UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Title: MEETING WITH ADVISORY COMMITTEE ON NUCLEAR WASTE (ACNW) - PUBLIC MEETING

Location: Rockville, Maryland

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2 NUCLEAR REGULATORY COMMISSION

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4 MEETING WITH ADVISORY COMMITTEE

5 ON NUCLEAR WASTE (ACNW)

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7 PUBLIC MEETING

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10 U.S. Nuclear Regulatory Commission

11 One White Flint North

12 Rockville, Maryland

13

14 Wednesday, June 26, 1996

15

16 The Commission met in open session, pursuant to

17 notice, at 2:30 p.m., Shirley A. Jackson, Chairman,

18 presiding.

19

20 COMMISSIONERS PRESENT:

21 SHIRLEY A. JACKSON, Chairman of the Commission

22 KENNETH C. ROGERS, Member of the Commission

23 GRETA J. DICUS, Member of the Commission

24

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1 STAFF SEATED AT THE COMMISSION TABLE:

2 JOHN C. HOYLE, Secretary of the Commission

3 GRETA J. DICUS, General Counsel

4

5 BRIEFINGS BY:

6 PAUL W. POMEROY, Chairman, ACNW

7 WILLIAM J. HINZE, ACNW

8 B. JOHN GARRICK, ACNW

9 MARTIN J. STEINDLER, ACNW

10 JOHN T. LARKINS, Executive Director, ACRS/ACNW

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

2 [2:30 p.m.]

3 CHAIRMAN JACKSON: Good afternoon, ladies and
4 gentlemen. As you know, the Commission meets periodically
5 with its Advisory Committee on Nuclear Waste to discuss
6 technical issues related to the management and disposal of
7 radioactive waste. The Commission recognizes that the
8 proper management of radioactive waste is vital for
9 protection of public health and safety and relies upon
10 technical input and advice from the Advisory Committee on
11 Nuclear Waste to carry out our responsibilities in this
12 area.

13 During today's meeting, the Committee intends to
14 provide the Commission its views on the following topics,
15 and you can correct me if I am wrong: 1) health effects of
16 low levels of ionizing radiation; 2) time span for
17 compliance of the proposed high-level waste repository at
18 Yucca Mountain; 3) comments on high-level waste pre-
19 licensing program strategy and key technical issues; 4)
20 issues and NRC activities associated with the National
21 Research Council's report technical basis for Yucca Mountain
22 standards; 5) ACNW priority issues; and 6) expert judgment
23 and elicitation.

24 I understand that copies of the presentation are
25 available at the entrance to the meeting.

1 Do either of my fellow commissioners have any
2 comments at this time?
3 If not, before I turn the meeting over to you, Dr.
4 Pomeroy, my colleagues and I would like to acknowledge that
5 this meeting marks the final Commission meeting for Dr.
6 Martin Steindler.
7 Dr. Steindler was an original member of the
8 Advisory Committee on Nuclear Waste and has served as its
9 vice chairman and chairman. He was also a past member of
10 the Advisory Committee on Reactor Safeguards as well as the
11 Atomic Safety and Licensing Board panel.
12 Dr. Steindler, your service over the past 24 years
13 has greatly contributed to the advancement of nuclear safety
14 and to improvements in our regulatory process, and I just
15 wanted to say publicly at this meeting, in addition to the
16 letter that we transmitted to you, that the Commission
17 greatly appreciates the very many contributions you've made
18 over the years, and we wish you all the best in all of your
19 future endeavors. Thank you very much.
20 MR. STEINDLER: Thank you.
21 CHAIRMAN JACKSON: In fact, I would like us to --
22 [Applause.]
23 CHAIRMAN JACKSON: And he's speechless.
24 MR. GARRICK: Yes. That's a world record.
25 [Laughter.]

1 MR. STEINDLER: Perhaps a rare event. Let me
2 remain speechless. Thank you very much.
3 CHAIRMAN JACKSON: Thank you.
4 Dr. Pomeroy.
5 MR. POMEROY: Thank you very much, Chairman
6 Jackson, members of the Commission.
7 The first presentation this afternoon will be on
8 health effects of low levels of ionizing radiation. We have
9 considered this in the past month or so and Drs. Garrick and
10 Steindler will share the presentation of this activity.
11 This is a work in progress rather than something that you
12 have seen in the form of a letter.
13 MR. STEINDLER: Well, let me start out by saying
14 that the viewgraphs that you have in front of you are not
15 going to be quite followed in the order or, in fact, some of
16 the contents that you have. This is a work in progress, and
17 so we have taken the liberty to shift things around and have
18 kept ourselves off-balance somewhat.
19 Let me start out simply by saying that clearly the
20 Commission has emphasized appropriately risk-based and
21 scientifically sound regulations as a fundamental approach
22 to how the Commission does its business. We think that's
23 clearly the basis for requirements to continue to examine
24 what it is that the Commission does.
25 In our domain and the Advisory Committee on

1 Nuclear Waste domain, there are significant attempts arising
2 to reduce residual levels of radiation to which the public
3 would be exposed in its access to formerly contaminated
4 facilities and formerly contaminated sites. Those attempts
5 pose some questions on cost-benefit and specifically the
6 things that have been raised in a very serious and emphatic
7 fashion I would say in an increasingly loud tempo over the
8 last several years. The costs that are involved and the
9 potential benefits that are to be derived and the comparison
10 of those two very often doesn't match.
11 Furthermore, from our standpoint -- that is, from
12 the committee's standpoint -- the generation of enormous
13 quantities of waste with relatively little according benefit
14 poses some problems in both waste disposal as well as
15 transportation and not trivial issues of risk to the workers
16 involved.
17 Those general background circumstances, which
18 we've in a sense outlined on the first viewgraph, led us to
19 look at the effects of low levels of radiation because those
20 issues, as I'll carry out a little further, keep arising in
21 several areas.
22 First off, the regulated nuclear activities in
23 this country and elsewhere, especially in those countries
24 that have been at it for a while, are now reaching the stage
25 where clean-up is becoming more and more prevalent. That

1 was not true perhaps 20 years ago, but it's certainly
2 becoming true now.
3 Furthermore, as a number of federal agencies can
4 attest to and also, of course, the private industry, the
5 costs associated with these clean-up operations and the
6 accompanying waste disposal processes are extreme. They are
7 often very difficult to bear and they're even very difficult
8 to justify. And that issue alone has become very important
9 as a national resource allocation issue.
10 The Commission has become involved appropriately
11 in decommissioning and the regulations involved in
12 decommissioning and the SDMP program, and all of those
13 programs invariably face the bottom line of how clean is
14 clean enough and how far do we have to go.
15 Of late, and by late I mean late in my kind of
16 time frame, which is years rather than minutes, the new
17 information that has been generated and has been brought out
18 and is increasingly visible in both the scientific
19 literature as well as what I would call the trade press,
20 that new information has become fairly massive and is
21 beginning to show that there are some unusual results,
22 unusual in the sense that they challenge some of our pre-
23 conceived notions, particularly the linear non-threshold
24 model.
25 The linear non-threshold model is, of course, the

1 basis for essentially all of the regulations that the
2 Commission uses, and so we have now encountered what could
3 well become a challenge to the risk-based notion of
4 regulations.
5 We as the committee, I think, in the next
6 viewgraph, if I remember what order I asked Andy to put it
7 together, have made some comments that talk about negligible
8 residual risk, which is akin to and related to certainly the
9 whole question of, does the linear non-threshold model
10 apply?
11 So with that as a background, our committee,
12 actually part of a subcommittee with the ACRS, began to
13 focus in on waste issues and specifically we began to look
14 at the question of what are the health effects at very low
15 dose rates and very low dose levels, which is where, of
16 course, regulations normally operate. And the question we
17 were addressing is, what sort of regulation bases are there
18 and are they scientifically sound.
19 In order to get started on that program, we,
20 together with some ACRS people, in a joint subcommittee,
21 held a meeting to try and explore some of the information
22 that is not involved in the linear non-threshold theory or
23 model. The second viewgraph, I think, if Andy can pull it
24 out, will show you a litany of our activities and the kind
25 of things that we have been looking at from time to time on

1 this topic.

2 Well, following the -- I would say not quite a
3 working group meeting in the sense that it wasn't a full
4 day, but we had almost a half a day-plus on the subject, it
5 was our conclusion that this was a subject that the
6 Commission should be looking at and should be looking at
7 from the standpoint of collecting information so that the
8 bases for its actions are at least transparent.

9 So our original conclusions, which you had in your
10 viewgraphs, which gave you two options -- one is that we
11 would suggest that you go through a study on your own or,
12 two, we then learned that the NCRP was asked to look at that
13 program and look at that topic and come back to the
14 Commission with a study of what information is available.
15 That was our original conclusion.

16 Then we had a chat with Dr. John Glenn, who is the
17 supervisor from research of the NCRP interaction, and found
18 that the kind of things that were concerning us -- namely,
19 the need to be effectively complete in the analysis of the
20 data, the need to be sure that not only are people looking
21 at the information and the health effects of low levels of
22 radiation, but that they do so in the context of some
23 radiobiological theory and some understanding of the
24 biological mechanisms that could be involved -- those were,
25 in fact, being covered by the NCRP study in accordance with

1 their action plan, their task definition.

2 So in a sense, the things that we were interested

3 in recommending to the Commission are, in fact, now being

4 done.

5 Our conclusion, therefore, you know, has been

6 truncated from what you have in front of you. Our

7 conclusion comes in very simple terms. One, we believe this

8 is a very important and very timely subject, and it looks

9 like that the folks in research have agreed to that general

10 conclusion. We certainly strongly support the research

11 initiative in moving ahead with the program, with the NCRP.

12 We will make what efforts we can to monitor the progress of

13 that program, and it is not yet clear to us what kind of

14 progress reports the NCRP committee would turn out, but if

15 it turns out intermediary reports between now and their

16 final conclusions, we will probably look at them.

17 But equally important, once the report of that

18 commission -- committee is out, we will try and analyze that

19 and determine what implications those results have for the

20 activities of the Commission in relation to formulating

21 regulations.

22 It is work in progress. We believe it is quite

23 timely and we think it's certainly important in relation to

24 the rationale of regulations. That basically, I think, is

25 our situation at this point.

1 I might just add that there is on question that
2 this is a very controversial topic. The issues that we're
3 looking at do not intend to simply dive into a controversial
4 issue. That's not the purpose. The purpose is to see
5 whether we can clarify in terms useful to the Commission
6 what the data show and then analyze the impact on future
7 regulations.
8 CHAIRMAN JACKSON: Is the end point of what you're
9 trying to do summarized -- and I guess the viewgraphs are
10 not numbered.
11 MR. STEINDLER: Unfortunately, they're not
12 numbered.
13 CHAIRMAN JACKSON: It's the third from the back of
14 this particular group, the one that says the committee's
15 most recent general perspective --
16 MR. STEINDLER: Yes.
17 CHAIRMAN JACKSON: -- was noted. Is that a
18 particular end point that, you know, you're focusing your
19 attention to?
20 MR. STEINDLER: At this point, our concern -- the
21 answer is no. At this point, our concern is to make sure
22 that the data collection that the NCRP turns out and the
23 quality of the critique of the information they have
24 uncovered stands or could stand scrutiny in a fairly hard-
25 nosed fashion.

1 What then follows from that remains to be seen.
2 Part of what follows from that could well be in accord with
3 this viewgraph.
4 CHAIRMAN JACKSON: Okay. Is there going to be a
5 follow-on by Dr. Garrick?
6 MR. STEINDLER: I think --
7 MR. GARRICK: No, I don't have anything to add to
8 it. But Marty is correct in that there are two separate
9 issues here. There is the issue that could be described as
10 a negligible risk issue, and then there is the linear
11 threshold issue, and they don't necessarily need to be
12 addressed simultaneously.
13 CHAIRMAN JACKSON: Okay. Mr. Rogers?
14 COMMISSIONER ROGERS: No, I don't have any.
15 COMMISSIONER DICUS: You mentioned some cost
16 benefit and the savings that might be had. Of course, I
17 recognize also this is a work in progress. Is there any
18 feel for what kind of cost savings or benefits there are
19 down the road? A broad question.
20 MR. STEINDLER: No, it's in fact the key question.
21 In the course of our trying to put this thing together, one
22 of the things we've said to ourselves is it would be very
23 good if we had some estimate of what kind of cost-benefit
24 ratios we had. The answer to the question is no, we do not
25 at this point have those data available.

1 In thinking through what processes we might use to
2 try and extract some order of magnitude, which everybody
3 seems to be doing for some kind of hazardous material, and
4 it doesn't make any difference whether it's lead and paint
5 or arsenic and groundwater, we had some difficulty arriving
6 at a decent protocol.
7 My personal intuition is that you can probably do
8 this, but the data would be shaky, particularly since you
9 don't know what the end point is. And it's the end point
10 that we're trying to get at at this stage in the game.
11 Former Commissioner DePlanque addressed that issue
12 in the paper she wrote, largely from analytical standpoints.
13 And so there is -- a portion of that information has already
14 been looked at. One can make a stab at it, but it would be
15 a little iffy.
16 CHAIRMAN JACKSON: In your actual suggestions, you
17 had two pieces to it.
18 MR. STEINDLER: Yes.
19 CHAIRMAN JACKSON: You seem to be endorsing the
20 support, you know, and supporting the research initiatives
21 with the NCRP.
22 MR. STEINDLER: Right.
23 CHAIRMAN JACKSON: Does that cover both aspects of
24 your recommendation? I'm looking particularly where you
25 indicate that you thought that NRC would need to have

1 special attention in selected areas with the assignment of
2 relevant experts. I mean, would --
3 MR. STEINDLER: We initially thought we would find
4 that as a compelling suggestion until we had a look at the
5 make-up of the committee. Upton is heading that committee,
6 and our contention was that as long as he's heading the
7 committee, some of the concerns that we had would disappear.
8 We did not and could not on our own evaluate the
9 other members of the panel, and so that conclusion was based
10 on knowledge of the chair. And we thought at the moment
11 that was perfectly adequate, but the -- a portion of the
12 controversy of this topic arises because, essentially in
13 keeping with Thomas Kuhn's paradigm problems, the violation
14 of the non-threshold model, linear non-threshold model is
15 unpopular and was unpopular, and data that did not meet that
16 model often failed to show up in the literature, and it's
17 that problem that we tried to address, maybe not as
18 obliquely as it should have been, in some of our
19 conclusions. I think our general consensus is that, at this
20 point, the NCRP will take care of that problem.
21 MR. GARRICK: Yes. Our underlying interest in
22 this is to take steps towards establishing at least what our
23 knowledge base is on this subject and to calibrate its
24 quality, because we observed papers and studies that take
25 very strong positions and some of them have been peer

1 reviewed and rigorously confirmed by other authors. Others
2 have not. And this whole issue of the instability of the
3 information base is something that even without further
4 research, if we could do something about that, I think it
5 would be very helpful to us all.
6 We very seldom know where we should be starting
7 from, and that's what I think the NCRP type investigation
8 and some sort of distinctive and credible evaluation of the
9 work that's been done, I think that would be an important
10 first step, and that's sort of what's behind our
11 recommendation.
12 CHAIRMAN JACKSON: Okay. But at this point, you
13 don't feel that any additional expertise or resources are
14 necessary.
15 MR. STEINDLER: Our understanding is that the
16 committee is not fully constituted at this point, the NCRP
17 committee or group is not fully constituted. It remains to
18 be seen who else they put on the committee.
19 But let me just make a comment, that our concern
20 on the quality of the information is on both sides of the
21 coin.
22 MR. GARRICK: Yes. Yes.
23 MR. STEINDLER: There are problems with folks
24 whose results do not support the linear non-threshold
25 theory, and there are problems with data on the other side

1 as well.

2 COMMISSIONER DICUS: You referenced the new

3 information or new studies coming to light or studies that

4 may not have been used in the past. Can you give us just

5 quickly an idea of what some of those studies are.

6 MR. STEINDLER: Well, the one most often cited in

7 the halls of this agency, the shipyard workers study of 700-

8 some-odd thousand people, and there is a mammogram x-ray

9 exposure Canadian study which has been subject to a

10 significant amount of controversy.

11 Myron Polycove probably would be able to give you

12 a more complete list, and we can certainly --

13 MR. GARRICK: The shipyard study is an example of

14 what appears to be, when it's described, a very

15 comprehensive and controlled study on the one hand. On the

16 other hand, it really wasn't published except in pieces and

17 parts. And so that's the type of problem we're having as we

18 hear about this whole subject.

19 CHAIRMAN JACKSON: The NCRP study is focusing on

20 the linear no-threshold model and the quality of that

21 knowledge base?

22 MR. STEINDLER: Yes.

23 CHAIRMAN JACKSON: And its validation?

24 MR. GARRICK: Yes.

25 CHAIRMAN JACKSON: It is not looking at the

1 quality of the knowledge base with respect to threshold
2 models and studies? I mean, is that what you're telling us?
3 MR. STEINDLER: I'm not sure they are going to
4 limit -- once you define a work scope for the NCRP
5 committee, they will expand the work scope as appropriate.
6 So the answer to your question is --
7 MR. GARRICK: It's called research.
8 [Laughter.]
9 MR. STEINDLER: I believe that's a valid
10 statement.
11 CHAIRMAN JACKSON: Okay.
12 MR. STEINDLER: But they are charged with looking
13 at the data and critically evaluating it, and I would assume
14 they are going to cover all aspects of it.
15 The Commission's interests are fairly narrow in
16 the sense that we're looking at low dose and low dose rates,
17 and in that sense, one of the things which has been commonly
18 used to back the linear no-threshold theory becomes
19 irrelevant -- namely, the Atomic Bomb Casualty Commission's
20 database for the Japanese, which are high dose rates, low
21 dose, modest dose, dose levels, and BIER 5 and others have
22 made that distinction already.
23 CHAIRMAN JACKSON: Okay. Thank you.
24 MR. POMEROY: And our next presentation this
25 afternoon will be on the time span for compliance of the

1 proposed high level waste repository at Yucca Mountain,
2 Nevada. The lead members that will conduct this discussion
3 are Drs. Hinze and Garrick.
4 Bill?
5 MR. HINZE: Right. Thank you, Paul.
6 As we promised to you in a recent letter, we were
7 going to look at this kind of compliance issue in greater
8 detail. We have done so, and we have sent you a letter this
9 month as a result of our deliberations presenting the
10 findings on the application of this to Yucca Mountain.
11 The first page here, the first slide, shows an
12 outline of our -- basically the letter and the presentation.
13 We're going to say a few words about the background of this
14 very vexing problem, and then we will look at the
15 considerations in defining a time of regulatory compliance
16 from a generic standpoint. And on the basis of the
17 assumptions and premises in these considerations, we will
18 then suggest regulatory principles from a general standpoint
19 for establishing this time span for compliance of nuclear
20 waste facilities; then, to focus this in on Yucca Mountain,
21 we will look at the scientific and technical insights that
22 we have learned over the past 15 years at the Yucca Mountain
23 repository site; and then we'll apply this to the general
24 principles for recommendations to you.
25 The time period of regulatory compliance can be

1 defined very simply as the period that risk of adverse
2 consequences will be below a specified standard. This will
3 be the standard, the risk standard in 197.
4 The existing generic standards in 191 and our own
5 Part 60 have been stated at 10,000 years within five
6 kilometers of the repository. This, of course, has been
7 subject to a considerable amount of controversy in arriving
8 at those numbers and subsequent to the acceptance of those
9 standards and regulations.
10 As a result, the National Research Council's panel
11 that looked into the site specific Yucca Mountain standards
12 rejected the 10,000-year compliance period, stating that it
13 was without technical or scientific justification, and in a
14 sense they were appropriately -- we agree that this is
15 without that technical justification. They suggested
16 possibly a -- or potentially a much longer period of time.
17 The dilemma, as we have spelled it out in this
18 second slide, in developing a time span of compliance, is
19 that the period of compliance must be long enough an event
20 to evaluate the potential releases of radionuclides and the
21 processes involved in transporting these to the biosphere to
22 the critical group, and yet they must not be so long that
23 the uncertainties overwhelm the process and the results
24 become questionable at best. So we have this dilemma;
25 however, we felt that with site-specific information, we

1 could make reasonable assumptions in order that a defensible
2 solution could be arrived at for the time of compliance.
3 In the next slide, the third slide, what we did
4 was we tried to define some general assumptions as I've
5 stated, and the first of these was kind of a baseline, and
6 that is that the high-level repository system must be
7 capable of preventing leakage of the radionuclides to the
8 biosphere for a minimum of several thousands of years.
9 The second is that the risk evaluation must
10 consider all of those things that are in 60 as part of the
11 defense in depth, and this should be done using performance
12 assessment.
13 But we are also cognizant of the fact that there
14 are limitations to performance assessment as a predictive
15 tool. It is primarily in its best sense used as an
16 investigative tool, and helping us to distinguish between
17 positive and negative attributes at the repository site and
18 also looking at relative risks under various scenarios.
19 CHAIRMAN JACKSON: Let me ask you a question.
20 What alternatives to performance assessment would you then
21 recommend?
22 MR. HINZE: We do recommend the use of performance
23 assessments.
24 CHAIRMAN JACKSON: No, I know, but I mean what
25 predictive tools do you recommend?

1 MR. HINZE: Well, the alternative that is commonly
2 mentioned as the alternative to performance assessment is to
3 look at natural analogues, and we do have some natural
4 analogues. And, of course, the Center, particularly in
5 their geochemical studies, including those at Pena Blanco,
6 have been out front in terms of using natural analogues.
7 And this is a very important benchmarking, if you will, to
8 the performance assessment, and it's why this committee in
9 letters to you has supported the natural analogues as an
10 important aspect of the entire program.
11 CHAIRMAN JACKSON: Couldn't one argue that the use
12 of natural analogues have a role in helping to bound
13 uncertainties in performance assessment, you know, in order
14 to set, if you will, confidence intervals?
15 MR. HINZE: Well, I believe that they are very
16 useful. The natural analogues can be very useful in setting
17 bounding conditions and also in calibrating, if you will,
18 the performance of the site, and therefore calibrating the
19 performance assessment modelling that you're doing.
20 MR. GARRICK: Not being a geologist, I can get
21 reckless in this area. I think that the way I understand it
22 as a non-geologist is that the natural analogues can -- and
23 I think this is actually what you were alluding to -- the
24 natural analogues can help us a great deal in reducing the
25 uncertainty with respect to the natural geologic setting.

1 Now, the question is how much of the uncertainty
2 has its origin there versus its origin with respect to
3 human-related activities, and that includes not only the
4 issue of human intrusion, but also all the human activities
5 having to do with disturbing the geologic formation from the
6 actual excavation work to imposing foreign material in there
7 in the form of engineered barriers and what have you to the
8 issue of human intrusion.
9 So it really depends upon what turns out to be the
10 largest contributor to uncertainty, but there is no
11 question, my geology friends have convinced me, that the
12 natural analog is one source of giving us increased
13 confidence in the geologic setting.
14 CHAIRMAN JACKSON: Thank you.
15 MR. HINZE: If I may proceed, then, we also felt
16 that the time of compliance is very intimately connected
17 with the definition of the reference biosphere and the
18 critical group and should be tied to that in the
19 regulations, not in the standard, but simply be based upon
20 the risk that is specified in the standard.
21 Finally, we concluded that the uncertainties
22 associated with processes and events that affect the
23 repository will increase with time. I think that is pretty
24 clear. Then if you apply those assumptions --
25 CHAIRMAN JACKSON: So there's on circumstance

1 under which the uncertainties would not increase?

2 MR. HINZE: Well, no. For example, if you had a

3 long enough time period, the igneous activity, the potential

4 for volcanic activity would be one, would be the time span

5 that you would have involved in the definition of it. But

6 no, there are -- it's not a linear function of time. The

7 uncertainties would not be a linear function with time. In

8 fact, they may vary with time. And one of those aspects is

9 the climate, that that may -- that may undergo a variable

10 bound.

11 CHAIRMAN JACKSON: So it's not linear and

12 theoretically it's not necessarily monatomic?

13 MR. HINZE: That's right. And it's certainly

14 going to vary depending upon whether you're dealing with the

15 degradation of a canister or whether you're dealing with a

16 change in the geological process or the climate or the

17 change in the -- you know, and on infinitum.

18 CHAIRMAN JACKSON: Okay.

19 MR. HINZE: In any event, this has led us to a

20 suggestion in our letter to you of a two-part approach. The

21 first part of the compliance time period then should be

22 based upon the estimated time for release and transport of

23 the radionuclides to reach the critical group. This

24 estimate should be based upon consideration of the waste and

25 the repository, the site characterization, using a total

1 system performance analysis. And this GSPA must confirm the
2 integrity of the site for a baselining of several thousands
3 of years.
4 We have also suggested that the reference
5 biosphere and critical group defined -- should be defined on
6 the premise of no major changes in lifestyles from our
7 current society and based upon our present knowledge, and
8 that the climate changes can be reasonably bounded. Of
9 course, they will vary as a function of time.
10 Further, the compliance time should be
11 sufficiently short such that the extrapolations into the
12 future should be -- should not lead to undue uncertainties,
13 and this is a problem that we've just mentioned. And we
14 have suggested that they be limited to reasonably modest
15 uncertainties. That's the first part, and that's a
16 specified period of time.
17 Now, the second part is based upon assessments
18 extending to the calculated time of a peak risk, and this
19 follows, if you will, very closely to the National Research
20 Council panel's suggestion that -- and here we suggest that
21 there should be no definitive measure of compliance, and
22 thus, this should not become a de facto regulation.
23 But we certainly believe that one should test out
24 to that period of time of peak risk and identify the
25 important performance factors by comparing the calculated

1 peak risk and comparing that against the standard that's
2 specified in this first part, and on the basis of that,
3 depending upon the difference, that perhaps ameliorating
4 actions need to be taken, such as greater engineered
5 barriers, waste containers, et cetera.
6 CHAIRMAN JACKSON: So in a sense, that relates to
7 a kind of defense in depth or your way of crediting some
8 kind of regulatory action.
9 MR. HINZE: Yes, ma'am. This committee I think is
10 very much enamored with the defense in depth and appreciates
11 its -- what it is accomplishing. And that's something that
12 we have stressed throughout this.
13 We have been -- DOE has been investigating the
14 Yucca Mountain area for 15 years or so, and although the
15 site characterization is not complete, there are a number of
16 insights that are important that relate to the time of
17 compliance. And the first of these involves the climate.
18 The current climate is arid, and I guess the second
19 important thing is the climate is going to change, and
20 perhaps that term "likely" should be taken out. The climate
21 is going to change and it likely will change to a pluvial
22 condition where we will have colder, more humid conditions.
23 But still, it is our -- as our review of the situation
24 suggests, that the area will still be semi-arid. And the
25 net result is that we will have -- it's unlikely to have a

1 marked effect on the reference biosphere or lifestyle of the
2 critical group. This will be still south of the glaciation
3 and it will still be in an arid or semi-arid area.
4 Furthermore, the flux as a result of these pluvial
5 conditions will increase, but it will still be limited
6 through the repository site.
7 Furthermore, the recent site characterizations
8 have shown us that we have potentially short transport times
9 in -- of the fluids in the unsaturated zone, but we also
10 believe that there is potentially long transport times in
11 the saturated zone leading from Yucca Mountain to the
12 critical group, and the critical group located some 20, 30
13 kilometers away to the south in Amargosa Valley.
14 The uncertainties in predicting the time-dependent
15 and the spacial variations have come to the fore as a result
16 of these discussions, but it is the committee's belief that
17 with adequate site characterization and considering the
18 integrative qualities of the processes, that the time
19 dependent uncertainties and events and processes such as
20 climate change will be more prominent than those derived
21 from spacial variations. That is our conclusion. This is a
22 high tectonic -- high gradient tectonic climatic area.
23 I'm going to skip the next one, and we then reach
24 the point where we have the -- based upon these insights, we
25 have recommendations for the Yucca Mountain repository

1 compliance period, and these involve our two-part approach.
2 And if you'll bear with me, I'll do this rapidly, because
3 some of this is really repetitive of our general principles.
4 But first of all, the first part of the time
5 period of compliance should be defined in the NRC
6 regulations being developed to implement the EPA standard,
7 and this should be based upon the knowledge of the
8 engineering and scientific aspects of the repository. And
9 we should apply performance assessment -- it's the best we
10 have -- and use the best bounding conditions that we have as
11 the analytical tool.
12 It should be defined in concert, very closely --
13 has to be, I believe -- with the reference biosphere and the
14 critical group. And again, this is taking into account all
15 of those characteristics that we know at the present time.
16 Finally, this time period of compliance should not
17 be shorter than the estimated time for potential
18 radionuclide contaminates to reach the critical group and no
19 longer than the time period over which scientific
20 extrapolations can be convincingly made.
21 In this regard, we have suggested to you in the
22 letter that the NMSS staff might review the scientific and
23 technical components involved in this, needed for this, and
24 to be certain that there are no holes in our existing
25 knowledge that will be critical to making that no shorter

1 than/no longer than decision.

2 Based upon the current information, compliance
3 period may be even somewhat greater than 10,000 years. That
4 is certainly something awaiting much more detailed study
5 than we have carried out.

6 The second part of this, then, requires the
7 assessment, using the PA as the analytical tool, to extend
8 from the specified compliance period of time in the first
9 part to the calculated peak risk. The regulations for the
10 compliance here should be significantly less stringent than
11 are specified in the first part.

12 There needs to be strong consideration obviously
13 of the increasing scientific, technical and critical group
14 uncertainties, the biosphere, reference biosphere
15 uncertainties.

16 Depending upon the extent that the peak risk
17 exceeds the standard, steps may be taken to do something
18 about the difference, the two, bring it closer calculated to
19 the standard in the first part. And we strongly feel that
20 the second part should not become de facto regulation.
21 That's the second time I've said that and I really want to
22 emphasize that.

23 We think that this has the potential to be a
24 robust, relatively simple procedure of getting at the time
25 of compliance that will be defensible.

1 THE COURT: Commissioner Rogers?

2 COMMISSIONER ROGERS: Well, I take it that when
3 you say existing knowledge, that's really what we know right
4 now, I mean like as of today, because there is probably not
5 going to be much more available; is that right?

6 MR. HINZE: Well, we had a presentation by Steve
7 Brocum from DOE this morning, and he was talking about the
8 studies that DOE plans to continue in terms of confirmatory
9 studies up until 2010. We don't have the details of those.
10 We've asked for some of the details on that, but we don't
11 have those. But presumably we're going to be getting some
12 small amount more of information, but I don't think we're
13 going to get -- within even a couple of decades, we're not
14 going to get the kind of information that's going to give us
15 a great insight into what the reference biosphere or the
16 critical group might be several thousands of years or tens
17 of thousands.

18 So I think that the international community, I
19 think our -- the national community have set upon something
20 that comes pretty akin to the present, but also based upon
21 our knowledge. I would like to think that we have also --
22 this is my personal feeling, is that we also can look at
23 rates of change that we have at the present time.

24 COMMISSIONER ROGERS: I'm just wondering if it
25 doesn't seem as if we're using the knowledge that we have

1 now based on the site to define this period of compliance as
2 a regulatory requirement which in a sense somewhat seems to
3 say that it's already met it because it looks to me like
4 there's the possibility of a kind of circular process going
5 on here, that you set the TOC based on what you know and
6 then write that into a regulation, and how different do you
7 expect the result to be when you go to licensing from that,
8 because you've based it on what you know.
9 So I'm just a little bit uncomfortable about that
10 aspect of it, and I wonder if you might address that.
11 MR. HINZE: Well, we have been concerned or we
12 have certainly considered this ourselves. I don't know --
13 Marty, we've been discussing this just within the day.
14 Perhaps you would like to say a few words
15 MR. STEINDLER: Well, let me just make the comment
16 that what we have done here is we have defined a time of
17 compliance that's site specific in terms of numbers using
18 the generic approach or the general approach that in effect
19 says, one, it's a two-phase process; two, the first phase is
20 related to the site characterizations, namely, how fast does
21 that plume arrive at the critical group; and the second
22 phase is a site characteristic which says when and where is
23 the peak dose.
24 Now, it's not circular in the sense that this is a
25 simple time of compliance. What one then meeds to do is

1 define the risk at time of compliance. If that risk is
2 unacceptable, especially in the first phase, then you -- the
3 conclusion you draw is that this site, with the information
4 you currently have, doesn't look like it's going to be able
5 to support within regulations the facility. That gets you
6 to a linear conclusion. I don't think that will bring you
7 back around.
8 Now, if subsequently it turns out that the
9 analysis is fairly shaky because you're missing some very
10 important pieces of information and you, in fact, go out and
11 get that information, and you redo for the same or different
12 time of compliance the analysis to determine what the risk
13 is at time of compliance, then you can make a second
14 decision as to whether or not it meets the standards or it
15 doesn't.
16 But I think the issue that we're raising in this
17 letter, which I think Bill will probably carry further, is
18 that there are two things that we're saying. One is we
19 think we have a methodology for rationally determining time
20 of compliance rather than the coin-flipping which was done
21 for the 10,000 years or other times of compliance as used
22 internationally.
23 So, one, we have a rational way, which happens to
24 be, as it probably should be, site characteristically
25 specific; and then the second one for Yucca Mountain, Bill

1 indicated something in excess of 10,000 years because that's
2 what we know right now.
3 Now, if it turns out that DOE for one reason or
4 another addresses the issue of the critical group and how
5 fast the plume moves to it, and concludes on the basis of
6 convincing evidence that it isn't 20,00 years, it's 4,000
7 years, then the time of compliance moves. But that's a site
8 characteristic driven number.
9 MR. HINZE: You cannot be assured that the site is
10 going to meet the standard on the basis of this time of
11 compliance. It very well may not be, if the -- if -- if the
12 totality of the systems analysis doesn't give you that
13 correct number at the -- if you don't remain below the
14 standard at that time of compliance. It gives you a measure
15 of the integrity of the total system, including the site.
16 It would be somewhat circular, I think, if you started
17 moving the critical group around or you started changing --
18 COMMISSIONER ROGERS: No, I'm not thinking about the
19 critical group. I'm just thinking about the engineering and
20 scientific aspects of the repository. I'm not talking about
21 the critical group. That's a different set of
22 considerations, it seems to me, than what I'm concerned
23 about. But I'm just troubled with what seems to me a
24 requirement that you must have enough information to be able
25 to do -- which -- and fed into a model of some sort to

1 determine this time of compliance, these arrival times.

2 When you have that, isn't it rather -- I mean, if

3 you have it with any confidence, because that's going to be

4 now a rule, I mean, that's going to be the critical test

5 that has to be applied to the acceptability of the site or

6 the proposed licensing of the site, then isn't it just

7 rather a simple step to decide based on an acceptable

8 definition of the critical group as to whether the exposure

9 limits are acceptable, the risk is acceptable?

10 MR. STEINDLER: Having pegged the time of

11 compliance, you can ignore other statements concerning the

12 level of risk. If you can't do that a priori, then it is

13 the level of risk that determines whether at time of

14 compliance, that facility will fly. But the level of risk

15 remains an independent variable.

16 COMMISSIONER ROGERS: Well, determined by what?

17 MR. STEINDLER: Well, among other things, the

18 transport properties, the source term, the chemistry, the

19 geochemistry in the area.

20 COMMISSIONER ROGERS: Don't you need those to get

21 the time of compliance?

22 MR. STEINDLER: No. The time of compliance

23 largely will be determined by water travel time. Some

24 things move with water; some things don't.

25 COMMISSIONER ROGERS: Yes, but the different

1 characteristics of the site with respect to water transport
2 have to be known --
3 MR. STEINDLER: Yes.
4 COMMISSIONER ROGERS: -- to determine the time of
5 compliance, don't they?
6 MR. STEINDLER: Yes. Or at least estimated with
7 some reasonable certainty.
8 COMMISSIONER ROGERS: Yes. Right.
9 MR. STEINDLER: That's right.
10 COMMISSIONER ROGERS: Well, I don't know, this is
11 something I have to chew on a bit. It's a somewhat
12 different way to approach it and I would like to think about
13 this more. But the second approach, the -- well, before we
14 get to that, the sort of bounds that you've set should be no
15 shorter than estimated time for potential radionuclide
16 contaminants to reach the critical group and no longer than
17 the time period over which scientific extrapolations can be
18 convincingly made.
19 Now, what is that upper bound? How do you get at
20 that? What is this time period over which scientific
21 extrapolations can be convincingly made? Isn't that a very
22 difficult thing to pin down?
23 MR. HINZE: Well, it is a tough thing to pin down,
24 and that's why we suggest this estimated time for the
25 degradation of the waste as well as a transport as

1 specifying the time. You want to minimize that time as much
2 as possible so that you don't get into these large
3 uncertainties.
4 We are -- I think we're going to have a very
5 difficult time putting a bound on these uncertainties and
6 their meaningfulness after a long period of time, and that's
7 the problem with accepting, for example, the peak risk,
8 because you're so far out there that your results are of
9 questionable value in terms of the bounding conditions.
10 Does that make sense?
11 COMMISSIONER ROGERS: Well, yes, except I don't
12 know -- I don't have any feeling about -- I mean, I think of
13 this, the process you're describing here, in terms of three
14 time periods. One is one in which the engineered barriers
15 work fine before anything gets out, and then the time when
16 things start to leak out of the engineered barrier and start
17 to head towards the boundary and arrive at the point where
18 you're going to measure the total period of compliance at
19 that point. So there are two time periods there, the
20 transport time and the time before release, which could be
21 quite long. If the engineered barrier is really effective,
22 and some people think that they could be very effective --
23 we won't get into that debate -- but if you're talking about
24 thousands of years, some people think thousands of years
25 isn't too hard a thing to satisfy an engineered barriers.

1 So you've got thousands of years in your first
2 time period before anything gets out of the engineered --
3 past the engineered barrier, then the time to get out to
4 wherever you're going to measure its arrival, where it could
5 start to do some damage, you've got a second time period,
6 and then you've got another time from then until the peak of
7 the exposure starts to hit. And I don't have any feeling
8 about what that third time is compared to the second time.
9 How long does it take for -- since the, you know,
10 first arrivals start to show up before the peak develops and
11 what determines that? Is that a -- I mean, you've sort of
12 implied that that's a very long time, but what sets it as a
13 long time? I mean, I'm not challenging it, I just don't
14 understand it. But then, if we're talking about very long
15 times, then aren't we -- don't we have to worry about other
16 kinds of effects which have -- external effects of various
17 kinds, maybe vulcanism or something of this sort, that has a
18 much greater chance of taking place, or earthquakes that
19 might have a very much greater chance of taking place at
20 that site if you wait long enough.
21 MR. HINZE: Exactly.
22 COMMISSIONER ROGERS: So the longer the time of
23 compliance is, the more challenges can hit the site from
24 these other sources even though it may be a very good site.
25 So if you go into the very long extreme limit, something is

1 going to hit it.

2 MR. HINZE: The probability of vulcanism is one.

3 COMMISSIONER ROGERS: Yes.

4 MR. HINZE: Yes.

5 COMMISSIONER ROGERS: And so then does that wipe

6 it out?

7 MR. HINZE: That's why we have --

8 COMMISSIONER ROGERS: Because you've met the time

9 of compliance, but you've also had a, you know, assurance

10 that the site will be wiped out by an earthquake or a

11 vulcanism. And so these are the things that, you know, I

12 have a little trouble in putting together in understanding

13 how this would work.

14 MR. GARRICK: You have articulated very well why

15 performance assessment is difficult.

16 MR. STEINDLER: Well, let me just make a comment

17 for the far out time. That's precisely why we're fairly

18 careful saying that the stringency of criteria against which

19 you judge that peak dose ought to be relaxed considerably,

20 because your uncertainties get to be really fairly

21 pronounced. It is not necessary, just because of the

22 probability of vulcanism someplace in the area that you in

23 fact blow all of the activity downstream. There is, you

24 know -- and it's in that sense that you're not assured if

25 you wait long enough that there will be a debilitating

1 catastrophe at the repository, and that's the thing that
2 presumably will save you.
3 The other side of the coin is, depending on how
4 you --
5 COMMISSIONER ROGERS: That's a little shaky to --
6 MR. STEINDLER: It is shaky, and my geology friends are
7 going to have to work very hard to convince somebody that
8 they have a reasonable handle on it.
9 MR. GARRICK: I think the idea of breaking it into
10 the kind of pieces you have is exactly what the performance
11 assessment is attempting to do. You can think in terms of a
12 source term and when, in fact, there is a source, and you
13 can think in terms of the transport, and then -- through the
14 geosphere and then finally the biosphere and uptake.
15 If we are to believe the performance assessments
16 that have been performed by DOE, there is indications that
17 the time to get to the biosphere is of the order of
18 thousands of years, tens of thousands possibly with
19 considerably uncertainty, and the time to peak risk is of
20 the order of hundreds of thousands of years. And what we're
21 really mainly talking about, as we gather more information
22 and as we prove our understanding and develop new insights,
23 is reducing the uncertainty in those kinds of numbers. I
24 think that's what the characterization program will do.
25 I think that's what we -- I doubt that we're going

1 to change, if you wish, the central tendency parameters very
2 much, but we certainly are, with new information, going to
3 have a major impact on the uncertainty, and that's a very
4 important part of this whole process and we'll be probably
5 coming back to that subject in a little while here.
6 MR. HINZE: If I may, I don't want to be
7 repetitive, but it seems to me that it's just the reasons
8 that you were bringing up, Commissioner Rogers, concerning
9 this long time frame that has prevented us from accepting
10 this idea of calculating and setting the regulation out to
11 peak risk.
12 What we're really interested in is evaluating the
13 integrity of the site and basically using some form of the
14 subsystem requirements, looking at the various subsystem
15 elements and making certain that the integrity of the site
16 is sufficient that you will meet that standard in terms of
17 the risks specified.
18 THE COURT: Commissioner Dicus?
19 You may go on.
20 MR. POMEROY: We're going to give Dr. Hinze about
21 ten seconds. The next item on our agenda is comments on
22 high level waste prelicensing program strategy and key
23 technical issues, and as I say, Dr. Hinze will also present
24 that.
25 MR. HINZE: Well, thank you, Paul, and thank you

1 for the ten seconds.

2 [Laughter.]

3 Let me try and summarize. The Staff's high level
4 waste prelicensing program strategy is an evolving strategy
5 and that's necessarily true because of the changing DOE
6 program and the resources available.

7 We certainly give, as we have stated in our
8 February letter to you, our general support for this
9 approach, and as we have heard more from the Staff on this
10 topic, our concerns have been, continue to be decreased. We
11 think that it has many strengths.

12 There are some weaknesses that I have listed out
13 in I think it is the third slide here. I think one of the
14 more important of the weaknesses that we feel still at this
15 time is that it is unclear to us how the issue resolution
16 will be achieved.

17 In the next slide we suggest that resolution
18 should not be required of NRC, nor should the DOE be
19 compelled to perform studies or analyses that they believe
20 are unwarranted. We seek a cautious approach where we can
21 expect that there will be differences remaining between the
22 DOE and the NRC going into the licensing arena but we want
23 to minimize that as much as possible, and we urge full
24 documentation of those uncertainties.

25 CHAIRMAN JACKSON: You also suggest that certain

1 issues should be left to a licensing board.

2 MR. HINZE: That's right. There will be

3 differences that will be left to the licensing board. Yes,

4 ma'am.

5 CHAIRMAN JACKSON: And you are positing that from

6 the point of view of neutrality, schedule, resources?

7 MR. HINZE: Maybe that you could throw an infinite

8 amount of resources and still not reach closure on it.

9 I think there are some topics that are going to be

10 of a scientific nature that there will be questions

11 remaining.

12 I think that is the Committee's view.

13 CHAIRMAN JACKSON: And so you are saying that a

14 licensing board is the way to come to some ultimate --

15 MR. HINZE: That's right.

16 MR. STEINDLER: I think the answer is more

17 neutrality than resources.

18 CHAIRMAN JACKSON: Yes.

19 MR. HINZE: I guess I'd like to point out two more

20 things in summarizing this, Paul, is that there has been

21 concern about some of the KTIs, at least on the part of DOE.

22 We are strongly supportive of this activity, KTI, and the

23 seismic and tectonic processes and in the last slide we

24 refer to future ACNW activities in which we are going to

25 follow up in a working group meeting later this Fall, late

1 Fall, on igneous activity which we hope to evaluate the path
2 to resolution on this issue.
3 We also had been concerned about coupled
4 processes. These are processes in which the one will affect
5 the other so one plus one might not equal two. There are
6 several KTIs that deal with these. These are going to be
7 integrated in the technical integration in the TSPA, KTI.
8 We just want to make certain that this is not lost, that the
9 integration in these coupled processes, because it's
10 integration that really is the important thing in the
11 coupled processes.
12 We plan to hold a working group on this in which
13 we will look at the integration. We'll be holding that in
14 August.
15 CHAIRMAN JACKSON: Thank you. Commissioner
16 Rogers?
17 COMMISSIONER ROGERS: Yes. You made the point
18 that you didn't think that DOE ought to be required to do
19 any studies that it doesn't feel it should do.
20 I wonder how that squares with your strong support
21 for the vertical slice approach.
22 I am a great supporter of vertical slice
23 approaches. They have worked very, very well in the reactor
24 area and you seem to be quite enthusiastic in the
25 application here.

1 On the other hand, suppose that DOE has a number
2 of layers of information on systems but not everything that
3 is necessary for vertical slice -- there are discontinuities
4 in the vertical slice.
5 Are you -- what do you do then if the vertical
6 slice fails to that extent that you can't go all the way
7 through the system if there is information that is necessary
8 to be collected to take that step and DOE doesn't' feel that
9 it ought to be doing that right now? It costs money that
10 they don't want to put in that direction. They want to put
11 it someplace else. It seems to me you have an inherent
12 possibility of a conflict there in the vertical slide
13 approach between the continuity of that and the program
14 management, DOE's management of the program from their point
15 of view, which is not a vertical slice necessarily.
16 MR. HINZE: That conflict may remain and this in
17 my view would have to go to the licensing arena to be
18 resolved, whether the DOE has adequately justified their
19 position with the analyses and data that they have, and that
20 the NRC is asking too much or it's off on the wrong aspect.
21 That is a decision that DOE, it seems to me, has
22 to make. We have to, the NRC has to give them our best
23 shot.
24 COMMISSIONER ROGERS: Well, that's your answer --
25 MR. HINZE: And I think the Staff is doing just

1 that.

2 COMMISSIONER ROGERS: In a sense it fails the

3 vertical slice approach but there still may be enough left

4 there to be useful.

5 MR. HINZE: There is enough. I think you will

6 find us strong supporters of the vertical slice. There are

7 inherent dangers. This is the first of a kind, non-

8 prototype, complex issue, and one of the things that I

9 appreciate every time the Staff talks to us, the first word

10 is "flexibility" and I appreciate that because we have to

11 remain flexible and as we review this with the Staff, that

12 is one of the things that we're constantly looking for is

13 this ability to know when to close out an issue and that is

14 important, too, and we need more information on that -- when

15 do we close it out? When do you just give up? You have

16 given them your best shot in terms of questions and

17 comments.

18 CHAIRMAN JACKSON: What you're really seeming to

19 be dealing with is what I call "pay me now or pay ne later."

20 The issue becomes one of, you know, what can be viewed as

21 requirements at a prelicensing phase -- what ends up being

22 part of a documentary, needed for a documentary record on

23 which to make a licensing decision at a later stage.

24 It seems that what you are really doing is saying

25 if it can't be resolved at the prelicensing phase, you're

1 basically going to punt it over to the licensing.

2 MR. HINZE: Yes, ma'am.

3 CHAIRMAN JACKSON: Okay -- just want to be sure.

4 MR. POMEROY: And let me just say that we can even

5 begin to see the beginnings of some of that already.

6 COMMISSIONER ROGERS: If I could just ask one

7 little question. I didn't really understand what you were

8 talking about with respect to iterative processes in the

9 vertical slice.

10 I mean I know what an iterative process is but I

11 don't quite see what you have in mind here with respect to

12 the vertical slice approach.

13 MR. HINZE: Well, I think the process here, and

14 it's been described that way by the Staff to us, is that you

15 work your way down the vertical slice, but you get further

16 information, and this may bump you back up and so that you

17 go through the iteration, or -- and I'm concerned about

18 this, I think the Committee is concerned about it -- where

19 it --

20 MR. POMEROY: -- it touches on the coupled

21 processes.

22 MR. HINZE: Yes, sir. Coupled processes is the

23 perfect example and we're also concerned about the

24 horizontal integration, if you will, because you have to be

25 able to kick from one to the other and this may start the

1 whole process all over again and that's just good science.
2 CHAIRMAN JACKSON: Dr. Pomeroy?
3 MR. POMEROY: The next item on our agenda, and I
4 would say that we may not make all six of the items, but --
5 CHAIRMAN JACKSON: No, all you have to do is 7
6 minutes each, 6 and half minutes.
7 MR. POMEROY: I am not sure I can force Dr.
8 Garrick into that.
9 MR. GARRICK: That's an acceptable challenge.
10 Actually this is a very brief topic because we
11 covered many of the items already and I am going to talk
12 about a letter we sent you on issues in NRC activities
13 associated with the National Research Council's report, the
14 technical basis for Yucca Mountain standards.
15 As you well know, that National Research Council
16 committee was asked to examine the technical basis of the
17 standard and not to develop the standard and many of the
18 issues that we addressed in that letter and that were
19 addressed in the standard we have talked to you in one way
20 or another in the past, and I am talking about things like
21 timeframes, the issue of the critical group, human
22 intrusion, the issue of subsystem performance or as we like
23 to call it, "Defense In Depth."
24 So those are things that are not new but they are
25 affected by this site-specific standard that we are moving

1 towards.

2 In our letter we address several issues and they

3 included regulatory timeframes and we have discussed that

4 today, so I don't need to expand on that.

5 We also touched on the issue of low levels of

6 radiation and their effects and we have covered that.

7 We also indicated in our letter that we would be

8 doing work on the critical group and the biosphere.

9 In fact, we had a working group meeting here

10 yesterday on those subjects and we'll be reporting on those

11 in some detail later.

12 On the next exhibit one of the topics that was

13 discussed in the Yucca Mountain standard report was this

14 issue of threshold dose and what the identification of an

15 acceptable threshold dose would mean in terms of the

16 implementation of the Yucca Mountain standard and I think we

17 have discussed that, and I distinguish that issue from the

18 linear non-threshold theory issue. That's simply the issue

19 of a policy matter of deciding that there should be a

20 threshold dose.

21 As to other issues that we discussed on my last

22 exhibit, we discussed this issue of using individual risk or

23 critical group risk as opposed to using a resource or a

24 surrogate measure of risk such as the ground water standard.

25 The Yucca Mountain standards committee made a very

1 important recommendation having to do with human intrusion
2 and in particular suggested the idea of a reference scenario
3 that would be again somewhat policy driven but would be done
4 in such a way that it would give added indication and added
5 insights as to the containment capability of the repository.
6 And should the results from that differ in the
7 wrong way from the results of complying with the standard
8 otherwise. Then, of course, actions would have to be taken
9 in a risk management sense to make the -- to comply with the
10 standard.
11 One of the issues that you have heard about
12 already today a couple of times, and the feeling of the
13 committee, our committee toward that, is the issue of
14 defense in depth. We are strong believers in the notion of
15 defense in depth. On the other hand, when there is a
16 specific site and the ability to deal with the specific
17 design and that's the only one you're dealing with, then the
18 emphasis is more on calibration of the performance of those
19 subsystems, it seems to us then prescribing what those --
20 each of those subsystems should -- how they should perform.
21 So our position here is more one of quantifying
22 the subsystem performance than it is one of prescribing
23 subsystem performance and finally, as we said, we are very
24 interested in this whole subject and the basis for computing
25 the risk. That has to occupy a lot of attention, and the

1 role of these issues that are in progress, such as the
2 definition of the biosphere and the critical group in
3 bringing us closer to a basis for recommending, if you wish,
4 an approach to peak risk quantification.
5 CHAIRMAN JACKSON: With respect to what was, in yr
6 letter, a fairly strong statement on population protection?
7 MR. GARRICK: Yes.
8 CHAIRMAN JACKSON: Vis-a-vis protection of
9 groundwater as a resource, have you focused on a methodology
10 for addressing that issue?
11 MR. GARRICK: Well, I think that, as far as what
12 the actual standard is going to be, of course, that is out
13 of our hands. But, as far as a methodology is concerned,
14 if -- it seems to us that the primary issue here, given what
15 we now know about the transport model and the biological
16 uptake model, the primary issue here is how do we want to
17 define the critical group.
18 One of the underlying principles that we have
19 suggested be followed in our letter was that whatever we do
20 in this regard, it ought to be compatible with a risk-based
21 perspective. And so that would suggest that some sort of a
22 critical group that involves definition that would give us
23 confidence that it is compatible with a risk approach on the
24 one hand and on the other hand clearly address the issue of
25 the health and safety of individuals.

1 As you know, that's where there is a lot of debate
2 right now and in the Yucca Mountain standard report by the
3 National Research Council, there was a minority position
4 taken on that issue that the critical group should
5 essentially be the maximum exposed individual versus the
6 other 14 members of the committee that favored a critical
7 group that was more in line with a risk area.
8 So we have heard both sides of the argument and we
9 have not ourselves come to grips with the conclusion there
10 but we probably will be doing that fairly soon.
11 CHAIRMAN JACKSON: We will hope to hear from you.
12 MR. STEINDLER: Let me make a quick comment. In
13 response to your question, it is likely that, first, the
14 protection of the resource should be separate from the
15 protection of the population, critical group or otherwise
16 makes no difference. So it is radiation protection versus
17 resource protection can be separated into two parts.
18 The second point is that likely, it seems to me,
19 and that's -- we can -- the answer to your question is, no,
20 that the committee itself has not addressed that issue
21 specifically but it's also likely that the resource
22 protection is going to be a site-specific activity and as
23 such, then, the generic answer to how do you do this depends
24 on where you're looking.
25 The radiation protection issue is fairly

1 straightforward. We're familiar with that. The resource
2 protection, how do you protect the aquifer if you wanted to
3 or if you had to at Yucca Mountain for example? It's likely
4 to be Yucca Mountain specific. But beyond that, I don't
5 think we have thought very much further on it.
6 The issue came to a head because the EPA pulled
7 both of those together into a single unit, lumped it under
8 the population protection at 4 millirem per year and then
9 when questioned as to what kind of risk level that
10 represented brought in the fact that they in fact didn't --
11 the risk is not the basis for that number; resource
12 protection is the basis for that number. And now things got
13 pretty fuzzy.
14 That's the thing that we were trying to avoid.
15 MR. GARRICK: Yes, we were trying to make a
16 distinction, simply, between resource protection and
17 population protection. And the other -- the argument that's
18 going on relative to the critical group is an argument of
19 somewhat of consistency with respect to the application of a
20 risk-based approach throughout the analysis, the thought
21 being that if you have an analysis that has 10 elements to
22 it, that it's not consistent to analyze nine of those
23 elements one way and then the tenth element a different way.
24 And on the other hand, there are those who feel
25 that such a change at that point in the calculation, "that

1 point" being the actual calculation of the health effects or
2 the dose to the maximally exposed individual, that such a
3 change is warranted and that's just something that has to be
4 resolved on the basis of information and evidence as we move
5 toward trying to come to grips with this issue ourselves.
6 CHAIRMAN JACKSON: Okay. Commissioner Rogers,
7 Commissioner Dicus?
8 MR. POMEROY: Okay, let me not follow the slides
9 in these next two presentations but simply give you one or
10 two of the highlights of the slides in order to fit into our
11 time schedule.
12 I would first like to talk briefly about the
13 ACNW's priority issues. I believe you all have a list of
14 those in front of you and we certainly don't want to speed
15 through them. I want to make the point that this is a
16 dynamic document. We have changed it as a result from its
17 initial configuration from -- as a result of, rather,
18 changes in programs by DOE and resultant changes in the
19 program of the NRC. We continue and would welcome comments
20 from you with regard to items that should be on this list
21 that are presently not on this list but this list is
22 important to us because it serves as an important vehicle
23 for focusing our activities and attention.
24 CHAIRMAN JACKSON: I just had a question with
25 respect to priority item six, having to do with low-level

1 waste disposal. And the question was whether or not you
2 were soliciting input from agreement states?
3 MR. POMEROY: Yes, we are. In fact, we are
4 talking with four agreement states tomorrow with regard to
5 the question of time compliance for low-level waste
6 disposal, Texas, Nebraska and two others. We are doing that
7 and we are moving towards looking at the question of the
8 time of compliance and the possible application of the same
9 kind of generic thinking that went into the time of
10 compliance for high-level waste as well.
11 As you know, we have a very strong concern about
12 low-level waste.
13 CHAIRMAN JACKSON: We are well aware.
14 MR. POMEROY: These issues that you see before you
15 were, in fact, derived by some sort of informal elicitation
16 of expert judgment, namely the judgments of the four people
17 sitting across from you and the staff, but they were based
18 on what we considered to be the most important issues to the
19 Commission and their timeliness and we are trying to treat
20 them somewhat in that order as we go along.
21 I want to -- everything that you've heard today,
22 of course, fits into that priority listing and we talk about
23 that on one of the slides.
24 I would just like to mention, as far as our
25 priorities go now, that in the next six months we have

1 planned something on the order of five working groups, one
2 of which we began yesterday, namely the specification of
3 critical group and reference biosphere that Dr. Garrick just
4 mentioned. We intend to have a working group in August on
5 thermal loading and coupled processes. We have tentatively
6 scheduled the radionuclide transport question for our
7 September meeting. We have tentatively scheduled a review
8 of the vulcanism issue as Bill mentioned earlier in our
9 November meeting and we are discussing a working group on
10 the analysis of uncertainties in the bonding calculations
11 that fits under one of our categories of priority issues.
12 We are trying to focus on the things that we think
13 are the most important and of the most immediate interest to
14 the commission.
15 I'd like to stop there on that item.
16 CHAIRMAN JACKSON: You don't want to talk about
17 expert judgment?
18 MR. POMEROY: I'd like to say two words about
19 expert judgment, if I may.
20 The -- first of all, this committee is very
21 pleased that we -- the branch technical position on the use
22 of expert elicitation and the high-level radioactive waste
23 program is nearing its completion. We are looking forward
24 to a briefing by the staff in August, at which time we will
25 take up some of the concerns that we still have remaining

1 and we know that other people in the external community have
2 those same concerns and we are looking forward to discussing
3 the staff's response to those external community comments as
4 well.
5 We continue to believe this is an extremely
6 important subject. We believe that it -- when -- that some
7 issues are not resolvable, as we discussed earlier, and we
8 think that in the licensing hearings we are going to see
9 formal elicitations of expert judgment perhaps not only from
10 DOE but also from perhaps necessarily from the NRC and
11 perhaps from several intervening groups and one of the
12 questions, of course, is how does one decide, how does one
13 decide the admissibility of some of that information and I
14 know that the Office of General Counsel certainly has worked
15 hard, I believe, with the staff to reach some acceptable
16 standard for this branch technical position and we look
17 forward to a continuing interaction with them to try to
18 establish what the groundrules are going to be.
19 We feel very strongly that all of the information
20 from diverse formal elicitations should be introduced,
21 somehow, into the licensing process so that the
22 administrative judges in that case can look at the full
23 range of uncertainty within a given issue and we want to see
24 what the techniques are for ensuring that that careful and
25 complete examination takes place.

1 CHAIRMAN JACKSON: Would you go so far as to want
2 to require expert judgment in a safety evaluation format?
3 MR. POMEROY: I can see where it might be
4 necessary. I would like to think about that.
5 CHAIRMAN JACKSON: All right, I will ask you
6 again.
7 MR. POMEROY: Right. Thank you.
8 CHAIRMAN JACKSON: Commissioner Rogers?
9 COMMISSIONER ROGERS: No questions.
10 CHAIRMAN JACKSON: Commissioner Dicus?
11 COMMISSIONER DICUS: No questions.
12 CHAIRMAN JACKSON: Well, thank you. I would like
13 to thank very much the members of the Advisory Committee for
14 a very comprehensive and informative briefing. You have
15 presented a lot of information to us that says that you are
16 working quite hard to help us independently assess the
17 current issues regarding the safe management of radioactive
18 waste. We look forward to continuing to work with you and
19 to interact with you both on the content and the ranking of
20 your priority issues. I am sure you will be hearing from
21 us.
22 But what you've done appears to be well conceived
23 and well documented and so we look forward to our continuing
24 work. And, again, I thank you and again I take note of the
25 excellent service of Dr. Steindler.

1 Unless there are further comments, we're
2 adjourned.
3 MR. POMEROY: Thank you very much.
4 [Whereupon, at 4:01 p.m., the meeting was
5 concluded.]
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CERTIFICATE

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

TITLE OF MEETING: MEETING WITH ADVISORY COMMITTEE ON NUCLEAR WASTE (ACNW) - PUBLIC MEETING

PLACE OF MEETING: Rockville, Maryland

DATE OF MEETING: Wednesday, June 26, 1996

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

Transcriber: Christopher Cotchall

Reporter: Mark Mahoney

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

June 21 1996

MEMORANDUM TO: John C. Hoyle
Secretary of the Commission

FROM: John T. Larkins, Executive Director
Advisory Committee on Nuclear Waste

R. Cavers for

SUBJECT: BACKGROUND MATERIAL FOR MEETING BETWEEN THE COMMISSIONERS AND THE ADVISORY COMMITTEE ON NUCLEAR WASTE, JUNE 26, 1996, 2:30 P.M.

Enclosed is background material for the upcoming meeting between the Commission and the ACNW. Included in this package are recent completed reports which will form the basis for four of the six presentations and a set of slides that correspond to the various discussion items.

The sessions on the health effects of low-levels of ionizing radiation and expert judgment are works in progress and a summary of the tenor of the reviews is provided along with a set of slides.

The topics discussed in the ACNW reports and the dates of the reports are enclosed, as follows:

Enclosures

1. Health Effects of Low-Levels of Ionizing Radiation (Work in progress)

2. Time Span for Compliance of the Proposed High-Level Waste Repository at Yucca Mountain, Nevada, dated June 7, 1996

3. Comments on High-Level Waste Prelicensing Program Strategy and Key Technical Issues, dated February 16,1996

4. Issues and NRC Activities Associated with the National Research Council's Report, "Technical Bases for Yucca Mountain Standards," dated February 9, 1996

5. ACNW Priority Issues, dated December 28, 1995

6. Expert Judgement and Elicitation (Work in progress)

cc w/atts: ACNW Members
ACNW Technical Staff

MEETING BETWEEN COMMISSIONERS AND ACNW
OWFN COMMISSION CONFERENCE ROOM
JUNE 26, 1996 - 2:30 P.M.

TOPIC (lead member(s))

	2:30 - 2:40 P.M.	Introduction by Chairman Jackson
1)	2:40 - 3:00 P.M.	Health Effects of Low-Levels of Ionizing Radiation (Drs. Garrick/Steindler)
2)	3:00 - 3:20 P.M.	Time Span for Compliance of the Proposed High-Level Waste Repository at Yucca Mountain, Nevada (Drs. Hinze/Garrick)
3)	3:20 - 3:30 P.M.	Comments on High-Level Waste Prelicensing Program Strategy and Key Technical Issues (Dr. Hinze)
4)	3:30 - 3:40 P.M.	Issues and NRC Activities associated with the National Research Council's Report, "Technical Bases for Yucca Mountain Standards" (Drs. Garrick/Steindler)
5)	3:40 - 3:50 P.M.	ACNW Priority Issues (Dr. Pomeroy)
6)	3:50 - 4:00 P.M.	Expert Judgment (Dr. Pomeroy)

ENCLOSURE 1

HEALTH EFFECTS OF LOW-LEVELS OF IONIZING RADIATION

HEALTH EFFECTS OF LOW-LEVELS OF IONIZING RADIATION

ACNW observes that the increased emphasis placed by Commission on risk-informed regulation makes it imperative that the actual health risk of low-level ionizing radiation be assessed accurately without unnecessary conservatisms

Committee believes that there could be very significant costs associated with the conservatisms associated with LNT and concludes that reexamination of the regulatory model in light of all relevant information is most appropriate at this time.

HEALTH EFFECTS OF LOW-LEVELS OF IONIZING RADIATION

- No ACNW consensus - The ACNW is discussing the topic in the context of its importance in risk-informed regulation

- Broad spectrum of presentations at joint ACNW/ACRS Subcommittee meeting - March 26, 1996

- Draft letter discussed during May '96 ACNW meeting and during the June '96 ACRS meeting; ACNW plans to issue a letter on the subject in the near future

- ACNW is following recent relevant activities both within/outside agency

- General observations (have not yet reached a consensus)
  - reexamination at this time of the regulatory model in light of new information is needed
  - evaluation must be complete and impartial
  - models used have significant impact on risk-informed regulation

HEALTH EFFECTS OF LOW-LEVELS OF IONIZING RADIATION

Committee has viewed topic with continuing interest and concern as to regulatory impact of LNT model and its role in risk-informed regulation.

Regulatory relevance exacerbated by HLW repository dose calculations (micro doses to mega-populations).

In 1995 issue reinforced on national level by NAS TBYMS report.

Issue further reinforced in March 1996 by Health Physics Society position statement.

HEALTH EFFECTS OF LOW-LEVELS OF IONIZING RADIATION (cont'd)

Committee most recent general perspective noted in February 9, 1996 TBYMS letter

> **"...if definition of the biosphere and critical group were to be accompanied by a threshold dose to humans below which the repository would be deemed in compliance, it would represent a major accomplishment in the field of practical, risk-based regulation..."**

HEALTH EFFECTS OF LOW-LEVELS OF IONIZING RADIATION (cont'd)

Presentations at March 26, 1996 Joint ACNW/ACRS subcommittee by NRC, NCRP, HPS, MASS. EMRG MGT ASSN. In addition had benefit of numerous published articles and references.

Committee also represented at June 25 RES seminar on topic as well at May 29 LLW Forum presentation.

Some recent investigations (US, China, Sweden, Poland, Canada, France, Japan, LLNL, UNSCEAR, EPRI) reached conclusions that do not support linear threshold model (LNT) - some studies suggest a threshold or perhaps even a beneficial risk (hormesis) at lower doses.

HEALTH EFFECTS OF LOW-LEVELS OF IONIZING RADIATION (cont'd)

ACNW suggests:

1) NRC create an independent body to examine all evidence. Participants should be impartial and represent all relevant disciplines, or

2) if NRC support is to be limited to NCRP evaluation of LNT assumptions, the NRC require special attention in selected areas, viz. - assignment of scientists with diverse background and view points (such as expertise in statistics or information science, i.e., NIST) and consideration of <u>all</u> LNT-related studies.

ENCLOSURE 2

TIME SPAN FOR COMPLIANCE

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

June 7, 1996

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

Dear Chairman Jackson:

SUBJECT: TIME SPAN FOR COMPLIANCE OF THE PROPOSED HIGH-LEVEL WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA

The purpose of this letter is to communicate the Advisory Committee on Nuclear Waste's (ACNW) observations and suggestions on the general principles for establishing the time span for compliance of nuclear waste facilities and our recommendations for specifying the regulatory time frame of compliance for the proposed geologic high-level waste (HLW) repository site at Yucca Mountain, Nevada. This letter follows up a letter from the ACNW dated February 9, 1996, on "Issues and [U.S. Nuclear Regulatory Commission] NRC Activities Associated with the National Research Council's Report, *Technical Bases for Yucca Mountain Standards*."

The time period for compliance of geologic HLW repositories is established at 10,000 years in the Environmental Protection Agency (EPA) standard 40 CFR Part 191 and the NRC regulation 10 CFR Part 60. Elements of the HLW standards and regulations were scrutinized by a National Research Council/National Academy of Sciences (NAS) Committee, which was prescribed by the Energy Policy Act of 1992. The findings of the NAS Committee are published in the *Technical Bases for Yucca Mountain Standards* (National Research Council, 1995). The NAS Committee concluded that there was no scientific justification or basis for specifying a truncation of the analyses at 10,000 years or at any other period of time. Instead, it recommended that the compliance evaluation be conducted to peak risk within the limits of the basic geologic stability of the Yucca Mountain region, which it suggested was on the order of a million years. In contrast to this recommendation, the ACNW has supported the 10,000-year time frame (e.g., letters to the Chairman of the NRC of June 27, 1991, and February 9, 1996). Nonetheless, in our most recent letter on this topic, the ACNW stated that further deliberations on the subject were appropriate. This letter reports on the results of our additional study. The ACNW will report to you in the near future on our recommendations on the time span for compliance of low-level nuclear waste facilities, building upon the

principles identified and discussed in this letter. In addition, the ACNW plans to review the reference biosphere and critical group issues.

Our recommendations are derived from a working group meeting on "Regulatory Time of Compliance for Radioactive Waste Disposal" held during the 82nd meeting of the ACNW on March 27, 1996, and subsequent deliberations by the Committee. Three main topics were discussed at the working group meeting: (1) background and regulatory context for the existing HLW standard that specifies 10,000 years as a time frame for regulatory compliance, (2) insights on time of compliance from performance assessments for both high- and low-level nuclear waste, and (3) scientific/technical issues and concerns. During the working group meeting, presentations were made by personnel from the EPA; the Division of Waste Management, Office of Nuclear Materials Safety and Safeguards, NRC; the U.S. Department of Energy; the National Research Council staff; the Electric Power Research Institute; the Oak Ridge National Laboratory; as well as by individuals from private industry and academia. The latter individuals provided both national and international viewpoints on the problem of compliance time in regulations.

Background of the Problem

A necessary element of a standard or regulation that ensures the health and safety of the public is the compliance period -- the time that the risk of adverse consequences is below a specified level. This compliance period requires the integrity of the facility over the stipulated time interval. In the case of an HLW repository, the assessment of risk involves evaluation of the repository source term, including inventory and waste form; the performance of waste containers and engineered barriers; and the geological, hydrological, and climatological attributes of the site. If the risk of health effects is to be determined, this assessment also involves the specification of the biosphere and the critical population group in proximity to the repository.

In the existing generic standard for geologic HLW repositories, 40 CFR Part 191, EPA established a 10,000-year time of compliance at a distance of no more than 5 km from the boundary of the repository -- a time value that also was used in the NRC regulation. This time period has no scientific or technical justification but was based on an arbitrary compromise between conflicting desirable characteristics. Long time periods have attendant large uncertainties in the behavior of the geosphere and the biosphere, while short time periods have lower uncertainties but do not adequately address the time spans of some of the critical processes that cause release of radionuclides to the biosphere. This compromise was perhaps a justifiable approach for comparative evaluation of the

multiple sites being considered when 40 CFR Part 191 was promulgated. Although not considered a compelling technical basis, this time period was roughly consistent with the period of glacial cycling and the potential profound impact of continental glaciation upon the geosphere and the biosphere. In providing a rationale for the 10,000-year time limit, the EPA stated, "This is not to say that times beyond 10,000 years are not important, but the Agency feels that a disposal system capable of meeting the proposed Containment Requirements for 10,000 years would continue to protect people and the environment well beyond 10,000 years." Although the standards of other nations differ in detail, the international community largely accepts the 10,000-year time frame, but also recognizes the need to evaluate site performance beyond the 10,000-year period, which constitutes a two-part approach.

In its appraisal of the technical bases for site-specific Yucca Mountain standards, the NAS Committee rejected the 10,000-year compliance period although it accepted that a transition to a glacial climate with its cooler, wetter seasons is probable during the next 10,000 years. Rather, the NAS Committee decided that long-lived radioisotopes derived from the repository might not reach the biosphere for more than 10,000 years, and thus it is important to evaluate the repository for a longer time interval. The NAS Committee chose to set this period of time at the predicted time of peak risk to the population as a result of leakage from the repository. It viewed this decision as requiring a period of time possibly extending into hundreds of thousands of years. In so doing, it did not accept the view espoused in the EPA and NRC standards and regulations that the uncertainties in predicting the repository performance at these periods are so large that the results are of questionable utility. The basis of the argument is that the subsurface environment at the repository horizon of Yucca Mountain is sufficiently stable that repository performance can be assessed with an acceptable uncertainty over a period of roughly one million years. The NAS Committee believes that inherent spatial uncertainties in interpolation of site characteristics, which are time independent, are a major contributor to assessment uncertainty.

The dilemma faced in developing the time span of compliance is that the period of time must be sufficiently long to include the evaluation of potential processes leading to the loss of the integrity of the repository and transport of radionuclides to the biosphere. Yet the time span should not be so long that the uncertainties in the process and events, and in the biosphere and critical population group, lead to meaningless results. In the case of a specific site, sufficient information should be available so that reasonable assumptions can be made in order that a defensible solution can be reached regarding the problem of a regulatory period of compliance. This approach is based on general

principles and knowledge of the engineering and scientific aspects of the repository and its site.

Considerations in Defining a Time of Regulatory Compliance

After reviewing the basis for establishing a time of regulatory compliance, the ACNW has concluded that a series of premises and assumptions are a necessary foundation for the decision making process. These include general policy decisions that are generic and a range of scientific and technical considerations that are largely specific to the site and problem:

- The HLW repository system -- waste, containers, engineered barriers, and site geology -- must be capable of preventing leakage of radionuclides to the biosphere for a minimum period of time measured in several thousands of years.

- Risk evaluation is based on characterization of the repository site and investigations of the waste and its container and engineered barriers using performance assessment (PA). However, in the development of the regulations, the marked limitations in using PA as a predictive tool needs to be recognized. PA is primarily an investigative tool that can be used to distinguish between positive and negative attributes of the elements of the repository and, in the best of conditions, the relative range of risk under various assumed scenarios.

- The standard for a nuclear waste repository should be based on limiting risk to a critical group without the constraint of a prescribed time period of compliance. A time period should be defined in the regulations that implement the standard and should be prepared in concert with the characteristics of the waste, engineered barriers, and the nature and vagaries of the geosphere and the biosphere of a specific facility and site.

- The reference biosphere and the critical group that are used in assessing compliance should be defined in the regulations. These definitions are necessarily based on site characteristics and on the impact of climate and predicted climate modifications. They are related to predictions of the nature of society through time. Because of the great uncertainties in the latter, the ACNW recommends that the current societal state be used as the base scenario in predictions of the future states of society.

- Uncertainties in assessing future risks associated with the geologic/geographic setting and the repository design and related engineered features will increase with time. Factors that influence this increasing uncertainty include the

following: geologic conditions and events that may disrupt the repository; climatic changes that could drastically increase the flux of water through the disposal system or change the regional hydrologic flow regime; degradation of the waste containers or repository materials; and synergistic effects of changing site conditions on the degradation of repository features. Design features can be implemented to preclude extreme variations in releases (e.g., waste forms, containers, and near-field barriers may be engineered to minimize transport out of the immediate repository facility and thus minimize uncertainties in transport for several thousand years).

Regulatory Principles for Establishing the Time Span for Compliance

On the basis of the preceding considerations, the ACNW recommends that a two-part approach to definition of the compliance period be established for nuclear waste facilities. The first part involves the following three elements:

(1) The time period for compliance should be based on the estimated time for release and transport of the radionuclide contaminants to reach the critical group. This time estimate should be based on geologic, geochemical, and hydrologic characterization of the site and its environs, as well as regional study of geologic processes and their potential effects on the site, and total systems performance assessment. This estimate must confirm the ability of the repository system to retain radionuclides for a minimum of several thousand years. The selection of the time of compliance must be evaluated along with the specification of the reference biosphere and critical group.

(2) The reference biosphere and the lifestyles of the critical group should be defined on the premise that no major changes will occur in society that will significantly affect their lifestyles as they relate to risk from the repository and that the climate can be reasonably bounded. The minimum distance from the boundary of the repository to the critical group will be a major decision.

(3) The compliance time should be sufficiently short such that extrapolations of significant processes and their rates can be made robustly with reasonably modest uncertainties.

The second part of the compliance period regulations should be based on assessments extending from the specific compliance period to the calculated time of the peak risk to the critical group. There is no definitive measure of compliance in the sense of a numeric match between a standard and the calculated peak risk, and

this second part should not be allowed to become a de facto regulation. A comparison between the standard used in the first part and the calculated peak risk should lead to identification of important performance factors that define risk to the critical group. Depending upon the extent to which the peak risk exceeds the standard, ameliorating actions to reduce this difference should be initiated, such as increasing the integrity of the engineered barriers, improving site characterization to more closely bound uncertainties, or, in the extreme, abandoning the candidate site.

Scientific and Technical Insights Into the Time Span for Compliance of the Proposed Yucca Mountain Repository

Critical steps in the regulatory principles for establishing time of compliance as specified above in element (1) are the characterization of the proposed repository site and the relevant processes acting upon it and assessing the total system. Although site characterization is still in progress at Yucca Mountain, extensive data have been acquired and information has been derived from these data. The following scientific and technical insights that have been gained at the site over the past decade bear upon the definition of the compliance time in the forthcoming regulations designed specifically for Yucca Mountain.

- The current climate in the Yucca Mountain region is arid, with annual precipitation of roughly 15 cm. In the future, the climate will change, depending upon the relative importance of advancing cooler (glaciation) conditions and possible greenhouse effects that may counteract the cooling effect. Although the timing and precise amplitude of the climate change cannot be predicted, the range of conditions can be bounded in terms of timing and effect. Paleoclimatological studies in the region of Yucca Mountain suggest that during the last glacial period (14 to 20 thousand years ago) the precipitation may have been four times the present and the average annual temperature 10 °C cooler (Forester and Smith, 1995). Climatic conditions are anticipated to change, but the region is likely to be at least semiarid and will lie south of the glaciated area. Thus, it is unlikely that climate change will have a marked effect on the reference biosphere or the lifestyle of the critical group. Infiltration is likely to significantly increase as a result of the increased precipitation and cooler temperatures, but the total flux through the repository will still be limited. The maximum climatic change is not predictable with our present science, but all evidence from extrapolations indicates that the principal effect will occur prior to ca. 20,000 years.

- Results of recent site characterization activities at Yucca Mountain indicate that matrix, fracture, and fault infiltra-

tion are present in the unsaturated zone. Matrix flow results in long travel times, but fracture and fault flow that may lead to relatively rapid travel times also occurs. Ground water travel times within the saturated zone between Yucca Mountain and the location of the critical group, which is likely to reside in the Amargosa Valley several tens of kilometers south of the proposed repository, are poorly documented at this time. However, the low hydraulic gradient indicates that travel times are likely to be long. Further, the sorptive capacities of formations through which the water will traverse are not presently known and the degree of dilution of contaminants within the saturated zone has not been ascertained. In view of the likely long travel time of water in the saturated zone from the proposed Yucca Mountain repository to the critical group, the movement of contaminants may well take in excess of 10,000 years to reach the accessible environment, despite the potential for relatively short travel time through the fractures and faults of the unsaturated zone.

- The relative uncertainties in predicting the time dependent and spatial variations in the Yucca Mountain geosphere and related geologic processes have come to the forefront as a result of the NAS Committee's report and their statements on the confidence that can be placed on performance assessment at distant future times. The NAS Committee concluded that although ". . . the level of confidence for some predictions might decrease with time . . . [m]any of the uncertainties in parameters describing the geologic system are due not to temporal extrapolation, but rather to difficulties in spatial interpolation of site characteristics." The ACNW acknowledges that the spatial variations in the Yucca Mountain geosphere contribute to uncertainty. Nonetheless, we believe that with the completion of an adequate characterization of the site and with consideration of the integration over the heterogeneities for the operational scale of the pertinent processes, the time-dependent uncertainties in events and processes, such as climate change, will be more prominent than those derived from spatial variations. Yucca Mountain lies within a region of potentially high gradient tectonic and climatic processes. As a result, the ACNW anticipates that uncertainties will increase with time, although we agree with the National Research Council/NAS report that it should be possible to bound these uncertainties over a time span on the order of one million years.

<u>Recommendations for a Yucca Mountain Repository Compliance Period</u>

On the basis of the previous discussion of both generic principles and Yucca Mountain specific insights, the ACNW recommends the

following two-part approach to establishing the time period for compliance for the proposed HLW repository site at Yucca Mountain, Nevada:

The first part involves the following:

(A) The time period of compliance should not be specified in the risk-based standard for Yucca Mountain being prepared by the EPA. Rather, it should be defined in the regulations being developed by the NRC to implement the EPA standard and should use existing knowledge of the engineering and scientific aspects of this proposed repository and its environment.

(B) The time period should be defined in concert with specifying the reference biosphere and the critical group. The definition of the biosphere and the critical group should take advantage of known site characteristics and any other long-term effects that can be technically supported.

(C) The time span for the compliance period should be no shorter than an estimate of the anticipated time it takes for potential radionuclide contaminants to reach the nearest critical group and no longer than a time period over which scientific extrapolations can be convincingly made. Because of the need to come to closure on this subject, the ACNW suggests that the NMSS staff review the scientific and technical components needed to make these decisions, identify critical missing elements, and provide the necessary information in a timely manner. On the basis of currently available information, the ACNW anticipates that the appropriate compliance period will be somewhat greater than the present standard of 10,000 years. The increased distance from the proposed site to the nearest probable location of the critical group, the nature of the site and the likely characteristics of the waste, the containers, the engineered barriers, and the design of the repository, together with consideration of the stability of the site, suggest a time frame on the order of a few tens of thousands of years, but specifying a precise value must await more comprehensive assessments.

The second part of the compliance regulation should require assessment extending from the specified compliance period to the time of the calculated peak risk to the critical group. The regulation for compliance during this intervening period should be significantly less stringent than is used in the previous period, considering the increasing scientific, technical, and critical group uncertainties. Depending upon the extent to which the peak risk exceeds the standard for the first part, steps should be considered to ameliorate the potential risk. This second part of

the compliance regulations should not be allowed to become the de facto regulation.

Summary

The regulatory time period for compliance is an important element in regulations for nuclear waste facilities and remains a problem in developing site-specific requirements for protecting the health and safety of the Nation, as well as its environment. The ACNW suggests a solution to this problem from a generic standpoint, which employs two parts. Using scientific and technical insights into the environment of the repository proposed for Yucca Mountain, we recommend an approach that establishes the time of compliance of the facility at this site, which differs from the current regulation and the proposal on this topic made by the National Research Council/NAS Committee in its report, *Technical Bases for Yucca Mountain Standards*. We believe that our recommendations will lead to a simple, robust, and defensible regulation that can be readily implemented.

Sincerely,

Paul W. Pomeroy
Chairman

References:

1. Report dated February 9, 1996, from Paul W. Pomeroy, Chairman, ACNW, to Shirley Ann Jackson, Chairman, NRC, Subject: Issues and NRC Activities Associated with the National Research Council's Report, "Technical Bases for Yucca Mountain Standards"

2. Report dated June 27, 1991, from Dade W. Moeller, Chairman, ACNW, to Kenneth M. Carr, Chairman, NRC, Subject: "Response to questions Accompanying Working Draft #3 of the EPA Standards"

3. R. M. Forester and A. J. Smith, "Late Glacial Climate Estimates for Southern Nevada: The Ostracode Fossil Record," in High-Level Radioactive Waste Management, Vol. 4, pp. 2553-2561, 1994

TIME SPAN FOR COMPLIANCE OF PROPOSED HIGH-LEVEL WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA

Outline

- Background of the Problem
- Considerations in Defining Time of Regulatory Compliance
- Regulatory Principles for Establishing Time Span for Compliance
- Scientific and Technical Insights for Proposed Yucca Mountain Repository
- Recommendations for Yucca Mountain Repository Compliance Period

Background of the Problem

- Time of Regulatory Compliance -- Period That Risk of Adverse Consequences Is Required to Be below Standard

- Existing Generic EPA Standard 40 CFR Part 191, and NRC Regulation, 10 CFR Part 60
  - 10,000-year compliance within 5 km of repository

- Site-specific Yucca Mountain Standards -- National Research Council Committee
  - Rejected 10,000-year compliance period

- Dilemma in Developing Time Span of Compliance
  - long enough to evaluate potential release and transport to biosphere
  - Not so long that uncertainties lead to meaningless results

- Site Specific Information Provides Basis for Making Reasonable Assumptions

Considerations in Defining a Time of Regulatory Compliance

- HLW Repository System must Be Capable of Preventing Leakage of Radionuclides to the Biosphere for a Minimum of Several Thousands of Years

- Risk Evaluation Considers all Elements of Waste Containment and Site Characteristics using Performance Assessment (PA)
  - PA primarily an investigative tool
  - Distinguish positive and negative attributes of repository
  - Assess relative range of risk under various assumed scenarios

- Standard for a Nuclear Waste Repository Should Be Based on Limiting Risk to a Critical Group without Prescribing Time Period of Compliance

- Regulations Should Define Time of Compliance in Conjunction with Reference Biosphere and Critical Group

- Uncertainties Associated with Processes and Events that Affect Repository Will Increase with Time

Regulatory Principles for Establishing Time Span for Compliance

Two-Part Approach

- First Part of the Compliance Time Period Based on Estimated Time for Release and Transport of Radionuclides to Reach Critical Group

  - Reference biosphere and critical group defined on premise of no major changes in lifestyles from current society and that climate changes can be reasonably bounded
  - Compliance time should be sufficiently short such that extrapolations of significant processes and rates can be made with reasonably modest uncertainties

- Second Part Based on Assessments Extending to Calculated Time of Peak Risk

  - No definitive measure of compliance
  - Should not become a de facto regulation.
  - Identify important performance factors
  - Ameliorating actions may be taken if peak risk significantly exceeds standard

Scientific and Technical Insights For Proposed Yucca Mountain Repository

- Current Climate in Yucca Mountain Region Is Arid (Annual Precipitation ~ 15 Cm)

  - Climate likely to change, to cooler conditions in future (glacial regime)
  - Will still be semiarid
  - Unlikely to have marked effect on reference biosphere or lifestyle of critical group
  - Total flux through repository still limited

- Potentially Short Transport Times in Unsaturated Zone Indicated by Recent Site Characterization at Yucca Mountain

- Potentially Long Transport Times in Saturated Zone Between Yucca Mountain and Possible Critical Group in Amargosa Valley 20-30km South of Proposed Repository

- Relative Uncertainties in Predicting the Time Dependent and Spatial Variations of the Yucca Mountain Geosphere and Related Geologic Processes

- ACNW Believes Time-dependent Uncertainties in Events and Processes, Such as Climate Change, Will Be More Prominent than Those Derived from Spatial Variations

Figure 1. View looking southeast from Yucca Mountain to Amargosa Valley.

Recommendations for Yucca Mountain Repository Compliance Period

Two-Part Approach

I. First Part of the Time Period of Compliance

- Should be Defined in NRC Regulations Being Developed to Implement EPA Standard

  - Use existing knowledge of engineering and scientific aspects of proposed repository and environment
  - Employ performance assessment as analytic tool

- Should Be Defined in Concert with Reference Biosphere and the Critical Group

  - Take advantage of known site characteristics and long-term effects that can be technically supported

- Should Be No Shorter than Estimated Time for Potential Radionuclide Contaminants to Reach Critical Group and No Longer than Time Period over Which Scientific Extrapolations Can Be Convincingly Made

  - NMSS staff review scientific and technical components needed to make these decisions
  - Based on current information compliance period may be somewhat greater than the present standard of 10,000 years

Recommendations for Yucca Mountain Repository Compliance Period

Two-Part Approach (Continued)

II. The Second Part

- Require Assessment Extending from Specified Compliance Period to Time of Calculated Peak Risk to Critical Group
- Regulation for Compliance Should Be Significantly less Stringent than Used in First Period
- Consider Increasing Scientific, Technical, and Critical Group Uncertainties
- Depending upon Extent That Peak Risk Exceeds Standard Steps Should Be Considered to Ameliorate Potential Risk
- Second Part of Compliance Should Not Be Allowed to Become De Facto Regulation

ENCLOSURE 3

KEY TECHNICAL ISSUES

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

February 16, 1996

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

Dear Chairman Jackson:

SUBJECT: COMMENTS ON HIGH-LEVEL WASTE PRELICENSING PROGRAM STRATEGY AND KEY TECHNICAL ISSUES

This letter communicates our recommendations and suggestions on the "Revised Prelicensing Program Strategy for the U. S. Nuclear Regulatory Commission High-Level Waste Repository Program ('Vertical Slice Approach')" and the NRC staff's plans for resolving key technical issues (KTIs) dealing with the proposed high-level waste (HLW) geologic repository at Yucca Mountain, Nevada. These remarks are based on presentations by the NRC staff to the Committee concerning the vertical slice approach at the 77th ACNW meeting, September 1995; on key technical uncertainty integration and resolution of KTIs at the 79th ACNW meeting, November 1995; and subsequent deliberations of the Committee.

The Committee is aware of the changing emphasis and scope of the NRC's HLW prelicensing strategy as a result of modifications in the Department of Energy's (DOE's) site suitability investigations and prelicensing programs and the reductions in resources to both DOE and NRC. Although there are uncertainties in implementing plans and projecting strategies, we wish to support the general approach of the NRC staff in dealing with both the program strategy and the KTIs.

The ACNW commends the staff for its development of a vertical slice concept designed to focus the HLW program on the most critical licensing issues. In particular, we are pleased to learn of the emphasis on risk to repository performance in identifying elements of the prelicensing strategy and plans for conducting the program. We support the emphasis on issue resolution, but not to the point of compromising legitimate concerns that could impact the health and safety of the public. Other concerns include the need to develop review and acceptance criteria to determine the adequacy of bounding analyses, an apparent lack of emphasis on coupled processes, and the need to maintain sharp focus on risk to the predicted performance of the repository.

Revised Prelicensing Program Strategy

The revisions in the NRC HLW prelicensing program strategy (vertical slice approach) incorporate a comprehensive review of critical issues in the DOE program that have the highest risk of noncompliance with regulations for licensing an HLW geologic repository at Yucca Mountain, Nevada. An important objective of the program is to provide DOE with timely information required for a substantially complete license application. The program is designed to increase the efficiency and effectiveness of NRC's prelicensing activities in view of the changes being made in the DOE prelicensing program and the decreasing resources available to the HLW programs of both agencies. The Committee notes many strengths of the vertical slice approach, including: its focus on the key licensing problems, recognition of the need for flexibility in designing and implementing the program, the integration of disparate key technical uncertainties (KTUs) into KTIs, the integration across and within scientific/technical disciplines, the emphasis on resolving issues with DOE, and the potential for efficiency in utilizing scarce resources.

The NRC staff acknowledges and discusses potential weaknesses of the vertical slice approach in the September 1, 1995 draft of the revised "Prelicensing Program Strategy" document. We support the concern raised in this document that a less than comprehensive approach to prelicensing has some inherent risks. The currently identified list of key issues may not be complete. Our ability to specify these issues is limited by the technical and scientific complexity of the unprecedented effort to license the potential HLW repository at Yucca Mountain. A focused prelicensing program that eliminates substantial issues from review or that is inflexible with regards to selection of KTIs is possibly open to problems. The Committee urges the staff to remain flexible with regard to the selection of KTIs. Performance assessment, expert judgment, experimental programs, and special studies are all valuable procedures for evaluating existing KTIs and identifying new ones.

The Committee has developed the following observations and recommendations on the basis of its evaluation of the NRC's HLW prelicensing program:

1. Issue resolution, which is an important objective of the vertical slice approach, is also important to the progress of licensing the HLW repository. The issue resolution approach should focus on health and safety to the public, reduction of uncertainties in meeting reasonable assurance criterion, and decreasing the risk of noncompliance with the regulations. This requires a cautious approach to issue resolution. In view of the complexity of the problems involved in the repository, it is likely that differences will remain between DOE and NRC on some issues. These differences, and the

evidence supporting them, need to be fully documented with the expectation that these matters will be presented before a licensing board. Resolution should not be required by NRC, and DOE should not be required to conduct data acquisition and analysis it believes to be unwarranted.

The design of the vertical slice approach regarding the actual procedures to resolve issues continues to evolve. The Committee notes that the NRC recently proposed to DOE a process for resolving issues, entailing interactions, documentation, and generic criteria. This process includes the disaggregation of KTIs into subissues. The Committee believes this process needs to assure that the disaggregation mechanism maintains the integral nature of the KTIs and their impact on health and safety. An NRC/DOE task force will be established to review the process. Instruments for specifying and documenting resolution, such as the NRC Issue Resolution Reports, letter reports, Prelicensing Evaluation Reports, and Safety Evaluation Reports, will be developed. But, it is unclear how actual resolution of the KTIs will be achieved between DOE and NRC.

In the interest of achieving the efficiency that is central to the vertical slice approach, criteria should be developed to determine when activities should be terminated within a specific vertical slice. DOE is planning to rely on bounding analyses for decision making. We urge the staff to expeditiously develop methods and acceptance measures to review bounding analyses by using the iterative performance assessment framework. We anticipate that these measures will be significant in establishing termination criteria.

2. The NRC will receive numerous data synthesis and process model reports from DOE in 1996. These reports will synthesize the information available on a topic and will provide a source of reference for the related data. Such reports appear especially important to prelicensing activities because they presumably will contain DOE's approach to bounding analyses. The Committee recommends that the NRC give high priority to reviewing these reports as rapidly and thoroughly as possible so that DOE is informed of any NRC licensing concerns and data needs before it completes its prelicensing activities and makes a decision about repository viability.

3. The vertical slice approach should involve an iterative process within and among vertical slices. We believe the iterative process is important to successfully complete a review and needs more emphasis in the description and implementation of the vertical slice approach. The Committee believes it important to have a process for guiding the

iterations of the KTIs in concert with the iterations of the performance assessment.

4. NRC must ensure that its schedule to conduct priority activities is synchronized with DOE's revised schedule of activities and milestones. Given the uncertainties in DOE's program and budget, NRC should review previously defined time constraints in the prelicensing program. Modifications may be necessary because of current and anticipated funding and staffing limitations and the need to maintain the highest quality products from the NRC.

Key Technical Issues

The Committee supports the important activity of recognizing KTIs through the process of integration of KTUs previously identified through the Systematic Regulatory Analysis Program. We generally agree with the criteria the staff used in this process. We especially support the use of risk to repository performance as the prime criterion wherein both probability of occurrence and consequence are considered. We have the following observations and recommendations pertinent to the identification of KTIs and their investigation in the vertical slice approach:

1. We note that DOE has taken exception to identifying Igneous Activity and Structural Deformation and Seismicity as significant KTIs. We believe that these issues should continue to be subject to review in the vertical slice approach because of the controversy regarding their potential risk to the repository performance. Igneous Activity is important as a KTI because of the uncertainties associated with the probability of occurrence of igneous events and their impact on the repository. Structural Deformation and Seismicity is also significant as a KTI because of the need to determine the level of seismic hazard and to evaluate direct effects on waste containers and engineered barriers. In addition, indirect effects on repository performance resulting from modifications in near- and far-field flow and transport properties of geologic strata and water table elevation changes need further consideration.

2. The Committee is not satisfied that the issue of Thermal-Mechanical-Hydrological-Chemical Coupled Processes is moving toward resolution. Elements of this issue are treated only within individual KTIs. The process by which they are integrated and evaluated as a total system is unclear. Presumably, it will be considered in the Total Systems Performance Assessment (TSPA) and Technical Integration KTI. However, the strong possibility exists that the interaction of phenomena and their resulting modifications of parameters and processes may be neglected in the face of the major emphasis

on TSPA in this KTI. The Committee is concerned with the issue of coupled processes and supports a strong program to resolve this issue with the vertical slice approach.

3. The Committee has long had a major interest in the integration of site characterization activities and their conclusions. We are pleased to see a KTI that considers integration. However, it is unclear at what level(s) integration will be considered in the KTI and how the results of other individual KTIs will be brought into the integration KTI. Further, it is unclear whether components involved in integration will be available in a timely manner. TSPA and Technical Integration is a particularly significant KTI because it will play a key role in establishing the importance of issues and subissues to overall repository performance.

4. The priority rankings assigned to KTIs by staff are open to question. In view of the central role of repository design on DOE's proposed viability assessment, we encourage the staff to place high priority on all KTIs that are closely tied to repository design considerations, since we believe that mixing of scientific/technical issues with management/policy issues has the potential to confuse priorities.

5. The Committee has a longstanding interest in performance assessment and the veracity of the attendant codes and models. DOE will be attaching major importance to its TSPA-1997/1998 results in the conclusions of the viability assessment. In view of the drastic reduction of the site characterization and related studies, it will be particularly important for NRC to conduct confirmatory performance assessments and to evaluate the performance assessment codes and models used by DOE. We note that the latter activity has been removed from the TSPA KTI. This decision should be reconsidered.

6. The NMSS staff has considered preparation of a yearly status report on KTI activities and results. This excellent proposal will prove useful to NRC and DOE. We urge that it be implemented.

Summary

The ACNW commends the staff for its revised HLW Prelicensing Program Strategy (vertical slice approach) and the identification of KTIs that will be the subject of prelicensing activities. The Committee recommends that the staff ensure that there is a mechanism to provide rapid and continued input to DOE to influence the site viability decision, data collection, testing, and TSPA. In addition, the staff needs to periodically reevaluate the list of KTIs on the bases of new information, new analyses, and issue

resolution while staying focused on issues impacting repository performance.

The Committee has made several suggestions which, if accepted, should sharpen the vertical slice approach and its implementation. The Committee wishes to be kept informed of the progress of the vertical slice program and to be included in review of the staff's related products, such as Implementation Plans, Issue Resolution Reports, and the Performance Evaluation Reports.

Sincerely,

Paul W. Pomeroy
Chairman

Reference:
U. S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, "Revised Prelicensing Program Strategy for the U. S. Nuclear Regulatory Commission High-Level Waste Repository Program ('Vertical Slice Approach')," September 1, 1995

HLW PRELICENSING PROGRAM STRATEGY AND KEY TECHNICAL ISSUES

The "Vertical Slice Approach"

- Manages reduced staff resources.
- Response to change in DOE Program.
- Identifies Key Technical Issues (KTIs) important to licensing.

HLW PRELICENSING PROGRAM STRATEGY AND KEY TECHNICAL ISSUES

ACNW Conclusions

- Strengths
  - Focus on issues that affect risk to performance.
  - Recognition of need for flexibility.
  - Integration of scientific/technical disciplines.

HLW PRELICENSING PROGRAM STRATEGY AND KEY TECHNICAL ISSUES

ACNW Conclusions

- Weaknesses
  - Identification of issues may not be complete.
  - Priority ranking of KTIs open to question.
  - Disaggregation of KTIs into subissues may not maintain the integral nature of the KTI.
  - It is unclear how issue resolution will be achieved.

HLW PRELICENSING PROGRAM STRATEGY AND KEY TECHNICAL ISSUES

Issue Resolution

- Should focus on health and safety.
- Should not be required by NRC.
- Requires a cautious approach.
- Needs documentation.

HLW PRELICENSING PROGRAM STRATEGY AND KEY TECHNICAL ISSUES

ACNW's Recommendations

- Periodic evaluation of KTIs and program emphasis.
- Integration unclear.
- Establish criteria for terminating activities within a specific KTI.
- Maintain focus on predicted performance.

HLW PRELICENSING PROGRAM STRATEGY AND KEY TECHNICAL ISSUES

Future ACNW Activities

- Igneous Activity
  - Potential risk to performance controversial.
  - Working Group meeting to evaluate path to resolution of this issue.
- Coupled Processes (T-H-M-C)
  - Interactions important to performance.
  - Working Group meeting to evaluate NRC activities.

ENCLOSURE 4

TECHNICAL BASES FOR YUCCA MOUNTAIN STANDARDS

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

February 9, 1996

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

Dear Chairman Jackson:

SUBJECT: ISSUES AND NRC ACTIVITIES ASSOCIATED WITH THE NATIONAL RESEARCH COUNCIL'S REPORT, "TECHNICAL BASES FOR YUCCA MOUNTAIN STANDARDS"

During its 80th meeting on December 19-21, 1995, the Advisory Committee on Nuclear Waste (ACNW) was briefed on activities associated with the subject report. The Committee heard two presentations from the staff. The first reported on the staff's activities in anticipation of receipt of a Yucca Mountain standard from the Environmental Protection Agency (EPA) to be issued later this year. The second presentation was specific to the technical analyses being performed relative to the National Research Council's recommendations. Also, at its 77th meeting on September 21, 1995, the Committee was briefed by Robert W. Fri, Chairman of the National Research Council's committee that prepared the report.

The Committee is prepared to provide at this time only preliminary comments on the implications of the report and on the activities of the NRC staff. Many important issues are associated with the development of the standard and the Nuclear Regulatory Commission (NRC) regulations that must conform with it. Some topics, such as the "critical group" require more study by the Committee before specific recommendations can be made. It is to be noted that the Committee has commented on many of the issues discussed herein in previous letters. These issues include the concept of defense in depth (September 30, 1994), compliance time frames for repository performance (March 3, 1993), human intrusion (February 5, 1993), and critical group (May 1, 1990, January 29, 1991, April 29, 1991, September 30, 1992, and February 5, 1993).

In general, NRC staff activities connected with the standard are satisfactory. The principles being applied by the NRC staff include a strategy of developing Yucca Mountain specific regulations, keeping the regulations as simple as possible, and focusing on key issues such as the implication of a peak risk standard and regulations specifically designed to reflect a risk- and health-based standard. These principles are appropriate and

sound. The staff appears to have effectively identified many other specific issues that will need special study and consideration before the regulations can be modified or developed. Such specific issues include time frames of compliance, definition of the biosphere and the critical group, calculation of peak dose (risk), human intrusion, and subsystem performance. The Committee was pleased to see the staff analyses include different exposure scenarios and conditions as this will enhance the staff's ability to respond effectively to any standard the EPA may propose. On-going technical interaction between NRC and EPA staffs as the EPA develops a proposed standard is an important activity. The Committee urges the staff to maintain what appears to be a sound program.

Preliminary conclusions and recommendations of the Committee are: there needs to be serious consideration of retaining a compliance time frame in the planned standard and regulations, subsystem performance needs to be quantified but not prescribed in advance, human intrusion should not be a part of the standard or the regulations except in a general way, and neither the standard nor the regulation should be tied to the EPA groundwater risk standard. While not a major topic in this letter and as discussed in the National Research Council's Yucca Mountain standard report, the Committee believes that the concept of a "negligible risk" needs revisiting in view of the possibly very long time frames associated with the application of a peak dose calculation and the extreme difficulty of defining acceptable risk.

The following specific points are briefly discussed below:

- regulatory time frame
- definition of the biosphere and the critical group
- foundation of the standard: population or groundwater
- human intrusion
- the defense in depth policy and the matter of subsystem performance criteria
- NRC conformity with EPA in a separate Yucca Mountain regulation
- NRC staff activities

<u>Regulatory Time Frame</u>

Extreme uncertainties in the prediction of magnitude and time of the peak dose are highly likely. Also we concur with the strong desire for regulations to be as simple as can be reasonably achieved. These factors contribute significantly to the Committee conclusion that a specified regulatory time frame for repository performance is necessary. The Committee believes that the balance of factors accompanying modification of the 10,000 year time frame results in no clear advantage for changing the present approach, but will conduct additional reviews on this topic in the near future through working group meetings.

Definition of the Biosphere and the Critical Group

Because the site is known, the opportunity exists to develop a very focused definition of the biosphere. The Committee urges NRC staff to take full advantage of the known site characteristics (land use, climate, habitation potential, potable water sources and usages, etc.) in any proposals to define the Yucca Mountain biosphere. In particular, the Committee believes that the definition of the biosphere should include such elements as risk-relevant pathways, locations and withdrawal rates of wells, and uptake factors of biological systems of the Yucca Mountain site. The Committee sees the biosphere definition as an extremely important opportunity to achieve simplicity in the regulations.

The Committee will require more time to study the topic of the critical group. The Committee recommends that the treatment of the critical group issue be consistent with the concept of a risk- and health-based standard. The Committee believes that the definition of the critical group should be determined by the compliance time frame and on any supporting evidence, including the uncertainties involved.

The Committee believes that if definition of the biosphere and the critical group were to be accompanied by a threshold dose to humans below which the repository would be deemed in compliance, it would represent a major accomplishment in the field of practical, risk-based regulation.

Foundation of the Standard: Population or Groundwater

The Committee has previously expressed concern over using a groundwater contamination requirement for resource protection as a surrogate for protecting the health and safety of the public against the effects of ionizing radiation. Because of the extremely long times involved and the uncertainty in the dose calculations at levels approximating the groundwater standard, invoking the groundwater standard would be inappropriate and not in concert with traditional nuclear regulation.

Human Intrusion

For time frames on the order of thousands of years, it is not reasonable to preclude consideration of human activities that could violate the integrity of the repository. The Committee believes it is better to focus on a well-designed repository that retains its integrity over a long period of time under conditions of the natural geological setting. It is then possible to consider different scenarios of human intrusion to further gain confidence in the general performance of the repository.

The Defense in Depth Policy and the Matter of Subsystem Performance Criteria

In previous letter reports, the Committee has expressed strong support for the concept of defense in depth for achieving safety. We continue to believe that multiple lines of defense are important where there is considerable uncertainty about the risk of a facility. In the case of Yucca Mountain (the site is known, the inventory and characteristics of the waste are known and there will be only one design), we believe it unnecessary to put as much emphasis as we have in the past on such subsystem requirements as container performance, rate of release from engineered barriers, and groundwater travel time. The Committee believes that under the specific conditions of the Yucca Mountain repository, the basis exists for less stringent and more flexible subsystem requirements than have been traditionally imposed. Emphasis should be placed on the contribution of subsystems to overall performance of the repository. The Committee strongly favors quantifying all subsystem performance, engineered and natural, in the performance assessment. Should it be clear from an assessment that a waste container, an engineered barrier, groundwater travel time or another potential subsystem is a particularly critical factor in total system performance, then a logical basis exists for making decisions on how to improve the overall safety of the repository.

NRC Conformity With EPA in a Separate Yucca Mountain Regulation

Pursuant to the Energy Policy Act of 1992, NRC regulations must conform to the final EPA standards within one year. Since the EPA standard will be specific to Yucca Mountain, it follows that NRC regulations should be site specific. Close cooperation between the two agencies is needed to make the standard and the accompanying regulations as seamless as possible. The Committee believes the joint working group is an excellent way to discuss how best to address some of the issues raised by the National Research Council report. The Committee considers the establishment of a technical liaison in frequent contact with EPA a very positive action that should pay excellent dividends. The Committee strongly urges that this process be maintained.

NRC Staff Activities

The Committee agrees with the NRC staff's approach in performing technical analyses related to the National Research Council's recommendations concerning the Yucca Mountain standard. The decision to use existing information and models, including the Iterative Performance Assessment Phase 2 model, to develop near-term insights on such issues as the evaluation of peak doses, to examine critical data needs, and to use conceptual models is sound. The evaluation of scenarios involving different exposure conditions, compliance periods, etc., is an excellent way to anticipate potential problems with implementing a risk-based

standard. The ability to share and discuss the findings with EPA is extremely important to the development of a technically practical standard. Meanwhile, the NRC staff is accumulating experience for efficient in-depth and comprehensive analyses once the standard and regulations are established.

The Committee strongly recommends that these analyses be sharply focused on conditions specific to Yucca Mountain. Besides emphasizing Yucca Mountain conditions, the Committee recommends realistic calculations wherever possible with respect to such phenomena as radionuclide retardation in fracture flow, dispersion effects in the transport models, and a judicious selection of such events as earthquakes and igneous activity. The assembly and analysis of data will strengthen the staff's understanding of the performance of the site.

We provide here only preliminary observations, conclusions, and recommendations. We believe the evolution of the standards and regulations for the proposed Yucca Mountain repository is a very important activity for NRC and EPA and plan to maintain awareness of the progress made. We urge the NRC staff to pursue these programs in a timely manner.

Sincerely,

Paul W. Pomeroy
Chairman

Reference:

"Technical Bases for Yucca Mountain Standards," National Research Council, 1995

TECHNICAL BASIS FOR YUCCA MOUNTAIN STANDARDS

ACNW February 9, 1996 letter - noted multiple previous Committee comments (since 1990) on defense-in-depth, timeframes, human intrusion, critical group.

Committee addressed several issues in February 9 letter:

- **Regulatory Timeframes - reported on earlier during this briefing.**
- **Health Effects of Low-Levels of Ionizing Radiation - reported on earlier during this briefing**
- **Critical Group/Biosphere - working group held yesterday.**
- **Biosphere definition important. Critical group should be consistent w/concept of a risk and health-based standard.**

TECHNICAL BASIS FOR YUCCA MOUNTAIN STANDARDS (cont'd)

Also believe if threshold dose could be generally accepted, at least for regulatory purposes, it would be major accomplishment. Further additional information required before this issue resolved...considerable discussion between scientists likely with resolution apolitical.

TECHNICAL BASES FOR YUCCA MOUNTAIN STANDARDS (cont'd)

Also addressed in February 9 letter:

population protection vis-a-vis protection of groundwater as resource (groundwater standard inappropriate);

human intrusion - focus should be on a well-designed repository that retains integrity for a long time (perhaps then consider human intrusion scenarios to gain further confidence in repository performance);

defense-in-depth/subsystem requirements - for site specific (Yucca Mountain) do not need subsystem requirements, but should quantify performance of all subsystems, engineered and natural, in the performance assessment.

Committee will continue to review and comment upon EPA proposed Yucca Mountain standards and the conforming NRC regulations.

ENCLOSURE 5

ACNW PRIORITIES

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D C 20555

December 28, 1995

MEMORANDUM TO: Chairman Jackson

FROM: Paul W. Pomeroy
ACNW Chairman

SUBJECT: REVISION OF ACNW PRIORITY ISSUES

The attached draft document dated December 28, 1995, presents the results of a recent Advisory Committee on Nuclear Waste (ACNW) review of topics that are potential items for deliberation by the Committee in high-level waste, low-level waste, and related performance assessment. It includes all issues directed to the Committee by the Commission as well as those requested by the NRC staff and several initiatives of the ACNW. The items in each category of issues are arranged in order of decreasing priority, but no attempt is made to prioritize issues among categories.

Highest priority is assigned to those topics directed to the Committee by the Chairman and Members of the Commission. All topics are ranked in order of their importance to the Commission and their due date. In selecting action issues, the ACNW also considers the resources available to the Committee and its general areas of expertise.

Although issues for deliberation are continually added to the agenda of its meetings based on directives and requests, the ACNW's agenda is generally based on a periodically revised listing of high-priority issues. The priority listing is used as a vehicle for obtaining advice from the Chairman on the issues of greatest interest to the Commission and as a guide for setting ACNW meeting agendas. Both short-term issues resolved within a few months and longer-term concerns are included in the priority issues list.

A review and revision of ACNW priority issues is timely because of the recent changes in the Commission, the rapidly evolving DOE high-level waste program, and the NRC response to these changes, as well as the decreasing resources available to the various elements of the waste program. The latter situation impacts the ACNW in several critical ways. First, declining funds for implementing DOE's characterization and prelicensing activities for the proposed underground repository at Yucca Mountain have drastically curtailed these programs and related NRC activities. As a result, the ACNW must react to these programmatic changes. Further, the decline of resources has limited the number of direct interactions with the DOE and NRC staffs. Finally, the restricted funding available to advisory committees necessarily limits the ACNW activities.

Accordingly, the enclosed priority list is directed at the most important issues. In addition, the ACNW has cut back on meetings by one-third. Efficiency is achieved by limiting the number of personal interactions with NRC, DOE, and other stakeholders. This has called for some modification to our operational procedures, with a greater emphasis on independent study by the members and staff of the ACNW and subsequent collegial deliberations at our meetings.

I look forward to discussing this most recent draft list of priority issues with you and Commissioner Rogers in the near future. I would welcome any comments and suggestions regarding additions, deletions or changes in emphasis that you might wish to make.

Attachment: Priority Issues

cc: Commissioner Rogers
J. M. Taylor, EDO

DRAFT

December 28, 1995

PRIORITY ISSUES

HIGH-LEVEL WASTE

1. Regulatory Framework

The Advisory Committee on Nuclear Waste (ACNW) is reviewing the consistency and compatibility of the regulatory process for licensing a high-level waste repository in accordance with the recently published National Academy of Sciences report on the "Technical Bases for Yucca Mountain Standards," EPA's pending 40 CFR Part 197, and NRC's response with modifications or alternatives to 10 CFR Part 60. The central focus is to review the technical basis for NRC's subsystem requirements versus bottom line performance measures. New ideas to preserve the defense-in-depth concept and its implementation will be considered. The ACNW intends to provide advice to the Commission to ensure a workable regulatory framework for high-level waste disposal that will provide adequate assurance of protecting public health and safety.

2. Adequacy of Revised Program Approach

The prelicensing and licensing activities of the NRC and DOE are in major transition. In its transition planning, DOE has changed its focus from a technical site suitability (TSS) decision and license application submittal to a Viability Assessment. The Viability Assessment involves repository design completion sufficient for evaluation of performance, and definition of costs and schedules. The key elements include repository and waste package design, total system performance assessment, a license application plan, and a Mined Geologic Disposal System life cycle cost. In addition, DOE will focus in 1996 on data analysis and synthesis rather than on data collection.

The NRC will conduct a preliminary review of DOE's Viability Assessment to identify licensing concerns using the Regulatory Review Plan. The NRC's current focus is on resolution of Key Technical Issues (KTIs) as part of its reduced vertical slice program, including working toward resolving KTIs.

The ACNW will evaluate DOE's revised approach, and NRC's revised program procedures, including resolution of KTIs and the high-priority tasks needed for their resolution.

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3. Site Characterization Activities Related to Waste Isolation Strategy

The ACNW will provide advice to the Commission on DOE's Viability Assessment determination for the Yucca Mountain project and its waste isolation strategy. The ACNW will provide advice to the Commissioners and guidance to the staff on site characterization and analysis activities related to DOE's topics and NRC's KTIs.

4. Repository Design (Includes Thermal Loading and Coupled Processes)

The ACNW will review the repository design including thermal loading. Questions to be addressed include: What coupled processes are affected by the thermal load and how? What will be the effect on the hydrology, geochemistry, and mechanical processes, and is there adequate research in place to aid our understanding? Have adequate models been constructed to predict repository behavior? The broader question of coupled processes (geology/geochemistry/ hydrology/thermal and mechanical effects) will be considered under this task and appropriate advice provided.

5. Regulatory Review Plan/NRC's Repository Licensing Strategy

The staff is shifting its focus from developing the License Application Review Plan (LARP) to a modified Regulatory Review Plan consisting of acceptance and review criteria for KTIs. The NRC staff continues to place a high priority on developing key portions of the LARP in its Regulatory Review Plan. The ACNW will focus attention on the Regulatory Review Plan, which will provide the framework and indicate the technical issues that must be addressed in DOE's Yucca Mountain project license application. Issuance of EPA standards and conforming changes to 10 CFR Part 60 will have a profound impact on the regulatory framework. These modifications and their implications will be the subject of intense scrutiny by the ACNW.

PRIORITY ISSUES

LOW-LEVEL WASTE

6. Role of NRC/ACNW in LLW Disposal

The ACNW is reviewing the role of the NRC in low-level waste (LLW) disposal. This review includes studying various alternatives NRC could pursue from maintaining the current LLW program to eliminating all activities related to LLW disposal. Issues also include the adequacy and compatibility of the Agreement States program. There is a perceived need for the Office of Nuclear Materials Safety and Safeguards to develop

a prioritized set of elements in the LLW disposal program that must be accomplished to ensure public health and safety and to satisfy a national need.

7. Risk-Based Regulation

The ACNW expects to support an effort designed to help move the agency from deterministic regulations toward risk-based regulations. The goal is to link more closely adequate assurance of safety with the regulations. This effort would focus on practices in other nations that have begun to move in the direction of risk-based regulations. Efforts toward risk harmonization with the EPA would be considered in this project. (A similar effort is appropriate for high-level waste disposal.)

8. Role of ACNW in Decommissioning

The ACNW believes it can make an important contribution to the agency's efforts associated with decommissioning. This advice would be applicable to both materials facilities and nuclear power plants. The ACNW has been asked by the Commission for advice on the Site Decommissioning Management Plan (SDMP) and is currently formulating such advice. The Committee has also reviewed the lessons learned from the decommissioning of the Pathfinder reactor. Concerns regarding residual levels of contamination will be considered.

PRIORITY ISSUES

PERFORMANCE ASSESSMENT

9. Treatment of Uncertainty in "Bounding Issues"

The ACNW will study the treatment of uncertainty in DOE's use of bounding analyses, as part of its overall review of total system performance assessment (TSPA) and iterative performance assessment (IPA). Uncertainty analysis is one of the most important aspects of performance assessment. Insights from uncertainty analysis enhance the determination of the adequacy of site characterization data. How will the NRC determine whether or not DOE has indeed bounded a parameter or analysis? Should the NRC produce a separate guidance document on the treatment of uncertainty or possibly include it in the Regulatory Review Plan?

10. Role of Expert Judgment

The ACNW will explore the proper role of expert judgment and, in particular, formally elicited expert judgment. The function of peer review panels will be examined. How are the opinions of experts preserved if they are no longer available to testify at a license hearing? In general, how will expert opinion be used in the decision process? A significant near-term task for the ACNW is to provide advice on the NRC staff's development of a guidance document on the use of expert judgment.

ACNW PRIORITIES ISSUES

[1] **Regulatory Framework**

[2] **Adequacy of Revised Program Approach**

[3] **Site Characterization Activities Related to Waste Isolation Strategy**

[4] **Repository Design (Includes Thermal Loading and Coupled Processes)**

[5] **Regulatory Review Plan/NRC's Repository Licensing Strategy**

[6] **Role of NRC/ACNW in LLW Disposal**

ACNW PRIORITY ISSUES (cont'd)

[7] Risk-Based Regulation

[8] Role of ACNW in Decommissioning

[9] Treatment of Uncertainty in "Bounding Issues"

[10] Role of Expert Judgment

[11] Negligible Incremental Risk Level

[12] Source Term/Container

Why Have a Priority List?

The ACNW considered a number of high-impact regulatory issues of importance to the Commission and focused, for resource reasons, its attention on twelve areas

How were they picked?

The items were picked by a majority consensus of the Members. A large number of issues were considered (bottom-up), as well as topics that are important to safety and key to an effective regulatory program in the next few years (top-down). The twelve priority issues resulted from this process. These choices were made on the basis of regulatory impact.

As progress is made in these areas or changes occur in the NRC's regulatory agenda, focus of individual issues will shift or new issues will replace the current group.

Current progress on these Priority Issues?

Each of the items discussed today can be found on our priority list of issues:

11. Negligible Incremental Risk Level

1. Regulatory Framework (TBYMS/Time Frame)

5. Regulatory Review Plan/NRC's Repository Licensing Strategy (Key Technical Issues/Vertical Slice)

10. Role of Expert Judgment

Planned Future Reviews on Priority Issues

In the near future (next 6 months) the Committee anticipates working on the following topics:

- **Specification of the Critical Group and Reference Biosphere (Priority Issue 1 Regulatory Framework)**
- **Thermal Loading and Coupled Processes (Priority Issue 4, Repository Design)**
- **Radionuclide Transport (Priority Issue 3, Site Characterization)**
- **Volcanism (Priority Issues 3, Site Characterization)**

The Issues on the Priority are Interrelated not Independent Issues

The issues on our list are interconnected: for example, a better understanding of the effects of low-levels of radiation will form the basis of a risk-informed regulation. In a similar manner, the treatment of uncertainty analysis in performance assessment will aid in the formulation and use of risk-informed regulation.

Another illustration would be judging the adequacy of the Revised Program Approach (Issue 2), where elements from Site Characterization (Issue 3) and NRC's Repository Licensing Strategy (Issue 5) would play a significant role.

ENCLOSURE 6

EXPERT JUDGMENT

EXPERT JUDGMENT AND ELICITATION

Comments And Concerns With Process Issues

- The Process and Steps in Conducting an Expert Elicitation
  - NRC's nine step process
  - The selection of the experts
  - Loss of members from elicitation group - impact on testimony, requirements for a sponsoring witness
- Process for Reaching Closure, Including Aggregating Opinions

EXPERT JUDGMENT AND ELICITATION

DOE/NRC Interface Issues

- Resolution of Possible Conflicts Between DOE Approaches to Using Expert Judgment and NRC's Guidance

- Resolution of Open Issues Between DOE and NRC

EXPERT JUDGMENT AND ELICITATION

Legal and Licensing Issues

- The Legal Acceptance of the Elicitation in a Licensing Hearing
  - Expert elicitation as a methodology to develop technical information and judgments (as opposed to a litigation tool)
  - Establishing a protocol for using expert elicitation in licensing
  - Testimony of expert panel members
  - Resolution of conflicts in expert testimony by licensing boards and judges
  - Admissibility of items in a litigation context
  - Resolving legal conflicts of interest
- Rulemaking to Resolve Some of the Potential and Likely Legal Issues That May Arise in a Hearing, Possibly Many Years after the Elicitation