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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

**Title: BRIEFING BY NUCLEAR WASTE TECHNICAL
 REVIEW BOARD - PUBLIC MEETING**

Location: Rockville, Maryland

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1 UNITED STATES OF AMERICA
2 NUCLEAR REGULATORY COMMISSION

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4 BRIEFING BY NUCLEAR WASTE
5 TECHNICAL REVIEW BOARD

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7 PUBLIC MEETING

8
9 Nuclear Regulatory Commission
10 One White Flint North
11 Rockville, Maryland

12
13 Tuesday, July 30, 1996

14
15 The Commission met in open session, pursuant to
16 notice, at 10:00 a.m., Shirley A. Jackson, Chairman,
17 presiding.

18
19 COMMISSIONERS PRESENT:

20 SHIRLEY A. JACKSON, Chairman of the Commission
21 KENNETH C. ROGERS, Member of the Commission
22 GRETA J. DICUS, Member of the Commission

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1 STAFF AND PRESENTERS SEATED AT THE COMMISSION TABLE:

2 JOHN C. HOYLE, Secretary

3 KAREN D. CYR, General Counsel

4 JOHN E. CANTLON, U.S. Nuclear Waste Technical
5 Review Board

6 JARED L. COHON, U.S. Nuclear Waste Technical
7 Review Board

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P R O C E E D I N G S

[10:00 a.m.]

CHAIRMAN JACKSON: Good morning, ladies and gentlemen.

This morning, the Commission is pleased to welcome John Cantlon and Jared Cohon from the U.S. Nuclear Waste Technical Review Board, who will brief the Commission on the status of their activities.

Dr. Cantlon, Dr. Cohon, we are very pleased to have you here.

It has been more than two years, since March of 1994, since the Technical Review Board last briefed the Commission about the Board's activities and recommendations and its perspectives on the Department of Energy's program to manage high-level radioactive waste. Much has changed in that period, some of which I won't mention, but in fact the makeup of the Commission itself is quite different in that this will be the first briefing that Commissioner Dicus and I have had with the Nuclear Waste Technical Review Board. We both have been looking forward to this briefing.

Since the last briefing, the National Academy of Sciences, as you know, as directed by the Energy Policy Act of 1992, has issued its report that provides advice to the Environmental Protection Agency for establishing standards for the disposal of high-level waste in a geologic

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1 repository. Based on the National Academy's study, the EPA
2 is now developing standards for Yucca Mountain and the NRC
3 would amend its regulations as appropriate to the revised
4 standards.

5 Changes have also occurred in the DOE program.
6 The tunneling program at Yucca Mountain has progressed
7 nearly four miles into the mountain, allowing a more
8 detailed assessment of specific site issues. The DOE has
9 issued a viability assessment for determining the technical
10 suitability of the Yucca Mountain site and, as you are all
11 aware, Congress is currently considering legislation that
12 could significantly alter the existing high-level
13 radioactive waste program. So it is clear then that the
14 high-level radioactive waste program has been and continues
15 to be in a state of change, so the Commission believes that
16 this briefing is very timely in that sense and is
17 particularly interested in receiving your views and the
18 views of the Nuclear Waste Technical Review Board on the
19 state of DOE's civilian radioactive waste management
20 program.

21 Commissioner Rogers, do you have anything you
22 would like to add?

23 COMMISSIONER ROGERS: No.

24 CHAIRMAN JACKSON: Commissioner Dicus?

25 COMMISSIONER DICUS: No.

1 CHAIRMAN JACKSON: If not, we look forward to
2 hearing from the two of you.

3 DR. CANTLON: Chairman Jackson, Commissioners,
4 ladies and gentlemen, good morning. It is a pleasure for us
5 to be here today.

6 Just by way of background, my background is in
7 environmental biology and Jerry Cohon is the dean of the
8 School of Forestry and Environmental Studies at Yale
9 University.

10 Since we have not met with you before, let me just
11 begin briefly by summarizing what the Nuclear Waste
12 Technical Review Board does. It is charged, as you know,
13 with evaluating the technical and scientific aspects of the
14 Department of Energy's high-level nuclear waste management
15 program. This includes site characterization and transport
16 of high-level radioactive waste and spent nuclear fuel.

17 Today, in our prepared remarks, we would like to
18 briefly review some of the key developments of 1995 and the
19 first half of 1996. These have been somewhat turbulent
20 times, as you referred to, but there also has been
21 substantial progress. I would like especially to offer our
22 thoughts on some of the legislative and regulatory changes
23 that were proposed during '95 and which still are under
24 consideration.

25 Then we will summarize for you the Board's current

1 views on the status of the program, including DOE's plans
2 for evaluating the viability of Yucca Mountain site within
3 the next two years. After our prepared remarks, we look
4 forward to a free ranging and candid discussion that has
5 been characteristic of our past meetings with the
6 Commission.

7 As you are aware, the program funding in recent
8 years has been anything but stable, following the sharp
9 increase in the program's budget. For fiscal '95, it became
10 apparent that funding levels for fiscal '96 and beyond would
11 not support the activities and the milestones that had been
12 laid out in the 1994 program plan.

13 Faced with a 40 percent reduction in budget, DOE's
14 Office of Civilian Radioactive Management had to reduce the
15 scope of its activities and then set tougher priorities for
16 its efforts for the coming years.

17 Does is now pursuing this viability assessment for
18 siting a repository at Yucca Mountain to be completed in
19 1998. Viability is affirmation of life and the purpose of
20 this assessment seems to be to decide whether or not
21 continued site studies and repository design efforts are
22 warranted. The relationship between the viability
23 assessment and an evaluation of the technical suitability of
24 the Yucca Mountain site is really unclear.

25 In the Board's view, a recommendation of the site

1 to the President should require an assessment that it is
2 technically suitable for development of a repository. The
3 Board has defined suitability to mean a high probability
4 that the site, along with the appropriate engineered
5 barriers, can provide long-term waste isolation. The 1998
6 viability assessment appears to be a less well documented
7 and less conclusive evaluation of the site's potential.

8 Slide five shows the general configuration of the
9 exploratory studies facility, including the location of the
10 test alcoves and the thermal test facility now being
11 constructed off the main tunnel.

12 Slide six also illustrates the general layout of
13 the ESF but this time shows its relationship to the two
14 blocks where the radioactive waste might be emplaced in the
15 repository.

16 Recently, one of the most visible parts of the
17 program has been the operation of the TBM to construct the
18 exploratory studies facility. The Board was an early
19 advocate of underground exploration at the Yucca Mountain
20 site and remains so today. The exploration at Yucca
21 Mountain has provided a number of geological insights that
22 would have been difficult to obtain from surface based
23 activities.

24 Underground exploration has indicated, so far,
25 that the quality of the rock inside Yucca Mountain is better

1 than anticipated from surface mapping. The discovery,
2 however, of elevated levels of chlorine 36 at a few
3 locations suggests that pathways exist along which
4 occasional pulses of precipitation can penetrate very
5 rapidly to the repository level.

6 One of the most important tasks ahead for the DOE,
7 as it evaluates the suitability of the Yucca Mountain site,
8 will be to determine how widespread, how numerous and how
9 fast these paths are, how much water they carry and how
10 often that water flows to the repository level. It would
11 also be very useful to know whether they continue downward
12 to the water table.

13 While somewhat less visible, substantial progress
14 also has been made in developing a technically credible
15 waste isolation strategy for a potential repository at Yucca
16 Mountain's site. As this slide indicates, the strategy is
17 based on two primary goals: Near complete containment of
18 radionuclides within the waste packages for several thousand
19 years and acceptably low annual doses to members of the
20 public living near the site.

21 The strategy contemplates achieving these goals by
22 relying on five engineered and geologic barriers which the
23 DOE refers to as attributes to isolate the waste from the
24 accessible human environment.

25 The Board believes that the strategy must be

1 soundly grounded in credible and testable hypotheses
2 concerning the interactions between the engineered and the
3 natural components of the repository over long periods that
4 accommodate change in climate, in geology, hydrologic,
5 geochemical and ecological processes occurring at the site.

6 If soundly developed, demonstration of probable
7 performance of the strategy will provide a technically
8 supportable basis for setting the priorities for future
9 activities at Yucca Mountain and for the repository design
10 efforts.

11 Another area of progress for the DOE during 1995
12 was completion of a more detailed, total system performance
13 assessment for the Yucca Mountain repository. This analysis
14 projects, based on current knowledge, how well and over what
15 period a repository would be able to isolate waste. Equally
16 important, it helps identify the most important parameters
17 affecting performance, again allowing the DOE to better
18 focus its future studies of those parameters.

19 Changes in the legislative and regulatory
20 environment have affected the U.S. high-level nuclear waste
21 program from its inception. As you know, changes in the
22 basic health and safety standards for a Yucca Mountain
23 repository are now under consideration as directed by
24 Congress in the Energy Policy Act of 1992.

25 For some time, the Board has believed that current

1 regulations and perhaps the health and safety standards
2 governing spent fuel disposal needed to be updated. Current
3 EPA health and safety standard and the NRC and the DOE
4 regulations were really too detailed and probably enacted
5 too early in the process of searching for a permanent
6 repository site.

7 Scientific and technical knowledge, particularly
8 when applied to a first-of-a-kind undertaking, take time to
9 evolve. In retrospect, a wiser course may have been to
10 collect that knowledge and to use it in developing a
11 regulatory framework.

12 In the absence of such an approach, the Board
13 believes that the NAS report and the current scientific and
14 technical understanding of the conditions at the Yucca
15 Mountain site should provide a basis for revising safety
16 standards and regulations. However, the standards in the
17 proposed regulations are well above risk levels and well
18 below the time periods for assuring safety that are being
19 considered by other nations.

20 In response to a request from the EPA, the Board
21 expressed its view on several key issues raised by the NAS
22 report. The Board stated its belief that if the EPA's
23 standards for a Yucca Mountain repository are to apply for
24 more than 10,000 years, appropriate language should be
25 included in the standards to accommodate the increasing

1 levels of uncertainty in projected human health risks over a
2 very long period.

3 The Board noted that the stringency of the
4 standards for the long-term performance of a repository at
5 Yucca Mountain also will depend on the definition of the
6 critical group. The Board endorsed the general concept of a
7 probabilistic critical group but the alternatives suggested
8 in the NAS report, a subsistence farmer critical group,
9 seems overly conservative for a site like Yucca Mountain
10 which has a harsh climate and lacks arable land.

11 A reasonable analysis using a probabilistic
12 approach should consider alternative lifestyles by which
13 individuals could be exposed to releases from a repository.
14 The Board stated its belief that incremental risk, if any,
15 associated with the gaseous carbon 14 releases from Yucca
16 Mountain repository should be considered negligible and
17 beyond regulatory concern. The Board also stated that it
18 agreed with the NAS that there is no scientific basis for
19 predicting the probability of inadvertent human intrusion
20 over the long time periods of interest for a Yucca Mountain
21 repository and, accordingly, intrusion analysis should not
22 be required and should not be used during the licensing to
23 determine the acceptability of the candidate repository.

24 In its letter to EPA, the board noted that the
25 form the standards eventually take could have significant

1 implications for repository design.

2 For example, if the repository standards apply out
3 to a million years, this may serve as a disincentive to
4 spend money to develop more robust engineered barriers or to
5 seek a better quantitative assessment of retardation in the
6 natural barriers. The board believes that wherever
7 practical releases should be delayed through the use of
8 repository design and engineered barriers.

9 Above all, the board has urged the EPA to keep the
10 standards simple. In the board's view there are limits to
11 what scientific knowledge can accomplish and the standards
12 should recognize and be consistent with those limits.

13 The board also thinks it may be time to look at
14 the overall process that the U.S. uses in siting, building
15 and licensing a permanent repository. The time may have
16 come to establish a process that acknowledges the need to
17 adapt to changing information. There are a variety of ways
18 of accomplishing this from changing the program's
19 organizational structure to changing the manner in which the
20 repository is licensed.

21 For example, a more realistic approach to
22 developing a repository may be to license and construct it
23 in increments, say, of 10,000 to 20,000 metric tons while
24 maintaining assured retrievability instead of developing a
25 final design and securing a license for the full 70,000 or

1 more metric tons.

2 Plans for continued testing and monitoring during
3 a repository's initial operation phase also seems to be a
4 very prudent step.

5 On March 20th, 1996, the board submitted to
6 Congress a report summarizing its views on the disposal of
7 storage spent fuel. The board recommended that the focus of
8 the U.S. policy should continue to be on permanent disposal
9 of spent fuel and high level waste. The board observes,
10 however, that centralized storage capacity which currently
11 is not available in the United States will surely be needed
12 in the future, especially when the reactors begin to shut
13 down in larger numbers.

14 A large, centralized storage facility will be
15 necessary, one, to facilitate repository operations and
16 waste handling, and two, to address storage needs which will
17 increase markedly around 2010, as the slide illustrates.

18 The board concluded that storing spent fuel at or
19 near Yucca Mountain now, before the site has been determined
20 suitable for repository development, risks prejudicing the
21 decision about the site suitability and may also threaten
22 the credibility of the waste management program.

23 It also would exacerbate the problem of limited
24 resources for the site characterization program.

25 The board concluded that there are no compelling

1 technical or safety reasons to move the spent fuel to a
2 centralized storage facility for the next several years.

3 Now there are some other developments which have
4 gone ahead, and Dr. Cohon will summarize these for the
5 board.

6 DR. COHON: Thank you, Dr. Cantlon.

7 I, too, am very pleased to be here, Chairman
8 Jackson. This is also a first for me.

9 Progress in assessing the Yucca Mountain appears
10 encouraging. The program is beginning to collect geologic
11 and hydrologic information from the repository horizon.
12 This will be crucial in determining the suitability of the
13 site.

14 If TBM excavation rates can be improved and if
15 management improvements are made and sustained in other
16 areas the program should be able to proceed more efficiently
17 toward a site suitability decision.

18 It is obvious that efficient progress cannot be
19 achieved, however, without adequate and stable program
20 funding. To determine the required level of funding, a
21 sound technical justification for the planned activities
22 should be developed.

23 To a large extent, this justification should flow
24 naturally from the evolving waste isolation strategy and the
25 results of total system performance assessment.

1 The board is pleased with the progress that was
2 made in 1995 in the formulation of a waste isolation
3 strategy and in the use of that strategy to help set
4 priorities for the activities of the Yucca Mountain project.

5 During 1996, however, further development of the
6 waste isolation strategy seems to have slowed. Additional
7 efforts are needed to continue development of the strategy
8 and to use it to develop a technical basis for planning
9 program activities.

10 Some of the problems that have caused continuing
11 frustration with the program have yet to be resolved.
12 Perhaps the most important of these is the perception of
13 program inefficiency.

14 The DOE's tardiness in articulating a technical
15 basis for its program activities has contributed to these
16 perceptions.

17 This sense of inefficiency is heightened by the
18 DOE's inadequate integration among the various activities in
19 the program. At times, as we have seen our board meetings,
20 some program participants seem to have little knowledge of
21 the activities of other participants.

22 The program also continues to be schedule-driven.
23 Despite the sharp reduction in funding for fiscal year '96
24 there seems to be an effort within the program to maintain
25 nearly the same schedules for repository development and

1 licensing.

2 For example, the DOE says that projected funding
3 will not permit a technical site suitability decision in
4 1998. The DOE's response has been to maintain a 1998
5 milestone nevertheless but to give the decision a new name,
6 a "viability assessment."

7 The technical basis for the viability assessment
8 will be less complete than had been anticipated for the
9 technical site suitability decision.

10 The board believes it would be better to establish
11 a strong technical basis derived from the waste isolation
12 strategy and total system performance assessments to
13 determine the scope of work required, then more technically
14 defensible schedules and decision points could be
15 established.

16 Perhaps the single most important technical
17 decision facing this program is evaluating the suitability
18 of the Yucca Mountain candidate site. For the next two
19 years the program will focus on a viability assessment of
20 the site, however. As we understand it, this decision of
21 viability is not a finding that the site is suitable for
22 development as a repository. It is instead merely a
23 determination that the site continues to be a live candidate
24 that requires additional studies leading to a site
25 suitability decision in 2001 and completion of a license

1 application in 2002.

2 Senate Bill 1936, as we understand it, currently
3 to stand would move the site recommendation forward in time
4 to 1998 with a much diminished technical basis for that
5 decision.

6 The board believes that additional studies beyond
7 those planned for the viability assessment will be needed to
8 evaluate the site suitability, most notably an east-west
9 excavation across the candidate repository block.

10 Years of underground construction worldwide show
11 that no amount of surface-based testing can eliminate the
12 necessity for underground exploration and testing. It is
13 the board's position that a technically defensible
14 evaluation of the site cannot be made without exploration
15 that would eliminate or greatly decrease existing hydrologic
16 uncertainties.

17 The board continues to believe that an east-west
18 crossing of the geologic block west of the Ghost Dance
19 fault, i.e., in the upper waste emplacement block, is
20 necessary prior to any technically defensible decision on
21 site suitability and in evaluation of the adequacy of its
22 disposal capacity.

23 The current desire for the repository has all or
24 almost all waste emplacement in the upper waste emplacement
25 block west of the existing tunnel. This block, which is 4

1 kilometers long and 1.2 kilometers wide, has not been
2 explored by drilling or by subsurface exploration.

3 Without the east-west exploration the geologic and
4 hydrologic uncertainties of the unexplored portion of the
5 repository block must be extrapolated -- the geologic and
6 hydrologic characteristics, I'm sorry, of the unexplored
7 portion of the repository block would have to be
8 extrapolated from those found in the portal-to-portal loop,
9 the current tunnel.

10 Exploration of such a long distance would be
11 difficult to justify technically.

12 The 1996 revision of the DOE's program plan shows
13 completion of an East-West excavation if deemed necessary.
14 However, even if undertaken, this excavation would not be
15 completed before the 1998 viability assessment.

16 In the board's view a technically supportable
17 decision about the suitability of the site for a repository
18 of adequate capacity simply cannot be made without the
19 information that would be obtained from an east-west
20 excavation across the block.

21 Initial results from underground tunnel scale
22 heater experiments also will be needed to predict better the
23 movement of water in the rocks surrounding the hot waste
24 packages. The DOE is now excavating facilities for these
25 tests but the tests cannot be completed and the results

1 evaluated before the 1998 viability assessment.

2 The board cautions against making more of the
3 viability assessment than it merits. Additional information
4 will be needed beyond that which will be available for the
5 viability assessment before a technically-supportable
6 decision can be made about the suitability of the Yucca
7 Mountain site.

8 The board believes that adequate information can
9 be acquired within four to five years to support a
10 suitability decision about the Yucca Mountain site but
11 adequate and stable program funding will be needed if this
12 goal is to be achieved.

13 This concludes our prepared presentation. We will
14 be happy to answer any questions you may have. Thank you.

15 CHAIRMAN JACKSON: Okay, thank you.

16 Let me start by asking you a couple of questions.

17 Let's talk explicitly for a moment about the east-
18 west crossing that you talked about and the words I guess in
19 your report indicated that the DOE's program plan shows
20 completion of that east-west excavation if deemed necessary.

21 Has there been any movement with respect to
22 renormalization of DOE's program plan with respect to
23 contemplation of that?

24 DR. CANTLON: Not that we are aware of. They are
25 aware of our concern about it. I think they concede that at

1 some point it would be necessary but they doubt that they
2 are going to have the funding to get it done before the
3 viability assessment.

4 CHAIRMAN JACKSON: Another question was in the
5 view of your board to what extent is the DOE program even in
6 this renamed or renormalized program focused on, still
7 focused on the most important issues perhaps without the
8 depth you would like to see, or is it in any way likely to
9 be compromising of the ultimate suitability evaluation that
10 you feel is necessary in order to determine the significant
11 attributes?

12 DR. COHON: Well, let me give you my opinion on
13 that.

14 I don't believe they've lost their way. I don't
15 believe that they are moving in directions that are
16 inconsistent with the suitability determination.

17 We would like to believe that a viability
18 determination is a step along the way towards suitability
19 and in fact we believe that to be the case.

20 What concerns us is the pressures on the program,
21 both funding and otherwise, which may lead the program to
22 renormalize -- that's a good word, Chairman Jackson -- so
23 that viability assessment becomes equated with suitability
24 determination.

25 As our statement indicated, we believe that simply

1 is not true. That is going farther than viability
2 assessment can take you.

3 CHAIRMAN JACKSON: Let me switch it over.
4 Assuming that you have a familiarity with what the NRC has
5 been doing, and you know that the NRC Staff has been
6 focusing on these key technical issues, to what extent do
7 you feel that they are in fact the appropriate issues to
8 focus on for evaluating repository performance or the safety
9 performance thereof?

10 DR. CANTLON: Well, clearly if one wants to put
11 spent fuel in that site for a very long period of time the
12 real challenge is to have that material retained above the
13 water table in such a substantial way that the small pulses
14 that get there over the longer period of time will then be
15 diluted out before it gets out to where people will have
16 access to it.

17 We think that if you now look at that challenge,
18 the geo-hydrology of the site is really the critical set of
19 issues and the finding of Chlorine 36 enriched waters at the
20 repository level tells you that bomb-affected water has
21 gotten there in 50 years, which isn't in an of itself a veto
22 of the site because if those occasions and if those places
23 are both very dispersed -- in other words, only a rare
24 event, one of the big thunderstorms that occurs, a 100 year
25 type flood -- and if it occurs in only a very few places,

1 then the emplacement process which repositories around the
2 world have conceded that you are not going to be able to
3 randomly place waste packages in the earth. You have to pay
4 attention to what the geology is, and by avoiding those
5 places.

6 So that is the one challenge -- to really
7 document -- and that is why we are so fixed on the idea that
8 until one knows in an east-west crossing that the bulk of
9 the area that is needed for waste emplacement isn't even
10 more permeated with Chlorine 36 pathways, it's very
11 difficult to assume that that site will have the capacity to
12 handle the spent fuel so it's the capacity issue.

13 Then one needs to look at the rigor, the
14 robustness of the engineered barriers and obviously this is
15 a conflict between the economics of doing the job and the
16 security that in the long range the transuranics are
17 actually going to be contained long enough and so the
18 question of what the backfill should be like and whether or
19 not there should be fillers in the package.

20 I personally -- I don't know how widely this is
21 shared in our board -- but my own personal view is that any
22 time you have large void spaces in a waste package,
23 eventually as that package crumbles, its strength
24 deteriorates, you are going to end up with little pockets as
25 those void spaces essentially create little pockets over

1 each waste package. Well, that is an invitation to
2 mobility, and so I think the idea of putting fillers in the
3 package is good.

4 Now what that does is to give you a real headache.
5 Who's going to do it? The utilities? Or are you going to
6 do it centrally out at the site? What are you going to use?

7 There are a lot of economic and safety issues that
8 relate from that, but if you really want to look at long-
9 range safety, I think you need fillers and you need
10 backfill.

11 DR. COHON: With regard to the question of whether
12 we, both our Board and your Commission, are looking at the
13 right issues, I think the big unknown here is what you
14 started your remarks with. That is, what is the pending
15 standard that we expect to be coming out from the
16 Environmental Protection Agency. That will have profound
17 implications on what we need to look at and, depending on
18 how that comes out, it will be interesting to see how both
19 the program and NRC respond to that. This is further
20 complicated and made uncertain by pending legislation.

21 CHAIRMAN JACKSON: Let me do one last question. I
22 keep saying they are "last." You have to beware of people
23 who have five last questions.

24 DR. COHON: Can we hold you to five?

25 [Laughter.]

1 CHAIRMAN JACKSON: I am going to read from your
2 prepared statement here. It says the Board believes it
3 would be better to establish a strong technical basis
4 derived from the waste isolation strategy which you have
5 just been speaking to and total performance assessments to
6 determine the scope of work required and, of course,
7 referenced to the appropriate standards. And then I do note
8 that you made a comment that, at times, some of the DOE
9 program participants seemed to have little knowledge of the
10 activities of the other participants.

11 Why am I bringing these two up in the same
12 paragraph? I had made some note of something like that when
13 I visited Yucca Mountain last year but I guess the question
14 becomes does that not have impact on being able to make a
15 total system performance assessment if all the pieces are
16 not communicating?

17 DR. COHON: Absolutely. The approach that the DOE
18 has developed to deal with that particular issue is the
19 creation of working groups around specific pieces of the
20 total system performance assessment. These working groups
21 include both technical managers and the modelers of the
22 performance assessment activity, as well as the scientists
23 who are doing the data collection. These working groups,
24 then, are intended to develop a single coordinated,
25 integrated component of the total system performance

1 assessment. This is just now happening so we can't comment
2 yet on how effective this is.

3 We are keenly aware from our sense of history with
4 this program that the program has made a very significant
5 transition from a science-based program without a great deal
6 of focus or direction in terms of trying to integrate or
7 coordinate to one where the design, the waste isolation
8 strategy and total system performance assessment are the
9 dominant activities. It is not easy for a program this
10 large to make such a dramatic transition and that is what
11 they are struggling with.

12 CHAIRMAN JACKSON: I am told that your Board
13 doesn't consider vulcanism to be a significant issue,
14 although it has been something that our staff has focused
15 on. Can you speak a little bit to that?

16 DR. CANTLON: Yes. I am a biologist and Jerry is
17 an engineer, so we are clearly out of our technical depth
18 here. But the geologists that have looked at and examined
19 the whole set of issues, it has to do basically with the
20 orientation of the past areas of vulcanism and whether one
21 projects that orientation, avoiding that block or not
22 avoiding the block. That is really the basic issue.

23 You know, it is extremely low probability, even
24 assuming an orientation toward Yucca Mountain. So we don't
25 think that that is going to be a project killer.

1 CHAIRMAN JACKSON: Commissioner Rogers?

2 COMMISSIONER ROGERS: Well, maybe I can ask
3 something that is in your field and that is the definition
4 of the critical group. I wonder if you could comment a
5 little bit on how you see that issue, which really still is
6 getting quite a bit of attention outside of the National
7 Academy study, particularly because the one dissenting
8 opinion was offered by a very distinguished leader in the
9 field, Professor Pickeford, in which he took the maximally
10 exposed individual approach and was very comfortable with
11 the subsistence farmer as a definition of that for a number
12 of different reasons that I think he explained in his
13 dissenting opinion.

14 How do you see that controversy? I am not quite
15 sure how to interpret your comments here with respect to the
16 definition of the critical group following a probabilistic
17 definition or concept. Would you elaborate on that a little
18 bit?

19 DR. COHON: Chairman Cantlon has designated me the
20 expert on this, so I will try to give you an intelligent
21 response.

22 This issue, as you point out, is a general one
23 that doesn't just, of course, affect the standard for the
24 Yucca Mountain repository but in fact is a key issue in risk
25 assessment generally. I think that -- well, let me first

1 explain the Board's position and try to explain the
2 philosophy, if you will, that is behind it.

3 The Board's position was to subscribe to the
4 notion that we don't know and can't know what population
5 will live in or near -- in the vicinity of Yucca Mountain.
6 Therefore, let's take an approach which assigns
7 probabilities to various kinds of populations, to various
8 critical groups. That is what we meant by that. That is
9 what the report recommended.

10 Why would we recommend that and not support the
11 notion of the maximally exposed critical group? I think the
12 argument here goes like this. Our colleagues on the Board
13 who are expert on this could probably give you a better
14 discussion. When you are talking about a situation like
15 this where we are trying to look out so far into the future
16 and where it is impossible to know or even, I would claim,
17 even to characterize the populations that will be there, on
18 what basis do you choose a maximally exposed critical group?
19 I mean, one has to fabricate it. In the spirit of
20 probabilistic risk assessment, it seems only appropriate
21 then that you should apply probabilities to those critical
22 groups rather than choosing one and designing and planning
23 for that one when you can't know what that one is.

24 This problem, being one of a kind and so far in
25 the future with so much uncertainty, is distinctive, I

1 think. There are other risk assessment situations where you
2 can't know in advance that a person or a group will be
3 exposed but at least the group exists and you know that they
4 do something or live in a place so that they have a
5 reasonable probability of being exposed. That's not so in
6 this case. I am sure Professor Pickeford could give a
7 wonderful and very rapid response to what I just said to
8 support his position, but I think I have explained the
9 rationale.

10 DR. CANTLON: One additional element in that
11 discussion, I am a native of Nevada so I grew up in the
12 desert and know that country and it is a little difficult to
13 visualize a subsistence farmer anywhere near Yucca Mountain
14 in today's climate so now one has to project ahead to
15 pluvial periods. If you project ahead to pluvial periods in
16 that area, the data that we have from pack rat middens and
17 other kinds of data to identify what vegetation and so on
18 was there, gets you up to about sagebrush level, which is
19 also the kind of vegetation that you have in the northern
20 reaches of the Nevada test site.

21 If you now project that around the state of
22 Nevada, there are very -- there are almost no subsistence
23 farmers in that environment. You have ranches, people
24 living off of ranches, but they use surface water. You
25 don't drill a well 1,000 feet deep and try to haul water up

1 to do a subsistence farm. It is just not a credible thing
2 for that environment today and it is even of shaky
3 credibility projecting it to the pluvial period, you know,
4 consistent with the Ice Age environment.

5 COMMISSIONER ROGERS: Just one other question.

6 How do you feel about the communication between
7 the Technical Review Board and NRC staff? How do you feel
8 that has gone and how do you see that in the future?

9 DR. CANTLON: Our communication is excellent. We
10 have raided you for two of our outstanding professional
11 staff.

12 [Laughter.]

13 COMMISSIONER ROGERS: Oh, you did? I am not sure
14 that was quite what I was getting at.

15 [Laughter.]

16 DR. CANTLON: So these individuals, Dan Fehringer
17 and Leon Reiter, have substantial NRC experience and have
18 colleagues here and so I don't think we have felt at any
19 time away from your technical people. Now, obviously, as
20 the Commission has come into its own conditions you, like
21 any organization, have to protect your information and there
22 are periods in which credibility is counterproductive.

23 CHAIRMAN JACKSON: Commissioner Dicus?

24 COMMISSIONER DICUS: I have no questions. Thank
25 you.

1 CHAIRMAN JACKSON: Let me ask you one more
2 question here.

3 I note that you do make a point about the
4 standards in the proposed legislation in the Congress being
5 well above risk levels and below the time periods being
6 considered in other nations. Is that in your prepared
7 statement from the point of view of diplomatic or political
8 difficulty or because you feel the standards being
9 contemplated are moving away from what would have a
10 reasonable technical foundation?

11 DR. CANTLON: Let me take a crack at that,
12 Chairman Jackson.

13 I am particularly troubled with the 1,000 year
14 standard proposed in the legislation. Now, obviously, when
15 you write a standard, you are writing a law and, since very
16 few governments have survived 1,000 years, I can understand
17 a kind of legal rationale for that. But it does seem to me
18 that if one looks at responsible intergenerational and now
19 we are talking multigenerational relationships, 1,000 years
20 is really an inadequate time.

21 Now, as I understand that language, it is the
22 obligation of the NRC to characterize if not to establish
23 the regulation so I think if it is sharply characterized out
24 to 10,000 years, that would not -- I think that is, in
25 simply recognizing the fact that laws don't exist for

1 multiples of thousands of years, as far as we know.

2 Now, as far as the 100 millirem standard is
3 concerned, that is substantially above international things
4 and while I personally believe that the basic data for
5 radiation effects at levels below 100 millirem are almost
6 nonexistent really in terms of solid data, it doesn't
7 trouble me as a level but it is an international problem in
8 that other nuclear nations have adopted much more stringent
9 levels of protection. Since you have a great deal of public
10 concern about it, that is going to give us a problem, I
11 think.

12 CHAIRMAN JACKSON: Dr. Cohon, did you have a
13 comment you wanted to make?

14 DR. COHON: Nothing, thank you.

15 CHAIRMAN JACKSON: Okay. The last last question.

16 In what sense do you believe, and this is just for
17 my technical edification, that the quality of the rock is
18 better than anticipated? And this is based on the surface
19 data.

20 DR. CANTLON: It simply means that there are
21 bigger areas in which the fracturing is not as profound and
22 that the quality of the fracture surfaces are such that it
23 doesn't indicate a great deal of water movement.

24 CHAIRMAN JACKSON: Okay.

25 Well, thank you very much. I appreciate your

1 coming for an excellent session. You have raised, in fact,
2 many of the same concerns that the NRC has had with the
3 high-level waste radioactive program and many others that we
4 will consider, you know, as we move along through this
5 prelicensing phase.

6 We appreciate your taking the time to come here
7 and brief us. We won't wait another two years. There is
8 too much that changes in the interim.

9 Commissioner Rogers, do you have any additional
10 comments?

11 COMMISSIONER ROGERS: No.

12 CHAIRMAN JACKSON: Commissioner Dicus?

13 COMMISSIONER DICUS: No.

14 CHAIRMAN JACKSON: Thank you.

15 This meeting is adjourned.

16 [Whereupon, at 10:48 a.m., the briefing was
17 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: BRIEFING BY NUCLEAR WASTE TECHNICAL
REVIEW BOARD - PUBLIC MEETING

PLACE OF MEETING: Rockville, Maryland

DATE OF MEETING: Tuesday, July 30, 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 Mitchell

Reporter: Jon Hundley

**The Department of Energy's
Civilian Radioactive Waste Management Program:
An Independent Perspective**

Dr. John E. Cantlon, Chairman

Dr. Jared L. Cohon, Member

U.S. Nuclear Waste Technical Review Board

**presentation to the
U. S. Nuclear Regulatory Commission**

*July 30, 1996
Rockville, Maryland*

Chairman Jackson, Commissioners, ladies, and gentlemen, good morning. It is a pleasure to be here today. My name is John Cantlon, and I am Chairman of the U.S. Nuclear Waste Technical Review Board. I am vice president emeritus for research and graduate studies and former dean of the graduate school at Michigan State University. My area of expertise is environmental biology. Accompanying me is Board member Jared Cohon, who will make part of our presentation today. Dr. Cohon is dean of the School of Forestry and Environmental Studies and professor of environmental systems analysis and mechanical engineering at Yale University.

Nuclear Waste Technical Review Board
 Created by Congress in 1987 to evaluate the technical and scientific aspects of the DOE's civilian spent fuel and high-level waste management program including site characterization, waste packaging, and transportation.

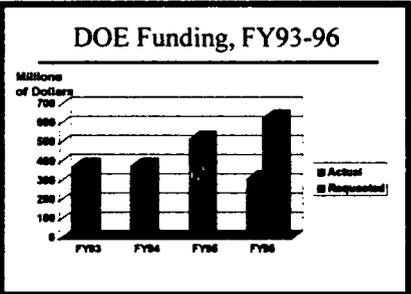
Since we have not met with some of you before, let me begin by briefly summarizing who we are and what we do. The Nuclear Waste Technical Review Board was created by Congress in the 1987 Amendments to the Nuclear Waste Policy Act and is charged with evaluating the technical and scientific aspects of the Department of Energy's (DOE's) high-level nuclear waste management program. This includes site-characterization activities at Yucca Mountain and activities relating to the packaging and transport of high-level radioactive waste and spent nuclear fuel. The Board is an independent agency within the federal government, *not* part of the DOE or any other agency. The Board is authorized to have eleven members who are nominated by the National Academy of Sciences and appointed by the President. I have served since the Board's creation and became its second chairman in 1992. Dr. Cohon was appointed to the Board in June, 1995. The appointments of several Board members, including my own, have expired, but last year's appropriations bill permits us to serve until replacement appointments are made. We expect that to occur within the next few months.

Overview of Presentation

- Key Program Developments
- Proposed Legislative and Regulatory Changes
- Program Status Today
- Assessing Site Suitability

Today, in our prepared remarks, we would like to briefly review some of the key developments of 1995 and the first half of 1996. These have been somewhat turbulent times for the program, but there also has been substantial progress. I would especially like to offer our thoughts on some of the legislative and regulatory changes that were proposed during 1995 and which remain under consideration. Then, we will summarize for you the Board's current views on the status of the program, including the DOE's plans for evaluating the "viability" of the Yucca Mountain site within the next two years. After our prepared remarks, we look forward to the free-ranging and candid discussion that has been characteristic of our past meetings with the Commission.

Key Program Developments



As you are aware, program funding in recent years has been anything but stable. Following a sharp increase in the program's budget for fiscal year 1995, it became apparent that funding levels for fiscal year 1996 and beyond would not support the activities and milestones that had been laid out earlier in the DOE's 1994 *Program Plan*. Faced with a 40 percent reduction in its budget, the DOE's Office of Civilian Radioactive Waste Management (OCRWM) had to reduce the scope of its activities and set better priorities for its efforts for the coming years. Surface-based programs at Yucca Mountain were cut back. Development of multipurpose canisters, which the DOE had planned to make

available for at-reactor storage of spent fuel beginning in 1998, was stopped at the direction of the Congress. As a result, the DOE has stated it will make its designs available to private developers in an attempt to ensure enough standardization of designs to allow efficient waste handling operations for transport, storage, and disposal. Preparation for repository licensing was ended, as were efforts to develop environmental impact statements for the repository and the multipurpose canisters. The DOE is now pursuing a "viability assessment" for siting a repository at Yucca Mountain, to be completed in 1998. The purpose of this assessment seems to be to decide whether continued site studies and repository design efforts are warranted. The relationship between the viability assessment and an evaluation of the technical suitability of the Yucca Mountain site is unclear. In the Board's view, a recommendation of the site to the President should require an assessment that it is technically suitable for development of a repository. The Board has defined "suitability" to mean a high probability that the site, along with the appropriate engineered barriers, can provide long-term waste isolation. The viability assessment appears to be a less thorough and less conclusive evaluation of the site's potential.

Recently, one of the most visible parts of the program has been the operation of the tunnel boring machine (TBM). The Board was an early advocate of underground exploration at the Yucca Mountain site, and remains so today. The exploration at Yucca Mountain has provided a number of geologic insights not anticipated from surface-based activities (i.e., geophysical measurements, mapping, and drilling). Underground exploration has indicated *so far* that the quality of the rock inside Yucca Mountain is better than anticipated from surface mapping. Some differences are being found between the predicted orientation of several faults and what was actually observed at depth. One *favorable* difference may be in the nature of the Drill Hole Wash structure. The apparent insignificance of this suspected structure may permit expansion of the repository block to the northwest, allowing more room for waste emplacement. Finally, access to the repository horizon has allowed collection of numerous rock and fracture coating samples, which may help to better define the hydrologic conditions within Yucca Mountain. The discovery of chlorine-36 at a few locations suggests that pathways exist along which precipitation can penetrate very rapidly through the mountain. One of the most important tasks ahead for the DOE as it evaluates the suitability of the Yucca Mountain site will be to determine how wide-spread and numerous these "fast paths" are, the amount of water they carry, and how often water flows through them.

Two Primary Goals of the Draft Waste Isolation Strategy

- Near-complete containment of radionuclides within waste packages for several thousand years.
- Acceptably low annual doses to a member of the public living near the site.

While somewhat less visible, substantial progress also was made in developing a technically credible waste isolation strategy for a potential repository at the Yucca Mountain site. As this slide indicates, the strategy is based on two primary goals—near-complete containment of radionuclides within waste packages for several thousand years and acceptably low annual doses to a member of the public living near the site.

System Attributes Important for Achieving the Goals

- Rate of water seepage into the repository.
- Waste package lifetime (containment).
- Rate of release of radionuclides from breached waste packages.
- Radionuclide transport through engineered and natural barriers.
- Dilution in the underlying saturated zone.

The strategy contemplates achieving these goals by relying on five engineered and geologic barriers—which the DOE refers to as attributes—to isolate waste from the human environment. The Board believes that the strategy must be soundly grounded in credible and testable hypotheses concerning the interactions between the engineered and natural components of the repository over long periods of change in the

climatic, geologic, hydrologic, geochemical, and ecological processes occurring at the site. If soundly developed, demonstration of the strategy will provide a technically supportable basis for setting priorities for activities at Yucca Mountain and for repository design studies.

Another area of progress for the DOE during 1995 was completion of a more detailed total system performance assessment (TSPA) for a Yucca Mountain repository. This analysis projects, based on current knowledge, how well a repository would be able to isolate waste. Equally important, it helps identify the most important parameters affecting performance, allowing the DOE to better focus its studies on those parameters.

Proposed Legislative and Regulatory Changes

Potential Legislative and Regulatory Changes

- EPA standards are being revised.
- NRC regulations to be revised.
- DOE siting guidelines to be revised.
- Congress is considering writing its own radiation protection standards into law.

Changes in the legislative and regulatory environment have affected the U.S. high-level nuclear waste program from its inception. As you know, changes to the basic health and safety standards for a Yucca Mountain repository are now under consideration as directed by the Congress in the Energy Policy Act of 1992. That law directed the EPA to contract with the National Academy of Sciences to analyze and recommend the scientific bases to be used in developing such a standard. The EPA would then promulgate a health and safety standard

for the Yucca Mountain site *based on and consistent with* the NAS recommendations. The NRC is directed to enforce the new standards through its regulatory, licensing and, oversight procedures.

In its report, *Technical Bases for Yucca Mountain Standards*, released on August 1, 1995, the NAS recommends risk-based standards that emphasize protection of individual members of the public. The report recommends that institutional controls not be relied upon as the means to prevent unacceptable exposures to releases from a repository. Furthermore, it finds that there is no scientifically supportable way to predict the probability of human intrusion over the long term. The NAS report recommends that performance standards for a Yucca Mountain repository apply for a time limited only by "the long-term stability of the fundamental geologic regime—a time scale that is on the order of 1,000,000 years at Yucca Mountain." The report stated that many of the details related to the standards involve making public policy choices that can be illuminated by, but not determined by, science alone.

Currently, the EPA is close to releasing a draft safety standard that is supposed to be compatible with the NAS recommendations. While the EPA is revising the health and safety standard for the potential repository at Yucca Mountain, proposed federal legislation, if enacted, would once again change the regulatory criteria for a repository. The legislation would establish the regulatory requirements for a permanent repository at an individual dose limit of 1 millisievert/yr (100mrem/yr) for the average person living near the repository. This is a factor of three to ten higher than other nations' dose limits, but it would become the standard unless the NRC determined that it would constitute an unreasonable risk to health and safety. It would limit the period of regulatory compliance to 1,000 years, but would require predictions of risk out to 10,000 years. It also would stipulate that institutional controls would be effective in preventing human intrusion into, or disruption of, the repository.

For some time the Board has believed that current U.S. regulations and, perhaps, the health and safety standards governing spent fuel disposal need to be updated. The current EPA

health and safety standard and the NRC and DOE regulations were too detailed and enacted too early in the process of searching for a permanent repository site. Scientific and technical knowledge, particularly when applied to a first-of-a-kind undertaking, take time to evolve. In retrospect, the wiser course may have been to collect that knowledge and use it in developing a regulatory framework. In the absence of that approach, the Board believes that the NAS report and current scientific and technical understanding of the conditions at the Yucca Mountain site should provide a basis for revising safety standards and regulations. However, the standards in the proposed legislation are well above risk levels and below time periods being considered in other nations.

Comments on NAS Report

- Uncertainty increases beyond 10,000 years.
- Stringency depends on definition of critical group. Board endorses concept of probabilistic critical group.
- Gaseous carbon-14 releases pose negligible individual risk.
- No scientific basis for predicting human intrusion

In response to a request from the EPA, the Board expressed its views on several key issues raised by the NAS report. The Board stated its belief that if the EPA standards for a Yucca Mountain repository are to apply for more than about 10,000 years, appropriate language should be included in the standards to accommodate the increased levels of uncertainty in projected human health risks over a very long period of time. The Board noted that the stringency of the standards for the long-term performance of a repository at Yucca Mountain also will depend on the definition of the critical group. The Board endorsed the general concept of a probabilistic critical group,

but the alternative suggested in the NAS report—a subsistence farmer critical group—seemed overly conservative for a site like Yucca Mountain, which has a harsh climate and lacks arable land. A reasonable analysis using a probabilistic approach should consider alternative lifestyles by which individuals could be exposed to releases from a repository. The Board stated its belief that the incremental risk, if any, associated with gaseous carbon-14 releases from a Yucca Mountain repository should be considered negligible and beyond regulatory concern. The Board also stated that it agreed with the NAS that there is no scientific basis for predicting the probability of inadvertent human intrusion over the long times of interest for a Yucca Mountain repository. Accordingly, intrusion analyses should not be required and should not be used during licensing to determine the acceptability of the candidate repository.

In its letter to the EPA, the Board noted that the form the standards eventually take could have significant implications for repository design. For example, if the repository standards apply out to 1,000,000 years, this may serve as a disincentive to spend money to develop more robust engineered barriers or to seek a better quantitative assessment of retardation in natural barriers. The Board believes that, whenever practical, releases should be delayed through the use of repository design and engineered barriers. Above all, the Board has urged the EPA to keep the standards simple. *In the Board's view, there are limits to what scientific knowledge can accomplish, and the standards should recognize and be consistent with those limits.* The Board also thinks it may be time to look at the overall *process* the United States uses to site, build, license, and close a permanent repository. The time may have come to establish a process that acknowledges the need to adapt to changing information. There are a variety of ways to accomplish this — from changing the program's organizational structure to changing the manner in which the repository is licensed. For example, a more realistic approach to developing a repository may be to license and construct it in increments of 10,000 to 20,000 metric-ton capacities, while maintaining assured retrievability, instead of developing a final design and securing a license for the full 70,000 or more metric tons before any construction begins. Plans for continued testing and monitoring during a repository's initial operating phase also seem to be a prudent step.

Additional regulatory changes also will occur soon. The Congress directed the NRC to

amend its repository regulations to conform to the revised EPA standards after those revised standards have been issued. More immediately, the DOE is planning to amend its siting guidelines, with proposed amendments to be released as soon as next month. The Board plans to examine issues related to the siting guidelines as soon as possible after their release.

The principal legislative proposals currently being considered by Congress would authorize the development of a storage facility soon at the Nevada Test Site, adjacent to the proposed repository site at Yucca Mountain. This legislation was proposed primarily to address the concerns of nuclear utilities about acceptance of their spent nuclear fuel. These utilities signed contracts with the DOE with the expectation that the DOE would begin acceptance of their commercial spent nuclear fuel for disposal at an operating repository beginning in 1998 or soon thereafter. Since then, a large group of state agencies and utilities have sued the DOE in the U.S. Court of Appeals for the District of Columbia to obtain a judgment making the DOE legally responsible to begin accepting utility spent fuel in 1998.

Concurrent with the introduction of these legislative proposals, Congress reduced the OCRWM's fiscal year 1996 appropriation by approximately 40 percent — from \$520 million to \$315 million. Congress earmarked an additional \$85 million for development of a centralized storage facility and related transportation systems, pending authorization of such a facility by the congressional committees responsible for nuclear waste programs. Together, these initiatives portend a possible change in primary focus of the U.S. spent fuel and high-level waste management, from permanent disposal to temporary storage.

On March 20, 1996, the Board submitted a report to Congress and the U.S. Secretary of Energy summarizing its views on disposal and storage of spent nuclear fuel. The Board recommends that the focus of U.S. policy should continue to be on the permanent disposal of spent fuel and high-level waste. The Board observes, however, that centralized storage capacity, which currently is not available in the United States, will be needed in the future, especially when reactors begin to shut down in large numbers. A large centralized storage facility will be necessary (1) to facilitate repository operations and waste handling and (2) to address storage needs, which will increase markedly around 2010, as illustrated in this slide.

In an effort to strike a balance between permanent disposal and temporary storage, the Board made the following recommendations in its report last March.

- The DOE should continue to assess the Yucca Mountain, Nevada, site as a potential repository site for the permanent disposal of the nation's spent nuclear fuel and high-level radioactive waste.
- Planning should begin now for a generic federal storage facility and supporting transportation structure that can be operating at full scale (3,000 metric tons/year) by 2010 — when U.S. reactors will begin shutting down in large numbers. Ideally, the storage facility should be located at the repository site.
- Siting and construction of a large storage facility should be deferred, however, until a decision is made on the suitability of the Yucca Mountain site. In the Board's view, this can be accomplished within about five years if the current pace of site characterization activities (which depends on adequate funding) is maintained.
- Limited-capacity backup storage should be made available at an existing federal nuclear facility to accommodate utility hardship cases and emergencies.

The Board concluded that "storing spent fuel at or near Yucca Mountain now, before the site has been determined suitable for repository development, risks prejudicing the decision about site suitability and threatening the credibility of the waste management program; it also would exacerbate the problem of limited resources for the site-characterization program." The Board also concluded that there are no compelling technical or safety reasons to move spent fuel to a centralized storage facility for the next few years.

Those are some of the more important developments during the last year and a half. Now, let's turn to the Board's views on the status of the program today.

Program Status Today

<p style="text-align: center;">Program Status and Opportunities for Improvement</p> <ul style="list-style-type: none">• Progress at Yucca Mountain is encouraging.• Adequate and stable program funding is needed.• Continued development of a waste isolation strategy is needed.• Program efficiency and integration could be improved.

Progress in assessing the Yucca Mountain site appears encouraging. The program is beginning to collect geologic and hydrologic information from the repository horizon that will help determine the suitability of the site. If TBM excavation rates can be improved, and if management improvements are made and sustained in other areas, the program should be able to proceed more efficiently toward a site-suitability decision (i.e., whether there is a high probability that the site, along with the appropriate engineered barriers, can provide long-term waste isolation).

It is obvious that efficient progress cannot be achieved without adequate and stable program funding. To determine the required level of funding, a sound technical justification for the planned activities should be developed. To a large extent, this justification should flow naturally from the evolving waste isolation strategy and the results of total system performance assessments. The Board is pleased with the progress that was made in 1995 in the formulation of a waste isolation strategy and in the use of that strategy to help set priorities for the activities of the Yucca Mountain project. During 1996, however, further development of the waste isolation strategy seems to have slowed. Additional efforts are needed to continue development of the strategy and to use it to develop a technical basis for planning program activities.

Some of the problems that have caused continuing frustration with the program have yet to be resolved. Perhaps the most important of these is the perception of program inefficiency. The DOE's tardiness in articulating a technical basis for its program activities has contributed to such perceptions. The sense of inefficiency is heightened by the DOE's inadequate integration among the various activities within the program. At times, some program participants seem to have little knowledge of the activities of other participants. With a program as large and complex as this one (about 2,000 employees scattered in many organizations), good integration is essential for efficient program management.

The program continues to be schedule-driven. Despite the sharp reduction in funding for fiscal year 1996, there seems to be an effort within the program to maintain nearly the same schedules for repository development and licensing. For example, the DOE says that projected funding will not permit a "technical site suitability" decision in 1998. The DOE's response has been to maintain a 1998 milestone, but to give the decision a new name — a "viability assessment." The technical basis for the viability assessment will be less complete than had been anticipated for the technical site suitability decision. The Board believes it would be better to establish a strong technical basis, derived from the waste isolation strategy and total system

performance assessments, to determine the scope of work required. Then, more technically defensible schedules and decision points could be established.

More use of outside experts is needed. When the project consulted outside experts to improve TBM performance, the results were impressive. After months of very poor TBM performance, several modifications were made, as recommended by outside experts. These modifications allowed excavation of the ESF to greatly improve. The project also established a standing board of consultants to advise it on ESF engineering and construction. The board of consultants has suggested to the DOE a number of specific ways to improve the design and construction of the ESF. Similar use of expert consultants in other areas may identify additional ways to improve the effectiveness of the program's operations.

Assessing Site Suitability

Assessing Site Suitability

- "Viability assessment" is *not* site suitability.
- Suitability decision will require:
 - East-west exploration across repository block.
 - Initial results from thermal tests.
- Suitability *can* be determined within 4-5 years if funding is adequate and stable and program efficiency is improved through integration.

Perhaps the single most important technical decision facing this program is evaluating the suitability of the Yucca Mountain candidate site. For the next two years, the program will focus on a "viability assessment" of the site. As we understand it, this decision is *not* a finding that the site is suitable for development as a repository. It is merely a determination that the site continues to be a "live" candidate that requires additional studies, leading to a site-suitability decision in 2001 and completion of a license application in 2002. Senate Bill 1936 would move the site recommendation forward in time to 1998 with a much diminished technical basis for the decision.

The Board believes that additional studies, beyond those planned for the viability assessment, will be needed to evaluate the site's suitability, most notably an east-west excavation across the candidate repository block. Years of underground construction worldwide show that no amount of surface-based testing can eliminate the necessity for underground exploration and testing. It is the Board's position that a technically defensible evaluation of the site cannot be made without exploration that would eliminate or greatly decrease existing hydrologic uncertainties. The Board continues to believe that an east-west crossing of the geologic block west of the Ghost Dance fault (i.e., the upper waste emplacement block) is necessary prior to any technically defensible decision on site suitability and an evaluation of the adequacy of its disposal capacity. The current design for the repository has all, or almost all, waste emplacement in the upper waste emplacement block west of the existing tunnel. This block, which is 4 kilometers (2 1/2 miles) long and 1.2 kilometers (3/4 mile) wide, has not been explored by drilling or by subsurface exploration. Without the needed east-west exploration, the geologic and hydrologic characteristics of the unexplored portion of the repository block must be extrapolated from those found in the portal-to-portal loop. Extrapolation over such a long distance would be difficult to justify technically.

The 1996 revision of the DOE's *Program Plan* shows completion of an east-west excavation "if deemed necessary." However, even if undertaken, this excavation would *not* be completed before the 1998 viability assessment. The Board believes strongly that an east-west crossing is needed. Today, we have very little information about the nature of the candidate repository block. No boreholes have been drilled into it, and the current tunnel of the exploratory studies facility skirts the eastern edge of the block. The Board believes that a small-diameter, east-west tunnel should be excavated across the candidate repository block to allow direct observation and testing of the geologic and hydrologic conditions that will determine the suitability of the site. For example, the recent discovery of elevated levels of chlorine-36

(presumably from 50 year old nuclear weapons tests) in the north-south exploratory tunnel suggests the existence of fast flow paths for water through the mountain. It is imperative to determine whether any such flow paths exist within the candidate repository block and, if they do, how pervasive they are, how much water they can transmit, and how frequently water moves through them. In the Board's view, a technically supportable decision about the suitability of the site for a repository of adequate capacity simply cannot be made without the information that would be obtained from an east-west excavation across the block.

Initial results from underground tunnel-scale heater experiments also will be needed to predict better the movement of water in the rock surrounding the hot waste packages. The DOE is now excavating facilities for these tests, but the tests cannot be completed, and the results evaluated, before the 1998 viability assessment.

The Board cautions against making more of the viability assessment than it merits. Additional information will be needed, beyond that which will be available for the viability assessment, before a technically supportable decision can be made about the suitability of the Yucca Mountain site. The Board believes that adequate information can be acquired within 4-5 years to support a suitability decision about the Yucca Mountain site, but adequate and stable program funding will be needed if this goal is to be achieved.

This concludes our prepared presentation. We will be happy to answer any questions you may have.