1

2

3

4 UNITED STATES NUCLEAR REGULATORY COMMISSION

5 MEETING WITH ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

6 (ACRS)

7 + + + + +

8 THURSDAY

9 June 5, 2008

10 + + + + +

11 The Commission convened at 1:30 p.m., the Honorable Dale E. Klein, Chairman,

12 presiding.

13

14 NUCLEAR REGULATORY COMMISSION

15 DALE E. KLEIN, CHAIRMAN

16 GREGORY B. JACZKO, COMMISSIONER

17 PETER B. LYONS, COMMISSIONER

18 KRISTINE L. SVINICKI, COMMISSIONER

19

20

21

22

1 ACRS COMMITTEE

2 DR. WILLIAM SHACK, Chairman, ACRS

3 DR. DANA POWERS, Member, ACRS

4 DR. GEORGE APOSTOLAKIS, Member, ACRS

5 DR. MICHAEL CORRADINI, Member, ACRS

6 DR. MARIO BONACA, Vice Chairman, ACRS

7 DR. SAID ABDEL-KHALIK, Member, ACRS

8 DR. SANJOY BANERJEE, Member, ACRS

9

10

11

12

13

14

15

16

17

18

19

20

21

22

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

2 CHAIRMAN KLEIN: Thanks for being here today. Obviously, the
3 ACRS gives us a lot of good advice and so we appreciate all the effort that you
4 and your other fellow participants do. The area, obviously, is very exciting in terms
5 of the volume of material I'm sure you're seeing is increasing.
6 So, today we're going to hear about a lot of our ongoing safety activities.
7 We'll hear about Digital I&C. We'll hear about the ESBWR and, of course, the
8 other acronym that we have to talk about SOARCA. So, we'll hear about
9 SOARCA and other activities and then the power uprates.
10 So, any comments from my fellow Commissioners before we start?
11 COMMISSIONER LYONS: Looking forward to the meeting.
12 CHAIRMAN KLEIN: Bill, would you like to begin.
13 DR. SHACK: Okay. I'm just going to begin with an overview of
14 some of our accomplishments since we last met with the Commission last June.
15 We've issued 29 reports. The topics that we've covered are a variety of topics.
16 Just let me highlight a few of the important ones.
17 We have completed our biannual review of the research program or
18 biannual review and evaluation of the safety research program which Dana will be
19 speaking about in more detail in a little bit. Next slide, please.
20 We've reviewed selected chapters of the ESBWR design certification
21 application and Mike Corradini will be discussing that, again, as part of our
22 presentation.

1 We've also written some reports on the State-of-the-Art Rector
2 Consequence Analysis (SOARCA) project and I'll be coming back to give a few
3 more remarks on SOARCA in a little bit.
4 We've spent a fair amount of activity on Digital I&C research project plan
5 and the interim guidance. George will be discussing that in more detail as part of
6 our presentation.
7 I would also note that we worked and sort of provided an on-line technical
8 review of the dissimilar metal weld issue in pressurizer nozzles as that was sort of
9 heating up, literally, over the summer time. Next slide, please.
10 We have, again, a fairly full plate of licensing activities, license renewals,
11 extended power operates and early site permit applications. Dr. Bonaca will be
12 discussing some of the technical issues that we've addressed as part of the
13 extended power operates.
14 And, of course, most important of all are our activities associated with new
15 plant activities. And again, we've established our design specific subcommittees
16 to handle certifications and combined operating license applications on a kind of a
17 design specific basis that we think will lead to fairly efficient reviews hopefully.
18 We've also reviewed the technology-neutral licensing framework for future
19 plant designs and we're going to report on that. Next slide.
20 The important thing is that we're interacting with the NRO staff periodically
21 to establish a schedule for ACRS reviews on all the new reactor activities to make
22 sure that the applicant and the licensing staff and the ACRS are sort of in sync so

that we don't run into scheduling roadblocks as we go out in the future. We've tried to establish this out over a fairly long time span.

Again, license renewal is an important activity. We've completed review of three license renewal applications and are still reviewing some ongoing license renewals.

Again, I think license renewal reviews have been efficient and predictable because of the good understanding and expectation we have for aging management programs, although new issues still do occur. We had the fatigue issue that arose this summer and some issues involved with the switch yard at Wolf Creek.

We have noted a number of exceptions that licensees are taking with Generic Aging Lessons Learned Report and again, I think future updates, the staff will take a slightly less prescriptive view.

Again, many of these exceptions turned out to be rather pro forma exceptions, but I think with some modification of the GALL report we can eliminate many of those.

Radiation and materials -- radiation protection and nuclear materials issues are going to be a new activity for us that will be important as we consider new licensees. There's no issues that were carried over from the ACNW&M when we met.

We will establish a new subcommittee to focus on radiation protection and nuclear materials issues to take up those new responsibilities and we're looking for

1 a new candidate for membership who will bring some expertise in that area to
2 complement the existing expertise that we do have.
3 Our ongoing and future activities, of course, are very associated. The
4 biggest one is with advanced reactors, both certifications, COLs.
5 Digital instrumentation is a major technical item there. Again, it's one of the
6 truly new features of many of the new reactors and it's difficult to handle both from
7 a certification and a risk perspective. George will be talking more about our
8 activities there.
9 For operating reactors, one of the issues that we do see coming up and we
10 will be paying some attention to are issues associated with high burn up fuel and
11 cladding.
12 Again, nuclear reactors are very efficient ways to make electricity, but
13 they're most effective when they're on line and running, so there's a great incentive
14 for people to keep them on line to drive the fuels the higher burn up, putting
15 greater demands on the cladding and we're reviewing that to make sure that the
16 regulatory requirements are consistent with the new demands that are being
17 placed on fuels.
18 Another important issue is also human reliability analysis. Again, that's
19 important for operating reactors and again for new reactors it will probably become
20 an even larger contributor to the possible reactor accident sequences.
21 Again, for operating plant issues it's our old favorite the PWR sump
22 performance. Still addressing issues like the chemical effects which turn out to be

1 more complicated perhaps than might have been expected.

2 In particular, the downstream effects that as one addresses the sump

3 blockage issue. One has to make sure that in fact we don't get blockages

4 downstream. And again, that's an area of ongoing activity.

5 That completes my overview a little bit ahead of time. I think we could

6 perhaps take that time and spend it on some of the other topics.

7 The next topic of interest is our Safety Research Program that Dana will talk

8 about.

9 DR. POWERS: I think you're aware that the ACRS spends an

10 enormous amount of its time looking at research in various capacities. We

11 certainly look at all the research that would support any particular regulatory

12 action.

13 We have a program where we look in depth at the quality of roughly four

14 individual research programs each year to see how well the research is going.

15 And every other year we produce a report that looks at the programmatics of the

16 entire reactor safety research program. We just issued our 2008 version of that

17 report. May I have the first slide, please?

18 The scope of our research report focuses very much on the reactor safety

19 research part. We do that review in terms of the technical disciplines, not the

20 particular research -- the way the research organizes its activities by project. We

21 do that just to fit the manpower in our committee.

22 The report does not address issues of security or safeguards and it does

1 not address issues of nuclear materials or waste management. Those are
2 covered in other venues, but otherwise it covers the entirety of research devoted
3 to reactor safety.
4 This year we added in a section which looked at the issues of long-term
5 sustained research in the nuclear area.
6 What's our general observation about the research program? The research
7 program has evolved. We find the current safety research program is very well
8 focused on supporting the near-term needs of the regulatory line agencies at NRC.
9 That does not say that there are not long-term research activities.
10 Certainly, the research that is going on in areas like thermal hydraulics and what
11 not is a long term research program.
12 The management within Research has been very good at eliciting support
13 from the line organizations for the longer-term research activities. And they
14 manage things so that what little discretionary research they have when they do
15 identify issues that merit continued examination, that they're going to the line
16 organizations and getting user needs requested for those.
17 One of the consequences of the program being very focused on the line
18 organization needs is that we did not identify any research activities that we felt
19 had met the regulatory needs and could be brought to an orderly close.
20 We, in fact, found all the research activities to be important and indeed
21 research is well subscribed by the line organizations.
22 In the course of doing this research we were certainly aware that there's a

1 flowering of interest in nuclear -- not only in this country, but throughout the
2 world -- and because of that flowering of interest there are research activities
3 being undertaken by other organizations.
4 And so, we made a fairly substantial effort to reach out to them and get their
5 opinions on what kinds of research the NRC should be doing.
6 We sought information from the International Atomic Energy Agency and
7 NEA, India, IRSN in France was kind enough to send two representatives to
8 discuss what they saw as the longer-term research needs in the nuclear, EPRI,
9 NEI and the industry in general provided representatives to talk about research.
10 What we found was the research program is generally well aligned with
11 those sorts of interests. That we see the emphasis within the U.S. nuclear
12 industry and their research activities making greater use of risk information,
13 certainly support, development and application of Digital I&C technologies,
14 improved understanding of the materials degradation within a plant and the use of
15 fuel to higher burn up.
16 We found that the research program was well positioned to address any
17 proposals that might come from that industrially supplied research.
18 Certainly, on the horizon some advanced reactor concepts that go beyond
19 conventional light-water reactors. The Department of Energy is certainly looking at
20 gas cooled reactors and liquid metal cooled reactors aggressively and fairly large
21 programs.
22 NRC in contrast has a very small program in both of those areas and we

1 found that appropriate; that they're far enough away that the activities that
2 maintained an awareness and an anticipation of these things looked to be to us
3 appropriate at this time.
4 One of the things that we highlight in the research program is the role of
5 international collaboration. There's a lot of research going on on reactor safety
6 around the world. A lot of good research.
7 I'm pleased to note that we have in the audience some representatives of
8 collaborators in the area of international reactor safety research.
9 The NRC is taking good advantage of this in many cases and we certainly
10 highlighted the substantial activities of collaborative research being taken in the
11 severe accident research program, fire research, seismic research and human
12 reliability research.
13 Fire research we're particularly happy with. Fire is one of those areas that
14 our risk analysis has shown us that it is a risk dominant contributor.
15 The technical capabilities to analyze fire risk are not commensurate with
16 other areas and so it merits research and we think that program is going quite well
17 in improving our understanding.
18 Seismic research, too, looks like one of the dominant sources of risk from
19 modern advanced plants and we called attention to what we called the energized
20 seismic research that the agency has under way.
21 We also called attention to some very substantial accomplishments under
22 way within human reliability research.

1 The flowering of interest in nuclear energy production. The Chairman
2 mentioned it in his opening comments. I think we're all aware of it. I think you're
3 aware of the evolving demographics of your staff and the growth of your staff.
4 These are going to pose challenges in the long term to the agency. They
5 may be posing challenges right now, but certainly in the long term.
6 A more subtle challenge that's coming about arises because licensees will
7 continue to try to utilize margin that exists between the current operating regimes
8 of the reactors and regulatory limits.
9 They quite frankly have done the easy stuff. And to make use of more and
10 more of that margin they will become much more technically sophisticated. So,
11 you have a staff that is going to be less experienced.
12 It's going to have a heavier workload and it's going to require more
13 technical sophistication to handle that work.
14 That, to us, suggested that there were some real challenges that the
15 research program is going to have to confront. It's not an issue of what topics the
16 staff was going to have to deal with, but rather how they dealt with it.
17 And certainly one of our recommendations was to take some of the
18 research resources that you have and look to how you can better -- how the staff
19 can better do its work in the future making greater use of computational
20 capabilities and information sciences that are coming available today.
21 That's a thumbnail sketch of our research report. We addressed each of
22 the activities, but in general I can give you a fairly positive review of the research

1 program.

2 They are well subscribed and seem to be functioning aggressively in

3 meeting the needs of the line organizations.

4 DR. SHACK: Next topic will be our activities associated with Digital

5 I&C and George will review our work in that area.

6 DR. APOSTOLAKIS: Before I start going over the slides, I'd like to

7 make an observation that there is an underlying theme here that you will see as

8 we move on. And that is that the committee believes that we do not as a

9 community understand the failure modes of digital systems and that it is premature

10 to work on probabilities.

11 So, we are encouraging the staff throughout here in a number of letters to

12 focus its activities on identifying those failure modes, trying to understand the

13 failure modes and defer any activities on evaluation of probabilities.

14 Before any permanent guidance is given to the staff in the Standard Review

15 Plan, the staff has been issuing interim staff guidance documents and we

16 reviewed three of them -- the first slide, please -- last October.

17 One on diversity and defense-in-depth, which of course was of great

18 interest to everyone, one on communications and one on human factors.

19 Overall, we concluded that these ISGs would be useful to the staff in doing

20 their reviews. There was an issue that was related with diversity and defense-in-

21 depth. The ISG stated that there should be no credit for human -- manual operator

22 actions in the first 30 minutes of an incident after an incident.

1 If necessary, then there should be a backup system installed. The industry
2 opposed this and they said an evaluation should be done on a case by case basis
3 because in some instances perhaps it could be demonstrated that the manual
4 action would be reliable.
5 We noted that in another context in a fire analysis our own staff had in fact
6 given a process as to how one would credit manual actions regardless of the
7 timing.
8 So, we recommended that the staff in the longer term should revisit this
9 issue and develop an alternative process with a 30 minute criterion to determine
10 the conditions under which operator manual actions could be credited.
11 Another ISG on the review -- the next slide please -- of new reactor Digital
12 I&C PRAs came to us last April and there was a lot of discussion on probabilities
13 there and sensitivity analysis based on past activities; take the probabilities that
14 were submitted in this context and then start doing sensitivity analysis.
15 We felt that this was inappropriate, that it would not lead to any meaningful
16 conclusions and we recommended that the ISG be revised to emphasize the
17 importance of the identification of failure modes and deemphasize all the
18 sensitivity studies. In fact, maybe eliminate them completely from the ISG
19 anything that involves probabilities.
20 There was a NUREG report that was reviewed in May: "Approaches for
21 Using Traditional PRA Methods for Digital Systems". The staff had two research
22 activities in the area of PRA and Digital I&C.

1 One had this title of using traditional PRA methods where these were
2 defined to be traditional fault tree events, recent Markov models. And another
3 activity that was named advanced methods that were basically simulation based
4 approaches.
5 We concluded after we -- well, we reviewed the advanced method some
6 time ago, but we've seen the results of this last effort last May where the
7 researchers found that they did have to resort to simulation in order to get some
8 results.
9 We concluded that this distinction between traditional methods and
10 advanced simulation methods is artificial. It is not meaningful. It should be
11 abandoned.
12 Also, coming back to the report itself, some of us were surprised to find out
13 that software failures were not included, that it was focused on hardware failures.
14 We felt that this should have been emphasized up front in the abstract and maybe
15 with capital letters somewhere else.
16 So, we made these recommendations for revision of the report. Then we
17 came to the conclusion which was stated in the same letter to you that there ought
18 to be an integrated program on Digital I&C and integrated in the sense that there
19 shouldn't be any distinctions between traditional and non-traditional methods.
20 The focus should be on the identification of failure modes and, of course,
21 this program should take advantage of everything that has been learned so far
22 from the other programs.

1 Again, the reliability or efforts to evaluate the reliability of Digital I&C
2 systems should be deferred until as a community we feel that we understand how
3 these things may fail.
4 I must say that our interactions with the staff have been very useful and
5 we're looking forward to continuing those interactions. And the staff has been very
6 responsive to our comments. Bill?
7 DR. SHACK: The next topic we want to discuss is the SOARCA
8 project. We wrote a report on that in February and our primary recommendation
9 about SOARCA was to perform level 3 PRAs for the pilot plants to benchmark the
10 staff's approach before extending the analysis to other plants.
11 Because that recommendation has turned out to be a rather contentious
12 one, I'd just like to expand again on our reasoning behind that recommendation.
13 SOARCA is intended to provide a more realistic and risk informed
14 assessment of the consequences of reactor accidents.
15 The SECY paper that the staff prepared outlining the SOARCA program
16 notes that the scenarios will be prioritized by risk significance; however, the
17 selection of scenarios is based not on the risk significance of the scenario, but
18 rather by a release frequency of ten to the minus six per year.
19 Implement the SOARCA approach the staff in fact used a CDF cut off
20 frequency of ten to the minus six, a somewhat more inclusive approach.
21 We believe that the use of a cut off frequency can potentially lead to an
22 inadequate characterization of risk in several ways. Although there's no serious

1 threat to public health from any accident that does involve core damage, the health
2 consequences of core damage accidents can vary by orders of magnitude
3 depending on the corresponding state of the containment.
4 The ten to the minus eight CDF events with open containments or
5 containment failure could have higher risk than ten to the minus six events
6 considered in SOARCA.
7 The SOARCA analysis also assume that when the appropriate support
8 systems are available for the ten to the minus six scenarios, mitigating systems,
9 actions and operator actions are always successful since additional failures would
10 put the scenario below the cutoff frequency, although the corresponding
11 consequences of the failure to mitigate could have very large consequences.
12 For internal events, SOARCA analysis seems to capture a large fraction of
13 the CDF, but the fraction of the risk captured is unknown. For external events,
14 even a fraction of the CDF captured is unknown.
15 The staff also recommends that SOARCA characterize consequences in
16 terms of the individual likelihood of early and latent cancer fatalities conditional to
17 a severe reactor accident of frequency ten to the minus six per year.
18 It's not clear to us how this would relate to what the public would perceive
19 as the real risk, the average individual likelihood of early and latent cancer
20 fatalities conditioned to the operation of a nuclear plant.
21 The staff may argue that they're not performing a risk analysis, but if their
22 results don't approximate or bound the risk they would not be really helpful in risk

1 communication with the public.

2 We continue to believe that the comparison of the results of SOARCA with
3 more comprehensive risk assessments are necessary to provide confidence that
4 the SOARCA approach captures a large enough fraction of the risk to make the
5 results truly representative of the frequency and consequences of nuclear reactor
6 accidents. Next slide.

7 Again, we had some other recommendations in that report. One of the
8 interesting insights from the SOARCA analysis is that even for operating plants the
9 risk may be dominated by external events, such as seismic events.

10 We all expected that to be true for the advanced plants where the internal
11 events frequencies have been driven very, very low, but that seems to be true at
12 least in terms of the pilot plants even for operating plants.

13 This is in many ways difficult to deal with since the results are very plant
14 specific for external events.

15 And because they are the dominant ones we really felt that the process for
16 selecting these sequences in SOARCA need to be made more comprehensive
17 and in particular with the seismic events they not only affect the plant or the
18 accident but the containment mitigation systems that could affect operator actions
19 and offsite emergency responses. We wanted to be sure that those were
20 evaluated realistically.

21 We had a third recommendation in terms of consequences. I think our
22 recommendation there is really encompassed by the staff option and

1 consequences that the Commission is now considering so that we don't have any
2 real disagreement with the staff there. There are a number of options.
3 We might have done it slightly differently and again, as a committee we
4 really haven't reviewed the SECY paper with the option that the staff has
5 recommended, but again, I think it's consistent with our overall intent behind our
6 recommendation and the consequences.
7 The staff did not agree with our recommendation that a limited set of level 3
8 PRAs be performed and so we've had a little exchange of letters.
9 The committee continues to believe that the credibility of the SOARCA
10 project can't really be seen to rely on the confidence and the judgment of the staff
11 in a novel analysis procedure that differs substantially from previously state of the
12 art analysis of consequences of severe reactor accidents.
13 We're continuing to have discussions with the staff on how we might get
14 insights, if not from new level 3 PRAs, from existing level 3 PRA work, like NUREG
15 1150 and whether those insights could address some of the issues that we think
16 need to be addressed.
17 And again, no conclusions there. That's really something that we're in a
18 matter of discussion with them. That completes what I wanted to say about
19 SOARCA.
20 Our next topic is ESBWR design certification and Mike will be leading us
21 through that.
22 DR. CORRADINI: Thank you, Bill. What I'd like to do is tell you a bit

1 about where we are with ESBWR. Could I have the first slide, please?

2 As many of you know, the ESBWR is a direct cycle power conversion

3 system similar to current BWRs. It's different in the sense that it has a natural

4 circulation in the reactor vessel, so that in difference to current plants there are no

5 recirculation pumps within it and you use essentially density differences between

6 what's in the core in the chimney and the down comer to drive a recirculation flow

7 and allow for core cooling given the feed water flow in.

8 It also is different in the sense that you have a passive emergency core

9 cooling system. On this system or under this plant, which is quite interesting, at

10 pressure you use an isolation condenser to remove decay heat which goes to a

11 condenser system, transports in, condenses and takes the condensate back into

12 the reactor.

13 You then can depressurize and then switch over to a Gravity Drain Cooling

14 System, GDCS, which then provides at low pressures any additional water that

15 you need to essentially keep the core covered and cooled under long periods of

16 time.

17 And finally, it has a passive containment system which essentially allows

18 you with the steam gas mixture to essentially take the materials, the gases and

19 gas mixture from the containment into another condenser, condense it again to

20 ultimate heat sink and then transport it back into the GDCS.

21 So, you essentially have a reflux of steam and gasses into the condenser,

22 water back into the GDCS and allows you for, by passive means, a continual path

1 for cooling the core under low pressure. So, it's a fairly unique design, very
2 intriguing design. Next slide, please.
3 In addition, it has different and innovative severe accident mitigation
4 systems. It has a core retention device in a lower drywell. It is coined BiMAC.
5 It's essentially a core retention device whereby if there is a core melt
6 accident and you have continued progressions such that you have a failure of the
7 vessel and release into the cavity or into this lower pedestal region, the lower dry
8 well, it essentially accumulates the material and then has sacrificial material where
9 it's going to be held by a passive drywell flooding system, such that in this case
10 what you have is the GDCS then diverts the flow from the core region to the lower
11 drywell and then allows water to come in after the deposition and allows for a
12 recirculation path such that it flows below the core melt material in this retention
13 device, travels up and then recirculates. Again, driven just by natural circulation
14 and buoyancy.
15 So, it's a unique design. It's designed in such a manner that there is no
16 need for emergency AC power for the first 72 hours and operator action per se for
17 transients or accidents. So, it's a passive system from the get-go. Next slide,
18 please.
19 In terms of our design certification review, the process by which we are
20 doing this is reviewing the SER with open items for the ESBWR on a chapter by
21 chapter basis. This was requested by the staff.
22 It was felt this would aid effective resolution of ACRS issues such that if we

1 had questions we could have subcommittee meetings. We could get to an
2 extensive discussion with staff and the applicant; try to understand better as these
3 open items are being identified. RAIs are being put out, answers are being given,
4 such that we can get some of these things resolved early on.
5 To date, we've completed an interim review of 15 SER chapters during
6 three full committee meetings and six subcommittee meetings. I think we have
7 seven to go.
8 We've issued three interim letters: in November 20th of '07, March and May
9 of '08. And in your tab you have all those letters, I think, that you've probably
10 already looked at, but details and discussions are provided there. Next slide,
11 please.
12 So, just to give you kind of what I'll call a very brief rendition. It's not
13 inclusive. It just tries to give you a few issues in which we've talked with the staff
14 and with the applicant that we want to make sure we pay attention to and be
15 aware of as the open items are being closed.
16 I should mention that all of these things have been identified by staff as
17 open items. The staff has been very cooperative with us, as has the applicant,
18 trying to explain to us so we get a clear picture of what the design is, what are the
19 challenges to essentially make sure we satisfy our concerns.
20 One example is further examination of system interactions. In this plant
21 because you have passive systems and naturally in current plants active systems
22 are what essentially allow you to take it to a safe, coolable state under all sets of

1 conditions; one of the concerns that we want to make sure we understand is the
2 interaction between active and passive system safety so that you don't get in a
3 situation where you may be using an active system and somehow by transitioning
4 over you defeat something and you get yourself in a situation you didn't expect.
5 A second example is addressing containment response to design basis
6 accidents. Right now, the way in which design basis accidents are being modeled
7 as have been historically they're quite conservative. We want to understand
8 where the conservatisms are.
9 We want to understand where the margin is and there could be possible
10 places where the performance would be challenged. We want to understand
11 where they are and make sure they're not buried within conservatisms.
12 We want to confirm performance of passive safety systems. Many times,
13 our questions and our questioning of the staff and applicant has been trying to
14 understand how steam and gases interact as you use a buoyancy driven or a
15 gravity driven system and how it has to perform under various situations.
16 One in particular we wanted to bring to your attention is the vacuum breaker
17 system. This is a different design concept. It's gone through extensive
18 experimental performance verification. We want to just make sure that we can
19 assure proper operation of it because it is a new design concept.
20 And then finally as another example, confirm coupled neutronic and thermal
21 hydraulic stability. In all BWRs when you bring them up to power you have to go
22 through a start-up procedure by which you very carefully and under certain

1 conditions essentially raise power or change flow.

2 Because you're driven by natural circulation here, this creates a different

3 situation and we want to understand how you come up to power and how you

4 change power to make sure thermal hydraulic stability with neutronic feedback is

5 maintained.

6 An example I gave here is core chimney interactions where you might have

7 interactions between the core and the chimney as we're coming up and have

8 various flow oscillations. Next slide, please.

9 So, in terms of future plans we want to perform the interim review of the

10 remaining chapters. As I said, we have seven to go. We're kind of in the middle

11 of it.

12 Just this week on Tuesday we had a subcommittee meeting where we

13 looked at the PRA, not for the first time, but I'll say for the current time of the

14 version that we've seen and had extensive discussions with staff and the applicant

15 about that.

16 We want to review the staff's resolution of the open items as I mentioned

17 and try to make sure that all of our issues are covered and discussed and

18 resolved.

19 And then review the final SER and issue a final report to support the

20 agency's schedule. That's kind of where we are. Bill?

21 DR. SHACK: The last topic we want to cover is in fact our major

22 activity in licensing actions for operating reactors, which is extended power

1 uprates and Mario will be discussing our efforts there.

2 DR. BONACA: Good afternoon. Next. First of all, I'll give you a

3 review status report. We completed the review of EPU applications for

4 Susquehanna Units 1 and 2 and Hope Creek and we're planning to review the

5 EPU application for Browns Ferry Units 1, 2, and 3 later in the year, as well as

6 Millstone Unit 3. It's a 7% power operate, but it's the first significant power operate

7 for a PWR. We're interested in learning about that uprate. Next.

8 The EPU technical issues we are dealing with right now are all dealing, of

9 course, with BWRs. That's the plans we have reviewed. They fall typically in

10 three categories: steam dryer integrity, containment overpressure credit, and

11 validation of analytical methods. Next.

12 On steam drier integrity. Steam dryer integrity remains a challenging issue

13 because the impact of acoustic loads on the dryer depends on the plant specific

14 dryer design and the steam line configuration. Therefore, all the resolutions are

15 very much plant specific.

16 Among the resolution that we have seen for the dryer integrity is steam

17 dryer replacement and typically that also brings about instrumentation of the dryer

18 to monitor performance power; use of new and evolving analytical methods to

19 predict the loads on the dryer, that's an alternative path which we have seen;

20 installation of branch lines to dampen vibrations; and finally, no cases we notice

21 reliance on very deliberate planning power ascension by the licensees, with hold

22 points and so on. Next.

1 To date, only Quad Cities Unit 2 and Susquehanna Unit 1 steam dryers
2 have been instrumented. Of course, they had new steam dryers so they could do
3 that.
4 Other licensees typically measure steam line strain data and depend on
5 analytical acoustic circuit model to infer steam dryer pressure loads.
6 We want to note that steam dryer modeling and prediction have been
7 significantly improved. Next.
8 To date, the acoustic circuit model was benchmarked; however, only
9 against Quad City Unit 2 measured pressure. Additional data from Susquehanna
10 may not be publicly available and yet it will be valuable if further validation of the
11 model could take place with the data.
12 Because, I mean, the validation against Quad City Unit 2 is limited in a way
13 for the model addressing such a complex set of conditions. We, however,
14 accepted the EPU -- the Hope Creek EPU application steam dryer evaluation in
15 part because of the predicted large margin to the stress limit over a factor of two.
16 That's a pretty unique circumstance.
17 In general, however, we are encouraged by the modeling that is taking
18 place and the ability to predict. There is progress there. Next.
19 The next issue that we're dealing with is containment overpressure credit.
20 At the higher power level, the suppression pool heats up more than the original
21 power level and therefore the NPSH available is reduced.
22 For some plants this action is not sufficient to allow them to have enough

1 NPSH, therefore, they require credit for backpressure.

2 Typically, we have seen situations also where in order to have enough

3 NPSH the operator is directed to terminate drywell cooling, which really is a

4 counter intuitive step. So, that somewhat concerns us. Next page.

5 Historically, the ACRS has not supported granting of NPSH backpressure

6 credit. But, we have moved somewhat in our position to Vermont Yankee, for

7 example, where we agreed that overpressure credit may be granted in small

8 amounts and only for short direction when the risk is low.

9 Now, we understand this is a very qualitative criterion, but it's a way for us

10 to establish a limit to how much could be given.

11 In part, it's because here we have a margin to cavitation that we don't want

12 to see and we would like to have some demarcation where it says that's really how

13 far we can go. I understand it's difficult to do, but we have done it qualitatively.

14 The staff position is that no limit in amount of credit granted and duration is

15 needed, provided that the credit is supported by a conservative calculation. We

16 recognize that they have expectation for that.

17 I put here an example from the upcoming review of Browns Ferry to provide

18 you an illustration of the concern that we have.

19 Browns Ferry, all units, will require significant backpressure credit for

20 short-term LOCA. In fact, for short-term LOCA the pumps will cavitate even with

21 complete credit for back pressure.

22 They need credit for long-term LOCA and also for the special events in

1 areas such as Appendix R. The limiting event from a perspective of amount of
2 credit and duration is the Appendix R scenario where only one RHR pump is being
3 used to bleed and feed it.
4 For this event, containment backpressure credit of 9.3 psig -- up to 9.3 psig
5 is needed for 69 hours, almost three days.
6 It doesn't really meet that requirement or expectation. In addition to this
7 general characteristic of the transient, the drywell cooling is terminated to
8 maximize available backpressure.
9 Even with this termination, the margin between available and required
10 backpressure is as low as 1.6 psi.
11 The SER essentially accepted this. We feel uncomfortable with this margin.
12 It doesn't give us the comfort that there will be in fact no cavitation because not
13 everything is known. There are unknowns out there and the 1.6 psi doesn't seem
14 to us like much of a margin.
15 So, this is the situation we have. Now, we have in a letter of February 16 --
16 next page -- 2007 which was the Unit 1 report on 5% power uprate, which was
17 supported by the calculations of 120% power. We stated that for the 120% power
18 credit we would need more complete evaluations. The next page describes what
19 that expectation will be.
20 Viable solutions minimizing the need for overpressure credit will include,
21 first of all, for the Appendix R scenario I would like to say that an alternative to our
22 analysis or to an analysis that exist and that's to protect the second train of RHR.

1 I mention it because other licensees previously have done that to avoid the
2 same situation that we're seeing here at Browns Ferry.
3 If an analytical approach is being used we appreciate to see a best estimate
4 calculation to see how much of the credit really is due to the excess -- in LOCA.
5 That's an important consideration.
6 But if in our best estimate calculation is presented then it should be
7 appropriate treatment of uncertainty and biases because, of course, without that
8 we don't have an appreciation of margin.
9 And finally, for the fire scenario we were presented a limited fire analysis
10 that would be appreciated by us because it would give us context, which is the risk
11 so low that we don't have to worry about it?
12 But the analysis that was presented did not include those initiators and
13 furthermore I understand the model does not treat actuation of the equipment due
14 to fire. And so, we asked for a more rigorous treatment of the analysis. So, there
15 may be some solution there.
16 I would like to complete this part of the presentation by pointing out that
17 however we resolve the issue for Browns Ferry, the fact that we have a difference
18 in criteria with the staff will create this problem again and again. So, we're working
19 with the staff to try to communicate, but I think we have different views. Next.
20 Finally, I would like to point out that this is the validation of analytical
21 methods for the Susquehanna EPU. The Susquehanna EPU and the applicability
22 of core response analysis methods at EPU conditions were reviewed concurrently.

1 So, we did not have a special effort separately to deal with the generic
2 attempt to validate AREVA methods at the EPU conditions.
3 We expressed some concern regarding some treatment of uncertainties
4 and biases in the methods. The staff took exception to ACRS recommendation
5 and accepted limited sensitivity analysis. In part, considerations defined were
6 based on application specific considerations.
7 We believe -- next page -- reduced margin to thermal limits for EPU
8 operation warrants a re-evaluation of the fidelity of the analytical methods, codes
9 and support the validation data.
10 Again, here I don't believe that the staff agrees with us that in general you
11 have to do that. Its just to the extent to which you have to do it and most of all
12 avoid plant specific considerations; otherwise we will find ourselves in the same
13 situation when we review the next plant.
14 And, in fact, the next plant is going to be Unit 2 and 3 of Brown's Ferry,
15 which also have AREVA fuel. This completes my presentation.
16 DR. SHACK: That completes our presentations for this meeting.
17 CHAIRMAN KLEIN: Thank you very much for a good overview and
18 we'll begin our questioning with Commissioner Lyons.
19 COMMISSIONER LYONS: Thank you very much. I really continue
20 to highly value the dedication of this committee in providing independent, technical
21 and policy advice to the Commission and staff. We've certainly got plenty of
22 challenges that are currently facing the agency and you're in the middle of

1 evaluating many of them. So, I truly do appreciate the contributions.

2 I'd also note that I think you're conducting your 552nd meeting; at least

3 that's what I was told you're up to in terms of numbers tracing back to 1959, which

4 is a most impressive record. Impressive record of service to the agency and to the

5 nation. So, my thanks.

6 You've talked about a number of different areas that are of great personal

7 interest to me and I'm really torn about where to go first on questions, but I think

8 that I'll start with SOARCA.

9 Bill, I very much appreciated your comments and I think I understand your

10 point that going with the level 3 analysis would provide still higher degrees of

11 confidence in the results as they're presented.

12 But at least as I understand the situation and I'd be interested in your

13 perspective, if we were to go with a level 3 -- an existing level 3 PRA it would be

14 using pretty dated information.

15 It would be using old demographics, old emergency planning and would not

16 be informed by perhaps even the decades of work in understanding severe

17 accidents.

18 If we go with a new PRA -- a new level 3 PRA, again, my understanding is it

19 doesn't exist, but I'd be curious in your assessment. And while it would be

20 possible to demand that it be done before any results from SOARCA are

21 communicated, I'm guessing that that's a delay of multiple years in moving ahead

22 with SOARCA.

1 I guess part of my question, then, is whether ACRS is -- number one,
2 whether my assessment of the status of level 3 PRAs is consistent with your
3 understanding.
4 And if it is consistent, then is that really what ACRS is suggesting; that
5 SOARCA be delayed by whatever time it takes to do the level 3?
6 I can't help thinking that it would be more appropriate to proceed to release
7 information from SOARCA now, begin to get assessments on that, let the public
8 start to interact and at the same time perhaps try to look towards creation of a
9 level 3 PRA.
10 But frankly, too, that requires substantial cooperation from one or more
11 licensees which may not be forthcoming.
12 I'm almost afraid that we're setting up a situation here with the ACRS
13 recommendations that may make it very hard to ever move beyond the 82 citing
14 studies and that bothers me because the whole rationale for SOARCA in my mind
15 was to have those 82 citing studies -- instead of using those 82 citing studies to
16 allow our planning and the public's understanding be informed by better -- by more
17 recent information.
18 That's a long speech, but how would you respond?
19 DR. SHACK: You're asking some questions, of course, that we have
20 no committee position on. Anything I say at this point is a personal opinion.
21 I hate to see the Sandia citing studies brought up as the basis for
22 comparison. I think our realistic assessment of the consequences of nuclear

1 reactors is 1150 as far as the NRC goes or the earlier -- some of the commercial
2 level 3 PRAs.
3 The Sandia citing studies were never meant to be a realistic assessment.
4 They were performed for a specific reason. They put the same source term at
5 every location to look at the impact of citing parameters.
6 If somebody's going to misuse that as a consequence analysis, I'm not sure
7 that there's a whole lot you can do about that. But to say -- those were not state of
8 the art reactor consequence analysis even in 1982. They were done for really a
9 different reason.
10 So, I would go back to the NUREG 1150 as our last state of the art realistic
11 assessment of reactor consequences.
12 I can appreciate that SOARCA has other uses other than understanding --
13 aiding the public's understanding of risk. For that reason you might want to
14 proceed with the SOARCA analysis on a basis.
15 I do think that if your goal is to communicate risk to the public that you won't
16 be able to do that effectively until you can benchmark the SOARCA analysis with
17 the level 3.
18 Now, whether you do that prior to proceeding with analysis, again, one of
19 my concerns about proceeding is that if you learn things from that comparison you
20 will have already invested in your SOARCA analysis and you won't be able to take
21 advantage of that understanding.
22 Does it take a new level 3 PRA? I think that's something -- that's part of the

1 discussions that are still ongoing with the staff. If we look at those level 3 PRAs
2 and we understand the results that we have from those level 3 PRAs; if we
3 understand how that understanding that was done in those level 3 PRAs might
4 change as we consider the new knowledge we've gained since those days and we
5 understand that impact, we still may be able to use those results as a benchmark
6 and to demonstrate that in fact we are capturing a large part of the risk if we sort of
7 consider perhaps I would call it instead of a new level 3 perhaps a modernized
8 1150 assessment. Whether that's possible or not, I really don't know.
9 It seems to me that's an approach that might be a little different than a new
10 level 3. And whether that would be successful or not, I don't know. That's sort of
11 an ongoing discussion, I think, that we have with the staff as to whether something
12 like that is possible and feasible.
13 COMMISSIONER LYONS: Well, I do appreciate your comments.
14 DR. SHACK: George, do you want to add anything?
15 DR. APOSTOLAKIS: No. Commissioner, please.
16 COMMISSIONER LYONS: No, go ahead. I'm very curious. I
17 personally have been concerned that the 82 citing studies are frequently
18 referenced. Now, I have to admit you're probably right, Bill, that if people want to
19 reference them, they're still going to reference them.
20 I was hoping that there would be considerable advantage to having more
21 modern results that could be used to better inform the public. George, did you
22 want to --?

1 DR. APOSTOLAKIS: Again, these are personal comments. We, as
2 an agency, have issued two really level 3 studies; WASH-1400, the first one and
3 then NUREG 1150. WASH-1400 was 1974/75; 1150, 1989 or so. I don't see why
4 we don't do another level 3 PRA now. It's almost 20 years since NUREG 1150.
5 The methods have improved.
6 Our understanding has improved and I know that the industry has done
7 several level 3 PRAs, not recently, but they have done them. I believe Millstone 3
8 has a level 3 PRA. Seabrook has a level 3 PRA and others. I believe Indian
9 Point, Zion, going back to the early '80s.
10 I'm not sure that the argument that it's too expensive to do one or we will
11 not have cooperation from the utilities is a good one. Why did we have
12 cooperation when we did 1150? We have cooperation in other areas. I'm not
13 even sure we tried.
14 Now, if we decide not to do a level 3 PRA it seems to me that anytime
15 anyone proposes a new way of doing business that group has a burden on
16 themselves to prove or to provide evidence of this new way is reasonable; it is
17 based on things that we have been doing in the past or maybe change them a little
18 bit.
19 In this case we are asked to believe this, really to believe it, that based on
20 the judgment of the staff this is a good approach. All we're saying is give us more.
21 Do something. Can you go back to an 1150 or another level 3 PRA and apply
22 your approach and see what you leave out?

1 Maybe you find that you cover 99% of the risk. That's great! I'd like to see
2 that. But we have not been able to do this. The argument is always you shouldn't
3 even mention level 3 PRA. That doesn't promote understanding that some
4 evidence of what SOARCA gives us is meaningful.
5 COMMISSIONER LYONS: I do appreciate your comments and I
6 hope you're right that we can find ways to either update or obtain new level 3. My
7 concern is whether we should come to a screeching halt while we do that.
8 I'm not arguing -- personally, I'm not arguing against the cost of a level 3.
9 I'm more concerned with the time and whether the program stops while this is
10 done. That's more of a concern to me because I think it may take quite a while to
11 get to the point that you're suggesting.
12 But I guess I should wait and see what your discussions are with staff.
13 Okay, that's one subject, sir.
14 CHAIRMAN KLEIN: We can probably have a hearing just on
15 SOARCA. Commissioner Svinicki?
16 COMMISSIONER SVINICKI: Thank you. I want to add my thanks to
17 all the committee members for the work you do. As someone who is just
18 beginning to acquaint myself with even the body of work that was conducted over
19 the past year which was provided to us in advance of this meeting is very
20 impressive and I compliment and it's also produced, I know, in a very timely
21 fashion. The Commission appreciates that very much.
22 I was going to turn to the topic of SOARCA, but since my colleague who is

1 much more learned on that has covered it. I was trying to understand as I look at
2 the communications back and forth and the letters and Brian Sheron had
3 responded, I think, to the ACRS letter.
4 I was trying to understand -- just really fundamental. It sounds like there's
5 not a committee position on this matter, but whether the level 3 PRA is the next
6 step or is acknowledged as being eventually needed.
7 I think some of the dialogue here kind of informed my thinking on that a little
8 bit. Am I correct that there is not currently a committee position on that?
9 DR. SHACK: I think the committee position is to do the level 3 PRAs
10 before proceeding.
11 COMMISSIONER SVINICKI: Okay.
12 DR. SHACK: Again, there are pluses and minuses to that, but that is
13 the committee position.
14 COMMISSIONER SVINICKI: Okay, then, would a natural
15 consequence of that be as Commissioner Lyons has suggested that everything
16 else related to SOARCA would suspend until that was done?
17 DR. SHACK: You can do them simultaneously. As I say, I think
18 there's a certain risk that if you learn things in doing the level 3 that you may have
19 wanted to change how you did the SOARCA analysis approach. I realize it's a
20 question of timeliness versus the potential for a misapplication of resources.
21 COMMISSIONER SVINICKI: Okay. Thank you. On the review of
22 the NRC safety research program, I suspect I would direct this to Dr. Powers, but if

1 anyone else would like to respond.

2 In the area of advanced non-LWR research, if I understood the presentation
3 correctly, the conclusion was that there's an appropriate level of research being
4 conducted. I wrote a note that it's a small program, but that that's appropriate at
5 this point.

6 As the Commission deliberates and tries to resource FY '09 and FY '10
7 activities looking forward I think we're struggling with the level of potential industry
8 interest in other types of reactors and trying to resource appropriately not knowing
9 with clarity what will manifest and what will not in terms of a regulatory or any
10 applications.

11 Did you look at any kind of a range of scenarios there? What is your
12 conclusion predicated on? Is it just some healthy skepticism?

13 DR. POWERS: I think we're fairly familiar with what the plans are
14 with respect to liquid metal cooled burner reactors. The Department of Energy
15 might be coming forward, too. And there, I think you've got plenty of time.

16 Your biggest concern now is staff that has a familiarity with particularly the
17 physics of liquid metal reactors. They're getting a bit long in the tooth. And so,
18 you have a knowledge preservation issue to confront there.

19 But you have substantial expertise even yet on the staff because they have
20 been through things like the fast flux test facility that was built in Washington State
21 and the preliminaries for the Clinch River Breeder Reactor, though both of those
22 were loop reactors and not pool reactors.

1 The physics, the critical issue there which literally is a criticality issue and a
2 coupling between criticality and thermal hydraulics is one that they're familiar with.
3 The gas reactors pose a more troublesome scenario for us because there
4 are people who are very active in promoting the gas cooled reactors and
5 episodically make claims that eminently they will come forth with something akin to
6 a certification claim.
7 We looked at it and said what kinds of data bases would they have on
8 critical things like the fuel and how long does it take to develop what we would
9 think would be an acceptable database on fuel performance for these reactors.
10 We said they do not currently have a fuel that we find acceptable, and the
11 testing time that they would need to expend to produce a certification application
12 that we would find palatable is long compared to your planning horizons of '09 and
13 '10.
14 I don't think we attempted to say they need to start budgeting for '12 or '13.
15 We thought you had that kind of time.
16 We were quite impressed with the litany of issues that were revealed by the
17 staff when they looked at phenomenon identification and ranking for the gas
18 cooled reactors, both fuel as an individual item and just the reactor physics, the
19 thermal hydraulics and things like that. As a general issue, they certainly identified
20 quite a few issues.
21 In our looking at it, we did not identify a firm technical foundation for
22 producing a certification report. So, we thought maybe any prognostication that a

1 certification was eminent might be fairly optimistic at this point.

2 Again, we saw what the staff had done as far as the PERT panels they set

3 up and said, gee, they had familiarized themselves enough so that they could

4 critically review any pre-application report and certainly line those things out. They

5 were in a position to do that. That seemed appropriate.

6 They also seemed to have staff identified to pay attention to these things

7 and raise a flag if indeed we were overly pessimistic here. And they didn't accuse

8 us of a great deal of pessimism.

9 That was our thinking; not especially rigorous, but I think we were

10 comfortable with it. We said they're doing about the right thing. We just really

11 couldn't come back and make what I would say useful suggestions to improve

12 upon what they were doing right now.

13 COMMISSIONER SVINICKI: Thank you for that. That's helpful.

14 This was not necessarily a topic of discussion today, but with the indulgence of my

15 colleagues I am trying to better acquaint myself with NFPA 805 and fire related

16 issues.

17 DR POWERS: Good luck!

18 COMMISSIONER SVINICKI: It's not been easy. I wondered if

19 anyone could speak -- again, at an overview level -- because I haven't delved into

20 it too deeply. Cable fire testing results and modeling improvements and how they

21 might relate to progress on NFPA 805. I hope I've articulated that question.

22 And again, just to share some very high level thoughts on that. I don't know

1 to whom to address that.

2 DR. POWERS: I guess I can speak to some of those issues. As you

3 are aware, the safety requirement we would like to have plants preserve is a

4 capability to shut down and keep the plant cool in the event of a fire. The problem

5 one has is that fires affect cabling and can cause shorts.

6 Fires and cable systems are absolutely amazing because you'd like to think

7 of safety systems as being either available or not available. Fire can give you a

8 third option, which means they're available, but they perform badly.

9 You get intermittent activity actions; things come on when you don't want

10 them on; things go off that you don't want to be off; valves close and open.

11 There's been quite a lot of discussion on just how prevalent are these kinds

12 of things when you heat cables up in a fire. There have been assurances that this

13 is a rare thing. It doesn't happen very often in spite of the fact that we had the

14 Browns Ferry fire just at the birth of the agency in which there was a huge number

15 of what I would call spurious actuations and things like that.

16 Well, the activities that have been undertaken is to try and understand

17 better what is the likelihood of hot shorts, spurious actuations, that sort of thing,

18 and fires. And the experimental programs have been undertaken in support of a

19 much more quantitative and rigorous risk assessment that's going to be required

20 by NFPA 805.

21 These kinds of things still support the more deterministic analysis of

22 Appendix R. They're still useful for that, but quite frankly we're thinking in terms of

1 NFPA 805 sort of thing. And what kinds of things do they discover.

2 Well, indeed hot shorts occur, their more likely in thermoplastic types of

3 insulations then they are in thermal set types of insulations, different configurations

4 are important. They're developing a data base on this kind of thing. That's all very

5 useful.

6 We have other kinds of issues emerging in connection with fire. For

7 instance as we move to more and more digital electronics, suddenly the dispersion

8 of smoke within the facility becomes of great interest because what is smoke that

9 comes from cable fires? Well, it's very acidic material.

10 When it contacts low voltage electronic circuits it causes corrosion. So,

11 now you start facing situations where you could have a fire, put it out, everything is

12 very nice and six weeks later your plant shuts down on you. These are kinds of

13 things that are emerging and require more quantitative understanding of what fires

14 do to you.

15 And the staff has -- I really compliment them. They have really caught fire

16 on this sort of stuff and they're doing some excellent experimental work. It's a nice

17 synthesis program because they've gone out and found excellent experimenters

18 and at other laboratories excellent analysts and modelers.

19 As you're aware, NIST has some real capabilities in this area. Now they've

20 gone one step further. There's a superb experimental facility set up at Cadarache

21 in France and so now they're doing joint experiments with the French where the

22 instrumentation developed in the American programs are being applied to

1 experimentation in France. It's a really dynamic period of time.

2 We were privileged as a committee, I think, to be asked by the staff to do a

3 critical review of the quality of the CAROLFIRE experiments. I think you got our

4 report. We came back and said that this was a good professional job. We're quite

5 excited about it.

6 The staff themselves brought in their experimentalists and their analysts

7 and its one of those delightful programs where you find the experimentalists

8 learning from the analysts how to better do experiments and the analysts learning

9 from experimentalist how to do better modeling. Just an excellent program.

10 A lot of work to be done, but it's moving in the direction so that we have

11 better technical support for licensing plants in connection with NFPA 805 rather

12 than the old Appendix R.

13 COMMISSIONER SVINICKI: Thank you, Mr. Chairman.

14 CHAIRMAN KLEIN: We'll probably have another round because I

15 know that Commissioner Lyons and Commissioner Svinicki had some of the

16 questions I had SOARCA and long-term research. So, those are always good.

17 So, I'll start with another one with my fellow academic and talk about the ESBWR.

18 From my observation, I was a little surprised I guess at the lack of progress

19 that I had hoped we would make on the design certification for the ESBWR based

20 on the fact we had done a system 80, the ABWR, the AP600 and the AP1000.

21 So, when I came to the agency it seemed like there were a whole lot of

22 RAIs on the design certification for the ESBWR. Could you just comment as a

1 member of the ACRS kind of what you thought about the quality and content of
2 that application for the design certification for the ESBWR?
3 DR. CORRADINI: Before I do that, can I answer something different
4 first to kind of lead up to it? I guess as an academic we never really answer what
5 we're asked.
6 CHAIRMAN KLEIN: Sort of like politicians, right.
7 DR. CORRADINI: Pretty much. I guess my starting point on this
8 would be I think that in the ESBWR what we found -- and I'm going to speak for
9 myself, but I'll invite any of the other members to contradict me or to agree -- is
10 that the design although complete conceptually was somewhat incomplete in
11 detail.
12 And that's what I think caused the staff -- now I'm speaking from my
13 impression of where the staff came with the RAIs -- to have a lot of RAIs; a lot.
14 There's a number out there, but it's large and I think that drove the applicant to
15 define the design and crystallize the design more than they had upon the first
16 submission of the design control document that we originally got. So, I think that's
17 kind of the genesis of it.
18 Now, your question was more on quality. I guess I don't really want to say
19 "quality". I'll just say it was not as complete as others. I would also say that I
20 guess a little bit historically you go back to the '90s and again I was not a member
21 nor a consultant, so I observed from the outside.
22 I don't think -- I'll use the word "pressure" -- the pressure wasn't on relative

1 to the speed at which you wanted to look at it -- I think AP600, for example, was
2 relatively undefined with the RSAP program became more defined through that.
3 So, I think it's really a combination of where we are relative to plant orders
4 and expectations and the level of initial detail we got back in '05 when the design
5 control document came in.
6 I'm going to kind of stop there and see if the members have different views,
7 but I think that's kind of the reason we proceeded -- we are proceeding at the pace
8 we are.
9 DR. ABDEL-KHALIK: The biggest problem from my perspective is
10 that the design is still evolving and therefore you bring up issues. The issues are
11 addressed. They're brought back. There are other issues that are identified that
12 have to be addressed and therefore perhaps the process that is being followed in
13 reviewing the application chapter by chapter has added to the code inefficiency by
14 which this review is being done.
15 But really the measure contributor to what I would call that length of time
16 and efficiency of the process is the fact that the design is evolving. And there
17 have been some significant issues identified by the ACRS that the applicant had to
18 go back and see how the design can be modified to address those issues.
19 And those issues are quite critical when you talk about a gravity driven
20 system where the available driving forces are relatively small and therefore any
21 small perturbation can potentially impact the effectiveness of those safety
22 systems.

1 As a result, the applicant had to go back and make sure that those issues
2 are addressed.
3 CHAIRMAN KLEIN: Do you feel fairly confident in having
4 experimental data to back up the calculations for the gravity systems that they
5 have?
6 DR. CORRADINI: Again, I'm going to speak for myself on this. I
7 think I do, but I think that we have asked the applicant and the staff to do more
8 calculations, audit calculations by the staff and calculations by the applicant to
9 make sure that we understand how specific separate effect tests and specific
10 integral test fit in and how the calculations can link them to what we'd expect to
11 see in the full plant design.
12 I guess the only other thing I wanted to make mention of was that I think
13 that the applicant -- I should say -- let me phrase it this way historically. So, to
14 prepare myself for this, I went back and read AP600 ACRS letters and AP1000
15 ACRS letters. And what struck me first of all was the time line. It was a very long
16 time line.
17 So, it's back to a combination of specificity of the design and the time over
18 which it evolved and this is compressed now. We got it in '05 I think -- December
19 of '05 and we're here now two and a half years later and it's in some sense is a
20 credit to the applicant. They've gotten this far this quickly.
21 And simultaneously since it's an evolutionary -- what I'll call a Gen III Plus
22 design in terms of passive safety -- there are issues as Said has mentioned where

1 you have to look carefully because you want to make sure that since it's a passive
2 safety system that small driving heads really do give you what you need and we're
3 absolutely sure so that we don't come back later and get surprised by something.
4 So, I think that's kind of -- we're a bit naturally conservative in this regard
5 and I think that's where you see it from our standpoint. But I think it's the scope in
6 terms of what we got to begin with.
7 CHAIRMAN KLEIN: Thanks. Mario, you talked a little bit about
8 cladding failures and high burn ups and things of that nature. Have you all looked
9 at cladding failures in general? I know there's a big push by the industry to
10 minimize failures.
11 Have you looked at those that are sort of like manufacturing, operational
12 and other characteristics on what approach we should have as a regulatory body?
13 DR. BONACA: You brought up --
14 DR. SHACK: I would say that we are interested in that and we have
15 a subcommittee planned for September. In fact, we'll bring in all the fuel vendors.
16 It will be closed so we can have a fairly open discussion where we will come up to
17 date on many of those issues.
18 The NRC's focus, of course, is not on operational issues, but on safety
19 related issues. And so, I know that Argonne has just submitted a new NUREG last
20 week that sort of summarized much of the research that you might need for an
21 updating of 50.46(b).
22 So, the Commission is making progress on the regulatory side where you're

1 concerned about that accident behavior, but we are trying to stay up-to-date on
2 operational issues and sort of state-of-the-art on fuel designs.
3 DR. POWERS: I would call your attention to the fact that we have a
4 fuel now that's being driven to relatively high burn ups compared to the past. That
5 does challenge the cladding.
6 The staff has completed a relatively good research program on the effects
7 of reactivity and LOCA on that and has established a revised criteria on how you
8 handle oxidation and the extent of oxidation during the design basis accidents.
9 That said, we know that there are new clads coming along. We see the
10 evolution to M5 cladding which is a niobium zirconium alloy which seems to be
11 very good, but on the other hand seems to be very subtle to -- subtle changes in
12 alloy composition or texture or fabrication techniques and things like that that we're
13 going to have to understand better.
14 We know that there are new generations of clad being tested now that will
15 come forth and it's very likely we'll see substantial evolutions because with license
16 renewal one can amortize the cost of these over at least 20 years and in some
17 cases maybe an additional 40 years.
18 We know that the industry is very interested in moving now, not to 75
19 gigawatt days. Their target is to move to 85 gigawatt days per ton of heavy metal,
20 which is right now our regulatory limit is 62. So, that's a 30% increase in burn up
21 twice or three times the kind of burn ups that I was brought up with. So, they're
22 aggressively moving the fuel.

1 This is a good thing. This is a very good thing. This is a good thing
2 economically. This is a good thing societally. We want to facilitate that.
3 You need, however, to understand that there's a change in physics possible
4 as you go to these high burn ups. We've been caught once thinking that we can
5 extrapolate our codes from 16 gigawatt days up to 45 gigawatt days didn't work
6 too well because of a change in physics. We have to be careful about moving on
7 to these things.
8 You speak to ordinary cladding failures during operations and yes, the
9 industry has done a huge job in reducing that down. I mean, what is it now? The
10 average reactor operates with one cladding failure in a whole core; some
11 thousands of fuel rods has one failure.
12 And in recent months, years we've seen sort of a creeping back up of that.
13 I think my own interpretation is that is rendering fuel into a commodity product
14 where cost is the driving for the sales whereas they used to be high technology
15 tailored products of each reactor, now it's a commodity product.
16 So, you're going to see some backing off on the reliability of fuel. But it's
17 not very serious. It's still a very miniscule rate of operational failures in these
18 fuels.
19 I don't know if that answers your question. I will caution you that you have
20 a demographic problem among your experts in fuel within the agency and it does
21 need to be addressed. Your experts in fuel -- you know, we all get a little older, a
22 little slower and eventually your excitement about running a reactivity insertion test

1 on new fuel kind of wanes. You need these young bucks coming in to take over.

2 CHAIRMAN KLEIN: Some of our employees are having burn up,

3 too. Thanks. Commissioner Jaczko?

4 COMMISSIONER JACZKO: Thanks. Maybe just make a couple

5 comments on SOARCA to start. Perhaps I'm in a slightly different position

6 because I guess I can simply say I agree pretty much with where ACRS is. I know

7 I've been advocating for some time ever since we began this project that -- in

8 particular on the issue of having a cut off at 10 to the minus six that that may not

9 necessarily capture all the scenarios we need from a risk perspective.

10 I think as I've heard the staff and to the staff's credit I think the staff has

11 looked at what they believe are the scenarios beyond ten to the minus six that do

12 contribute from a risk standpoint, but I think in my mind -- perhaps I think George

13 said it best that I want to be convinced that that's the case. Right now I'm not

14 convinced and if we have the ability to calculate below that then we should do that

15 and confirm that that is the case that in fact we haven't missed anything. I think

16 that aspect is, I think, easily resolved.

17 Certainly on a level 3 PRA I think it makes sense to do it. I think it's

18 important to keep in mind that there may not necessarily -- there's no -- this is not

19 a regulatory study we're doing. This is a technical study that we're using to gather

20 better information. So, I think we should take the time to do it right and make sure

21 that we do that so we're not using this in support of any particular regulatory action

22 right now.

1 In regard to the level 3, I think that is the right way to go, or at a minimum
2 the approach that has been suggested here that again to explore whether or not
3 the approach that's being used right now is sufficient and have a good
4 understanding of where it's sufficient and where it's not. That seems to be
5 something at a minimum that would be useful.
6 I would note, I think, that the Commission has not yet, I believe, made
7 public any of the SECY papers yet on SOARCA and I continue to believe that that
8 would be important.
9 We discuss this in public repeatedly and yet the Commission decisions
10 about initially moving forward in this direction have never been released, I think,
11 publicly. And I think that's something that would be beneficial to do. So, I won't
12 say more than that on that issue.
13 George, perhaps I could ask a question of you. You mentioned on Digital
14 I&C the issue -- and it's something that I recall, I think, from another ACRS
15 meeting a discussion we had and I think you made the comment that these often
16 in the Digital I&C systems the failures are software design failures and we don't
17 model those in PRA.
18 I have repeated that mantra in several occasions and several places lots of
19 times. What I find interesting is that that doesn't seem to be getting traction
20 anywhere with the actual users and the designers. I guess I would say more the
21 users of these systems.
22 I repeatedly hear statements from licensees and others saying we're going

1 to do studies, we're going to run these systems for a certain number of time and
2 we're going to determine probability failures from those runs. I hear what you say
3 that that may not necessarily be the right approach.
4 I guess my question is perhaps how do we get that message out there and
5 get everybody on the same page about really what the right way is to approach
6 dealing with these kinds of failures in Digital I&C systems. That may be a broader
7 question.
8 DR. APOSTOLAKIS: We should force them to read the ACRS letter.
9 COMMISSIONER JACZKO: I guess we should force them to read
10 Commission votes. I would note that I think EPRI has papers along these lines as
11 well. In the technical community, there seems to be a clear understanding of this
12 issue. There still seems to be, I think, a disconnect.
13 Again, I think it goes back to the issue that the committee has pointed out
14 which is we want to have some way to try and analyze these devices and so we
15 fall back on the methodologies that we know which is to use PRA to get risk
16 insights. That may not be the appropriate tool in this case.
17 DR. APOSTOLAKIS: Well, first of all, there is large literature out
18 there with papers doing this, doing that, failure rates and all that. I think maybe
19 one useful result of this is that some people have gotten tenure at the universities.
20 There is an effort -- in standard PRA and reliability analysis we do not
21 model design errors. The fact that something may have been wrong with a design
22 -- if its a component that we can test then it's fine because we can see.

1 But for example, if it's something that will come to save us if there is a very
2 rare event that has occurred, it's very hard to model that. But people have taken
3 models that have been developed for standard reliability and risk methods and
4 they force them upon the software.
5 There are also studies that have looked at past experience with software
6 and I believe the numbers vary, but 30%, 40%, 50% of the observed failures are
7 due to specification errors and requirement errors which in our language in
8 hardware we would call design errors. We don't model those.
9 And then the other thing is and I think Dana mentioned it in the context of
10 cables; the concern is not that a particular piece of software will work or not work.
11 The concern is what if it does crazy things? We don't know. We have seen some
12 of these in the past, but we don't quite understand these failure moods.
13 Now, people find it easy perhaps to say based on expert opinion, you know,
14 trying to discredit really the whole idea of expert opinion elicitation, we will assign a
15 number of 10 to the minus three and then start playing games with it. Well, no.
16 That's not the right way to do it.
17 Our own staff when they came before the ACRS a number of years ago
18 when it was the first time we were dealing with this issue, they told us that they
19 had visited Boeing and other aerospace companies that had been using, of
20 course, digital systems for a long time. They were told that the literature on
21 software reliability is useless. These are the words they used.
22 So, real practitioners know that these reliability numbers don't mean

1 anything. And what we've been trying to do is impress upon the staff that this is a
2 situation and that sensitivity analysis are meaningless if you start with numbers
3 that have no basis.
4 We really have to understand what the failure and potential failure modes
5 are and then start thinking about possible quantification.
6 So, now, what should we do as regulators? Well, the traditional way. Try to
7 have defense-in-depth, diversity and all that stuff, which is expensive as
8 experience has shown, but based on the present state of the art I don't think we
9 are ready to risk inform anything that involves these things.
10 COMMISSIONER JACZKO: I appreciate that and it does seem that
11 there is a way forward and that is with the defense-in-depth. I think that is
12 important to keep in mind that most of what I see from vendors, from licensees,
13 from potential applicants is a desire to want to minimize the use of defense-in-
14 depth and to do that through the use of PRA.
15 Again, there is a solution path and that is to have defense-in-depth so that
16 we have some guarantee of a way to manage the uncertainties from a safety
17 standpoint. I appreciate that.
18 I wanted to turn to a different subject if I could, Bill. I think you talked about
19 this in your initial discussion or maybe Mario touched on it. It was the comment
20 that right now that there are numbers of exceptions to the Generic Aging Lessons
21 Learned in the license renewal context. I actually wasn't aware that there were.
22 Maybe you could talk a little bit -- if any of you could speak a little bit to what

1 the nature of those are. I think you touched on it a little bit what the nature is, but
2 what the nature of those exceptions are.
3 As I understand the GALL its really there to provide kind of best practices
4 so that when we do these license renewal reviews we can do them in a more
5 systematic and straightforward way because people will be using those aging
6 programs that we have reviewed and determined to be acceptable.
7 DR. SHACK: A giant Reg Guide for license renewal.
8 COMMISSIONER JACZKO: Yeah. A cheat sheet to some extent. I
9 don't know if you can comment a little bit on what the nature of some of those are?
10 DR. SHACK: I brought it up, but Mario is the license renewal expert.
11 DR. BONACA: Well, there different categories. Some of them have
12 to do with ASME standards being chosen. It's understandable that if a site, an
13 older plant for example, has already negotiated with the NRC a certain ASME
14 standard and that's acceptable, they would invoke that.
15 It seems to me that there is more -- the burden is on GALL to try to
16 accommodate or maybe represent some examples so that there are less
17 exceptions.
18 Other exceptions that we see are tied to, for example, monitoring intervals.
19 GALL can be prescriptive. It says you shall do the following inspection every 12
20 months. So, some licensees say, "Well, we do it every 18 months and its good
21 enough because operational experience shows that." So, the staff accepts it.
22 Again, there it seems to me that the flexibility had to be built into GALL to

1 represent the experience. I think that by now there is sufficient information from
2 previous license renewals that it could be expanded.
3 My guess is that you could reduce significantly the number of RAIs and
4 paperwork that comes because so much of the SER has to do with resolutions or
5 debates and resolution of the issue of this nature. They're time-consuming and
6 they're not necessary there.
7 I understand the update of GALL is a significant undertaking. I don't think
8 it's a safety issue of any kind. I think it's an efficiency issue.
9 COMMISSIONER JACZKO: I appreciate that. I think it's important
10 to clarify that. From the budget and management standpoint those things can be
11 important. I do think to the extent that we can minimize the need for those
12 exceptions it will improve the regulatory -- our ability to review these in a timely
13 and transparent way. I certainly have a couple more questions.
14 CHAIRMAN KLEIN: Commissioner Lyons?
15 COMMISSIONER LYONS: Well, Dana, I very much appreciated the
16 thoroughness, the thoughtfulness that went into the review of the research
17 programs. And I also recognize and I think concur with your view, or the view
18 expressed in the report that much of our current research program is coupled to
19 immediate needs of industry -- immediate needs of the organization in order to
20 evaluate industries approaches.
21 You made a number of points in your presentation and also in the
22 document about the need for perhaps increased attention to the future of

1 experimental facilities, the need to develop state-of-the-art independent analysis
2 tools.
3 You talked about the role that research programs can play in attracting staff
4 and you talked about the importance of international collaboration.
5 As I read through your report there seems to be a number of areas of fairly
6 long term or long horizon research that the ACRS was suggesting needed to be
7 carefully considered by the agency.
8 I think the staff's response and I think you may have even commented in
9 your remarks that this will require some very careful budget prioritization as we
10 look into the future.
11 I don't know if you want to respond to this or not, but I can't help wondering
12 how much of this optimization can be accomplished through budget prioritization
13 and whether we are in a, perhaps, overly constrained resource situation as we
14 look towards long-term research needs of the agency?
15 DR. POWERS: We studiously avoid going into the resource issue
16 because we see it as your purview and it's a difficult issue and we don't like to
17 work very hard.
18 But if I'm going to look at it and say if I were in your position and was
19 looking forward, I would say yes, your research program is minimally funded right
20 now, especially if you're looking at the kinds of workload that you're looking at right
21 now and the kind of changes that I see licensees are going to be making.
22 They very much want to get the most out of each one of those plants that

1 they possibly can. You've given them the financial incentive to do so because
2 they can now amortize the cost of going to a higher level technology over many
3 more years.
4 You've simply got to be in a position not to get out gunned by the resources
5 that they can bring to bear on these things and you're very much running into that
6 problem.
7 Now, you are blessed as I have said many times by an exceptional staff
8 here. They are thinking about these issues, but they do have a resource
9 constraint. At the very minimum you've simply got to think about what's the next
10 generation of thermal hydraulics codes you have. What are the next generation of
11 neutronics codes?
12 Right now, as we point out in the report for neutronics and what not you've
13 got a fine set of codes. They do everything you need to do today, but at a
14 substantial cost of time.
15 For instance just setting up the cross sections for an ESBWR calculation it
16 takes about 17 hours of computer time to set up cross-sections because the codes
17 were written for a high degree of core symmetry.
18 Now we see lots of half section rods and things like that being used. The
19 codes just don't -- they struggle to do non-symmetric cores. You've got to think
20 about those sorts of things and invest in that if you're going to confront an industry
21 that wants to get as much as they can out of these units and can afford to do so.
22 So, yeah, if I were in your position I would worry about the resource

1 constraint and I would worry about also how do I get these tools into the hands of
2 the line organization.
3 Right now, you do a good job on matrixing work; that is, if I have a problem
4 in the line that involves corrosion there are guys I can tap in the corrosion group.
5 I can go subscribe to them and they get subscribed for relatively routine things
6 because they have the expertise.
7 They have the calculational tools and they've done it historically. They do it
8 very reliably. They know how to do things on time to meet the criteria, but that's a
9 very slow way to go about doing things especially as those guys get more heavily
10 subscribed.
11 So, now you need to think about how much of this stuff can I move over into
12 the operational line and it's at their fingertips? Routine kinds of calculations.
13 Why can't people do the thermal hydraulics codes and the code analysis
14 and the line that are now doing in Research just as a matter of routine? Just call it
15 up. You don't have to be an expert in thermal hydraulics to do that.
16 That's the kind of long-term research we were suggesting that you think
17 about to make it much more facile. If you go to engineering organizations,
18 consulting engineering organizations, especially in California, you'll find an
19 average operational engineer has at his desk access to a 64 processor
20 computational unit.
21 He has available to him an array of wonderful codes for doing routine heat
22 transfer analysis, fluid flow, piping analysis, that sort of thing. He's not an expert,

1 but he can use them routinely and doesn't have to go to a matrixing operation.

2 He only goes to matrixing when he has to go beyond established

3 technology. Those are the kinds of things you need to think about and that's

4 where you need to think about devoting a portion of your research program to

5 getting those kinds of capabilities for you.

6 We mentioned cabling analysis and what not like that; hot shorts. For the

7 life of me I do not understand why hot short analysis isn't a computer code now.

8 The way you do it is following a computer code in your brain. Why can't we do

9 that routinely? Why is it so difficult?

10 People complained do you do one at a time or two at a time failures. Why

11 not at any at a time? Let the machine do it. Those kinds of things need to be

12 thought about especially if your -- your staff is going to end up being overworked

13 because I do not believe that you will be allowed to grow your staff at the rate that

14 I see the nuclear industry wanting to grow.

15 You've got to think about investing in those sorts of things. And your

16 current research budget is allowing you to meet the current needs. That's your

17 problem.

18 COMMISSIONER LYONS: I appreciate those comments. I'm over

19 time, so I won't turn to George on Digital I&C.

20 CHAIRMAN KLEIN: Commissioner Svinicki?

21 COMMISSIONER SVINICKI: That's playing on my sympathies. I

22 want to yield you some time, but I'm not going to.

1 I wanted to turn briefly to a subject of power uprates and this is again a very
2 high level question. I think of it from what I've come to understand as a very
3 mature process here and we talk a lot about COLs and other things and we don't
4 spend a lot of time thinking about power uprates.
5 But when we look at what's happening with fossil fuel costs it would seem
6 to me that the business case very separate and aside from the safety case, the
7 business case is becoming more and more compelling, I would think, for industry
8 to want to look at ringing as many megawatts as they can.
9 Just collectively from your experiences where do you think we are in terms
10 of should we be prepared to have a real up tick in interest in more power uprate
11 applications do you think?
12 And then I'm thinking of this again. I'm back to my resourcing for the
13 coming years, both ACRS and the agency staff to be prepared for that. Do you
14 have any thoughts on that?
15 DR. BONACA: I think the BWRs are on track to power uprates. I
16 think that -- I don't know how many of them would make the final decisions to go
17 there, but I would expect it to be common experience in the sense that it's
18 becoming more of a routine process.
19 Even from a safety standpoint I believe that there are good controls,
20 although for example, fuel is being run at a higher temperature somewhat, but I
21 think they have -- the issues are the controls safety wise.
22 I think for the PWR is more of a question of how much can you really get in

power more than you get right now. For example, we see Millstone 3 coming up for a 7% power uprate. I would expect that that's as much as they can pull out of the plant.

So, the question becomes what is the balance between the cost and the extra power you get. Boiler seems to be capable of 20% power uprate and that's a substantial amount of update.

I dare say, however, that the investment for the uprate is significant and that's why when we bring up the issue of backpressure, for example, maybe there could be some more investments also in taking care of some of those systems that are not being used, but really if you have to use them you want to make sure they work. So, that's just a comment.

But in general, I think we will see probably most of the BWRs coming our way for power uprates.

DR. POWERS: The PWR power uprates -- PWRs are limited two ways: steam generators and peak clad temperature. If you're limited with your steam generator, replace the steam generator. Many of them are having to do it anyway. Put a bigger one in.

Those that are peak clad temperature are going to move to best estimate codes. They're going to try to refine the analysis down so they can get the temperature increase that they will need to sustain there and that's a more technically sophisticated analysis.

In order to review it, you're going to have to have similar technically

1 sophisticated analyses. The best estimate kinds of techniques require detailed
2 analyses, systematic analyses of the uncertainties.
3 You're going to have to have capabilities to review those kinds of detailed
4 uncertainty analyses. Much more technically sophisticated analysis then a classic
5 Appendix K analysis.
6 That's what's going to happen to you because now the cost that the plant
7 owner has to endure to go to a best estimate calculation for an Appendix K change
8 to his license. He can amortize it over 20 years. Then it becomes very attractive.
9 To get to go beyond 7% to go to 20% power uprate it suddenly becomes
10 very interesting. It's the cheapest power around. About $185 an installed kilowatt
11 versus $1,500 for a new plant -- minimum of $1,500 for a new plant.
12 DR. BONACA: There are some issues, of course, that we also have
13 to look at like core exit temperatures and the effect it may have on materials.
14 There will be issues we will have to review and that's why we are looking at
15 Millstone 3 application. It will teach us something.
16 DR. ABDEL-KHALIK: I think conceptually the applicants more than
17 anybody else know the economic case for power uprates. What we have to be
18 concerned about -- you know, conceptually you look at it and it doesn't matter
19 which way you look at it, you increase the power, you reduce margin. And what
20 we need to make sure is that even though power might be increased the health
21 and safety of the public is still assured.
22 COMMISSIONER SVINICKI: Thank you.

1 DR. SHACK: Just another note. We did write a letter -- part of this is
2 the efficiency of doing these reviews depends on the quality of the report. And
3 what we found, of course, is that uprates that depend on a topical report where
4 everybody has agreed to the methods before hand, they have been reviewed
5 generically, are really much more efficient than uprates where we're essentially
6 analyzing the methods as well as the application itself.
7 Now, again, that's sort of the applicant's choice. The only way to leverage I
8 think the NRC might have, is perhaps a priority system. If you come in with a
9 system that's based on topical reports and had a little bit more. That makes a
10 great deal of the effectiveness in the efficiency of the review.
11 DR. BONACA: That was part of the last bullet in my presentation
12 was to do with that because we'll review them and we'll review the applicability of
13 the methods of the EPU level in a complete fashion independent of any application
14 so that the issues were dealt with in a complete fashion genetically.
15 For the EPU at Susquehanna that was not possible because it was
16 combined with the review of the AREVA methods. And so you have issues of
17 plant specificity that come in that may bring a resolution to the specific question
18 you have on the table at that point, but they're not providing a generic resolution of
19 the issue for future applications.
20 DR. ABDEL-KHALIK: I might bring another issue. We have to be
21 careful not to be schedule driven in these applications. Some of these cases need
22 to be looked at very carefully without sort of a preset schedule that drives the staff

1 into perhaps a less than appropriately detailed evaluation.

2 COMMISSIONER SVINICKI: Thank you.

3 CHAIRMAN KLEIN: As a follow up to Kristine's question, it seems

4 that on the power uprates we've done on the boiling water reactors, the steam

5 dryers have been a challenge.

6 Could you just comment on where you think our understanding of the steam

7 dryers are technically? Do we really have a good handle on that now?

8 DR. BONACA: Well, as I said, we are learning and the method that

9 is being developed in dryer behavior from readings in the steam lines seems to be

10 effective. Still, we have limited information regarding the effect. Maybe I can turn

11 to Said. You probably can provide a better answer to that.

12 DR. ABDEL-KHALIK: When people replace steam dryers they can

13 adequately instrument them and therefore we know where we're heading as you

14 increase power. But if you can't instrument the steam dryer, people instrument the

15 steam line and rely on very complicated models to infer from the measurements

16 they make on the steam lines what the loadings are going to be on the steam

17 dryers themselves.

18 Once you know the loadings you can do the stress analysis and make sure

19 that your peak stresses are below the ASME limits.

20 The question is how good is that coupling model where you're measuring

21 something which is the steam line strains and inferring something else which is the

22 loading on the steam dryers.

1 Now, that model is fairly complicated. It has not been adequately validated.
2 It has only been validated by a limited set of data from Quad Cities Unit 2.
3 There will be some data coming from Susquehanna because that new dryer
4 has been instrumented and hopefully that data will be used to further validate the
5 data. What gave us confidence in approving the Hope Creek application was the
6 safety factors that had been predicted are fairly large.
7 So, granted there is uncertainty in the model simply because it has received
8 limited validation, but we feel that with the large safety margin that has been
9 predicted, coupled with the relatively deliberate power ascension process,
10 whereby if anything that is not predicted is observed then people would stop and
11 analyze the situation before they go to the full power uprate.
12 But at this time, I would sort of caution against the use of the acoustic
13 coupling model in its current state unless we have fairly large safety margins to
14 overcome the fact that we don't have much validation for that model, for those
15 models.
16 DR. BONACA: For upcoming EPU I understand it would be a factor
17 much less than the factor of two that we have for Hope Creek.
18 CHAIRMAN KLEIN: Thanks. I'll ask Commissioner Lyons' question
19 to George, then. Obviously Digital I&C is near and dear to all of us since that's
20 where we're going; the fact that analog systems are a little difficult to purchase
21 these days.
22 You talked a lot about in your talk on page 77 that we should focus on the

1 failure mode identification. How are we doing? Are we they're yet?

2 DR. APOSTOLAKIS: No, no. The staff is -- I think the work is in

3 progress, but I haven't seen any evidence that we're getting close.

4 CHAIRMAN KLEIN: What do we need to do to get there?

5 DR. APOSTOLAKIS: We are an advisory committee, Mr. Chairman.

6 We don't solve problems.

7 [LAUGHTER]

8 CHAIRMAN KLEIN: You just advise.

9 COMMISSIONER JACZKO: One could argue that you create

10 problems.

11 DR. APOSTOLAKIS: I would start by reviewing carefully the

12 experience that our industry and other industries have had. Looking at the failure

13 modes, creating a classification or categorization of these, at the same time look at

14 what kinds of Digital I&C we are using.

15 For example, actuation systems I would say are simpler than just feedback

16 and control systems. Then draw some conclusions because every time I talk to

17 people outside our industry they're telling me, yes there's this categorization and

18 you have a corrupt input and you don't know what you're going to get out and all

19 this. I don't see any of that in our reports.

20 So, maybe I would start by creating a group of people and asking them

21 specifically to come back with failure modes and don't you dare talk about

22 reliability. Failure modes. And they're going to do it.

1 We asked for a categorization of systems that are being used in nuclear
2 plants; Digital I&C. We asked for a systematic study of failure modes. I don't think
3 we're there yet.
4 And I'm not sure -- personal opinion now -- that this kind of activity is getting
5 the priority it deserves. Personal opinion.
6 CHAIRMAN KLEIN: Thanks. Commissioner Jaczko?
7 COMMISSIONER JACZKO: I just want to make a brief comment.
8 Commissioner Svinicki had asked a good question about the relations between
9 NFPA 805 and the multiple spurious actuation studies. I think Dana talked a little
10 bit about that.
11 I think that something you mentioned on the second round and hit on an
12 important point and I think that in the end these issues like multiple spurious
13 actuations are going to require computer modeling to solve and I think the reality is
14 that what we're seeing is it’s issues like multiple spurious actuation that should
15 drive us to NFPA 805 because the Appendix R methodologies may be challenged
16 when it comes to solving these complex problems; I think ultimately that is going to
17 move us in that direction.
18 I think it should and I think it's what we get out of something like 805. A
19 brief question I had and I think again, Bill, this is something that you had touched
20 on, but not gone into extensive detail on. And that has to do with the resolution of
21 GSI-191 and where we stand right now with, I think you commented that the
22 chemical affects testing continues to be a challenging issue.

1 I know my information on GSI-191 is probably about three or four months
2 out of date at this point, but at the last briefing I had on this my understanding was
3 that we're getting some surprising information on the integrated affects testing
4 that's being done.
5 In some cases it's validating what was anticipated. In some cases it's not.
6 I'm wondering if maybe you can comment on where the committee -- or anyone on
7 the committee -- where you see that issue right now and are there still technical
8 areas of lack of understanding or are we really at the point of just having to make
9 regulatory decisions right now.
10 DR. SHACK: Specifically on chemical effects?
11 COMMISSIONER JACZKO: Well, I guess on resolving the whole
12 issue. You touched on down stream effects as well, but I think chemical effects, I
13 think, has been the one I have seen certainly that the staff has been a little bit
14 more focus on and more concerned with right now.
15 DR. SHACK: I think -- we haven't been briefed on chemical effects
16 and I have a conflict of interest, of course.
17 COMMISSIONER JACZKO: That's true. I should probably have
18 asked that to someone else.
19 DR. SHACK: I do chemical effects testing, so I think punt on that
20 one unless someone else would like to address it.
21 (microphone not on) DR. BANERJEE: What's happening right now
22 is that the utility [audio lost] -- takes care of a lot of these problems because what

1 happens is the chemical effects increase the pressure losses [audio lost] -- of
2 course, when you put much larger screens stuff goes through and you can think of
3 the reactor core as being another screen down stream of this very large [audio
4 lost] -- and can potentially pick up whatever goes through [audio lost] -- the
5 emphasis has sort of changed a little bit now on what happens in the core when
6 you put these very large screens in [audio lost] – that's the downstream effect.
7 That hasn't really got results.
8 COMMISSIONER JACZKO: I guess I wouldn't even say at this point
9 that we have resolved the chemical effects.
10 DR. BANERJEE: (Podium microphone not on) We haven't resolved
11 the chemical effects, but there's a lot of proof testing going on. The proof tests
12 indicate that [audio lost] -- you are getting maybe acceptable behavior –[audio lost]
13 -- updated actually tomorrow and so we've been periodically updated, but we
14 haven't written a letter because it was a little premature.
15 We are planning to write a letter in September – [audio lost] -- as a
16 perspective, I think that utilities are adopting multiple means of dealing with [audio
17 lost] -- and other insulations perhaps something – [audio lost] -- changing the
18 ways. So, each plant is different and each plant has a unique solution for this.
19 COMMISSIONER JACZKO: I appreciate that and I certainly look
20 forward to the letter.
21 DR. SHACK: Let me just add one -- since it's not necessarily a
22 conflict of interest. I would just note that you have to be careful that you're

1 prototypical test is prototypical.

2 Since it isn't prototypical, there are questions that always have to be raised

3 about these tests and I think we're beginning. There's a reasonably good

4 understanding, but there are always surprises and you're still working your way

5 towards an answer.

6 COMMISSIONER JACZKO: I appreciate that and like I said I

7 certainly look forward to the letter. This is an issue that I think we are behind in

8 our schedules to get resolved. We do need to move behind -- or get behind this

9 and it's an important issue.

10 If I could, I just have one more question. This is more of a general

11 question. Again, anyone who would like to comment, I'd be interested to hear your

12 thoughts.

13 We talk a lot about life beyond 60 -- yeah, I guess life beyond 60 and in the

14 context of additional license extensions. I'm wondering just in a general way if any

15 of you have views on how we should tackle and approach these issues or how we

16 should tackle and approach this concept.

17 We certainly have no operating experience at this point with plants beyond

18 40 years of operation and then to start thinking about beyond 60 it's not clear to

19 me that we know exactly what the issues are or will be or more importantly how to

20 figure out what the issues are going to be.

21 I don't know if anybody has any comments that they'd want to make on that.

22 It's a slightly general question.

1 DR. POWERS: I'm not at all -- personally, I am not at all concerned
2 that the committee has not taken a position on life beyond 60, but quite frankly it
3 has gone so swimmingly for going the first 20 that we have such a good
4 framework for doing that, I'm sure there are new things to be thought about,
5 additional things to be thought about, intensity things to be thought about, but I
6 don't see it as a seed change.
7 My personal feeling is one of optimism on life beyond 60 for the boiling
8 water reactors. For the PWRs you have the vessel embrittlement problem, but I
9 see people thinking very, very seriously now that if you can change out a steam
10 generator you can change out a vessel. It's the same size hole in the containment
11 you have to make.
12 So, my personal feeling is one -- it's not an issue that I spend a lot of time
13 saying, "Boy, we're going to have to really think carefully about this." I think the
14 staff is in very good shape. And I know that they've begun to think about life
15 beyond 60.
16 I know the industry is beginning to think about that. I think they have an
17 excellent framework to think about it in. It's just not -- I'm not tossing and turning
18 at night over that one.
19 DR. BONACA: I think, too, it's not a safety issue in my judgment.
20 It's going to be an economic issue. I believe that beyond 60 you'll see a measure
21 of component replacements as Dana pointed out for the vessel. There is other
22 components that will be in the balance and that's where the challenge is going to

1 be. It's going to be an economic decision whether or not it's a viable alternative.

2 DR. SHACK: It's not at all clear, of course, that there aren't new

3 aging mechanisms out there that will come into -- if we look at PTS our current

4 understanding would indicate that many reactors can easily go to 60. Look at

5 embrittlement things, but whether you've identified every mechanism of

6 embrittlement for extrapolating data new mechanisms can occur.

7 COMMISSIONER JACZKO: For the PWRs, if you replace your

8 vessel then I guess that solves some of those issues.

9 DR. SHACK: Right. But whether you have enough surveillance

10 material to know what's happening to your vessel -- you may be able to replace

11 the vessel, but it's not a decision you're going to make lightly.

12 By and large I agree with my colleagues that we have aging management

13 programs and there's no real reason that those are necessarily limited to 20 years.

14 COMMISSIONER JACZKO: Anybody else? Thanks.

15 CHAIRMAN KLEIN: Well, thank you very much. Obviously you can tell by

16 our questions we could have extended this time for questioning quite beyond our

17 normal time. And even though as George articulated that you don't solve

18 problems, you just advise, on behalf of the Commission let me thank you for your

19 advice. The meeting is adjourned.

20 (Whereupon, the meeting was adjourned.)