR. POWERS: And I think you will find we have had

1 several members and a fellow working on statements on
2 exactly that issue, and what we have called the need for a
3 defense-in-depth policy statement.
4 DR. KRESS: And if you were to happen to read the
5 transcripts of our meeting this morning, you will find that
6 one member made a really radical statement, that we should
7 quit dwelling on the concept of preserving the design basis.
8 There's lots of reasons that that gives us a great deal of
9 problems, and maybe should not be a regulatory intent in the
10 first place. It's just something for you to think about.
11 DR. POWERS: They probably have more than enough
12 to think about, Tom.
13 COMMISSIONER DIAZ: But, of course, it just
14 depends on how robust our PRA is.
15 DR. POWERS: Absolutely.
16 COMMISSIONER DIAZ: What we are saying is there
17 comes a time when a robust, really well-set PRA based
18 decision will be dominant compared to whatever comes from
19 defense-in-depth.
20 CHAIRMAN JACKSON: And we haven't gotten there
21 yet.
22 COMMISSIONER DIAZ: And we haven't gotten there,
23 and that is the point that we are approaching.
24 DR. KRESS: And it has to be related to the
25 uncertainties. We are not quite sure how to do that, but it

1 has to be.

2 DR. APOSTOLAKIS: We have addressed the issue in

3 one of our letters, and slide 35 addresses it if you want to

4 jump there, but I don't think we will have to go to the

5 actual presentation. Where we listed in that letter on

6 impact of PRA results and insights on the regulatory system,

7 the strengths and limitations of defense-in-depth and PRA

8 --35.

9 DR. POWERS: It's under --

10 DR. APOSTOLAKIS: Pardon?

11 DR. POWERS: 6, 6-A.

12 DR. APOSTOLAKIS: So, and I think this will be the

13 starting point for addressing the questions that Dr. Powers

14 and Dr. Kress raised. But you have to understand the

15 strengths and limitations of each approach.

16 Now the recommendation we had in that letter is

17 that defense-in-depth should be invoked when PRA

18 uncertainties are a major issue, in the sense that you

19 cannot make a decision because the uncertainties are very

20 large, and they may be -- and these uncertainties will be

21 primarily due to incompleteness, very poor modeling of

22 something, and so on. We are not talking about some

23 parameter being up and down. I mean we are talking about

24 big things. So there is something already in the books, and

25 I have finished my presentation.

1 DR. KRESS: I would like to add one more comment
2 on the F-C curves before we leave them. The current LERF
3 acceptance value in 1.174 really is just a surrogate for the
4 prompt fatality at an individual reactor. There may be
5 other regulatory objectives, such as latent fatalities,
6 total fatalities, land -- you could name a great many of
7 them. LERF will not give you much of an insight as to
8 whether or not those are being met.
9 The F-C curves, on the other hand, can encompass
10 any one of those objectives that you wish to choose because
11 they focus on the right thing, the fission product release,
12 which is a common ingredient of all those risk matrices at
13 the end. So if one wanted to expand his look at what our
14 regulatory objectives are, beyond just prompt fatalities,
15 then one would have to go the route of F-C curve somehow to
16 develop new acceptance criteria that would relate to the
17 regulatory goal -- there may not be a regulatory goal for
18 some of those, like land interdiction, but if you had one,
19 you could derive surrogates down at a lower level, at the
20 fission product release level, using F-C curves. And that,
21 to me, is where their attractiveness lies.
22 CHAIRMAN JACKSON: You know, one could make the
23 following statement, or I will make the following statement;
24 that by focusing on core damage frequency and/or large early
25 release frequency, that that is in fact how one de facto

1 puts defense-in-depth into risk --

2 DR. APOSTOLAKIS: Yes.

3 CHAIRMAN JACKSON: And so that is a justification

4 within the current framework for doing things like what Reg

5 Guide 1.174, in fact, has built into it.

6 COMMISSIONER DIAZ: If I may piggyback on the

7 Chairman, if we actually look at the center of what -- or

8 let's call it the focal zone of what PRA is now capable of

9 doing, which is center on structures, systems and

10 components, CDF becomes a much more predictable and much

11 more closer and less uncertain, you know, quantity in which

12 --

13 CHAIRMAN JACKSON: That's right. And that's the

14 reason for focusing in that arena, because you both de facto

15 have, you know, built in your defense-in-depth, and you are

16 dealing in an arena in PRA space where the uncertainties are

17 at a point where you are more comfortable with.

18 DR. KRESS: That, in fact, is why we originally

19 talked about elevating CDF to the fundamental zones.

20 DR. APOSTOLAKIS: And if you look at the

21 cornerstones, that's a further statement of

22 defense-in-depth.

23 CHAIRMAN JACKSON: Exactly. Exactly.

24 DR. APOSTOLAKIS: As long as we don't overdo it,

25 Chairman Jackson. I mean what do we do then? Do we take

1 one cornerstone and put another layer and another layer?
2 Somewhere we have to draw the line and say enough
3 defense-in-depth.
4 CHAIRMAN JACKSON: Well, I think that there was a
5 line drawn and a line is being drawn in the work the Staff
6 is doing in the assessment and inspection program, and
7 relating it, and what the levels are in which --
8 DR. POWERS: We definitely see a tendency --
9 perhaps well articulated by the Chairman in her comments on
10 50.59 -- that to utilize defense-in-depth as a basis to
11 retain control over issues that have previously been part of
12 the Staff's domain, and we have, I think, now collected
13 several instances where issues that you would think would be
14 resolved by a straightforward risk or availability analysis,
15 that the PRA is supposed to be very good at, but the
16 redundancy or diversity is retained, despite PRA saying it's
17 not necessary because we have this defense-in-depth.
18 So you have to be careful that we don't end up in
19 a situation of where we have developed a marvelous
20 technology, but its predictions are always curtailed or
21 constrained because we do this for defense-in-depth. You
22 have to have a criterion for applying it, and the necessary
23 and sufficient criterion is the things we are going to do,
24 the committee itself is trying to prepare for you.
25 CHAIRMAN JACKSON: Well, the way you have to get

1 at that is to be able to answer the question of if you draw
2 the line at a certain place -- core damage frequency, LERF
3 -- how much of what we traditionally call defense-in-depth
4 is covered by that. And then are we comfortable with that.
5 And if so, then that's the place to start.
6 DR. APOSTOLAKIS: That's correct.
7 CHAIRMAN JACKSON: You haven't walked away from
8 quote, unquote, defense-in-depth, but you are not overly
9 hanging onto things that you could let go. But that's what
10 I mean about a series -- and this is in a different context
11 -- of questions that you need an answer to. That is, how
12 much defense-in-depth does drawing the line here provide
13 versus here provide, versus here provide, and then given
14 that information, it's a public policy decision that a
15 Commission is meant to make.
16 DR. APOSTOLAKIS: And I think the guiding force
17 there should be the quality of the PRA, the uncertainties.
18 As you go down, if you find that something is not modeled,
19 you should immediately go back to the traditional way,
20 prescriptive way of controlling things.
21 CHAIRMAN JACKSON: Well, I think the fundamental
22 is not one on -- see, the quality of the PRA should not
23 drive the public policy. The public policy is rooted in how
24 much one wants to hold onto defense-in-depth, and where does
25 one draw the line in terms of where the focus should be, in

1 terms of how much defense-in-depth is preserved.

2 Then there is a separate question in terms of

3 applicability of a methodology, in terms of how good it is

4 to allow you to do that. Those are two separate things.

5 DR. APOSTOLAKIS: And I understand that.

6 CHAIRMAN JACKSON: Okay.

7 DR. APOSTOLAKIS: But I think this thinking is

8 probably more applicable at the high level, where you are

9 saying I don't care what the technology can do, I will have

10 a criterion on LERF and CDF. Why? I want the containment,

11 period. It's a principle of mine. I want defense-in-depth.

12 CHAIRMAN JACKSON: Well, that's a public policy.

13 DR. APOSTOLAKIS: Yeah, it's a public policy.

14 CHAIRMAN JACKSON: Okay.

15 DR. APOSTOLAKIS: But what I was referring to was

16 at the much lower level --

17 CHAIRMAN JACKSON: No, but what you are talking

18 about is at an implementation level.

19 DR. APOSTOLAKIS: Yes.

20 CHAIRMAN JACKSON: But to set the policy, you have

21 got to be clear on what defense-in-depth really means and

22 what the -- given -- drawing the line or what you are going

23 to use as the decision point, how much defense-in-depth, if

24 that's a fundamental principle, that provides. So there are

25 two questions.

1 DR. APOSTOLAKIS: Yes.

2 CHAIRMAN JACKSON: Do you want to preserve
3 defense-in-depth? And if you do, you know, where are you
4 willing to draw the line. Then you come to the next
5 question having to do with what do you use to implement it,
6 and how well does a given methodology, you know, allow you
7 to do that, and are you comfortable enough with any
8 uncertainties to use it.

9 DR. APOSTOLAKIS: I agree.

10 CHAIRMAN JACKSON: And that, to me, is where you
11 -- but the point is, as you yourself said, the more to the
12 left you are, the smaller the uncertainties.

13 DR. APOSTOLAKIS: That's correct.

14 COMMISSIONER McGAFFIGAN: Could I ask, the quality
15 of the PRA issue came up earlier, and now it's just come up,
16 and I'd like to just focus on that for a moment because I
17 can give you a chance to respond to some criticism that Mr.
18 Loughbaum from the Union of Concerned Scientists has
19 delivered to the Commission, and more is coming. But
20 basically he told us last month that any self-respecting
21 analyst out there in the industry can tweak a PRA and make
22 it as least as obscure as any deterministic analysis and get
23 it to come out any which way he wants.

24 He further said that there are -- the quality of
25 the PRAs out there isn't high, in his view; not just things

1 left out, but almost identical plants in one case will have
2 something making a large contribution to core damage
3 frequency, and another plant, a practically identical one,
4 won't even look at it in its IPE, and vice versa. And he
5 cited, I think, Wolf Creek and Callaway as two that are
6 practically identical and yet in -- so, you know, the
7 question for a Commissioner who is not a practitioner in PRA
8 is are we building a house of cards here, and when is this
9 quality issue actually going to get addressed. You know,
10 because the Staff, I think in the IPEs, a retired staffer
11 told me when I was first here, a lot of these IPEs were
12 crappy. We've never said that as a Commission statement,
13 but he was about to walk out the door, so it's easy --
14 [Laughter.]
15 COMMISSIONER McGAFFIGAN: So what do we do?
16 DR. POWERS: Let me interject, first thing.
17 I would like to call your attention to your IPE
18 insights document which brings up a lot of these issues, and
19 it will remind you that it's unfair to equate IPE with PRA.
20 CHAIRMAN JACKSON: That's exactly right.
21 DR. POWERS: They have two different missions.
22 Then the issue of quality, of course, has been in
23 front of the Staff for some time and, in fact, the Staff is
24 now engaged in an ASME/ANS exercise to define what are the
25 standards for PRA and, indeed, the industry itself is

1 actually ahead on this game on saying what is an inadequate
2 PRA with their certification program, where they are
3 certifying PRAs, not blessed and go forth and use it for
4 everything, but they have said we will bless it for
5 particular types of applications. It's a very attractive
6 possibility because some plants want to be part-way
7 pregnant, that is they would like to use PRA a little bit
8 -- CHAIRMAN JACKSON: Doesn't work.
9 DR. POWERS: Not a whole lot, and in this case I
10 think you can be partially pregnant, in that you -- and it
11 is appropriate to be because we have plants with different
12 forecasted lifetimes and different interests in extending a
13 license renewal.
14 Now the general issue, or the specific issues of
15 completeness and comparison between identical plants is an
16 issue that I believe you have approved the Staff to go in
17 and look at further, and they recognize that this occurred
18 in the IPEs and at least one that I was promptly familiar
19 with, or the one I asked about, the Staff emerged and said
20 it turns out they are identical only up to the point that
21 causes the differences in the risk.
22 So just because you can find two plants that they
23 say, well, they are almost sisters, does not mean that they
24 have the same exact risk profile.
25 CHAIRMAN JACKSON: That's right.

1 DR. POWERS: And similarly, let me be very
2 cautious about equating IPE and PRA because there was such a
3 specialized expectation of the IPE and some plants, quite
4 frankly, some institutions, quite frankly, minimalized that,
5 and some institutions have just gone way beyond that and, in
6 fact, they have exploited the technology to its fullest.
7 CHAIRMAN JACKSON: Please.
8 DR. POWERS: Oh, I'm sorry, Commissioner Diaz.
9 COMMISSIONER DIAZ: Well, I was just going to
10 actually make a statement for you which I'm sure that you
11 will enjoy because, you know, you are so balanced in your
12 views.
13 [Laughter.]
14 COMMISSIONER DIAZ: When you said a while ago how
15 much defense in-depth is enough, of course, you also meant
16 how much PRA is enough, and that the issue is, where are the
17 confidence limits of each one.
18 DR. APOSTOLAKIS: See, I think again we're getting
19 into a pitfall that is very common. We are asking Mr.
20 Lochbaum this. There was a design error someplace. Your
21 PRA didn't catch it, okay? There was some line there that
22 was unavailable and so on, it's not in your PRA. That's not
23 the right question. Did you find that out using -- I mean,
24 was it in the traditional deterministic framework included
25 the fact that that line was unavailable? That's the

1 question. Are you enhancing the ability of the system to
2 make rational decisions by bringing PRA into the system or
3 not? That's the fundamental --
4 CHAIRMAN JACKSON: Well, I think --
5 DR. APOSTOLAKIS: But to say that the PRA had a
6 problem doesn't mean anything.
7 CHAIRMAN JACKSON: Well, I don't think we're here
8 to debate that point as such. I mean, I think the
9 Commission has essentially gone on record with the PRA
10 policy statement, the implementation plan, with the
11 risk-informed changes that we're making. We're moving down
12 a certain track. Nonetheless, these are valid questions --
13 DR. APOSTOLAKIS: Yes.
14 CHAIRMAN JACKSON: -- relative to the degree of
15 comfort the Commission and Commissioners may have in terms
16 of how broad-based a use of these methodologies can be made.
17 DR. APOSTOLAKIS: Right.
18 CHAIRMAN JACKSON: Right.
19 DR. APOSTOLAKIS: And on slide 35, it says what if
20 we are wrong.
21 CHAIRMAN JACKSON: Right.
22 DR. APOSTOLAKIS: So that gives you a way out of
23 it.
24 DR. POWERS: I think we have touched right --
25 moved right to the heart of the issue of Part 50, and I

1 think we might let Dr. Kress speak to the options for making
2 Part 50 risk-informed. He is --
3 CHAIRMAN JACKSON: Sounds good.
4 DR. POWERS: -- somewhat insufferable lately since
5 Tennessee won the National Football Championship, so you
6 might excuse him if he gloats just a little.
7 DR. KRESS: I won't inflict any more of that --
8 [Laughter.]
9 CHAIRMAN JACKSON: Well, since the Denver Broncos
10 won the Super Bowl, I'm in a mellow mood.
11 [Laughter.]
12 COMMISSIONER DIAZ: But I would say that Tennessee
13 winning the National Championship was outside the realm of
14 probability.
15 [Laughter.]
16 CHAIRMAN JACKSON: I will go further than that,
17 and for those of you who have ever studied physics, I would
18 say it went off the --
19 COMMISSIONER McGAFFIGAN: I think the Chairman at
20 the moment is more concerned about RPI winning the hockey
21 championship.
22 [Laughter.]
23 COMMISSIONER McGAFFIGAN: I see all these large
24 18-year-old Canadians going into the Chairman's office. No,
25 I'm just kidding.

1 [Laughter.]

2 CHAIRMAN JACKSON: Let's be clear. Don't go

3 there.

4 [Laughter.]

5 DR. KRESS: I have about 50 percent of my master's

6 courses from RPI, so I can --

7 CHAIRMAN JACKSON: Well, then you have total

8 credibility.

9 [Laughter.]

10 DR. KRESS: I thought that might help a little.

11 Anything I can do to help.

12 The discussion we just had, of course, is relevant

13 mostly to a large extent to Part 50. The discussion I'm

14 going to have is going to be a very short one, though, and

15 not because we don't think this is an important issue -- in

16 fact, we think it's one of our highest priority, most

17 important issues at the moment -- it's because for the ACRS,

18 it is still a work in progress. It's one of these

19 participatory reviews that we talk about.

20 So we really haven't formulated our full position

21 and the best approach to do it yet. We've had only one full

22 committee meeting, and that was to discuss the number of

23 options that you've already seen on certain policy issues,

24 and we wrote a letter to the EDO, and even in that, we only

25 put forth some of our preliminary positions on just a couple

1 of items, one of which you I'm sure will have great interest
2 in is we came down on the side of voluntary versus mandatory
3 conformance if you had a Part 50 that's fully informed, and
4 that was strictly pragmatic.
5 We didn't have a strong technical basis for that;
6 it was pragmatic in the sense that we felt that here was a
7 case where a regulatory analysis would be almost impossible
8 to make, and more than likely, if you could make one, it
9 would fail the backfit requirement.
10 We're not certain of that. This was a judgment.
11 We work on judgments, too. And we also felt that there will
12 be a number of plants out there with a very small amount or
13 a little amount of time left on their license which would
14 like not to be part of this because it will cost some money
15 to implement.
16 CHAIRMAN JACKSON: Let me ask you a question about
17 that, if I may. I hate to interject. But if we move down
18 the path, what about for new plants?
19 DR. KRESS: I would make new plants --
20 CHAIRMAN JACKSON: Mandatory.
21 DR. KRESS: Yes, ma'am. Certainly would. And
22 there's a real argument, I think, --
23 CHAIRMAN JACKSON: Mandatory for new plants.
24 DR. KRESS: -- for mandatory for existing plants,
25 really. You know, if you're going to go risk-informed, you

1 need to go risk-informed, and carrying a two-tier system of
2 regulations gets to be a real burden to NRC, frankly, and
3 part of the purpose of this is to help NRC do their job
4 better.
5 So there's a real argument for that. We just
6 think in this case, it probably -- you would probably end up
7 in court and not be able to defend it. But we can leave
8 that up to the legal people on things like that.
9 We did not even discuss selective implementation,
10 parts of it, if some -- if they're willing to pick and
11 choose the parts. We haven't even discussed that at all, so
12 we have no preliminary position at all.
13 COMMISSIONER McGAFFIGAN: Madam Chairman, could I
14 just note that it sounds like Chairman Powers did from what
15 he said about five minutes ago, that --
16 DR. KRESS: Partly pregnant?
17 COMMISSIONER McGAFFIGAN: Well, allowing selective
18 implementation might be a pragmatic thing to do.
19 DR. POWERS: I think it's fair to say that
20 historically, we have always come down on --
21 DR. KRESS: We've come down on that side. But
22 here's a little bit more of a magnitude of change, and it
23 may be a little more difficult to determine the risk
24 implications of a selective application. In fact, if we
25 write the Part 50 rule correctly, the risk-informed one,

1 there may not be a way to do a partial implementation. I'm
2 not certain of that because I haven't figured out how to
3 write it myself, but it is an issue and we haven't discussed
4 it and we don't really have a position on it yet.
5 COMMISSIONER DICUS: Can I ask you a question? If
6 we were to make a decision to make this voluntary, have you
7 thought about or do you have any thoughts you would like to
8 share on then how do we handle Part 50? Because we're going
9 to have our current Part 50, we'll have a risk-informed Part
10 50. So do we have two Part 50s or do we make the
11 risk-informed part just folded in, or do we make it a
12 separate appendix, or how would you -- do you have any ideas
13 on how we would do this?
14 DR. KRESS: A very good question. We thought when
15 we discussed this that it would be a two-tier system, that
16 you would almost keep your current Part 50 as is and have a
17 different Part 50 for voluntary, and it would be almost
18 two-tier.
19 COMMISSIONER DICUS: 50-A and B.
20 DR. KRESS: Otherwise, you're doing this partial
21 implementation, --
22 COMMISSIONER DICUS: Right.
23 DR. KRESS: -- which -- because you're mixing the
24 two.
25 CHAIRMAN JACKSON: But if you pick one path, A or

1 B, you have to go all the way.

2 DR. KRESS: You have to go all the way.

3 COMMISSIONER DICUS: Right.

4 DR. KRESS: That was our feeling.

5 We did think it was a good idea to have a couple
6 of pilot plants to try out a risk-informed Part 50, and
7 that's because we think that has been traditionally a good
8 way to understand all the implications, consequences, the
9 risk, and you can do it in a way that you can manage the
10 risk if there is any. You can --

11 CHAIRMAN JACKSON: By using Reg Guide 1.7.

12 DR. KRESS: Yes, that would be our approach. You
13 would have -- each -- what you're going to come down to is
14 changes to the plant, and --

15 CHAIRMAN JACKSON: Well, we can't do it, then,
16 until we get 50.59 done.

17 [Laughter.]

18 DR. KRESS: That's part of Part 50, you're right.
19 We'll have to have that done, too.

20 But this is a way that the staff can manage the
21 risk on a basis until they -- you learn to walk before you
22 run in this kind of a magnitude of change. So we thought
23 that was a good idea --

24 CHAIRMAN JACKSON: But tracking cumulative risk.

25 DR. KRESS: Pardon?

1 CHAIRMAN JACKSON: Tracking cumulative risk.
2 DR. KRESS: Yes. Yes.
3 CHAIRMAN JACKSON: Should the plants that receive
4 these exemptions be subject -- or be required to meet a
5 subsequent final rulemaking?
6 DR. KRESS: Would you repeat the question again,
7 please? I'm not quite sure I --
8 CHAIRMAN JACKSON: You could grant exemptions and
9 there could be differences in regulatory positions approved
10 in the plant specific --
11 DR. KRESS: The pilot plants being exempt.
12 CHAIRMAN JACKSON: Right.
13 DR. KRESS: Yes. Okay.
14 CHAIRMAN JACKSON: But then all of this is going
15 to lead to some wisdom that presumably will lead, you know,
16 to some final formal rulemaking, and the question becomes,
17 if once these plants receive exemptions, should they be
18 subject to whatever the subsequent final rule requires?
19 DR. KRESS: We haven't discussed that, but my
20 personal opinion is yes, they would -- should be. I don't
21 like the idea of having half of our plants out there subject
22 to a different set of rules, and I think you would make them
23 revert to the new rule at the end --
24 CHAIRMAN JACKSON: Right.
25 DR. KRESS: -- when you've got it. Yes, that

1 would be my --

2 DR. POWERS: One has only to look at the cost and

3 difficulties of fire --

4 CHAIRMAN JACKSON: Protection?

5 DR. POWERS: -- inspection and fire protection to

6 understand what happens when you get a diversity of plants,

7 --

8 CHAIRMAN JACKSON: Exactly.

9 DR. POWERS: -- and then look at the amount of

10 hours spent in debating interpretation and guidance on those

11 things to see you really don't want to have any more of a

12 proliferation of classes of plants than is absolutely

13 necessary out of fairness and protection of the public

14 safety.

15 COMMISSIONER MERRIFIELD: Chairman, I have a

16 question on that score. You mentioned that having a

17 voluntary nature is appropriate for some classes -- for a

18 class of plant where they may be being decommissioned in a

19 relatively short time down the road, so there's no sense to

20 transition into something new for that time period.

21 Would it make sense to bring us back to some unity

22 at some later point to require as a contingency of

23 relicensure that they go into this program?

24 DR. KRESS: Yes, I think that might be a good

25 place to put a mandatory requirement. I think that would be

1 a good place to think about it, yes.

2 DR. POWERS: Recall, of course, that if -- you
3 would need to look and make sure that you did not again get
4 into the kinds of problems we got into when we imposed
5 Appendix R where there were some plants that simply
6 physically could not tolerate the rule and we had to grant a
7 plethora of exemptions and things like that. You would want
8 to look at it very carefully. It's one of those things that
9 requires lots of groundwork and, quite frankly, that's the
10 kind of groundwork we've not done.

11 COMMISSIONER MERRIFIELD: But you would agree it's
12 worth exploring.

13 DR. POWERS: It's definitely worth exploring. A
14 caution from what we've learned out of Appendix R is not a
15 bad idea.

16 COMMISSIONER McGAFFIGAN: I would just point out
17 that two viewgraphs down, they say this is a very long-term
18 project, and so I hope there will be a fair number of plants
19 all the way through license renewal before this becomes an
20 issue, and certainly doing something near-term isn't even
21 conceivable, I suspect.

22 DR. KRESS: As a matter of fact, that's the reason
23 we came down on being in favor of a two-phase approach.
24 This also impacts on the question of two tiers of
25 regulation. We think you can change the current regulation

1 to be a little more risk-informed by changing the definition
2 of what's in the scope of important safety, and that would
3 give a lot of regulatory relief without -- and you can
4 demonstrate, we think -- well, before you do it you would
5 have to demonstrate that it wouldn't change the risk status
6 an undue amount.
7 So we think that would be a good thing to look at
8 to see to do while you're going through this longer-term
9 process of making the whole thing risk-informed, and we do
10 think that's going to be a long-term process for a number of
11 reasons, and we think there are a lot of things that need to
12 be done up-front that maybe are not being done just yet, and
13 they relate to our discussion on defense in-depth.
14 We think you need to really define what your
15 regulatory objectives are -- are they just LERF and CDF or
16 are there other things like preventing a certain dose level
17 or a certain injury level, because a lot of the
18 deterministic regulations relate to dose levels, and those
19 are injuries. Is that part of your regulatory objectives?
20 Defense in-depth is clearly a philosophy, and you
21 will want to maintain some of it. The question is, how does
22 it fit in with the risk-informed system and what are the
23 necessary and sufficient limits?
24 I think all this ought to be done ahead of time,
25 because that will determine the form that you make this rule

1 risk-informed. You need to know those things, and we don't
2 really see that being done.
3 CHAIRMAN JACKSON: See, risk-informed is not
4 risk-informed versus defense in-depth.
5 DR. KRESS: No, it's --
6 CHAIRMAN JACKSON: Risk-informed --
7 DR. KRESS: Yes.
8 CHAIRMAN JACKSON: -- as opposed to risk-based
9 means that by definition, you have to address how you
10 resolve the use of risk assessment with defense in-depth.
11 DR. KRESS: Yes. And we don't really see how the
12 thought process in place to put necessary and sufficiency
13 limits on defense in-depth in particular, but -- and there
14 may be other issues, like do you want to preserve some dose
15 limits? This will be frequency fission product release, at
16 low levels of fission product release, do you want to
17 preserve some of that in your regulatory objectives? Do you
18 want to really revisit the safety goals in the sense that
19 are our only regulatory objectives latent -- individual risk
20 of latent and prompt fatalities, or should we -- in reality,
21 we are concerned about land interdiction, we are concerned
22 about total deaths. You have a rule that limits population
23 because of that. We're concerned about injuries and ALARA.
24 I think you need to think out how much of that and
25 in what manner we'll preserve in a risk-informed Part 50,

1 and that needs to be done up front before you can change the
2 rule, and that was our -- that was the reason for this quote
3 that I put on that last slide.
4 CHAIRMAN JACKSON: Thank you.
5 COMMISSIONER DIAZ: I'm trying to reconcile in my
6 mind the statement on slide 16 with a lot of the other
7 comments, and let me see if I can take an exercise in here
8 that will bring me back to many years ago.
9 I remember Dr. Urich used to call me to the
10 classroom and say, now, you know, it's very difficult to
11 solve the transport equation, because it has seven
12 dimensions in it, and so it's going to be a terrifically
13 complex problem. However, this morning we're going to drop
14 the angular distribution, and then tomorrow morning we will
15 drop the time dependency, and then eventually we will reduce
16 it to a one or two-dimensional problem, and then we can
17 solve it. And isn't that what we're saying, that we need to
18 make this problem into a problem that we can chew on,
19 resolve it, practically, and then add another dimension to
20 it?
21 DR. APOSTOLAKIS: Yes. But when we go from the
22 full class-perfect equation to the diffusion equation, we
23 know very well what approximations we are making. And I'm
24 not sure we know --
25 COMMISSIONER DIAZ: Shame on you, George.

1 [Laughter.]

2 DR. POWERS: If the PRA people would just do their

3 job, George.

4 [Laughter.]

5 COMMISSIONER DICUS: I have a question. Would you

6 care to give us some idea how long "very long" is on slide

7 16?

8 COMMISSIONER MERRIFIELD: Actually, if I can layer

9 on top of that, could you also discuss the resource

10 implications that would have on the agency, given the other

11 activities we have underway with relicensing and license

12 transfers, and all the other important things on the tasking

13 memo?

14 DR. KRESS: Well, since I wrote the statement, in

15 my mind, I had in mind five to seven years as a long term,

16 that it's going to take at least that. Now, that --

17 CHAIRMAN JACKSON: How long?

18 DR. KRESS: Five to seven years.

19 CHAIRMAN JACKSON: That long, huh.

20 DR. KRESS: And unless you can do a great deal of

21 effort to expedite it.

22 CHAIRMAN JACKSON: Let me ask you a question. You

23 know, there were experimental programs and accident analysis

24 codes developed that were necessary to, you know, undergird

25 and achieve a certain qualification level vis-a-vis the

1 existing design basis accidents. If we completely overhaul
2 Part 50, would that potentially require any new analysis
3 techniques and/or experimental testing programs, or do we
4 know all we need to know?
5 DR. POWERS: Well, what I can tell you is that,
6 first of all, this idea that's built into much of the
7 regulation of here is an approved conservative analysis tool
8 is something you're moving away from when you're moving
9 toward a risk-informed regulation. You're trying to get to
10 a much more realistic analysis.
11 Now you pose this question of okay, we have
12 superior analytic tools, and what is their experimental
13 validation. Well, in many cases, we do have some
14 experimental validation, but it is very far from complete,
15 and in fact it's becoming a -- repeatedly coming up to be a
16 concern to us is that when is it in an area when
17 experimental work is taking a second seat to improved
18 analytic models, that experiment comes forward and you have
19 to validate these codes, that you can't rely on the
20 persuasive quality of your approximations. And that's
21 becoming a concern to us. We certainly see it, and we have
22 seen examples of it coming forth, and you will see examples
23 of issues related to exactly that. The examples that come
24 promptly to mind is when people start applying to have fuel
25 go to higher burn-ups than 62 gigawatt days per ton.

1 There's going to be a tendency to say surely by now we have
2 seen all the physics that will occur. Well, maybe not. It
3 seems to be capable of surprising us.
4 You will see it again in resolution of circuit
5 analysis with surely we have seen everything that fire can
6 do with circuits. Well, maybe not.
7 I think the answer is that as you more
8 aggressively go pushing the margins, as you start deviating
9 farther and farther away from what is known as a
10 conservative bound, based not an Aviar-Stokes equation, but
11 on mass balance and energy balance arguments. As you move
12 away from that, you are going to find people more and more
13 uncomfortable with magnitude of the uncertainties and
14 whether you have left -- whether the omissions, the
15 incompleteness is more severe.
16 I think we need to spend some time thinking about
17 those kinds -- a criteria of that, what is the magnitude of
18 deviation between a bound based on incontrovertible and
19 easily evaluated physics, mass balance, energy balance, and
20 is that measure -- when does that measure get big enough
21 that I really do need an experiment that is a prototypic
22 validation of that. Surely we will -- we can formulate
23 something in a conceptual basis. Can we formulate something
24 on a practical and useful basis? I don't know. But it is
25 certainly an issue that has not escaped the attention just

1 based on the number of examples that are coming to us of
2 where relying on computer codes and experiments have taken a
3 second fiddle.
4 As soon as I say we need an experiment, the next
5 question is, who is responsible for getting that
6 experimental data?
7 DR. FONTANA: Let me add something here. I think
8 one advantage of doing it is that you would do the
9 experiments for whatever additional information you need,
10 you would do them on a basis of risk and basis of need. In
11 the past we have had a real imbalance, we have had a
12 tremendous amount of work on open-ended pipe break, and
13 that, as you know, is not for risk-significant accidents.
14 So I think planning here experimental programs, whatever it
15 need to be, on a basis of risk thinking will put things in
16 the right priorities.
17 DR. POWERS: I think what we see is in fact that
18 at the onset of the nuclear industry, models and
19 calculations were expensive to do; experiments were fairly
20 easy to do. We are seeing a reversal of that trend.
21 Computing power is becoming wildly capable -- I mean each
22 one of you probably has the equivalent of a Cray on your
23 desk nowadays. Whereas experiments, because of a much
24 greater caution, but also because the kind of experiment
25 that has to be done now to qualify as useful and prototypic

1 has just become really amazingly expensive. In fact, within
2 this agency there's a general concession that any major
3 experimental program can't be done by this agency alone, it
4 has to be done in cooperation with your counterparts in a
5 large number of countries, and they too agree with that,
6 that it's much more comfortable for them, and it has certain
7 advantages to that. You get much better scrutiny of the
8 experiment to say yes, verily, this is definitive.
9 DR. KRESS: I don't think you got a fully
10 definitive answer to your question. In coming down on the
11 side of saying we think one should go to risk-informed
12 regulation, this committee has already made a judgment that
13 the PRA technology, which includes the severe accidents and
14 the containment codes, is good enough to progress in that
15 direction, in spite of the fact that there are very large
16 uncertainties. But we have also said that those
17 uncertainties need to be accounted for, and that's why it
18 should be risk-informed and you account for those
19 uncertainties somehow in your defense-in-depth provisions.
20 And so I think we have made the judgment that we
21 are already there. That's not to say you can't improve
22 those things, those severe accident codes and the PRAs -- in
23 fact, they probably should be improved in a number of areas.
24 Dana's high burn-up fuel is one. That should affect fission
25 product release. I know it will, for a fact. There may be

1 other physics that will affect it. We have always said the
2 ESO codes are good enough because the uncertainties are so
3 large elsewhere. Well, that may change now that we have a
4 different use for them, other than just to get severe
5 accident insights. Now we want to regulate, to fission
6 product release, say. You may have a different view then.
7 You may need to be able to pin those down a little better.
8 I think the decision will depend on a balance
9 between defense-in-depth and the uncertainties in these
10 codes, and I'm not sure where that balance is at the moment,
11 or how to do it, but that's where we need to focus.
12 COMMISSIONER McGAFFIGAN: Madam Chair, mentioning
13 the severe accident codes and someone mentioned citing
14 earlier, reminded me of a quotation in Nucleonics Week a
15 couple of months ago by the head of Framatome who was
16 bemoaning the fact that the European regulators, presumably
17 using the same PRA techniques, the same severe accident
18 codes, were requiring a European pressurized reactor to put
19 on what he regarded as expensive bells and whistles, like
20 containment liners and corium spreaders, et cetera, and the
21 evil Americans, yours truly, and I guess you, based on your
22 advice, did not require similar things of the advanced
23 American reactors which would put them at a competitive
24 advantage.
25 How do you get such different -- if everybody's

1 using the same severe accident codes, the same -- how do you
2 get such different judgments? And if that's the case -- I
3 mean, again, you know, I'm trying to figure out how firm the
4 ground is underneath my feet.
5 DR. KRESS: I have an answer for you.
6 COMMISSIONER McGAFFIGAN: Okay.
7 DR. KRESS: It stems from what your regulatory
8 objectives are. The Europeans would laugh at our prompt
9 fatality safety goal. They just discard it. They do not
10 like that goal, it's not severe or strict enough. They have
11 goals that are much more strict than ours. Their acceptance
12 value, so to speak. And they involve a high population in
13 regions around their plant in which their goal is not to
14 have any emergency response at all, no evacuation. Nothing
15 but sheltering. When you put those constraints on your
16 regulatory objectives you're trying to achieve, you're going
17 to have a LERF that's much different than this 10 to the
18 minus 5, much lower. And in order to meet that, you have
19 got to have better bells and whistles. Your codes are the
20 same. The codes have relatively the same amount of
21 uncertainty, but in order to meet a different regulatory
22 criteria, you've got to have the bells and whistles.
23 CHAIRMAN JACKSON: Well, but, see, that goes back
24 to my point of them playing off of these surrogates to how
25 much defense-in-depth. But how much defense-in-depth is a

1 public policy decision that's related to societal values?
2 And as the Europeans point out to me all the time, you know,
3 they live on top of each other in ways that we don't, and
4 that goes -- comes into play in terms of what your
5 regulatory objective is. If it is rooted in the fact of
6 life, what the societal values are, that translates into
7 what your regulatory objectives are, and then that tells you
8 essentially how you play off the surrogate to the
9 defense-in-depth.
10 COMMISSIONER DIAZ: Their regulatory oversight is
11 completely different than ours, so they actually deal more
12 -- I hate to use the word, defense-in-depth insight because
13 their regulatory oversight is not as strict as ours is.
14 CHAIRMAN JACKSON: Right. But that also goes to
15 societal values, and it goes to how the nuclear business is
16 organized. When you have shareholder-owned,
17 market-capitalized nuclear power plants, what the
18 cost-benefit calculation is is different, than when you
19 basically have a country, a national decision, and the way
20 the business is organized is that essentially you have
21 para-statal companies. Those are very different than
22 shareholder-owned market-capitalized companies in this
23 country. So these things -- that's why it's not so easy to
24 do these kind of back-of-the-envelope comparisons.
25 COMMISSIONER McGAFFIGAN: But if I could just pin

1 Dr. Kress down, if he could give me a guesstimate, given
2 that they have this different societal goal, if you are
3 guesstimating what they, in the back of their minds, CDF
4 delta LERF or their overall goal is in deltas -- I guess
5 their overall goal for CDF and LERF, what is it? What is it
6 that they are designing the EPR to achieve?
7 DR. KRESS: They have quoted CDF at 10 to the
8 minus 5, with goals of 10 to the minus 6. The LERF, they
9 don't even bat it around at all, but if you were to look at
10 this regulatory objective of nothing but sheltering, no
11 evacuation, and relate that to our goal of prompt
12 fatalities, if you had to meet our prompt fatality goal with
13 that constraint, you are bound to I think almost 10 to the
14 minus 7. I'm not certain of that, because they run the
15 numbers, but it's between 10 to the minus 7 and 10 to the
16 minus 8.
17 COMMISSIONER McGAFFIGAN: So it's two orders of
18 magnitude --
19 DR. KRESS: Something like two orders of
20 magnitude.
21 COMMISSIONER McGAFFIGAN: And that becomes the
22 constraining thing in some ways, or at least it forces these
23 containment --
24 CHAIRMAN JACKSON: That's the play-off between
25 that surrogate, and I remind you, defense-in-depth, and

1 that's why I -- the containment is, you know, the ultimate
2 defense-in-depth.
3 DR. POWERS: Also remember that they have
4 different kinds of criteria that sounds a lot more like
5 defense-in-depth, where they say we are going to physically
6 eliminate the possibility of early containment failure. I
7 mean they are looking for zero there, and that creates lots
8 of bells and whistles, because they defined another issue
9 that they encountered, one that I think we have to face up
10 to is that they have difficulties with public acceptance of
11 risk-based arguments, and it is one that is coming to the
12 fore to us, it is --
13 CHAIRMAN JACKSON: You have made that point.
14 DR. POWERS: And I will try to make it again and
15 again, perhaps in a little more complete description.
16 CHAIRMAN JACKSON: Well, you have caught my
17 attention.
18 DR. POWERS: And I think we'd better pay attention
19 to it big time.
20 I am mindful of your schedule, and I am --
21 CHAIRMAN JACKSON: Of what schedule?
22 [Laughter.]
23 DR. POWERS: And so I perhaps need some guidance.
24 We have other topics --
25 CHAIRMAN JACKSON: Why don't we try to walk

1 through and hit the high points, and I will even constrain
2 myself, difficult though it may be, and we will try to
3 constrain ourselves and let you at least walk through it
4 with the high points.
5 COMMISSIONER MERRIFIELD: Chairman, not to go in
6 contradiction to constraining ourselves, but there was a
7 question I asked Dr. Kress to answer, and I just wanted --
8 CHAIRMAN JACKSON: Well, that's part of the
9 previous discussion, so you're still constrained.
10 COMMISSIONER MERRIFIELD: Oh, okay.
11 Going back to your statement, you said five to
12 seven years for the complete overhaul. But under that, in
13 your thinking, what dedication of resources of the agency
14 would that require?
15 DR. KRESS: I'm afraid I would really be
16 speculating beyond whatever I thought if I give you a real
17 number, so, you know, I really don't know what that means in
18 terms of NRC resources.
19 COMMISSIONER MERRIFIELD: Well, you say five to
20 seven years, you said you have a very long-range project,
21 difficult policy decisions and extensive rulemaking.
22 DR. KRESS: Yes. It sounds like a lot of
23 resources to me, but, you know --
24 COMMISSIONER DIAZ: And that's a qualitative
25 statement.

1 [Laughter.]

2 COMMISSIONER DIAZ: Dr. Apostolakis, do you agree
3 with that -- five to seven years?

4 DR. APOSTOLAKIS: Again, we're back to fuzzy
5 concepts here. It depends what it means to revise to make
6 it risk-informed, it could take 15. I mean, it depends --

7 [Laughter.]

8 DR. APOSTOLAKIS: But that was just a comment.
9 Let me complete the sentence. I think we can do a lot of
10 useful things maybe in a two-year period, a lot of useful
11 things. We may not complete the revision, but I think a lot
12 of the good stuff can be done in the first two years.

13 COMMISSIONER MERRIFIELD: Using what resources? I
14 mean, I don't mean to keep harping on this, but we have --
15 I'm just trying to grapple with this because this directly
16 relates to an issue that we have before us right now in
17 terms of what direction we're going to go, and you can say,
18 you know, we can do a lot in one or two years, but what does
19 that mean relative to the other resources we have in --

20 CHAIRMAN JACKSON: I don't think they can answer
21 that.

22 DR. APOSTOLAKIS: I cannot answer that question,
23 but I can tell you one thing: If you put together a team
24 that has -- like the team that is working on the inspection
25 and enforcement program, you're going to go a long way in

1 two years. It's one of the best things this agency ever put
2 together.
3 DR. KRESS: You have Gary Holahan involved, also.
4 That ought to speed it up.
5 CHAIRMAN JACKSON: Gary is having a headache over
6 that.
7 [Laughter.]
8 DR. POWERS: I want to make it clear that you're
9 talking about a new vendor taking a change in culture, and I
10 know of no company in America that has discovered that to be
11 a painless process, and I know of no company in America that
12 has not underestimated the amount of time it takes to change
13 a culture. Since you're looking at changing not only your
14 culture here but those at a large number of other
15 institutions, don't underestimate the amount of time that it
16 takes to change cultures.
17 COMMISSIONER DIAZ: But if you put that statement,
18 you know, at page 16, and you put it, you know, right after
19 TMI, I would agree wholeheartedly with it. But we have been
20 25 years changing the state of the art, the philosophy,
21 dealing with stakeholders, moving step by step painfully,
22 carefully, okay, and many times not even moving, okay, you
23 know, in this direction is not a new issue, is not
24 confronting the public, the Congress or stakeholders, the
25 licensees, or the agency with an issue; it's just actually

1 trying to develop the benefit from it, and in probably an
2 aggressive fashion. So, you know, it is not possible to say
3 this is a new issue. It is not.
4 CHAIRMAN JACKSON: It is not a new issue, but in
5 terms of a step function change for NRC and, by implication,
6 for the nuclear power issue, it is -- you know, there's a
7 lot of groundwork that forms the basis of where we are as a
8 20-year tale. But in point of fact, if you're really
9 talking about managing change, unless you're going to kill
10 off everybody that runs the current nuclear facilities and
11 all the current people we have at NRC, I think we can
12 accelerate it, but we can't think it's coming in six months'
13 time, no.
14 DR. POWERS: I think I usually respond to the
15 statement on 25 years -- and it has been, there's no
16 question about it. The first inklings in what you could do
17 with risk came in 1974 for some of us, some of us a little
18 later than that following TMI. And I usually respond to my
19 colleague, yes, the PRA people sure are slow getting their
20 message across.
21 [Laughter.]
22 DR. POWERS: But on the other hand, I was there
23 during that debate and I know what it was taking. It was
24 taking a change in the mindset.
25 CHAIRMAN JACKSON: Exactly.

1 DR. POWERS: And let's not underestimate that.

2 DR. APOSTOLAKIS: I don't think Dr. Kress in his
3 seven-year estimate included a change in culture, so let's
4 leave culture out. And I think Commissioner Diaz refers to
5 the actual change in the regulations, and that's of
6 interest. I mean, the culture will take a long time.

7 CHAIRMAN JACKSON: Well, let me just put it to you
8 like this: I came here in 1995, as you know, and in the
9 Fall of 1995, I asked the staff to look at 50.59 relative
10 to, you know, the very issues at the heart of the issues
11 we've been talking about. 50.59 had been looked at by a
12 task force before my time, you know, before I even thought
13 about or anybody even thought about my coming to NRC, and
14 now this is three-and-a-half years later, and we're still
15 here, and we've narrowed it, and we've come a long way down
16 the line. This has to do with one rule change, not really
17 risk informing it in the sense that we're talking about.
18 One rule change. A key rule, critical rule, one that we and
19 the industry cannot live without, but it's three-and-a-half
20 years. And I'm hoping to get this Commission to make some
21 fundamental decisions on it before I go. And even so, that
22 will be bringing it close to the four-year line, and it will
23 not be a risk-informed rule at that point in time.

24 So let us be clear --

25 DR. APOSTOLAKIS: But the processes are very

1 linear, Chairman Jackson.

2 CHAIRMAN JACKSON: Agreed. Agreed.

3 DR. APOSTOLAKIS: You have already addressed the
4 steep part of the curve, I think, with risk-informed
5 initiatives, and especially after Regulatory Guide 1.174 was
6 released, I think now we know much more. Things should go
7 faster. They should. I don't know whether --

8 CHAIRMAN JACKSON: Thanks, Gary.

9 [Laughter.]

10 DR. POWERS: Well, let me proceed forward by just
11 stepping through both source term and license renewal. Tom,
12 you wanted to say some quick words about the source term?

13 DR. KRESS: Sure. I'll be very brief and just hit
14 the highlights. I'll assume you're already quite familiar
15 with source term issues. Just to remind you that the
16 revised source term was because the old traditional one was
17 unrealistic, and unrealistic has problems, but the revised
18 source term was meant to be for future plants, and the new
19 rule addresses whether or not to let voluntary usage for
20 operating plants.

21 There's a number of issues one might have to face
22 in deciding whether that is acceptable or not, and if you
23 move to slide 21, I have listed what some of those issues
24 are. The two major ones are the two middle bullets. That's
25 if you allowed voluntary change, what would it mean in terms

1 of plant changes? What does that relate to? Because you
2 have to know what the plant changes are before you can
3 determine the implications with respect to risk or other
4 objectives. And given those plant changes, what would be
5 the individual plant risk status change, and if it's
6 increased, would the magnitude be acceptable?
7 There are other issues there. I did want to
8 mention that I felt in this case the staff did a very good
9 job of addressing these issues and did about all you could
10 expect, all you could ask them to do. So their findings --I
11 would like maybe to jump to slide 24 -- they did identify
12 some likely plant changes through a process of interacting
13 with the licensees and industry, and here are some of the
14 most likely plant changes listed.
15 The thing I wanted to point about these is that,
16 number one, they are all containment related items, which
17 you might expect when you're talking about changing the
18 design basis source term, and that the changes that are
19 anticipated are all relaxations on these, they are
20 reductions in burdens, and any relaxation in these would
21 have the potential to increase fission product release to
22 some extent. The question is how much and is that
23 acceptable.
24 The staff did a great deal of effort to address
25 those. They did it on a limited basis. They did some risk

1 analysis at Grand Gulf and Surry to represent PWR and BWR in
2 which they looked at these likely changes one at a time to
3 see what effect to expect, and they found out, not
4 surprisingly, that there was insignificant effect on the CDF
5 and LERF matrix. I think that could have been anticipated
6 because these changes are containment, they don't address
7 CDF and LERF almost automatically includes containment
8 failure, which these things don't involve.
9 There was little effect on defense-in-depth,
10 essentially no effect -- it depends on your definition of
11 defense-in-depth -- and that the dose requirements
12 that you get out of the deterministic rules are still met,
13 but, of course, that was part of the definition of the
14 changes. You have to meet those dose requirements or you
15 can't make the changes.
16 So what it appeared to us was that all of the Reg
17 Guide 1.174 like thinking provisions or strictures are met
18 with the usage -- with voluntary usage of the new source
19 term at that plant. So it was basically a no-brainer.
20 Here's a chance to give a great deal of regulatory burden
21 reduction on the plants, with a very minor impact on risk.
22 So it really seemed like a no-brainer to us to endorse the
23 voluntary usage of this at the operating plant.
24 COMMISSIONER McGAFFIGAN: Madam Chairman?
25 CHAIRMAN JACKSON: Please.

1 COMMISSIONER McGAFFIGAN: There are two benefits
2 other than burden reduction that I saw in the paper that
3 ultimately came to us, and one was cutting down on
4 unnecessary plant exposures. So we're having real safety
5 benefits for plant workers. And secondly, some cases, and
6 you make the point in one of your slides, there's actually
7 risk benefits in going to --
8 DR. KRESS: Very likely, you get a risk decrease.
9 COMMISSIONER McGAFFIGAN: Right. So you get
10 unnecessary burden reduction, risk decreases and plant
11 worker safety improvements. I mean, it's --
12 DR. KRESS: I went over these things quite
13 hurriedly.
14 COMMISSIONER McGAFFIGAN: Right.
15 DR. KRESS: Another benefit is with the old
16 unrealistic source term, we actually had a perturbed view of
17 how severe accidents progressed, and you don't want to have
18 an unrealistic view because it ruins your insights. And so
19 you might as well allow those insights to be carried over to
20 the operating plants.
21 CHAIRMAN JACKSON: Let me ask you two quick
22 questions. Are there any changes to the revised source
23 term, I mean that would change what we know if MOX fuel were
24 used instead of uranium oxide base fuel? And if you look at
25 issues such as the one Dr. Powers raised about higher

1 burn-ups, how do these statements then --

2 DR. KRESS: We're already using MOX fuel.

3 CHAIRMAN JACKSON: You know what I mean.

4 DR. KRESS: Yes.

5 [Laughter.]

6 CHAIRMAN JACKSON: Don't play that game.

7 [Laughter.]

8 DR. KRESS: But I think there will be a difference

9 in behavior. The fuel we have built up is plutonium to a

10 pretty high level, and it can be called MOX fuel.

11 CHAIRMAN JACKSON: That's right.

12 DR. KRESS: And when we talk about the fission

13 product release and meltdown behavior of fuel and the severe

14 accident codes end up giving you a source term, we're

15 talking about the behavior of a pretty high plutonium --

16 CHAIRMAN JACKSON: Content.

17 DR. KRESS: -- content, except I personally think

18 that starting out with a centered MOX fuel made up with the

19 plutonium put in in the first place gives you a different

20 animal than building it in by absorbing burn-up --

21 CHAIRMAN JACKSON: That's right.

22 DR. KRESS: -- and that they may behave quite

23 differently, the physics may be different. I don't think we

24 know that. I don't think we have enough information to make

25 a judgment.

1 My guess is that it won't make very much
2 difference in terms of the uncertainties we already have in
3 meltdown behavior and in fission product release behavior,
4 and that the source term that was chosen --
5 CHAIRMAN JACKSON: Have such analyses been done
6 anywhere?
7 DR. KRESS: No.
8 CHAIRMAN JACKSON: I mean, have the Europeans done
9 it?
10 DR. KRESS: I don't know of any. But my guess is
11 that the source term we have chosen as a design basis source
12 term is sufficiently conservative anyway; it can probably
13 incorporate that.
14 Now, from the -- your second part, the high
15 burn-up, I feel differently about that. I think high
16 burn-up can make a significant difference in both meltdown
17 behavior and fission product release, and I do not think we
18 have the database for that.
19 Dana, you might want to comment.
20 DR. POWERS: I would just comment on the available
21 database on MOX. There has been quite a lot of work at the
22 Transuranium Institute on fission product release, the
23 nature that we call gap release that figures in the source
24 term area. There is some work in the NSRR reactor planned.
25 They may have actually done a couple of experiments already,

1 again looking at more the gap release. There is some work
2 going on in France for what you would call the in-vessel
3 release where they're actually heating fuel pellets up.
4 There has been discussions on utilizing the MOX
5 fuel in a PHOEBUS type experiment which would carry you
6 completely through core degradation. I don't think those
7 have resulted in a decision to do a MOX fuel experiment.
8 I think the reluctance to do lots of MOX fuel is
9 MOX per se just isn't behaving enough differently in these
10 harsh steam high-temperature environments to really detect a
11 difference. If you were in a fast reactor environment with
12 liquid metal coolant, then you see a very distinct
13 difference. But steam and high temperatures are great
14 equalizers among fuel.
15 CHAIRMAN JACKSON: So high burn-up is more of an
16 issue than MOX per se, although the isotopic content of the
17 MOX is different than --
18 DR. POWERS: I understand that the more trouble --
19 CHAIRMAN JACKSON: -- than the one at the end of
20 life currently.
21 DR. POWERS: More troublesome with MOX is actually
22 the neutronics and the --
23 CHAIRMAN JACKSON: Right.
24 DR. POWERS: -- reactivity insertion accident.
25 CHAIRMAN JACKSON: Right.

1 DR. POWERS: And staff does have an activity going
2 on now to see if their codes for doing neutronics are
3 sufficiently well understood to handle MOX, and I believe
4 they're interacting closely with the Europeans on that, who
5 have a good deal more experience with MOX than we do.
6 But high burn-up is much more interesting from a
7 phenomenological point of view because now you get into
8 things where steam really does affect you. Certainly the
9 gap releases go way up. But in the core degradation area,
10 there has always been a discussion on what's called fuel
11 foaming, which is radically different than the way we model
12 core degradation now, and it seems like it's enhanced when
13 you go up to higher burn-up.
14 There seems to be room here for experimental
15 investigations. Our own research program here within the
16 United States as sponsored by the NRC doesn't address these
17 questions. It is addressing questions of have the decisions
18 made to allow burn-up to 62 gigawatt days per ton still
19 preserve adequate protection to the public health and
20 safety. They don't go into severe accidents. But they will
21 rely on the industry to provide information if you wanted to
22 go higher.
23 I have to say I think the staff is coming up with
24 a very clever approach on defining what kind of data the
25 industry should be bringing forth to justify going to higher

1 burn-up and to decide whether they need to go into severe
2 accident space on that.
3 We'll be hearing more on that proposed approach at
4 our next meeting and we'll be writing you a letter on that,
5 so I don't know that it's worth going into now, but I think
6 they have a very clever approach.
7 COMMISSIONER McGAFFIGAN: Madam Chairman, just to
8 -- I don't want to delay at all -- the Nuclear Control
9 Institute, Dr. Lymon, put out something recently about MOX
10 and actinides being a larger element of the source term or
11 whatever. At some point, I think it's DOE's responsibility
12 to respond to that, but at some point, we may need --
13 perhaps years down the road -- but you all to comment one
14 way or the other on that unless you already have looked at
15 it.
16 DR. POWERS: Well, there is a change in the
17 spectrum of fission products that are produced.
18 Fortunately, it's not very big of a change for the kinds of
19 things we worry most about.
20 DR. KRESS: It doesn't have much of a consequence
21 effect, the change.
22 CHAIRMAN JACKSON: So if I took a summary of what
23 you said, you know, it's a little bit off the mark, but that
24 MOX use per se, although, you know, some of the analysis
25 TBD, is probably not of, you know, the greatest consequence

1 from a fission product release perspective, but it is
2 probably more in terms of a reactivity control and
3 neutronics perspective, which in itself is non-trivial.
4 DR. POWERS: Non-trivial. You get real nervous
5 about losing control, yes.
6 CHAIRMAN JACKSON: Absolutely.
7 DR. POWERS: And it really has to do with a
8 delayed neutron fraction.
9 CHAIRMAN JACKSON: But high burn-up does come into
10 play vis-a-vis the fission product.
11 DR. POWERS: It's a bit more of a challenge to us
12 because we really don't understand all the physics that's
13 involved there.
14 CHAIRMAN JACKSON: Okay.
15 DR. KRESS: What we do know is that in general,
16 you will expect greater releases, faster releases, at higher
17 burn-up.
18 CHAIRMAN JACKSON: That's right. I know.
19 DR. KRESS: That we do know.
20 CHAIRMAN JACKSON: Well, I think those -- I just
21 happen to believe that from a safety perspective, that these
22 are non-trivial --
23 DR. KRESS: I think we would agree.
24 CHAIRMAN JACKSON: -- you know, the MOX side and
25 on the high burn-up side, and I'm only bringing them up more

1 to bring them to light and say that that's something that I
2 think you have to help the Commission work through.
3 DR. POWERS: And it is an area that we have a
4 subcommittee that pays particular attention to the fuels.
5 CHAIRMAN JACKSON: Great.
6 DR. POWERS: Let me ask Dr. Fontana if he would
7 quickly go through our plans on this very important issue of
8 license renewal, where we really are in the strategy
9 development more than the --
10 CHAIRMAN JACKSON: You have to Marios on the
11 committee.
12 DR. POWERS: We do now, and we're going to have to
13 develop some sort of a strategy for handling that.
14 [Laughter.]
15 DR. FONTANA: I've got a stiff neck from snapping
16 my head when I hear my name mentioned.
17 Let me walk you through very quickly on what we're
18 doing with respect to license renewal. I presume that you
19 -- well, I know that you've had briefing from the staff, so
20 I'll jump right into what the ACRS is doing.
21 CHAIRMAN JACKSON: Could you talk closer into the
22 microphone?
23 DR. FONTANA: Sure.
24 We're developing a process and identifying
25 assignments for review of the license renewal products, and

1 the activities to date have been understanding this really
2 rather arcane process and receiving overviews of the
3 industry and NEI approaches to license renewal, receive
4 summaries of the status, and obtaining an overview of the
5 environmental assessment requirements, reach an agreement
6 with the staff on a review schedule, and identifying the
7 license renewal generic issues.
8 We also have received one technical report which
9 we have reviewed informally and have not presented anything
10 on it, the Calvert Cliffs license renewal application, a
11 generic environmental impact statement, a list of generic
12 issues, list of generic license renewal technical issues,
13 which is not the same list as the generic issues that we had
14 with us for 20 years or more.
15 The next viewgraph shows the schedule for the
16 Calvert Cliffs' review and the intent of showing this is
17 that there are many intermediate milestones that don't show
18 here.
19 The main point to get across, the best way to
20 assure that a final review is completed without delay is to
21 conduct intermediate meetings, and we learned this
22 particularly in the success of the participatory reviews
23 that we've had with developing Reg Guide 1.174 and also the
24 benefits of the mid-course inputs that we got from the AP600
25 review.

1 Although the schedule is very tight, staff -- and
2 the staff is going to be really hard-pressed to meet this
3 schedule -- they have agreed with us that meeting -- having
4 interim meetings like this will minimize the potential for a
5 delay at the end because of some issue that came up late in
6 the review.
7 As you see in the viewgraph, the intermediate
8 points occur after the staff completion of the safety
9 evaluation report and after the public meeting, and we have
10 the final meeting in February 2000.
11 The next slide shows you the Oconee schedule, and
12 I won't go through that because it's essentially the same.
13 The next one shows license renewal of generic
14 technical issues. The staff and the industry have agreed to
15 98 technical issues that are generic with respect to license
16 renewal. They have grouped this into four priority
17 rankings, and I won't get into this. There are four
18 priority rankings; the important point is that there are 18
19 issues in priority one which must be resolved before
20 issuance of any renewed license. And we have not looked
21 into these in-depth, but I appear to be in general agreement
22 with them.
23 All the ACRS has at this time with respect to the
24 issues is a one-paragraph description, and we'll develop a
25 schedule and assignments for review of these issues.

1 The next viewgraph shows that we plan to review
2 the generic technical issues, as I said before, industry
3 topical reports, and these are generic reports that, once
4 they get reviewed, the future license renewal applications
5 can refer back to them, so it's important that we do this.
6 The updated standard review plan and regulatory guide, aging
7 related research.
8 Other reports that are under review by the staff
9 that we don't have yet is RCS piping, pressurized reactor
10 vessel internals. We have reports from the Owners' Group,
11 and I won't get into that list. And we still need to
12 determine the extent to which we're going to review these
13 reports. I mean, are we going to have to review them all or
14 will a spot check be adequate? And as you can see, our
15 resources are limited here.
16 As you know, the Reg Guide will remain in draft
17 form throughout the process of the first two reviews and
18 will be issued in 2001 according to the present plan.
19 We have very close interest in aging related
20 research, and that is crucial to the understanding of
21 extended operation of these plants. Some of these issues
22 are well known and I won't get into them.
23 The staff and the industry feel that license
24 renewal can be accomplished on the basis of present
25 knowledge, which is really quite extensive, and we intend to

1 review this area with respect to the impact on long-term
2 operation. Of course, we will review the license renewal
3 applications themselves.
4 Now, there are no more viewgraphs, but I think we
5 should summarize that the basic philosophy is that a plant
6 that meets the current licensing basis is in pretty good
7 shape and that the current regulations provide an adequate
8 assessment that those components and structures -- those are
9 the active components -- that are covered by them will
10 remain functional. So the license renewal focused on
11 passive components and identifying them and showing that
12 they will maintain their functionality throughout the period
13 of the license renewal.
14 There is a very strong reliance on current
15 regulations, and that means that any changes to these
16 regulations must be considered with respect to their
17 potential impact on license renewal and extended plant life.
18 They have to be tracked from that point of view.
19 Further, successful long-term operation depends on
20 maintaining corporate memory for safe, efficient operations
21 as utility and regulatory staff and cultures change over the
22 lifetime of a plant. We have seen some of these effects
23 over the lifetimes of the plants that are operating now.
24 The ACRS has not reviewed these in-depth, but from
25 my own point of view, I think the approach developed by the

1 staff and the industry appears to be appropriate, and as you
2 know, we have a statutory responsibility to provide our
3 findings on license renewal just like we did for initial
4 licensing, and this will require a lot of work and the
5 resources of the entire committee. We take that
6 responsibility seriously and will report to you as time goes
7 on.
8 CHAIRMAN JACKSON: Thank you.
9 DR. FONTANA: So that's about all I had to say.
10 COMMISSIONER MERRIFIELD: One brief question.
11 We're going to testify before the Senate Environment
12 Committee tomorrow. Is there anything -- and there's a
13 preferred answer to this question -- is there anything that
14 you have found so far that would lead you to conclude that
15 we will be unable to make the Commission's self-imposed
16 deadline of 30 to 36 months for the renewal of the Oconee
17 and Calvert Cliffs licenses?
18 DR. FONTANA: I really can't comment on that
19 because it's going to be a tight schedule, and we haven't
20 gone to the depth to really answer that question. But I
21 understand from talking with the Staff that that schedule
22 was put together under the assumption that everything goes
23 like clockwork, and it allows, I think it's six weeks for --
24 DR. UHRIG: External review?
25 DR. FONTANA: Pardon?

1 DR. UHRIG: For hearings and that sort of thing,
2 and that's normally pretty tight.
3 DR. FONTANA: So, as you know, most things don't
4 go like clockwork, so I don't know what -- I really can't
5 answer your question. It's a tight schedule, and it
6 probably could be made, but if someone really throws a
7 monkey wrench into the works, it's problematical.
8 COMMISSIONER MERRIFIELD: But there is nothing you
9 have found so far that would lead you to a conclusion other
10 than that?
11 DR. FONTANA: I don't really think so.
12 COMMISSIONER MERRIFIELD: I mean you say -- it
13 could be a situation where we may encounter something that
14 we force a delay?
15 DR. FONTANA: Yes.
16 COMMISSIONER MERRIFIELD: But so far you haven't
17 seen anything that would cause a delay?
18 DR. FONTANA: Nothing obvious.
19 COMMISSIONER McGAFFIGAN: The issue of resources
20 for you and for us comes up, as you just mentioned, in
21 passing. We are budgeting I think in 2000 for four renewal
22 applications. We know we are going to get one from Arkansas
23 Nuclear 1, and others will come in. If these first go well,
24 and fairly promptly, how much of a diversion, and a very
25 important diversion, is this going to be for you all, as you

1 -- in the next year as you deal with Oconee and Calvert
2 Cliffs applications, what fraction of your time is going to
3 be taken by those two?
4 DR. FONTANA: I'll answer and defer to our
5 chairman, but it's a very high priority activity for us, and
6 I think it will take our resources and needs. There is some
7 other work that's trying to tail off, but there are
8 obviously other things that we have to do. We may have to
9 make some priority determinations on some things that we
10 simply won't look at because it's of probably lesser
11 importance.
12 CHAIRMAN JACKSON: Do you have an operating plan?
13 DR. POWERS: We sure do, and we have a
14 self-assessment, and we are doing an update on that and a
15 report on that.
16 DR. KRESS: We think the reviews of the technical
17 documents being produced by the industry, they will used
18 probably for reference, will be a great help, because it
19 will take a lot of up-front review on our part of those
20 technical documents, and once we are through with that, I
21 think the later reviews will go a lot faster. It will be
22 slow at the start, but I think it will speed up.
23 CHAIRMAN JACKSON: Okay.
24 DR. POWERS: Well, that takes us through the first
25 line items. We have three what I would call, if there's

1 time available, items. Did you want to go on through those?
2 We have destroyed whatever schedule you had.
3 CHAIRMAN JACKSON: Well, I'll poll my colleagues.
4 I mean we could potentially devote maybe 15 more minutes and
5 see if we can close them out.
6 DR. POWERS: Sure. I think Dr. Uhrig has some
7 important points he wants to make on our report on research
8 for this year, so I'll ask, Bob, if you could hit the high
9 points on that.
10 DR. UHRIG: Thank you. In Staff Requirements
11 Memorandum dated September, the Commission requested that
12 the ACRS review a number of issues. This resulted in an
13 extensive review last year under the leadership of Chairman
14 Powers, and the result was NUREG 16.35, Volume 1, which I'm
15 sure that you are all familiar with, and I won't spend the
16 time repeating the recommendations which are in the slides
17 for the information of anyone who does not have access to
18 that report.
19 I'd like to take about 30 seconds and talk about
20 the report we are looking at for this year. We have a
21 number of candidate topics listed here. PRA research for
22 risk and performance-based regulation; high burn-up fuel
23 performance; thermal hydraulics code; and the integration of
24 the in-house capabilities; advanced instrumentation and
25 control; license renewal; and there may be some work in

1 decommissioning through the ACNW, that's yet to be
2 determined; and the last one listed here is the shutdown of
3 low power operations risk.
4 Now we do not expect this to be anything remotely
5 as extensive as the last report because of the limited scope
6 as well as the nature of the report that we are preparing
7 here. We have been meeting on a regular basis with the
8 Staff and the management of the Research organization within
9 NRC, and we expect momentarily to get feedback upon the
10 report from last year. And I think that's very important in
11 terms of our addressing continuing the dialogue with the
12 Research.
13 And that's basically where we are.
14 CHAIRMAN JACKSON: You mentioned that the NRC
15 should adopt a systematic framework for the design and
16 engineering of the research program that enforces a close
17 tie between the research activities and agency needs. And
18 you ran through a list of things, but do you feel that there
19 could have been a better balance or coupling in the past
20 between the conduct of aging research in preparation for
21 license renewal, or the work on high burn-up fuel prior to
22 licensees requesting conversion to higher burn-ups?
23 DR. UHRIG: The research by its very nature is
24 long term.
25 CHAIRMAN JACKSON: Of course.

1 DR. UHRIG: And the problem you run into is that
2 an applicant comes in, he has a problem, he wants it
3 addressed immediately, and if you have waited to start your
4 research program until you get that request, you are already
5 behind. And it's a very difficult issue. You do need this
6 anticipatory research, and we can in hindsight say, well, we
7 should have been able to see ahead that we are going to need
8 this. Well, I think the Commission did a good job in a
9 number of areas, for instance, in the aging area. I think
10 they did a fine job of anticipating what was going to happen
11 as license renewals came in.
12 CHAIRMAN JACKSON: Well, the reason I raise the
13 question is I mean you yourself just mentioned anticipatory
14 research, and there always is that question, and sometimes
15 controversy, in terms of the balance. And if you make a
16 statement about enforcing a close tie between research
17 activities and agency needs, then I assume you mean by that
18 anticipated as well as current agency needs.
19 DR. UHRIG: Yes, absolutely.
20 CHAIRMAN JACKSON: Because if that is not clear,
21 there is a tendency to have user needs driven, today's user
22 needs driven by research programs, and some of us might
23 argue that's not research at all, that it's technical
24 analysis. But it's not necessarily research.
25 So but you do mean both current and anticipated --

1 DR. UHRIG: Yes, ma'am.

2 CHAIRMAN JACKSON: -- needs, but one has to be

3 clever about trying to anticipate; is that a fair statement?

4 DR. UHRIG: Yes, it is.

5 CHAIRMAN JACKSON: Okay.

6 DR. POWERS: You will recall that we asked for a

7 much more comprehensive planning and felt that the users

8 need system itself needed substantial revision, yet a proper

9 appreciation of what the agency's real mission needs are.

10 CHAIRMAN JACKSON: Okay.

11 DR. POWERS: We now come back to the area that's

12 becoming our crusade, in the area of risk-informed

13 regulation and Professor Apostolakis --

14 CHAIRMAN JACKSON: Well, let me just ask you to do

15 something, because I think to some extent, Dr. Apostolakis,

16 you have talked to some of the issue of the impact of PRA

17 results on the regulatory system.

18 DR. APOSTOLAKIS: Yes.

19 CHAIRMAN JACKSON: And so what I would prefer you

20 focus on is VI.B, since that is not a topic that's been

21 explicitly addressed today.

22 DR. APOSTOLAKIS: Okay. The elevation of CDF from

23 a safety goal and possible revision of the Commission's

24 safety goal policy statement.

25 The reason why we felt core damage frequency goal

1 should be elevated from this level is on slide 41. Well,
2 the reason is not there -- well, it is. It's No. 3, that if
3 you work backwards from the qualitative health objectives
4 that the Commission has promulgated, and use reasonable
5 ranges for a site model and the containment failure
6 probabilities, you end up with core damage frequencies that
7 could be tolerated and still meet the goals, in other words,
8 that are maybe 10 to the minus 3 for some plans, and we
9 believe that for defense-in-depth purposes again and so on,
10 that would not be acceptable, 10 to the minus 3. So -- and,
11 in fact, we have been using 10 to the minus 4 for year after
12 year as sort of a given, and we are bothered by the fact
13 that this is really a policy statement -- a policy issue
14 that the Commission should address, and should not become de
15 facto out of the way we are doing business. So that's why
16 we are recommending that this be elevated.
17 CHAIRMAN JACKSON: Are you could say validated --
18 DR. APOSTOLAKIS: Or validated, yeah. Yeah, sure.
19 Then, of course, if you start looking at the
20 safety goal policy statement, there are other things that
21 would be useful to reconsider and maybe include. So it's
22 42, we are saying that the measures of societies should be
23 reconsidered. We want to talk about the number of
24 fatalities, talk about environmental contamination, and so
25 on, since we are revisiting, or proposing to revisit the

1 safety goal policy statement.

2 Then there is the issue of how to formulate them.

3 I'm sorry?

4 CHAIRMAN JACKSON: Please.

5 COMMISSIONER McGAFFIGAN: We opened up the safety

6 goal policy statement, you just said in a conversation

7 earlier that Europeans have a de facto, much tighter safety

8 goal. It's conceivable that public comment will come in

9 strongly on the side of adopt that European standard; if

10 it's good enough for the Europeans, why isn't it good enough

11 for us. Are you ready for that debate?

12 DR. POWERS: It's almost assured to happen, that

13 somebody will make that comment. Unfortunately, there is

14 not a European standard, there are lots of European

15 standards. I think you just have to concede they are going

16 to --

17 CHAIRMAN JACKSON: Well, one could argue that in

18 promulgating the reg guides and having them out for public

19 comment -- and that's what you're saying we need to come

20 around, with the de facto; we've done some of this, if it's

21 being memorialized in those reg guides.

22 DR. APOSTOLAKIS: Now on site 43, we are

23 addressing something that is a reality again but has not

24 been recognized in the books. I think there are really two

25 numbers, again they are not crisp numbers, but numbers that

1 are being used by the Staff to decide on action. A goal of
2 10 to the minus 4 for CDF, for example, is what everybody is
3 talking about, but if we exceed the goal, we would like to
4 know why, and whether to take any action, and we have 19 BWR
5 units that according to the IPEs are above the goal.
6 The moment you get down to 10 to the minus 3,
7 though, you see immediately action. People are flying over
8 there to find out why and what's going on and so on. So
9 there is this trigger effect up there. So why not then
10 think about formulating the safety goals in terms of three
11 regions, which is not a very novel idea, other people have
12 tried it and I found out recently rejected it.
13 But the idea is this: if you are above the goal,
14 you are necessarily unsafe. You are not unsafe, in fact,
15 not necessarily. I don't need the word necessarily. You
16 just -- there will be increased regulatory attention. Why
17 are you there? Can you do something, you know, on a
18 cost-benefit basis, to reduce the core damage frequency?
19 The moment you hit the upper limit, though, that of course
20 is not a factor any more. Now you are unsafe and we want
21 you to correct that. Otherwise, we will shut you down.
22 COMMISSIONER McGAFFIGAN: Can I just ask -- every
23 time they come in, we talk about the total number versus the
24 differential numbers, and which we should have more faith
25 in. But we recently had an AEOD study that said initiating

1 event frequencies are indeed lower than assumed.

2 DR. APOSTOLAKIS: Yes.

3 COMMISSIONER McGAFFIGAN: In various PRAs and IPEs

4 and maybe a factor of five -- did everybody get a factor of

5 five, are all these BWRs no longer above 10 to the minus 4?

6 DR. APOSTOLAKIS: No, they are not

7 COMMISSIONER McGAFFIGAN: Okay. I was just

8 hoping.

9 DR. APOSTOLAKIS: I don't think so.

10 COMMISSIONER McGAFFIGAN: But how do you use a

11 number which everybody admits is not as good as a

12 differential number, as something that's a regulatory tool?

13 DR. APOSTOLAKIS: Oh, I wouldn't treat it any

14 different from the goal itself. I mean we do know the 10 to

15 the minus 4 is not really a crisp number, that it should be

16 -- the 1.2 10 to the minus 4 work is not over. So I would

17 treat it the same way, but I think the --

18 CHAIRMAN JACKSON: Well, I think the problem is to

19 be talking about mean values. You never talk about it

20 without really talking about --

21 DR. APOSTOLAKIS: I would talk about mean values.

22 CHAIRMAN JACKSON: -- confidence intervals and

23 uncertainties. I think we --

24 DR. APOSTOLAKIS: That may be a part of it, but

25 even --

1 CHAIRMAN JACKSON: The discussion needs to be a
2 little more sophisticated.
3 DR. APOSTOLAKIS: That's right.
4 CHAIRMAN JACKSON: In application.
5 DR. APOSTOLAKIS: That's correct.
6 CHAIRMAN JACKSON: Maybe not in a Commission
7 meeting, but in application.
8 DR. APOSTOLAKIS: But even if you want to work
9 only with mean values, there is still this different
10 attitude between the two numbers. And all we are saying
11 here is maybe we ought to look into it and come up with a
12 three-region approach. And then -- this is basically it.
13 DR. POWERS: I think that covers the topics that
14 we wanted to talk to you about, besides asking if you have
15 any additional questions?
16 CHAIRMAN JACKSON: No, I think that is -- well,
17 let me just thank you for another very informative briefing.
18 I think we covered a lot of ground, and I think sometimes we
19 have given short shrift in worrying about the time, but we
20 thought we'd do it faster. But I think it was worthwhile
21 because the topics of today's presentation really are
22 focused on a number of issues critical to our maintaining
23 and improving our ability to regulate effectively. So I
24 encourage you, the ACRS, to continue to provide your
25 perspective to the Commission on these issues important to

1 our mission, and I look forward to continuing to hear from
2 you, but ask you to be forward-looking. But I will ask you
3 if you would specifically think about this issue of relative
4 to 50.59 and focusing on what some key questions are whose
5 answers would lead us to some resolution, if you can't see a
6 specific way or if the Staff and the NEI can't come to some
7 resolution, and to do it on the short term, as soon as you
8 can. And then I think there needs to be some amplification
9 of this playoff of what I'll call the surrogate, CDF, LERF,
10 and others that may not have been discussed with
11 defense-in-depth, where it puts you along the line, because
12 I think that's a very helpful discussion in terms of our
13 being able to rationalize the one system to the other and
14 potentially to make progress, given our existing framework,
15 and given that we do have containments over all of our
16 nuclear plants.
17 So on that note, we are adjourned. Thank you.
18 [Whereupon, at 3:20 p.m., the briefing was
19 concluded.]
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21
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24
25

CERTIFICATE

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

TITLE OF MEETING: MEETING WITH THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PUBLIC MEETING

PLACE OF MEETING: Rockville, MD

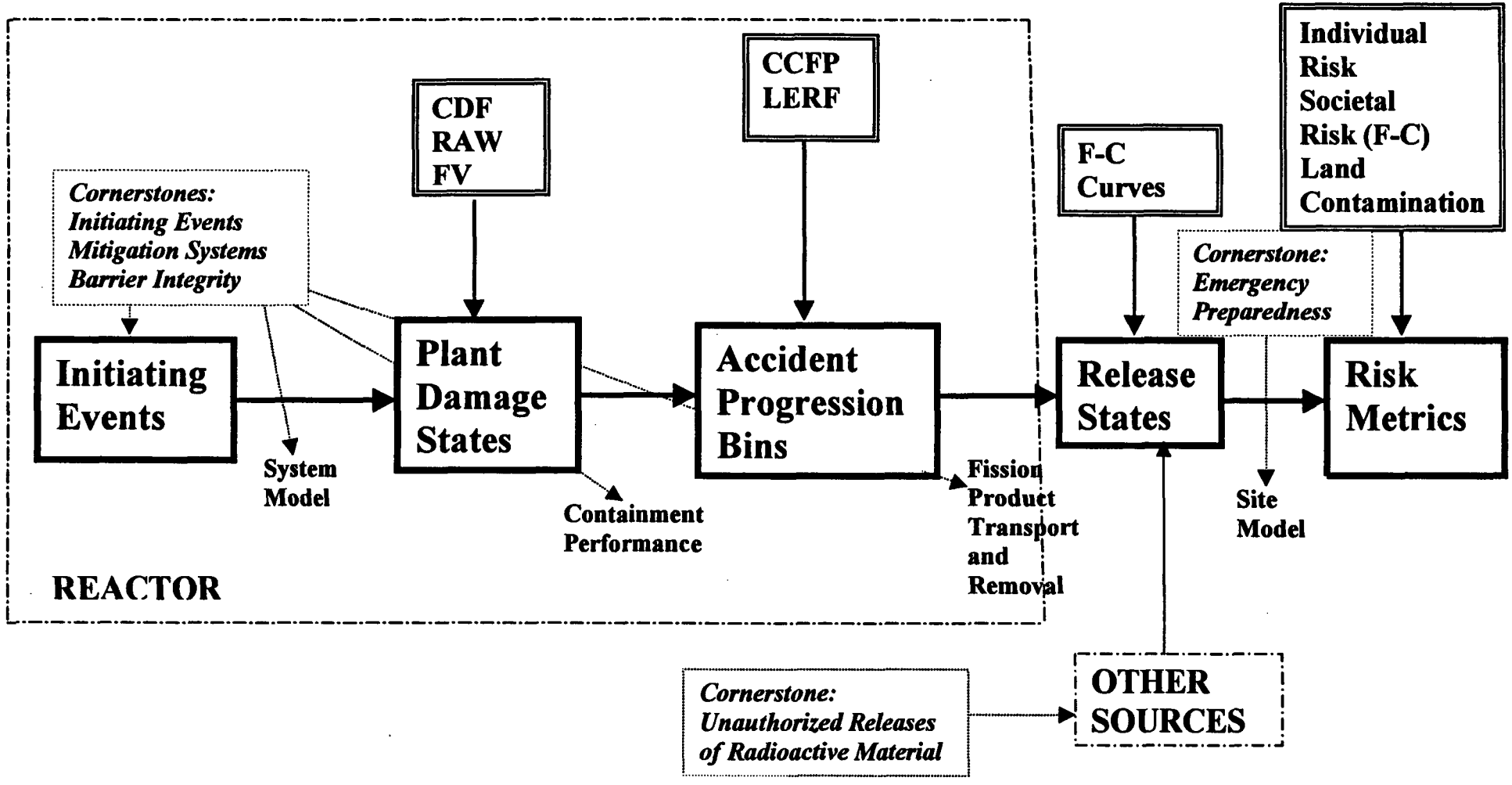
DATE OF MEETING: Wednesday, February 3, 1999

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

Transcriber: Mary Carpenter

Reporter: Mike Paulus

RISK METRICS



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

January 27, 1999

MEMORANDUM TO: Annette L. Vietti-Cook
Secretary of the Commission

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

SUBJECT: ACRS MEETING WITH THE NRC COMMISSIONERS – FEBRUARY 3, 1999

The ACRS is scheduled to meet with the NRC Commissioners between 1:00 and 2:30 p.m. on Wednesday, February 3, 1999, to discuss the following items. Time permitting, the topics under Item VI will be discussed. Presentation materials related to these items are attached:

I.	Introduction (**NRC Chairman/ACRS Chairman**)	10 minutes
II.	A. Proposed (Near-Term) Revisions to 10 CFR 50.59 (Changes, Tests and Experiments) - **J. Barton**	20 minutes
	B. Proposal for the Development of a Risk-Informed Framework for 10 CFR 50.59 - **G. Apostolakis**	↓
III.	Options to Make 10 CFR Part 50 Risk Informed - **T. Kress**	20 minutes
IV.	Proposed Rulemaking on the Use of Revised Source Term - **T. Kress**	15 minutes
V.	Status of ACRS Activities Associated with License Renewal - **M. Fontana**	10 minutes
VI.	A. Impact of PRA Results and Insights on the Regulatory System* - **G. Apostolakis**	10 minutes
	B. Elevation of CDF to a Fundamental Safety Goal and Possible Revision of the Commission's Safety Goal Policy Statement* - **G. Apostolakis**	↓
	C. NRC Safety Research Program* - **R. Uhrig**	↓
VII.	Closing Remarks (**NRC Chairman/ACRS Chairman**)	5 minutes

*Time permitting, these items will be discussed.

Attachment: As stated

cc: ACRS Members
ACRS Staff

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

MEETING WITH U.S. NUCLEAR REGULATORY COMMISSION

FEBRUARY 3, 1999

PROPOSED (NEAR-TERM) REVISIONS TO 10 CFR 50.59 (Changes, Tests and Experiments)

MR. JOHN BARTON
ACRS

THE ACRS REPORT OF JULY 16, 1998

- Revised guidance is overly prescriptive in defining reduction in margin of safety
- Use of ANSI/ANS 58.8 is inappropriate for determining minimal increase in probability of malfunction
- 10 CFR 50.59 can accommodate risk-informed decisionmaking
- Expedite completion of Regulatory Guide endorsing NEI 96-07 with exceptions and clarifications, as appropriate
- Two-phase approach for rulemaking is appropriate

PLANNED ACTIVITIES

- ACRS plans to review proposed final rulemaking following reconciliation of public comments
- ACRS plans to continue review of staff activities associated with making 10 CFR 50.59 risk informed
- ACRS plans to report on proposal for the development of a risk-informed framework for 10 CFR 50.59

PROPOSAL FOR THE DEVELOPMENT OF A RISK-INFORMED FRAMEWORK FOR 10 CFR 50.59

DR. GEORGE APOSTOLAKIS
ACRS

INTRODUCTION

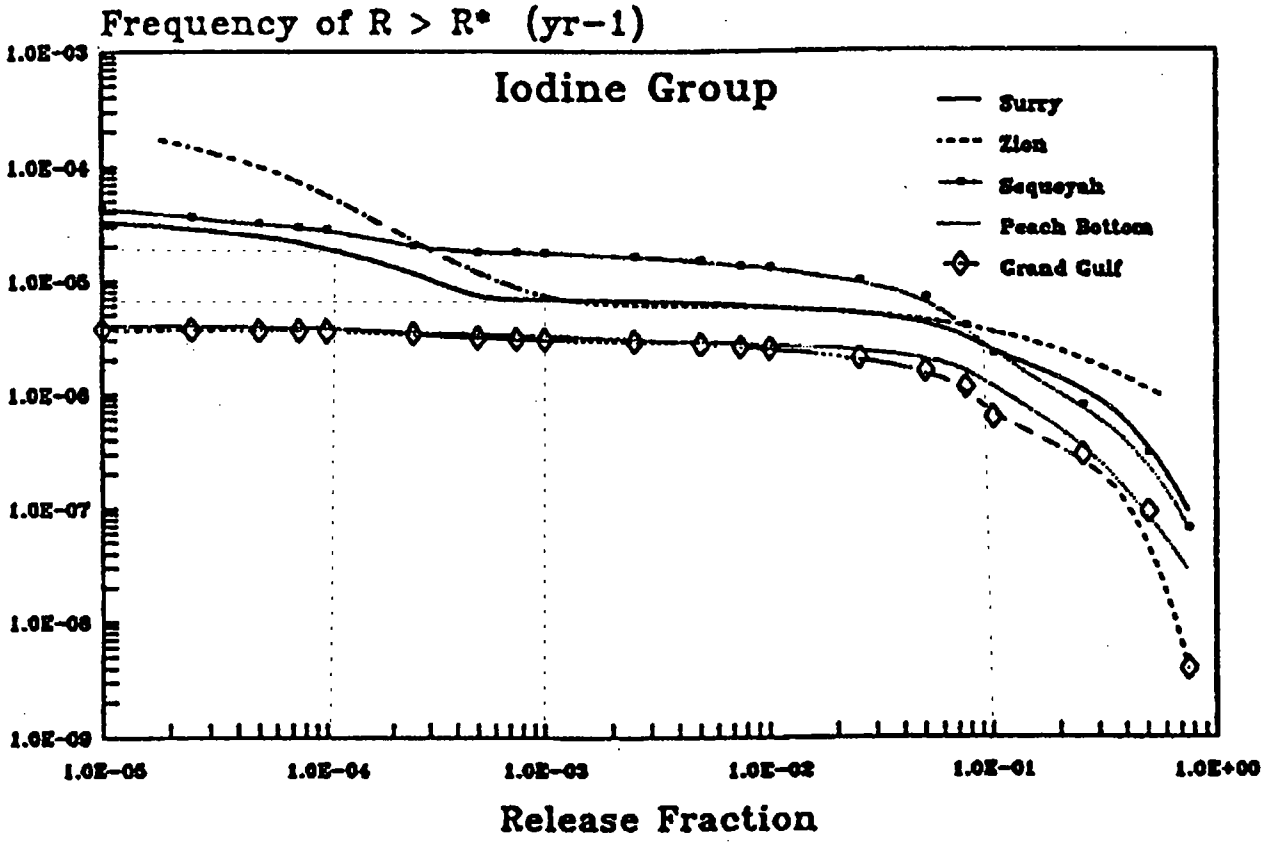
- A proposal for the development of a risk-informed framework for 10 CFR 50.59 was attached to the July 16, 1998 ACRS report on proposed revisions to 10 CFR 50.59

- ACRS stated it was examining how such a framework might be incorporated in developing an improved 10 CFR 50.59 process

- ACRS Subcommittee on Reliability and Probabilistic Risk Assessment met with invited experts and the staff on January 25, 1999 to discuss the feasibility of using the frequency-consequence curves in the development of a risk-informed framework for 10 CFR 50.59

- Frequency-consequence curves are among the options that the staff is currently examining in the development of a risk-informed 10 CFR 50.59

1. FREQUENCY-CONSEQUENCE (F-C) CURVES



- The “flat” part of the curve is controlled by the Core Damage Frequency (CDF); Large, Early Release Frequency (LERF) is considered at the low-frequency/high-consequence part of the curve

- *All* sources of radioactivity and *all modes* of operation can be included

- “Accidents” and “malfunctions” would not be treated separately

- The safety impact of “minimal” changes can be defined and evaluated within the context of F-C curves

- F-C curves would represent the risk-informed part of the decision-making process; other objectives, such as defense-in-depth, should be included

- The relative insensitivity of F-C curves to plant changes may lead to a more permissive 10 CFR 50.59. This would depend on the additional objectives

- Developing F-C curves for routine regulatory applications may be a challenge

2. Regulatory Guide 1.174

- Extend the approach in Regulatory Guide 1.174 to 10 CFR 50.59
- Limited to accidents involving core only

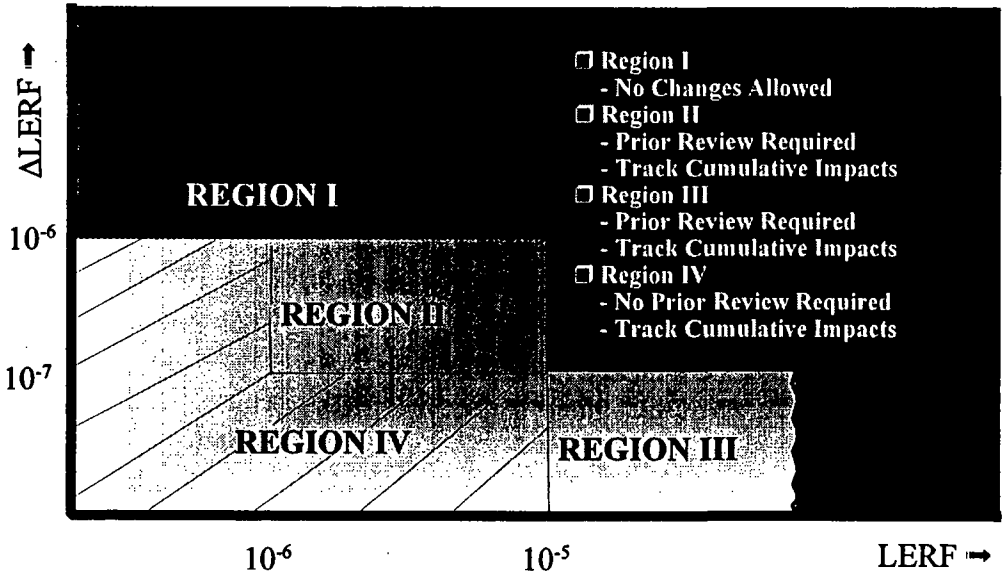


Figure 4. Acceptance guidelines for LERF including a region (IV) in which no prior review is required.

BACKGROUND

- ACRS Report dated July 16, 1998, Proposed Revisions to 10 CFR 50.59 (Changes, Tests and Experiments)
- ACRS Letter dated December 11, 1998, Options for Incorporating Risk Insights Into The 10 CFR 50.59 Process

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

July 16, 1998

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

Dear Chairman Jackson:

SUBJECT: PROPOSED REVISIONS TO 10 CFR 50.59 (CHANGES, TESTS AND EXPERIMENTS)

During the 453rd and 454th meetings of the Advisory Committee on Reactor Safeguards, June 3-5 and July 8-10, 1998, we met with representatives of the NRC staff and the Nuclear Energy Institute (NEI) to discuss proposed revisions to 10 CFR 50.59 (Changes, Tests and Experiments). We also discussed the Executive Director for Operation's (EDO's) response to the Commission's directions in the Staff Requirements Memorandum (SRM) dated March 24, 1998, regarding SECY-97-205. Our Subcommittee on Plant Operations met on June 19, 1998, to discuss these matters. We also had the benefit of the documents referenced. We previously provided reports to the Commission on April 8, October 9, and December 12, 1997, on the proposed revisions to 10 CFR 50.59 and related matters.

During our meeting with the staff on July 8, 1998, it became apparent that the staff had developed revised documents for consideration by the Commission. These documents were provided to us subsequent to our discussions with the staff. We have not had an opportunity to review these documents in detail. In our preliminary review, however, we found substantial changes had been made to these documents.

Conclusions and Recommendations

1. We disagree with the staff's evaluation of the proposed rulemaking language in response to the SRM dated March 24, 1998. Therefore, we recommend that the revised rulemaking package not be issued for public comment at this time.

2. We believe that the revised guidance is overly prescriptive in defining reduction in margin of safety. The revised rulemaking language will likely add significant regulatory burden without a clear safety benefit.

3. The staff's proposed use of ANSI/ANS-58.8-1994, "Time Response Design Criteria for Safety-Related Operator Actions," for determining when there is only a minimal increase in the probability of malfunction is inappropriate.

4. The staff should expedite completion of a regulatory guide for implementing 10 CFR 50.59, including endorsement of NEI 96-07 with exceptions and clarifications as appropriate.

Discussion

We disagree with the staff's evaluation of the rulemaking language provided in the EDO's response to the SRM dated March 24, 1998. We believe that the staff should complete the actions specified by the Commission in the SRM.

The staff's approach to reductions in margin of safety is overly prescriptive. We believe that the language proposed by the staff creates a *de facto* constraint of "zero increase" in probability or consequences. In addition, the lack of a working definition of "minimal" increase in risk may exacerbate the problem of excessive resources being required to perform evaluations for changes that are risk insignificant.

In our November 14, 1995 report, we informed the EDO that we found no technical basis for the estimates of minimum times for operator actions specified in ANSI/ANS-58.8-1994. We did not support the staff's proposed endorsement of ANSI/ANS-58.8-1994in the proposed final Regulatory Guide 1.164 and stated that we did not believe that this endorsement was the appropriate way to resolve Generic Safety Issue B-17, "Criteria for Safety-Related Operator Actions." Subsequent to the meeting, the staff informed us that it was unaware of our position and agreed to delete ANSI/ANS-58.8-1994 from the revised rulemaking package.

The staff has made some progress in reconciling its differences with NEI 96-07. However, more than a year has passed and the staff has not codified its positions through development of a regulatory guide. We believe that development of a regulatory guide and endorsement of appropriate industry guidance are essential to stabilize the 10 CFR 50.59 process. Therefore, we believe that a regulatory guide should accompany the proposed rulemaking and associated documents in soliciting public comment.

In our October 9, 1997 report, we encouraged the continued development of a plan for a 10 CFR 50.59 process that is consistent with risk-informed, performance-based regulation. In our December 12, 1997 report, we stated that the development of a risk-informed rule should be continued on an expeditious schedule. We continue to believe that 10 CFR 50.59 can accommodate risk-informed decisionmaking.

We believe that a deterministic regulatory framework poses substantial barriers to the development of the concept of minimal changes in accident probabilities or consequences. It is more likely that the minimal change concept can be defined satisfactorily within the framework of frequency-consequence (F-C) curves. A frequency-consequence framework can also accommodate the evaluation of new accident sequences. Dr. Apostolakis has offered a proposal (attached) for the development of a risk-informed framework for 10 CFR 50.59. We are examining how such a

framework might be incorporated in developing an improved 10 CFR 50.59 process. We plan to address this in a future report to the Commission.

Sincerely,

R. L. Seale

R. L. Seale
Chairman

References:

1. Draft Commission paper from L. Joseph Callan, Executive Director for Operations, NRC, to the Commissioners, Subject: Proposed Rulemaking on 10 CFR Parts 50, 52 and 72 Requirements Concerning Changes, Tests and Experiments and Staff Recommendations on Changes to Other Regulations and Enforcement Policy, and attachments, received July 8, 1998.
2. Memorandum dated May 21, 1998, from David B. Matthews, Office of Nuclear Reactor Regulation, NRC, to John T. Larkins, Executive Director, ACRS, Subject: Proposed Rulemaking on 10 CFR 50.59.
3. Memorandum dated May 27, 1998, from L. Joseph Callan, Executive Director for Operations, NRC, to the Commissioners, Subject: Evaluation of Rulemaking Language Proposals Concerning 10 CFR 50.59 (Changes, Tests and Experiments).
4. Memorandum dated March 24, 1998, from John C. Hoyle, Secretary of the Commission, to L. Joseph Callan, Executive Director for Operations, NRC, Subject: Staff Requirements SECY-97-205, Integration and Evaluation of Results from Recent Lessons-Learned Reviews.
5. Letter dated May 12, 1998, from Samuel J. Collins, Office of Nuclear Reactor Regulation, NRC, to Ralph E. Beedle, Nuclear Energy Institute, Subject: 10 CFR 50.59 Safety Evaluations and 10 CFR 50.71(e) Final Safety Analysis Report Updates.
6. Letter dated April 16, 1998, from Ralph E. Beedle, Nuclear Energy Institute, to Shirley Ann Jackson, Chairman, NRC, Subject: 10 CFR 50.59 Safety Evaluations and 10 CFR 50.71(e) FSAR Updates.
7. Letter dated January 9, 1998, from Samuel J. Collins, Office of Nuclear Reactor Regulation, NRC, to Ralph E. Beedle, Nuclear Energy Institute, Subject: NEI 96-07 Guidelines for 10 CFR 50.59 Safety Evaluations.
8. Report dated December 12, 1997, from R. L. Seale, Chairman, ACRS, to Shirley Ann Jackson, Chairman, NRC, Subject: Proposed Revisions to 10 CFR 50.59 (Changes, Tests and Experiments).
9. Report dated October 9, 1997, from R. L. Seale, Chairman, ACRS, to Shirley Ann Jackson, Chairman, NRC, Subject: Proposed Changes to 10 CFR 50.59 and Proposed Revision 1 to Generic Letter 91-18.
10. Report dated April 8, 1997, from R. L. Seale, Chairman, ACRS, to Shirley Ann Jackson, Chairman, NRC, Subject: Proposed Regulatory Guidance Related to Implementation of 10 CFR 50.59 (Changes, Tests and Experiments).
11. Report dated November 14, 1995, from T. S. Kress, Chairman, ACRS, to James M. Taylor, Executive Director for Operations, NRC, Subject: Proposed Final Regulatory Guide

1.164, "Time Response Design Criteria for Safety-Related Operator Actions," to Resolve Generic Safety Issue B-17.

12. U.S. Nuclear Regulatory Commission, NUREG-0933, Supplement, March 16, 1987, "A Prioritization of Generic Safety Issues," Item B-17, "Criteria for Safety-Related Operator Actions," Revision 2.

Attachment: A Proposal for the Development of a Risk-Informed Framework for 10 CFR 50.59 and Related Matters Prepared by ACRS Member Dr. George Apostolakis

ATTACHMENT

A PROPOSAL FOR THE DEVELOPMENT OF A RISK-INFORMED FRAMEWORK FOR 10 CFR 50.59 AND RELATED MATTERS

Prepared by ACRS Member Dr. George Apostolakis

Preamble

While I agree with my colleagues on what needs to be done in the near term, I believe that the issues that the revision of 10 CFR 50.59 has raised stem from some fundamental problems that cannot be eliminated by revising this particular regulation in isolation. A bolder approach is required.

10 CFR 50.59 is intended to limit to below a "minimal" level the impact of unreviewed changes in the plant on the probability or consequences of accidents. The point of reference is clearly the status of the plant before the change, as it has been approved by the staff. This approval is based on traditional "deterministic" calculations, as documented in the plant's Final Safety Analysis Report (FSAR). The staff's interpretation is that the changes ought to be minimal compared to the existing situation and not with respect to regulatory criteria such as a 25 rem exposure to the whole body and a 300 rem exposure to the thyroid. The Nuclear Energy Institute disagrees and argues that the point of reference ought to be the regulatory criteria. In other words, changes that are within the operating margin should not be subjected to staff review.

I understand that, in the majority of cases, 10 CFR 50.59 works very well and there is no controversy. There are several changes per plant per year, however, in which there are questions as to whether the changes are minimal and, consequently, whether staff review is required.

Direction from the Commission

In the Staff Requirements Memorandum dated March 24, 1998, the Commission directed the staff "to incorporate knowledge gained from risk insights, as appropriate" and to "consider the work it has done in updating the Standard Review Plan (NUREG-0800) and, in a different context (severe accidents), on draft Regulatory Guide 1.174 and Standard Review Plan Chapter 19 in formulating what constitutes a 'minimal' change."

The Commission also directed the staff to "evaluate for Commission consideration the advisability of allowing proposed changes that result in the creation of an accident or malfunction of a different type than previously evaluated that has 'minimal' safety impact."

The Problem

A major difficulty is defining the concept of a "minimal" increase in the probability of an "accident" and of a "minimal" change in the probability of equipment malfunction (which is treated separately from the probability of an "accident").

In the memorandum dated May 27, 1998, to the Commission, the EDO stated that any plant change that created the possibility of a new accident that had not been previously evaluated should be reviewed. The EDO also expressed the opinion that "it would be extremely difficult to develop a meaningful definition of minimal safety impact."

What are the Root Causes of the Problem?

Concepts such as a "minimal" change in probability or consequences and "minimal" safety impact are meaningful only in the context within which the evaluation is made. Something that is minimal in one context may be significant in a different context. The deterministic regulatory context is incomplete for such evaluations.

What is the Proper Context?

The proper context for evaluating changes in the spirit of 10 CFR 50.59 should include the information contained in the frequency-consequence curves (F-C curves), as well as the sets of accident sequences that probabilistic risk assessments (PRAs) produce.

Figure 1 is an example of such F-C curves developed in the NUREG-1150 studies. The independent variable is the release fraction of the core inventory of iodine. The ordinate gives the frequency of the release exceeding a given value, R*. As an example, we see in Figure 1 that the frequency of sequences leading to a release fraction greater than 10^{-3} is, for Surry, about 7×10^{-6} per reactor-year. I note that these curves deal with accidents that involve the core only.

These curves are an important element of the context within which we can evaluate what is minimal. Let us assume that a proposed change affects an accident sequence whose consequence is a release fraction greater than 10^{-3} and whose mean frequency is on the order of 10^{-8} per reactor-year. It is evident that changes that even double the frequency of this accident sequence could be considered minimal. If, on the other hand, the frequency of that accident sequence were on the order of 10^{-6} per reactor-year, such a change would not be minimal (in the sense that it would have to be reviewed).

If we consider release fractions greater than 10^{-4}, then the average frequency of the accident sequences leading into that interval is about 2×10^{-5} per reactor-year (for Surry), i.e., about a factor of three greater than the frequency of the interval $R \geq 10^{-3}$. Obviously, a "minimal" change in frequency would have a different numerical value for accidents in this new interval.

I note that these determinations are made with regard to the whole sequence and not separately for "accidents" and "equipment malfunctions," as the current 10 CFR 50.59 requires. The latter is unnecessarily intrusive.

The same reasoning can be applied to "new" accident sequences. What would determine whether they had "minimal" impact would be their frequency of occurrence and their consequences. Thus, if the consequences placed the new sequence in the release internal $R \geq 10^{-3}$, then "minimal" would be defined with respect to the reference value of 7×10^{-6} per reactor-year, as just described. If, on the other hand, the consequences were in the interval $R \geq 10^{-4}$, then the reference value for the frequency would be 2×10^{-5} per reactor-year.

I hasten to add that the preceding paragraphs are not intended to imply that final decisions would have to be made solely on the basis of the F-C curves. The process of "integrated decisionmaking" that is described in Regulatory Guide 1.174 would also apply here (with appropriate modifications). In the same spirit as that of Regulatory Guide 1.174, I am proposing to expand and modify the decisionmaking process of 10 CFR 50.59 to include risk information. Doing so would definitely be responsive to the Commission's direction that the work done on Regulatory Guide 1.174 be considered in revising 10 CFR 50.59.

This simple approach would obviate unnecessary debates regarding the operating and safety margins of the facility and how they ought to be handled.

Are Quantitative Assessments Always Required?

No. I believe that most cases could be handled qualitatively within this context. In other words, the accident sequences and their frequencies would add significantly to the basis for assessing qualitatively whether a change is minimal. I anticipate that a quantitative assessment will be required in very few cases.

Is the Necessary Information Available?

The F-C curves for severe accidents are either available or can be obtained from existing PRAs or Individual Plant Examinations (IPEs). These would have to be supplemented by the results for accidents that the regulations call Classes 1 through 8. This should not be a major problem, however. A first attempt to develop such curves for Class 3-8 accidents was made about 20 years ago in NUREG/CR-0603 (Reference 1). It should be a straightforward process to produce similar results with modern PRA tools and using our current state of knowledge.

The incompleteness of the PRAs/IPEs would be handled in a manner similar to that described in Regulatory Guide 1.174.

Can the Regulatory Guide 1.174 Process be Extended to the Regulation of Lower-Class Accidents?

Yes. What I discussed above dealt with changes that would not require staff review. The intent of Regulatory Guide 1.174 was, of course, to define changes that, after review, would be acceptable. The same idea can be applied to the whole spectrum of accidents.

Severe accidents are the contributors to releases of about 10% or greater of the iodine inventory (Figure 1). Regulatory Guide 1.174 provides acceptable ranges for changes in the frequency of a subset of these releases, namely releases that are "early," that is, those that are caused by accidents in which the containment is either bypassed or fails before vessel breach (these control the prompt fatalities). Figure 2 shows the guidelines adopted in Regulatory Guide 1.174 for large, early release frequency (LERF).

To apply the Regulatory Guide 1.174 approach to releases other than those caused by severe accidents, we must define goals for the frequency of smaller releases similar to the goal of 10^{-5} per reactor-year for large, early releases (Figure 2).

A way of defining goals for the frequency of lower releases is by defining appropriate Farmer curves. An example is given in Figure 3. The issue is what should the position of this curve be to ensure consistency with the Commission's stated Quantitative Health Objectives and subsidiary objectives (the region of severe accidents is indicated in this figure). The slope of the straight line has been the subject of debate ever since Farmer proposed his criterion more than 30 years ago (Reference 2). A slope of -1 reflects a "risk-neutral" attitude, which means that, if the consequences increase by an order of magnitude, the corresponding frequency decreases by an order of magnitude also. The Dutch nuclear regulatory body has adopted Farmer curves for prompt fatalities with a slope of -2, thus exhibiting a strong risk-aversive attitude.

Can the Regulatory Guide 1.174 Process Benefit from the 10 CFR 50.59 Process?

Yes. Regulatory Guide 1.174 requires that all increases in frequency must be reviewed by the staff, that is, Figure 2 does not have a region in which the change in frequency is so small that subjecting it to staff review would be a waste of everyone's resources.

The following interesting comment accompanies this figure in Regulatory Guide 1.174:

"The analysis will be subject to increased technical review and management attention as indicated by the darkness of the shading of the figure."

Clearly, this "attention" is significant when either the goal is exceeded or when the change in frequency approaches the limit of 10^{-6} per reactor-year. An example of a region in which no review would be required is shown in Figure 4.

What Should be Done?

The staff should evaluate the feasibility of employing frequency-consequence curves for the whole spectrum of accidents (Classes 1 through 9). In particular, this evaluation should include: 1. the definition of appropriate metrics for the consequences (I used iodine releases as an example only). 2. the definition of appropriate Farmer curves. 3. the definition of appropriate guidelines as to what constitutes a "minimal impact" on the frequency-consequence curves that would be applied for the whole spectrum of accidents and for all plants.

This effort should be coordinated with the current staff activities on possible revisions to the Safety Goal Policy Statement. For example, in its report to the Commission on "Elevation of CDF to a Fundamental Safety Goal and Possible Revision of the Commission's Safety Goal Policy Statement" dated May 11, 1998, the ACRS recommended that the staff evaluate the possibility of using three regions for some of the objectives. If the Policy Statement is revised to include three regions for LERF, then two Farmer curves should be defined for releases from Class 1 through 9 accidents, so that three regions would also be defined on the F-C plane.

What are the Benefits?

I realize that what I am proposing would be a significant change in the regulations. I do believe, however, that the benefits warrant this bold step. Specifically,

1. The processes of 10 CFR 50.59 and Regulatory Guide 1.174 would be consistent.

2. Debates about "who owns" the operating margins would be unnecessary.

3. A significant first step would be taken toward making Part 50 risk-informed.

4. A significant first step would be taken toward establishing the basis for the determination of rational performance criteria.

5. The regulatory system would be more rational and much less intrusive than the current one.

References

1. U.S. Nuclear Regulatory Commission, NUREG/CR-0603, "A Risk Assessment of a Pressurized Water Reactor for Class 3-8 Accidents," A. Buslik et al., October 1979.

2. F. R. Farmer, "Siting Criteria - A New Approach," presented at the Conference on Containment and Siting of Nuclear Power Plants, International Atomic Energy Agency, Vienna, 1967 (reproduced in *Nuclear Safety,* vol. 8, pp. 539-548).

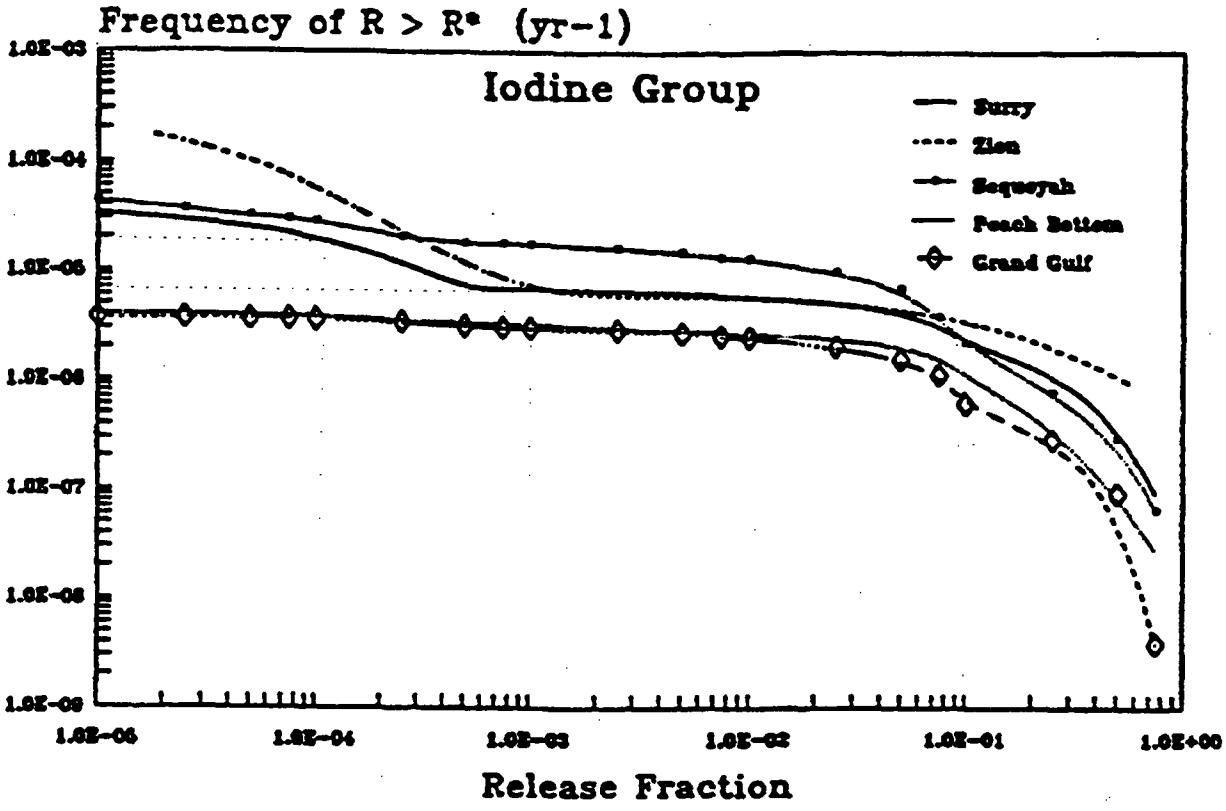


Figure 1. Example of F-C curves for iodine release (Fig. 2.7 of NUREG-1150, vol. 1)

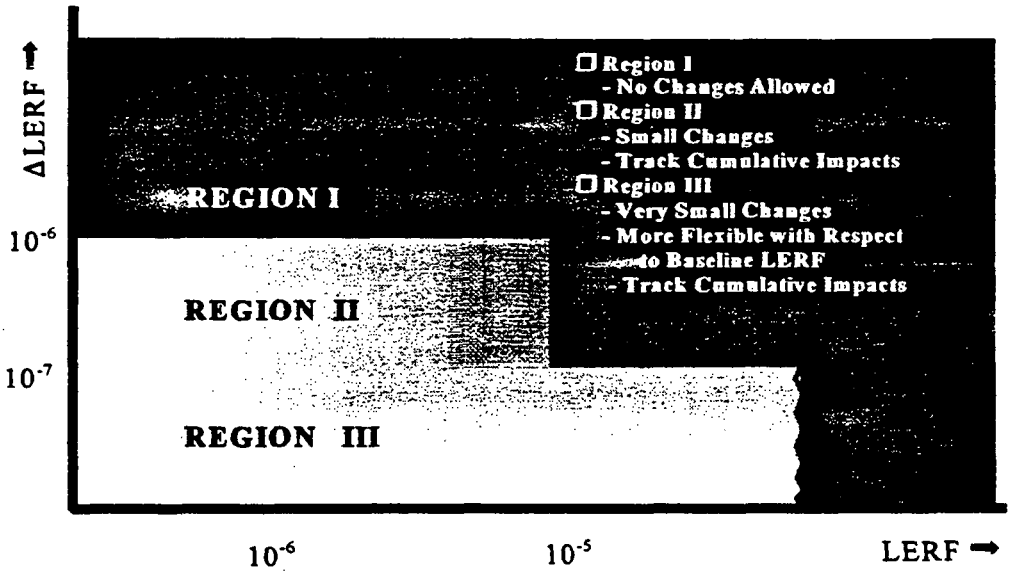


Figure 2. Acceptance Guidelines for Large Early Release Frequency (LERF), as given in RG 1.174.

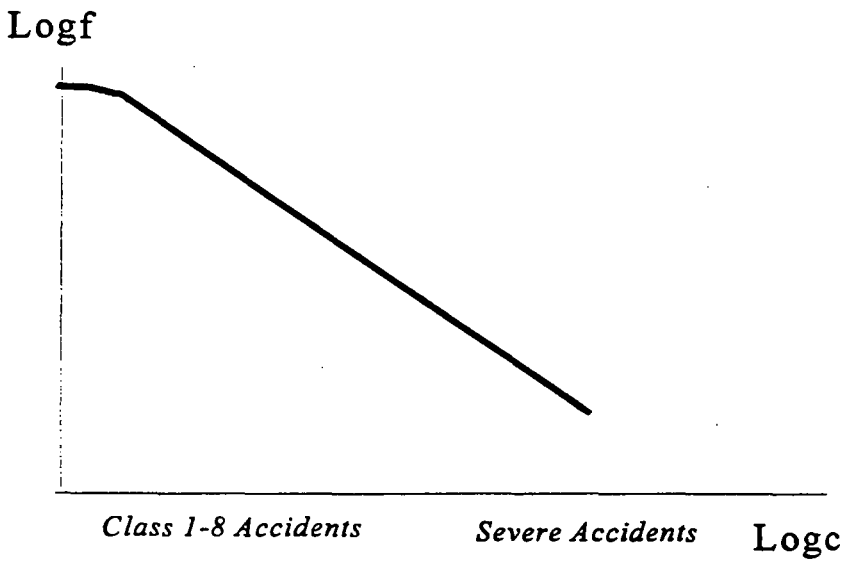


Fig. 3. Example of a Farmer Curve.

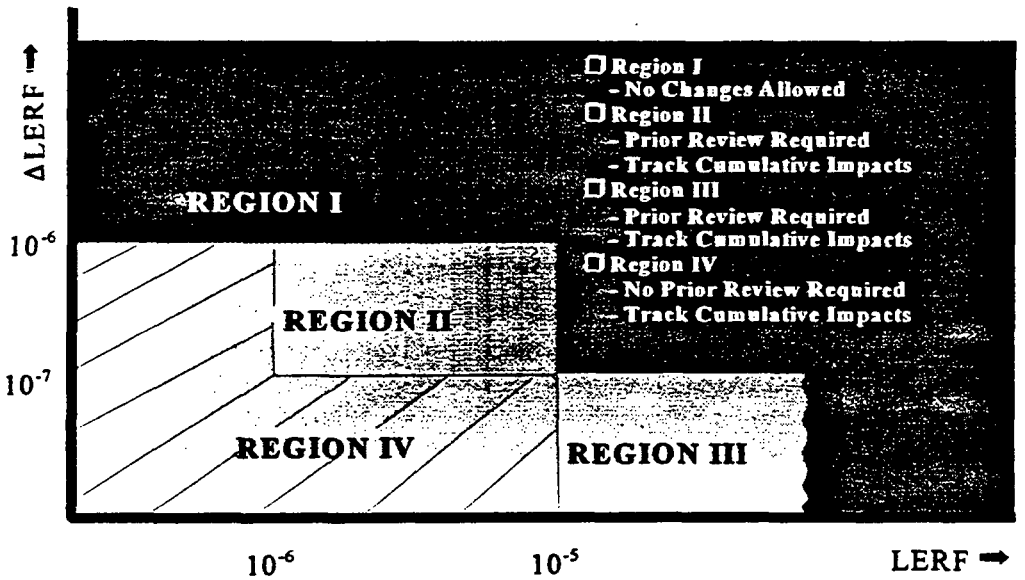


Figure 4. Acceptance guidelines for LERF including a region (IV) in which no prior review is required.

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

December 11, 1998

Dr. William D. Travers
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Dr. Travers:

SUBJECT: OPTIONS FOR INCORPORATING RISK INSIGHTS INTO THE 10 CFR 50.59 PROCESS

During the 458th meeting of the Advisory Committee on Reactor Safeguards, December 3-5, 1998, we met with representatives of the NRC staff to discuss options for incorporating risk insights into the 10 CFR 50.59 (Changes, Tests and Experiments) process. Our Subcommittees on Reliability and Probabilistic Risk Assessment (RPRA), Plant Operations, and Regulatory Policies and Practices met with the staff on August 26 and November 19, 1998, to discuss this matter. We had the benefit of the documents referenced.

We appreciate the opportunity to review the staff's work during the early stages of development. We recognize that the staff's approach is still evolving, therefore, we offer several observations and recommendations without commenting on the details at this time.

Observations and Recommendations

1. The objective of this work is to develop options for making 10 CFR 50.59 risk informed. A key part of this effort must be to determine which attributes of 10 CFR 50.59 are better served by the use of risk information and which are better left alone. The description of, and the problems associated with, the existing process should be used at the outset to identify where risk information can enhance the process.

2. Any changes to 10 CFR 50.59 must both preserve and improve the desirable features of the current process. The staff's report should start off by articulating clear measures for improvement and constraints imposed by other regulations or requirements. The draft report contains several useful evaluation factors. However, the term "enhanced safety decisions" is not a useful criterion unless it is made clear in the context of the safety objectives of the NRC.

   A difficulty with 10 CFR 50.59 is the lack of a clear basis for deciding when changes are allowable without prior NRC approval. We recommend that the staff evaluate how risk information may be used to address this problem and that it be documented in the beginning of the report to guide the development of viable options, and consideration of new alternatives.

The constraints on allowable changes need to be expressed clearly in one place. Currently, references to inadequately defined terms, such as "safety status," "adequate protection," "defense-in-depth," "safety margins," and "operational safety," are scattered throughout the report. If they are to be used as constraints on the options, they need to be gathered, defined, and listed so that they can be used in a more formal way to evaluate all options on a common basis.

3. The staff has considered several options and made preliminary evaluations. Although some features of these options appear desirable, none emerges as a clear candidate for implementation. We recommend that the staff reconsider the selection of options, involving creative combinations of the best aspects of those originally considered as well as other, bolder options, such as allowing changes that do not affect the technical specifications, or affect the technical specifications but satisfy criteria similar to the extension of the Regulatory Guide 1.174 criteria, as suggested in the attachment to our July 16, 1998 report.

4. We are concerned that the staff does not have sufficient time to properly evaluate the options. We believe that more time will be needed after this preliminary effort to evaluate the candidate options in detail. For example, we would like to see a set of test cases that verify and validate the mechanics of the competing approaches. Due to schedular constraints, the staff developed only one test case regarding the reclassification of the South Texas Project essential cooling water screen wash booster pump.

5. The staff should consider the issue of combining changes. In the report, the staff cited examples of individual changes that resulted in unreviewed safety questions, yet, when combined with corrective or compensatory actions, the overall change would meet risk-informed criteria. We recommend that corrective or compensatory actions be given more prominence in allowing collective plant changes using risk insights.

We look forward to discussing this matter with the staff during future meetings.

Sincerely,

R. L. Seale

R. L. Seale
Chairman

References:

1. Draft paper received November 20, 1998, from the Office of Nuclear Regulatory Research to the Office of Nuclear Reactor Regulation, Subject: Options for Incorporating Risk Insights into 10 CFR 50.59 Process (Predecisional).
2. Report dated July 16, 1998, from R.L. Seale, Chairman, ACRS, to Shirley Ann Jackson, Chairman, NRC, Subject: Proposed Revisions to 10 CFR 50.59 (Changes, Tests and Experiments).

OPTIONS TO MAKE 10 CFR PART 50 RISK INFORMED

DR. THOMAS KRESS
ACRS

INTRODUCTION

- ACRS is still in the process of formulating its position on the best approach

- ACRS has had several subcommittee meetings ....but only on specific activities on risk-informed revisions of specific Part 50 sections

- ACRS has had one full committee meeting to review the proposed staff options. Future meetings are planned to review risk-informed revisions to Part 50

THE ACRS LETTER OF DECEMBER 14, 1998

- Presented preliminary views on limited aspects of the Draft Commission Paper [SECY-98-300]

- ACRS position on three of the four policy issues

  - Voluntary vs. mandatory conformance
    - *Voluntary
    - *Did not discuss selective implementation

  - Exemptions from current Part 50 for pilot plants
    - *Yes: an expeditious way to understand implications and consequences
    - *There is some risk. Each proposed change to the plant should be reviewed & approved by the staff using the RG 1.174 concepts

THE ACRS LETTER OF DECEMBER 14, 1998 (Continued)

- Modification of the scope of Maintenance Rule
  - *An ACRS position has not yet been developed
  - *Need better understanding of the relationship to other regulations

- ACRS supported the staff's recommended option of a two-phase approach

  - Phase 1 – Address definition and scope of "safety-related" and "important to safety"
  - Phase 2 – Proceed to revise specific sections of Part 50

  A pragmatic way to reap early benefits

ACRS believes that a complete overhaul of 10 CFR 50 would be a very long-range project that would require difficult policy decisions and extensive rulemaking

The definitions of "safety-related" and "important to safety" are at the heart of making Part 50 risk informed

Modifying Part 50 will require more than just applying the principles in RG 1.174

A quote from the ACRS letter:

"*We believe that the lack of a clear articulation of the functional objectives of a risk-informed regulatory system is contributing to the difficulty in identifying and evaluating options for making the existing system risk informed.*"

BACKGROUND

- ACRS Letter dated December 14, 1998, Proposed Commission Paper Concerning Options for Risk-Informed Revisions to 10 CFR Part 50 - "Domestic Licensing of Production and Utilization Facilities"

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

December 14, 1998

Dr. William D. Travers
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Dr. Travers:

SUBJECT: PROPOSED COMMISSION PAPER CONCERNING OPTIONS FOR RISK-INFORMED REVISIONS TO 10 CFR PART 50 - "DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES"

During the 458th meeting of the Advisory Committee on Reactor Safeguards, December 3-5, 1998, we reviewed the proposed staff options for making risk-informed revisions to 10 CFR Part 50. Our Subcommittees on Reliability and Probabilistic Risk Assessment, Plant Operations, and Regulatory Policies and Practices have held four meetings since August 1998 to discuss NRC staff and industry activities associated with making Part 50 risk informed. During our reviews, we had the benefit of discussions with representatives of the NRC staff, the Nuclear Energy Institute, and other interested parties. We also had the benefit of the documents referenced.

We recognize the importance of revising Part 50 and of resolving the associated policy issues. Because of the staff's tight schedule for completing these tasks, we are holding frequent meetings and are making use of early draft documents. Since the staff's approach is still evolving, we offer our preliminary views on this matter without commenting on the details of the draft document.

In our recent meeting, the staff presented a number of options and policy issues for making risk-informed revisions to Part 50. The policy issues identified by the staff were:

- voluntary versus mandatory conformance with the revised Part 50,
- exemptions for pilot plants from current Part 50 requirements, and
- modification of the scope of the Maintenance Rule.

Our view is that there is really no choice but to make the revised Part 50 voluntary because a backfit analysis will be virtually impossible to do. Making the revised Part 50 voluntary, in a sense, connotes "proliferation" of regulations. As noted in our September 30, 1998 report, there will have to be two sets of regulations - the current rule and the revised rule. Although this should be recognized, it should not be made an issue.

Pilot plant studies should be helpful in identifying the range of plant changes that might result, along with the impacts on risk, resources, and on other regulatory metrics. Exemptions from the current Part 50 requirements for pilot plants will be an expeditious way to better understand the implications and consequences of the revised rule.

We are not yet prepared to express our view on modifying the scope of the Maintenance Rule until we gain a better understanding of the relationship to other regulations, especially the License Renewal Rule.

We support the staff's recommended option of a two-phase approach, which first addresses the definition and scope of "safety related" and then proceeds to a second phase of revising specific sections of Part 50. We believe that the redefinition of "safety related" is fundamental and necessary, and is a strategy that will produce the most positive effect in the short term.

Before the staff proceeds with the second phase, we recommend that the staff more completely define certain terms - particularly "safety" and "adequate protection." We also recommend that the staff better clarify the principles and policies for defense-in-depth in order to identify necessary and sufficient limits. The staff should determine which elements of Part 50 constitute defense-in-depth and which of these should be retained.

We believe that the lack of a clear articulation of the functional objectives of a risk-informed regulatory system is contributing to the difficulty in identifying and evaluating options for making the existing system risk informed. Satisfying the Quantitative Health Objectives, which can be measured by subsidiary goals such as the core damage frequency (CDF) or substitute goals such as the large early release frequency (LERF), is not the only concern of the Agency. Additional objectives, such as the preservation of defense-in-depth, safety margins, and operational safety are often cited by the staff.

Articulation of the regulatory objectives should be a restatement of the NRC's mission related to what it may consider to be the complete definition of safety, as contrasted to risk. For example, during its work on revising the inspection and assessment programs, the staff has identified a number of "cornerstones" that could be adopted as the objectives of the Agency. If all of the Agency's regulatory objectives were clearly stated, the requirements for making Part 50 risk informed could flow directly from these objectives.

Sincerely,

R. L. Seale

R. L. Seale
Chairman

References:

1. Draft Commission paper for the Commissioners, from William D. Travers, Executive Director for Operations, NRC, received December 1, 1998, Subject: Options for Risk-

Informed Revisions to 10 CFR Part 50 - Domestic Licensing of Production and Utilization Facilities (Predecisional).

2. Report dated September 30, 1998, from R.L. Seale, Chairman, ACRS, to Shirley Ann Jackson, Chairman, NRC, Subject: Impact of Probabilistic Risk Assessment Results and Insights on the Regulatory System.

PROPOSED RULEMAKING ON THE USE OF REVISED SOURCE TERM

DR. THOMAS KRESS
ACRS

INTRODUCTION

The source term (ST) is defined as the magnitude (quantity, timing, and chemical/physical form) of fission products released into containment

- With this definition, there is a different ST for <u>every</u> accident sequence evaluated by a PRA

- The "DBA source term," on the other hand, is a single specification contrived for regulatory convenience. It represents what we would expect as a "reasonably" conservative value for the <u>set</u> of DBAs required to be evaluated in the SAR

- Reg. Guides 1.3 and 1.4 associated with Part 100 specified TID-14844 ST for the DBAs considered acceptable for the licensing basis

Severe accident research showed the TID-14844 design-basis ST to be unrealistic (unrealistic does not necessarily mean conservative) in a number of ways:

- Timing of release
- Predominant chemical/physical form of iodine
- Amount of iodine and cesium
- Number of fission-product groups explicitly included

In short, our belief as to what to expect in the way of a reasonable ST for DBA-like sequences was changed. NUREG-1465 provided a revised specification for this new expectation and was intended for use only by <u>new license applications</u>

The proposed rule, however, would allow voluntary application of the revised ST to operating plants

What are the issues associated with the proposed rule?

- How does the revised ST compare with what you would actually expect from the various DBA-like sequences (margins?)?
- What are the likely plant changes that would result?
- Would individual plant risk status change? If increased, would the magnitude be acceptable?
- Would the doses associated with various deterministic regulations increase or decrease? Would the change be acceptable?

What did the staff do to address these issues?

- Performed limited calculations for Grand Gulf (GG) and Surry to compare the revised ST to calculated values for DBA-simulated sequences

- Sponsored limited studies for GG, Surry, and Zion using both the TID-14844 ST and the revised ST to gain insights on the resulting DBA doses

- Identified <u>likely</u> plant changes that would result

- Performed limited calculations for GG and Surry to determine the risk implications of the likely changes (CDF and LERF)

The staff's efforts generally showed that:

- Considerable margin exists with respect to the magnitude of the revised ST compared to actual expectation for all DBAs

  indicating that the revised ST is still reasonably conservative

- The calculated doses with the revised ST are generally smaller (in some cases by a factor of 6) for the same plant configuration

  indicating the potential to relax some requirements and still meet the dose requirements

The staff also identified changes that would likely result from application of the revised ST to operating plants. These include relaxed requirements on:

- Containment leakage rate
- Isolation valve leakage systems
- Isolation valve closure time
- Spray systems
- Clean-up systems (iodine)

Clearly, these relaxed requirements have the potential to increase the magnitude of fission product release if incidents occur. Is this acceptable?

The additional staff efforts with Grand Gulf and Surry led it to conclude that, for the likely relaxed requirements:

- There was insignificant effect on the risk status [CDF and LERF]
- There was no compromise of defense-in-depth
- The dose requirements of the current deterministic rules are met with margin

Thus, it appears that all the provisions of RG 1.174 would be met by any voluntary usage of the revised source term

The ACRS supports the proposed rule to permit voluntary application of the revised ST to operating plants

- The application of the "unrealistic" TID-14844 ST has had undesirable effects:

  - Unnecessary burdensome requirements [e.g., charcoal filters; chemical additives to sprays; requirements for rapid containment isolation time]

  - Preclusion of some safety improvements [e.g., more robust isolation valves]

  - A distorted view of accident sequences

- The effects on safety status appear to be acceptable:

  - Effect on CDF/LERF insignificant
  - No effect on defense-in-depth
  - Deterministic dose criteria still met

BACKGROUND

ACRS Report dated November 19, 1998, Proposed Rule on Use of Alternative Source Term at Operating Reactors

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

November 19, 1998

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

Dear Chairman Jackson:

SUBJECT: PROPOSED RULE ON USE OF ALTERNATIVE SOURCE TERM AT OPERATING REACTORS

During the 457th meeting of the Advisory Committee on Reactor Safeguards, November 4-7, 1998, we reviewed the proposed rule on use of the alternative source term at operating reactors and discussed the status of the associated pilot application under way at the Perry Nuclear Power Plant. During this meeting, we had the benefit of discussions with representatives of the NRC staff. We also had the benefit of the documents referenced.

The regulations (10 CFR Parts 50 and 100) and associated regulatory guides include a conservative source term (TID-14844) that the staff has considered acceptable for performing design-basis accident (DBA) analyses and for assessing the suitability of the containment design for an intended site. This source term is characterized by the composition and magnitude of the radioactive material, timing of release from the reactor core, and physical/chemical form of radionuclides assumed to enter into the containment under accident conditions. In practice, this source term has also been utilized in other regulatory activities, including assessment of the requirements for equipment qualification and for control room habitability.

New knowledge and experience gained through severe accident research revealed that the TID-14844 source term was unrealistic compared to what would be expected if a reactor actually experienced a core-damage accident of a magnitude commensurate with the DBAs. Consequently, the staff developed a revised source term (in NUREG-1465) with the intention that it be applied to the design and siting of future light-water reactors. The major changes in the revised source term were: an extended timing of introduction of the fission products; a change in the predominant chemical form of fission-product iodine from gaseous

to particulate; an increase in the quantities of iodine, cesium, and tellurium; and an increase in the number of fission-product groups.

The proposed rule would allow licensees to voluntarily apply the revised source term to operating plants. The staff has conducted a number of activities to obtain information for use in deciding whether this proposed rule is appropriate and acceptable, including the following:

- Identified likely plant modifications that would result from applications of the revised source term.
- Sponsored studies at the Grand Gulf, Surry, and Zion nuclear power plants using both the TID-14844 and the revised source term to gain insights on the impacts related to DBA doses.
- Undertook review of pilot plant studies submitted to address a range of revised source term applications to operating plants.
- Performed limited evaluations for the Grand Gulf and Surry plants to determine the risk implications [core damage frequency (CDF), large, early release frequency (LERF), and latent fatalities] of selected plant modifications.

The outcomes of the above activities include:

- The DBA doses are generally smaller with the revised source term (in some cases by a factor of six), implying the potential for relaxation of the fission product control requirements.
- The effects on the above risk metrics are insignificant.
- Considerable margin exists with respect to the magnitude of the revised source term, compared to the releases expected to accompany a DBA.

As a result of these findings for a very limited sample of plants, the staff has concluded that there is sufficient justification for the proposed rule that would allow plants to voluntarily adopt the revised source term and make appropriate plant modifications. Such modifications would have to be implemented by a license amendment under 10 CFR 50.90 (a new Section 50.67 would be added to provide the implementation requirements). The licensee would be required to repeat applicable portions of the DBA analyses included in its Final Safety Analysis Report to demonstrate compliance with regulatory requirements in the revised total effective dose equivalent (TEDE) form.

Because of the regulatory significance of source-term usage, we have had a long-standing interest in the subject. Previously, our endorsements of the staff's source-term related efforts have included: updating and defining a more realistic source term; using TEDE and the "worst" two hours for dose-acceptance criteria; developing guidance on acceptable methods for determining source-term mitigation in containment by natural and engineered

safety feature processes; allowing application of the revised source term to operating plants (including partial application – particularly the timing of the release of fission products); and developing a better understanding of the risk implications for implementing the revised source term in operating plants.

The primary reason for our past support to the development of a more realistic DBA source term was due to a concern that use of an unrealistic source term can result in placing regulatory and design emphasis in the wrong areas. There is also the possibility that risk-significant effects may have been missed or that safety enhancements may have been precluded. An unrealistic source term can result in unnecessarily burdensome regulatory requirements.

In formulating the proposed rule, the staff has developed risk information in two areas:

- The risk implications relative to CDF and LERF.
- The margins related to the DBA source term magnitude associated with best-estimate DBA releases.

The staff's efforts in addressing these two areas of concern have been commendable. The staff has done what could be expected within the constraints of the existing regulatory framework.

For the subject rulemaking, it is clear that, to some degree, the likely plant modifications will adversely affect the potential for some quantity of fission product release for plants opting to use the revised source term. For most plants, it is unlikely that the increases in fission product release will be of unacceptable amounts. To a large extent, this is confirmed by the risk-informed values calculated for CDF and LERF. This should be verified, however, for each application.

Recommendations

- In view of the low risk and the possible benefits, we support the proposed rule that would allow licensees to apply the revised source term to operating plants on a voluntary basis.
- Each application for use of the revised source term should be evaluated with respect to absolute values of CDF, LERF, and the effects of the proposed plant modifications on these risk metrics.

Sincerely,

R. L. Seale

R. L. Seale
Chairman

References:

1 Memorandum, dated October 16, 1998, from Jack W. Roe, Office of Nuclear Reactor Regulation, NRC, to John T. Larkins, ACRS, Subject: Transmittal of the Draft Proposed Rule Package - Proposed Amendments to 10 CFR Parts 21, 50, and 54; Regarding Use of an Alternative Source Term at Operating Reactors.

2 SECY-98-154, Memorandum dated June 30, 1998, from L. Joseph Callan, Executive Director for Operations, NRC, for the Commissioners, Subject: Results of the Revised (NUREG-1465) Source Term Rebaselining for Operating Reactors.

3. SECY-98-158, Memorandum dated June 30, 1998, from L. Joseph Callan, Executive Director for Operations, NRC, for the Commissioners, Subject: Rulemaking Plan for Implementation of Revised Source Term at Operating Reactors.

4. Memorandum dated September 4, 1998, from John C. Hoyle, Secretary of the Commission, to L. Joseph Callan, Executive Director for Operations, NRC, Subject: Staff Requirements - SECY-98-158 - Rulemaking Plan for Implementation of Revised Source Term at Operating Reactors.

5. Letter dated August 27, 1996 from D. Shelton, Centerior Energy, to NRC, Subject: License Amendment Request: Revision of Main Steam Line Leakage Requirements and Elimination of the Main Steam Isolation Valve Leakage Control System.

6. U. S. Nuclear Regulatory Commission, NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants," February 1995.

7. U.S. Nuclear Regulatory Commission, NUREG-1150, Vols. 1 & 2, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," December 1990.

LICENSE RENEWAL

DR. MARIO FONTANA
ACRS

INTRODUCTION

ACRS Plant License Renewal Subcommittee met with the NRC staff and the industry

- Met on January 23, 1998; July 16, 1998; November 18, 1998
- Agreed on general review approach and schedule
- Discussed technical topical report on reactor vessel
- Discussed license renewal generic technical issues and associated prioritization criteria

CALVERT CLIFFS MILESTONES/PROPOSED ACRS REVIEW SCHEDULE

	DATE
Staff Completes SER and Identifies Open Items	3/21/99
ACRS Subcommittee Meeting	**4/99**
Staff Holds Public Meeting	4/5/99
ACRS Full Committee Meeting/Interim Report	**5/99**
Staff Issues Supplemental SER	11/16/99
ACRS Subcommittee Meeting	**1/2000**
ACRS Full Committee Meeting/Final Report	**2/2000**

OCONEE MILESTONES/PROPOSED ACRS REVIEW SCHEDULE

	DATE
Staff Completes SER and Identifies Open Items	6/25/99
Staff Holds Public Meeting	7/10/99
ACRS Subcommittee Meeting	**7/99**
ACRS Full Committee Meeting/Interim Report	**9/99**
Staff Issues Supplemental SER	2/2000
ACRS Subcommittee Meeting	**3/2000**
ACRS Full Committee Meeting/Final Report	**5/2000**

LICENSE RENEWAL GENERIC TECHNICAL ISSUES

Staff and industry have agreed on license renewal generic technical issues and their prioritization

- 98 total issues
- 18 must be resolved prior to issuance of renewal license (according to staff)
- Schedule for resolving remaining issues to be determined
- ACRS has not yet reviewed license renewal generic technical issues

PLANNED ACTIVITIES

The ACRS plans to review:

- License renewal generic technical issues and their prioritization
- Selected industry topical reports
- Updated Standard Review Plan and Regulatory Guide
- Aging related research

IMPACT OF PRA RESULTS AND INSIGHTS ON THE REGULATORY SYSTEM

DR. GEORGE APOSTOLAKIS
ACRS

DEFENSE-IN-DEPTH

Principal Strength: Caution ("what if we are wrong?")

Principal Weakness: Inability to quantify the risk significance of structures, systems, and components (SSCs)

PRA

Principal Strengths:

1. Risk quantification
2. Ranking of the major accident sequences and risk-significant SSCs

Principal Weakness: Incompleteness and model uncertainty

Recommendation: Invoke defense-in-depth when PRA uncertainty is an issue in the decision under consideration

PAST AND CURRENT IMPROVEMENTS IN THE REGULATORY SYSTEM

1. Anticipated Transients Without Scram (ATWS) Rule
2. Station Blackout (SBO) Rule
3. Generic Safety Issue prioritization and resolution
4. Advanced Reactor Design certifications (ABWR, AP600, CE System 80+)
5. Licensing amendments

FUTURE IMPROVEMENTS OF THE REGULATORY SYSTEM

1. Oversight process

2. 10 CFR 50.59 process

3. Fire protection

4. Prioritization of research needs

5. Assessment of changes in post-Three Mile Island requirements

TRANSITION TO RISK-INFORMED REGULATION

- The transition will be incremental

- The Agency should be prepared to accommodate a two-tier system, i.e., a modified version of the current regulatory process and a risk-informed system

- The development of PRA technology should be continued. For example, a good understanding of risk is needed in low-power and shutdown operations, fire protection systems, software-based digital systems, and measures of safety culture

BACKGROUND

ACRS Report dated September 30, 1998, Impact of Probabilistic Risk Assessment and Insights on the Regulatory System

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

September 30, 1998

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

Dear Chairman Jackson:

SUBJECT: IMPACT OF PROBABILISTIC RISK ASSESSMENT RESULTS AND INSIGHTS ON THE REGULATORY SYSTEM

During the 455th and 456th meetings of the Advisory Committee on Reactor Safeguards, September 2-4 and September 30-October 2, 1998, we met with representatives of the NRC staff and the Nuclear Energy Institute to discuss the issues in the Staff Requirements Memorandum (SRM) dated April 20, 1998. In the SRM, the Commission requested the ACRS to identify situation-specific cases where probabilistic risk assessment (PRA) results and insights have improved the existing regulatory system and specific areas where PRA can have a positive impact on the regulatory system. Our Subcommittee on Reliability and Probabilistic Risk Assessment met on August 26, 1998, to discuss these issues. We also had the benefit of the documents referenced.

General Observations

In the past the NRC has utilized qualitative evaluations of risk, based on engineering judgment and experience, to carry out its mission to protect public health and safety. Uncertainties in the qualitative evaluations of risk have been addressed by adopting greater conservatism. Such qualitative evaluations of risk do not permit the most effective allocation of resources by licensees or the NRC. The traditional engineering analyses do not permit the examination of complex engineering systems like nuclear power plants in a detailed, integrated manner. Instead, safety analyses have been performed out of necessity on a subsystem-by-subsystem or even on a component-by-component basis. Interactions among systems and the unanticipated responses of multiple systems to unexpected situations can result in higher than expected risk even when each system or component meets all the regulatory requirements. Examples include the interfacing-systems loss-of-coolant accident that was identified by the Reactor Safety Study (WASH-1400) and the recent accident sequence, initiated by fire, identified by the Individual Plant Examination of External Events (IPEEE) for the Quad Cities Nuclear Power Plant.

The NRC has recognized the limitations of traditional engineering analyses and has pioneered the development of the quantitative risk assessment of nuclear power plants, namely, PRA

methodology. PRA builds upon traditional engineering analyses to develop quantitative assessments of risk. In fact, it is the only means for quantitative determination of risk. PRA methodology examines safety systems and their interactions in an integrated, comprehensive manner. It is scrutable in that engineering judgments are quantified. It yields quantitative measures of risk significance for individual systems, structures, and components (SSCs) that can provide a basis for a more efficient allocation of resources by licensees and the NRC. Although uncertainties are present in any type of analysis, many of the uncertainties can be quantified in PRA and this quantification should be used to constrain conservatism. Risk to the public can be expressed in terms comparable with other risks and objective definitions can be developed for the NRC's mission goal of preventing "undue risk."

The principal strengths of the current regulatory system are its caution ("what if we are wrong?") and the resulting development of the principle of defense-in-depth as well as its large experience base. The principal weakness is its inability to quantify the risk significance of SSCs.

The principal strengths of PRA are the quantification of risk and the identification and ranking of the major accident sequences and risk-significant SSCs. The principal weakness is incompleteness, i.e., the inability to identify all potential threats to the system and to develop adequate models for some identified threats.

The principle of defense-in-depth and PRA can complement each other well. When the uncertainties in the PRA are too large for regulatory decisionmaking (especially due to incompleteness), the principle of defense-in-depth can be invoked to deal with these uncertainties. Although this may appear obvious, it should be emphasized because it is too often ignored. The strengths and limitations of both the current system and PRA must be evaluated when a new regulatory application is contemplated. We believe that combining the strengths of PRA and defense-in-depth will lead to better-informed decisionmaking and improved regulatory coherence. We anticipate that it will also lead to greater regulatory efficiency and reduction of unnecessary burden on both licensees and the NRC staff.

Past and Current Improvements in the Regulatory System

Some specific examples where PRA has improved (or is expected to improve) the current regulatory system are:

1. *The Anticipated Transients Without Scram (ATWS) Rule.* PRA identified the importance of ATWS and provided the technical basis for regulatory action.

2. *The Station Blackout (SBO) Rule.* PRA identified the significance of SBO and provided the technical basis for regulatory action. PRA permitted the assessment of the risk from SBO on the basis of plant-specific configuration, as well as plant-specific grid, switchyard, and weather characteristics. It permitted evaluation of the cost effectiveness of alternative improvements, thereby leading to more efficient allocation of resources. This illustrates one of the strengths that PRA brings to the regulatory process.

3. *Generic Safety Issue Prioritization and Resolution.* Using PRA criteria, the original list of about 700 generic safety issues was reduced to about 200, thereby focusing NRC resources on the most important issues.

4. *Advanced Reactor Design Certifications (ABWR., AP600, CE System 80+).* PRA allowed the staff and each vendor to focus on the design issues important to safety, thereby leading to substantial reduction in risk for these designs.

5. *Licensing Amendments.* The recently issued regulatory guides allow the use of risk information in requests for changes in the technical specifications, inservice testing, and quality assurance requirements (the inservice inspection regulatory guide is still under consideration). The principal benefits are expected to be improved safety and efficient allocation of resources. Graded quality assurance provides an example where, even though the impact of quality assurance requirements on PRA is unquantified, one can still derive insights regarding the importance of SSCs from PRAs.

Future Improvements of the Regulatory System

1. *Oversight Process.* There is a widespread belief within the industry that the current inspection and enforcement processes are overly prescriptive and burdensome. Plant-specific risk information can and should be used to focus regulatory and licensee attention. Enforcement actions, too, should be graded in terms of risk-significance.

2. *10 CFR 50.59 Process.* The strength of the current process is that it ensures that changes made without prior NRC approval do not constitute an unreviewed safety question in accordance with the Final Safety Analysis Report (FSAR) which is the basis for licensing the facility. The major weakness is that the process refers to changes in probabilities that cannot be calculated using traditional deterministic methods. Furthermore, the Commission recently directed the staff to define "minimal" changes to ensure that such changes are sufficiently small that NRC review is not required. The quantification of frequencies of events, one of the strengths of PRA, provides the context within which contemplated changes can be declared "minimal." At the same time, one of the weaknesses of PRA is its insensitivity to very small changes in plant configuration and procedures. We, therefore, expect that a revised 10 CFR 50.59 process will retain parts of the "deterministic" criteria that the current process employs.

3. *Fire Protection.* The recent discovery of a major accident sequence, initiated by fire, identified by the IPEEE at Quad Cities demonstrated the limitations of the existing fire protection regulations. A revision of 10 CFR 50, Appendix R to include risk information would reduce the likelihood that such cases would reoccur. Such a revision would, of course, have to take into account the limitations of current fire risk assessment methodology (e.g., the lack of models for assessing the impact of smoke) and would rely on defense-in-depth. PRA would also be useful in the prioritization of inspections of fire barrier penetration seals that have been of concern recently, thereby avoiding the waste of resources on insignificant issues.

4. *Prioritization of Research Needs.* In an era of diminishing budgets, it is no longer sufficient to rely primarily on judgment to prioritize research. The principal criterion for prioritizing research needs should be their expected contribution to risk-informed regulatory decisions.

5. *Assessment of Changes in Post-Three Mile Island Requirements.* Many requirements were imposed in the immediate aftermath of the accident at Three Mile Island Unit 2. These changes did not have the benefit of significant input from PRA, which was a developing technology at the time. The risk importance of these requirements should be evaluated. Based on these evaluations, the requirements may be changed or eliminated.

Transition to Risk-Informed Regulation

The transition to a risk-informed regulatory framework will be incremental. Many of the present regulations are based on deterministic and prescriptive requirements that cannot be quickly replaced. Therefore, the current requirements will have to be maintained while risk-informed regulations are being developed and implemented. Furthermore, we expect that a number of licensees will, for a variety of reasons, be unwilling to embrace a new regulatory system. Therefore, the NRC should be prepared to accommodate a two-tier system, i.e., a modified version of the current regulatory process and a risk-informed system. This situation will prevail for a number of years and may create circumstances that should be addressed by the Commission. We have already seen such circumstances in recent requests for BWR power uprates. Even though licensee use of Regulatory Guide 1.174 is voluntary, questions were raised about the acceptability of the change in core damage frequency associated with power uprates. Although in this case the licensees voluntarily submitted the relevant information, conflicts might arise in the future.

Although we recognize that it will be necessary to maintain many of the current requirements during the transition, we strongly support the efforts of the staff to develop options to revise 10 CFR Part 50 to make it more risk informed. We believe that, as a minimum, revisions must be made to permit effective implementation of the initiatives associated with Regulatory Guide 1.174.

An example of the need for regulatory harmonization is the attempt to apply the recently issued Regulatory Guide 1.176 on Graded Quality Assurance. This Regulatory Guide utilizes PRA importance measures to categorize SSCs according to their safety significance. Industry representatives have stated that they expect that several thousand components, which are currently classified as safety-related, will be placed in the "low-safety significance" category, which indicates that quality assurance requirements on these components could be relaxed with little impact on safety. It is not clear whether, under the current regulations, this relaxation of requirements can be done under 10 CFR 50.59 or whether each request must be submitted to the staff for review and approval, in which case the potential benefits of graded quality assurance will be reduced significantly. We anticipate that similar cases will arise in the future.

To further the use of PRA in the regulatory process, we recommend that the Commission consider some policy decisions. First, determine whether risk itself or surrogate measures such

as core damage frequency are to be used in making decisions based on PRA. Second, direct the staff to allow credit for voluntary actions consistent with the Commission directive that risk assessments be as realistic as possible. Finally, we recommend that the Commission expedite the revision of 10 CFR 50.12 to allow the use of risk insights as a basis for exemptions to its current regulations.

The development of PRA technology should be continued. For example, a good understanding of risk is needed in the following areas: low-power and shutdown operations, fire protection systems, software-based digital systems, and measures of safety culture.

Sincerely,

R. L. Seale

R. L. Seale
Chairman

References:

1. Memorandum dated April 20, 1998, from John C. Hoyle, Secretary, NRC, to John T. Larkins, Executive Director, ACRS, Subject: Staff Requirements - Meeting with the Advisory Committee on Reactor Safeguards, April 2, 1998.
2. Memorandum dated August 18, 1998, from John C. Hoyle, Secretary, NRC, to L. Joseph Callan, Executive Director for Operations, NRC, and Karen D. Cyr, General Counsel, NRC, Subject: Staff Requirements - Public Meeting on Stakeholder Concerns, July 17, 1998.
3. Memorandum dated August 7, 1998, from Shirley Ann Jackson, Chairman, NRC, to L. Joseph Callan, Executive Director for Operations, NRC, Subject: Responding to Issues Raised within the Senate Authorization Context.
4. Memorandum dated August 25, 1998, from L. Joseph Callan, Executive Director for Operations, NRC, to Shirley Ann Jackson, Chairman, NRC, Subject: Response to Issues Raised within the Senate Authorization Context and July 17, 1998 Stakeholder Meeting.

ELEVATION OF CDF TO A FUNDAMENTAL SAFETY GOAL AND POSSIBLE REVISION OF THE COMMISSION'S SAFETY GOAL POLICY STATEMENT

DR. GEORGE APOSTOLAKIS
ACRS

Observations

1. Subsidiary goals or objectives should be consistent with the Quantitative Health Objectives (QHOs) as articulated in the Commission's Safety Goal Policy Statement

2. An objective of 10^{-5} per reactor year for large, early release frequency (LERF) is consistent with the prompt fatality QHO

3. An objective of 10^{-4} per reactor year for core damage frequency (CDF) is more conservative than the QHOs

Recommendation

CDF should be elevated to a fundamental safety goal in the Policy Statement

Observation

The current safety goals refer to individual risk only

Recommendation

The measures of societal risk should be reconsidered (e.g., total number of fatalities, environmental contamination in a revision of the Policy Statement)

FORMULATION OF REVISED SAFETY GOALS

Observations

1. Industry concern that plants above the goal are perceived as being "unsafe"

2. Insufficient guidance regarding the meaning of "goals"

Recommendation

Investigate the possibility of using a three-region approach

THREE-REGION APPROACH

- For risk levels above the upper limit, immediate action should be taken

- For risk levels between the upper limit and the goal, the possibility of reducing the estimated metric should be investigated, taking into account costs and benefits

- For risk levels below the goal, no action would be required

This approach would be consistent with the "risk-informed" philosophy, which recognizes that risk metrics are only part of the decisionmaking process, but if the value of a risk metric were found to be very large, this would lead to immediate action

BACKGROUND

ACRS Report dated May 11, 1998, Elevation of CDF to a Fundamental Safety Goal and Possible Revision of the Commission's Safety Goal Policy Statement

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

May 11, 1998

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

Dear Chairman Jackson:

SUBJECT: ELEVATION OF CDF TO A FUNDAMENTAL SAFETY GOAL AND POSSIBLE REVISION OF THE COMMISSION'S SAFETY GOAL POLICY STATEMENT

During the 449th, 451st and 452nd meetings of the Advisory Committee on Reactor Safeguards, March 2-4, April 2-4, and April 30-May 2, 1998, respectively, we met with representatives of the NRC staff and the industry to discuss the elevation of core damage frequency (CDF) to a fundamental safety goal and the need for revising the Commission's Safety Goal Policy Statement. In our August 15, 1996 report to the Commission, we recommended elevating CDF to a fundamental safety goal. Our Subcommittee on Reliability and Probabilistic Risk Assessment met on February 20 and April 16, 1998, to discuss these matters. Former NRC Commissioner Forrest Remick and former ACRS Member David Okrent participated in these discussions. We also had the benefit of the documents referenced.

The Quantitative Health Objectives (QHOs) regarding individual risk and societal risk promulgated in the Safety Goal Policy Statement are fundamental goals. Due to the large uncertainties in evaluating individual and societal risk, alternative objectives are often used. The most frequently used alternatives are limits on CDF and on large, early release frequency (LERF). These are generally referred to as "subsidiary" or "surrogate" goals to indicate that they are intended to be consistent with the fundamental safety goals (to the extent that the current computational capability allows the determination of consistency[1]). If one of these numerical goals were to be significantly more conservative than the QHOs, then it would no longer be subsidiary, but could itself be a new, *de facto* fundamental safety goal.

In its report dated May 13, 1987, the ACRS discussed a hierarchical structure to facilitate the implementation of the Safety Goal Policy Statement, and expressed concern over a *de facto*

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[1]In this regard, the Policy Statement advises that "It is the Commission's intent that the risks from all the various initiating mechanisms be taken into account to the best of the capability of current evaluation techniques." The check for consistency to which we are referring will also have to be done using the best current evaluation techniques.

change in policy: "Each subordinate level of the hierarchy should be consistent with the level above, but should be a more practical surrogate, representing a simplification or quantification of the previous level. Each surrogate should not be so conservative that it creates a de facto new policy."

The staff has stated numerical objectives for CDF and LERF in Regulatory Guide 1.174 and has employed these values in other regulatory decisionmaking. The question is whether these numerical values are consistent with the QHOs. There are plants that could have CDF values even greater than 10^{-3} per reactor-year and still be consistent with the QHOs because of their containment performance. Thus, we make the following observations:

> Observation 1: Existing Level-3 PRA results can be used to estimate specific values for LERF that would be consistent with the QHOs. Such estimates show that the current LERF objective of 10^{-5} per reactor-year is consistent with the QHO on early fatalities and, therefore, could be considered a surrogate goal.
>
> Observation 2: Results of analyses indicate that a CDF objective of 10^{-4} per reactor-year, if applied to all plants with their current level of containment performance, in many cases would be more conservative than the QHOs. This would, therefore, be a new *de facto* fundamental safety goal.

Although we agree with the criteria on CDF and LERF included in Regulatory Guide 1.174, we believe that such *de facto* changes in policy are not desirable. The issue of elevating CDF to a fundamental safety goal should be thoroughly scrutinized.

Irrespective of Observation 2, we agree with the staff position that a revision of the Policy Statement is needed to address the use of the goals on a plant-specific basis, to expand the discussion on uncertainties, and to remove the general plant performance guideline.

These and other issues regarding the current Policy Statement should be addressed if a revision is considered. Even though the Policy Statement refers to societal risk, the application guidance and practice result in essentially individual risk goals. Furthermore, environmental contamination and the total number of fatalities have been mentioned often as being appropriate societal measures of the consequences of accidents at nuclear power plants. Environmental contamination receives close attention within the nuclear regulatory framework of some other countries. The importance of environmental contamination resulting from accidents is recognized by the NRC staff in regulatory analyses and in environmental impact statements. The question is whether this and the total number of fatalities should be part of the Safety Goal Policy.

Thus, we make the following recommendation:

> Recommendation 1: There is a need to revise the Safety Goal Policy Statement. The revision should include: (a) a statement regarding the plant-specific use of the safety goals; (b) an expanded treatment of the role of uncertainties; (c) the removal of the general plant performance guideline; (d) a reconsideration of the set of fundamental goals and subsidiary objectives to ensure that they are consistent; and (e) a reconsideration of measures of societal risk such as environmental contamination and the total number of fatalities.

During our discussions with the staff, a question was raised regarding the level of detail that the Policy Statement should contain. Should such a document only express the overall safety policy and regulatory approach of the Agency, or should it also specify numerical values for the metrics? The current Statement does specify numerical QHOs. If it is decided to elevate CDF to the same level, should it simply state that the prevention of core damage is a fundamental safety goal and leave the specification of actual numerical guidelines in application guidance? In either case, attention will be drawn to the significance that the Commission places on core damage accidents and would be a clear statement of defense-in-depth in terms of PRA. We understand the attractiveness of providing clear, understandable criteria, yet the inclusion of too many quantitative objectives might be overly constraining and not sufficiently flexible to adapt to changes in technology.

An additional important conceptual issue is whether the objectives should be stated in terms of a single goal or a goal and an upper limit. The current Policy Statement specifies only a single goal for each objective, e.g., if the calculated risk of prompt fatality to an individual in the vicinity of a nuclear power plant is less than 0.1 percent of the sum of prompt fatality risks from other accidents, then that plant meets this objective, otherwise it does not.

An upper limit and a goal define three regions. For risk levels above the upper limit, immediate action should be taken. For risk levels between the upper limit and the goal, the possibility of reducing the estimated metric should be investigated, taking into account costs and benefits. For risk levels below the goal, no action would be required. This approach would be consistent with the "risk-informed" philosophy, which recognizes that risk metrics are only part of the decisionmaking process, but if the value of a risk metric were found to be very large, this would lead to immediate action.

The use of two values for making decisions involving risk metrics has been adopted by the nuclear regulatory agencies of The Netherlands and the United Kingdom (Versteeg, 1992; Ballard, 1993). Similarly, in a report dated October 31, 1980, the ACRS recommended decision rules that would employ a "goal level" and an "upper limit" on the various frequencies of the risk metrics. Even though the Commission did not adopt this earlier ACRS recommendation as part of its Safety Goal Policy Statement, it appears that both the staff and the industry act as if it were in effect. They respond immediately when a contributor to core damage is identified that increases the CDF to about 10^{-3} per reactor-year or greater. Some examples illustrating this behavior are the discoveries, by Individual Plant Examinations (IPEs) and Individual Plant Examination of External Events (IPEEEs), of such potential contributors initiated by internal flooding at the Surry plant and by fire at the Quad Cities plant.

The recently published report on the IPE program (NUREG-1560) states that "the CDFs for all boiling water reactors (BWRs) and most pressurized water reactors (PWRs) fall below 1E-4/ry; however, nine licensees representing 15 PWR units reported CDFs above 1E-4/ry" (page 7-3). Given the limited scope of the IPE studies, it is reasonable to expect that the number of units (both PWR and BWR) with CDFs greater than 10^{-4} per reactor-year is higher than the IPE findings.

Thus, if the CDF value of 10^{-4} per reactor-year were to become a fundamental safety goal, the two-interval approach might lead to the perception by members of the public that the units having

CDFs greater than the goal are "unsafe." In a letter dated July 23, 1997, to NRC Chairman Jackson, Mr. J. F. Colvin of the Nuclear Energy Institute articulated this concern: "...using core damage frequency as a fundamental safety goal now would send a message to the public that plants that exceed the core damage frequency objective are unsafe, even though they may be well below the safety goal quantitative health objectives." The three-region formulation helps to alleviate this problem.

Therefore, we offer the following recommendation:

> Recommendation 2: If revised, the Policy Statement should be written in terms of high-level principles and expectations and should include numerical guidelines on fundamental goals. We continue to believe that CDF should be elevated to a fundamental safety goal. Using three regions for some of the objectives should be evaluated, as opposed to the two that the current Policy Statement identifies.

We believe that a revision of the Policy Statement as discussed above would be a major undertaking. The staff stated that revising the Safety Goal Policy Statement would necessitate the reallocation of limited staff resources and would have an adverse impact on risk-informed regulatory activities. We view the completion and implementation of the Standard Review Plan and Regulatory Guides associated with risk-informed regulation as having great and immediate importance. We are, thus, led to the following recommendation:

> Recommendation 3: The staff's request to defer modifying the Policy Statement for one year to permit evaluation of related issues and impacts should be approved.

We plan to continue our discussions with the staff regarding these matters.

Sincerely,

R. L. Seale

R. L. Seale
Chairman

References:

1. Memorandum dated October 16, 1997, from John C. Hoyle, Secretary, to L. Joseph Callan, Executive Director for Operations, NRC, Subject: Staff Requirements - SECY-97-208, "Elevation of the Core Damage Frequency Objective to a Fundamental Commission Safety Goal."
2. Memorandum from L. Joseph Callan, Executive Director for Operations, NRC, for the Commissioners, Subject: "Modifications to the Safety Goal Policy Statement," received March 26, 1998 (Predecisional Draft).
3. Report dated May 13, 1987, from William Kerr, Chairman, ACRS, to Lando W. Zech, Jr., Chairman, NRC. Subject: "ACRS Comments on an Implementation Plan for the Safety Goal Policy."

4. Report dated August 15, 1996, from T. S. Kress, Chairman, ACRS, to Shirley Ann Jackson, Chairman, NRC, Subject: "Risk-Informed, Performance-Based Regulation and Related Matters."
5. SECY-98-015, Memorandum dated January 30, 1998, from L. Joseph Callan, Executive Director for Operations, NRC, for the Commissioners, Subject: "Final General Regulatory Guide and Standard Review Plan for Risk-Informed Regulation of Power Reactors." (Predecisional Draft).
6. M. F. Versteeg, "Showing Compliance with Probabilistic Safety Criteria and Objectives," *Reliability Engineering and System Safety*, 35 (1992) 39-48.
7. G. Ballard, "Guest editorial: Societal Risk-Progress since Farmer," *Reliability Engineering and System Safety*, 39 (1993) 123-127.
8. Report dated October 31, 1980, from Milton S. Plesset, Chairman, ACRS, to John F. Ahearne, Chairman, NRC, Subject: "An Approach to Quantitative Safety Goals for Nuclear Power Plants."
9. U. S. Nuclear Regulatory Commission, NUREG-1560, "Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance," Vols. 1-3, December 1997.
10. Letter dated July 23, 1997, from J. F. Colvin, President and CEO, Nuclear Energy Institute, to Shirley Ann Jackson, Chairman, NRC, regarding elevation of the core damage frequency subsidiary objective to a fundamental safety goal.
11. Memorandum dated July 2, 1997, from Shirley Ann Jackson, Chairman, NRC, to L. Joseph Callan, Executive Director for Operations, NRC, Subject: "The Statement of Core Damage Frequency of 1E-4 as a Fundamental Commission Goal."
12. Memorandum dated October 8, 1997, from NRC Commissioner Diaz, to John T. Larkins, ACRS, Subject: "Safety Goal."
13. U. S. Nuclear Regulatory Commission, Policy Statement, "Safety Goals for the Operations of Nuclear Power Plants," 10 CFR Part 50, August 21, 1986.

NRC SAFETY RESEARCH PROGRAM

DR. ROBERT UHRIG
ACRS

INTRODUCTION

In the SRM dated September 9, 1997, the Commission requested that the ACRS:

- Examine the need, scope, and balance of the Reactor Safety Research Program
- Examine how the Office of Research is positioned for the changing environment
- Examine how well the Office of Research anticipates research needs
- Take an active role in reviewing ongoing Research Program initiatives, such as those discussed in SECY-97-075 and in SECY-97-167
- Recommend whether the Nuclear Safety Research Review Committee (NSRRC) function is still needed
- Results of the ACRS review are documented in NUREG 1635, Vol. 1

ACRS RECOMMENDATIONS INCLUDE:

1. The NRC should adopt a systematic framework for the design and engineering of its Research Program that enforces a close tie between research activities and agency needs, assesses the value of the results to be achieved by the research, defines the requirements of the research, specifies the functions of the research activities, and defines the urgency of the results.

2. The NRC needs to adopt a practice of scrutable comparison of alternatives in addressing technical issues that require innovation in fields that are not well established.

3. The NRC should devise a process for identifying and prioritizing research needs that encompasses considerations of long-term benefits as well as short-term user needs. The user-needs process itself should be revised so that it better represents the full range of research needed by line organizations.

4. The NRC needs to develop its in-house risk assessment capability to the extent that it can be readily used throughout the agency. The in-house capability can be used to assess requests and to improve the planning of research.

5. A formal organizational structure that identifies and prioritizes research needs and subject these needs to peer review should be put in place to ensure close coordination and collaboration between the developers of research and the users of those results.

6. The NRC no longer needs most of the functions of the NSRRC. The Commission does need a Research Program and needs to ensure that this Program conforms to the NRC philosophy of research and to directions given to the Program by the Commission.

ACRS 1999 REPORT TO THE COMMISSION

- Anticipated issues to be addressed in the 1999 report include:
  - PRA research for risk-informed and performance-based regulations
  - High burnup fuel performance and core power upgrades
  - Thermal hydraulics code integration/in-house capabilities
  - Advanced instrumentation and controls
  - Plant life extension and decommissioning
  - Shutdown and low-power operations risk
- Not expected to be as comprehensive as the 1998 report
- The ACRS spent significant time and resources in preparing the 1998 report
- Feedback from the Commission on the 1998 report would be helpful in preparing the 1999 report