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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

AND

ADVISORY COMMITTEE ON NUCLEAR WASTE

NOVEMBER 14, 2001

The contents of this transcript of the proceedings of the United States Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards and Advisory Committee on Nuclear Waste, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

ADVISORY COMMITTEE ON NUCLEAR WASTE

(ACRS)

(ACNW)

MEETING OF THE ACRS/ACNW JOINT SUBCOMMITTEE

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WEDNESDAY

NOVEMBER 14, 2001

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ROCKVILLE, MARYLAND

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The ACRS/ACNW Joint Subcommittee met at
the Nuclear Regulatory Commission, Two White Flint
North, Room T2B3, 1545, Rockville Pike, at 8:30 a.m.,
Mr. B. John Garrick, Chairman, presiding.

Subcommittee Members Present:

Mr. B. John Garrick, Chairman, ACNW

Dr. Thomas S. Kress, Co-Chair, ACRS

Mr. Milton N. Levenson, Member, ACNW

Mr. Dana A. Powers, Member, ACRS

1 ACRS/ACNW Staff Present:

2 Mr. Howard Larson

3 Mr. Michael T. Markley, ACRS

4 Mr. Richard Savio

5 Mr. Sher Bahadur

6 Also Present:

7 Mr. Peter Hastings (via phone)

8 Mr. Ken Ashe (via phone)

9 Dr. Dennis Damon

10 Mr. Yawar Faraz

11 Mr. Carl Yates

12 Ms. Lydia Roche

13 Mr. Felix Killar

14 Ms. Marissa Bailey

15 Mr. Lawrence Kokaiko

16 Mr. Alan Rubin

17 Mr. Jack Guttman

18 Mr. Christopher Ryder

19 Mr. Brad Hardin

20 Mr. Moni Dey

21 Mr. Jason H. Schaperow

22 Mr. S. Khalid Shaukat

23 Mr. Ed Hacket

24

25

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A-G-E-N-D-A

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

8:30 a.m.

MR. GARRICK: Good morning. Our meeting will now come to order. This is the meeting of the Advisory Committee on Reactor Safeguards and the Advisory Committee on Nuclear Wastes Joint Subcommittee.

I am John Garrick, acting as chairman of the Joint Subcommittee. Tom Kress, on my right, is co-chairman. The committee members that are in attendance are Milt Levenson of the Advisory Committee on Nuclear Waste, and Dana Powers of the Advisory Committee on Reactor Safeguards, a distinguished group to be sure.

The Joint Subcommittee will continue its discussion on risk informing activities of the Office of Nuclear Materials Safety and Safeguards with emphasis on the proposed final version to the Standard Review Plan, Chapter 3, for integrated safety analysis. We will discuss the use of risk informed case studies and development of a probabilistic risk assessment for dry cask storage.

The subcommittee will gather information, will analyze relevant issues and facts, and formulate positions and actions as appropriate for deliberation

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1 by the ACNW full committee.

2 Mike Markley is the Cognizant ACRS/ACNW
3 Staff Engineer for this meeting.

4 The rules for today's meeting have been
5 announced as part of the notice of this meeting
6 previously published in the Federal Register on
7 November 2, 2001.

8 A transcript of the meeting is being kept
9 and will be made available as stated in the Federal
10 Register notice.

11 It is requested that if we have speakers
12 they identify themselves and speak clearly and loudly
13 so that we can hear them.

14 We haven't received any comments or
15 requests for time to make oral statements for members
16 of the public regarding today's meeting. However, we
17 do have a request from Mr. Peter Hastings of Duke-
18 Cogema to participate via telephone. I guess we are
19 accommodating that request.

20 One of the things the committee has to
21 decide and will be influenced by staff on this is
22 whether or not they wish to have a letter from us. It
23 seems as though one of the key issues associated with
24 at least the initial part of our meeting having to do
25 with the Standard Review Plan and having to do with

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1 integrated safety analysis in particular is the issue
2 of scope. What actually should be in the summary.

3 As a kind of aside and a curiosity, I find
4 it very interesting, and maybe the folks that present
5 to us today can answer this, that an institution like
6 the Army Chemical Corps who definitely has a chemical
7 culture, the culture that developed the process hazard
8 analysis methodology.

9 The Chemical Corps has chosen to use
10 probabalistic risk assessment, or PRA, on their
11 chemical waste disposal facilities, while the NRC, the
12 culture that developed probabalistic risk assessment,
13 seems to be choosing process hazard analysis as the
14 cornerstone of their integrated safety assessment.
15 Maybe that will all be -- the reasons for all of that
16 paradox will become clearer to us as we get more
17 deeply involved.

18 The committee has been discussing for its
19 last two or three meetings the risk informing
20 activities of NMSS and other matters. Maybe what
21 we're seeing here is a little difference between
22 subcultures, namely, something like the differences
23 between the NRR and their philosophy about methods and
24 techniques and the NMSS, but I'm not sure.

25 Okay. Unless the members have some

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1 preliminary comments they would like to make, Dana,
2 Milt, Tom, I think we'll turn the time over to Mr.
3 Faraz for the initial presentation.

4 MR. FARAZ: Good morning. Can everyone
5 hear me?

6 MR. GARRICK: You want to tell us a little
7 bit about yourself and your involvement in this?

8 MR. FARAZ: Yes. I'll do that. My name
9 is Yawar Faraz. I'm a senior project manager in the
10 fuel cycle licensing branch in the Division of Fuel
11 Cycle Safety and Safeguards in NMSS.

12 Within the next 30 or 40 minutes I'll be
13 providing you a very brief overview of Subpart H of 10
14 CFR Part 70. That's what the Chapter 3 of the SRP is
15 really based on.

16 I'll also provide you very briefly a
17 status of where the fuel cycle licensing branch stands
18 in terms of ISAs for fuel cycle facilities.

19 I've kept my presentation to a minimum.
20 I have a total of 10 slides. That's to allow a good
21 discussion on this topic. Anytime you have any
22 questions, please feel free to ask.

23 Immediately following my presentation, Dr.
24 Dennis Damon will provide a roughly 60 to 70 minute
25 briefing on how to conduct ISAs and how we would be

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1 reviewing ISAs.

2 The question is why did we devise 10 CFR
3 Part 70 and why did we include Subpart H in Part 70?
4 As you know, Subpart H was included in CFR Part 70.
5 The required fuel cycle licensees, as the name
6 implies, to integrate all the safety disciplines.

7 Subpart H requires the use of systematic
8 methods to (a) identify all potential accident
9 sequences, (b) determine the likelihoods, and (c)
10 estimate the consequences.

11 Another very important aspect of Subpart
12 H that it requires the licensees to identify items
13 relied on for safety, or IROFS. As you know, this can
14 both be hardware as well as administrative
15 requirements.

16 Who is required to comply with Subpart H?
17 It is those whose cycle facilities are authorized to
18 possess greater than a critical mass of SNM, or
19 special nuclear material. And who processed enriched
20 uranium and mix oxide fuel?

21 Currently there are six operating fuel
22 fabrication facilities in the U.S. that are required
23 to comply with Subpart H. Those are the six that I've
24 listed. In addition, there is also the MOX
25 application that we're currently reviewing. The MOX

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1 facility would also have to comply with Subpart H.

2 In addition to this, if there are any
3 future enrichment facilities that need to be licensed,
4 they would have to comply with Subpart H as well.

5 MR. GARRICK: How many of these facilities
6 already have something like an ISA?

7 MR. FARAZ: I would say most of the
8 facilities are already doing an ISA type -- they have
9 ISAs established in their systems. There are some
10 that are fairly forward and fairly advanced in their
11 application of ISAs and some that are not as advanced.

12 The rule requires that for a site-wide ISA
13 to be completed, it requires that it be done by
14 October of 2004. I would say that it appears that the
15 facilities are going to comply with that requirement.

16 What does Subpart H require in terms of
17 ISAs? One of the primary requirements that I just
18 mentioned is to have licensees conduct ISAs for their
19 facilities.

20 By conducting an ISA a licensee can ensure
21 for themselves and demonstrate to the NRC that the
22 facility that they operate would comply with the
23 performance requirements of Subpart H. These are
24 listed in 70.61.

25 Another very important aspect of ISAs is

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1 the identification of items relied on for safety, or
2 IROFS. To ensure that these IROFS are available and
3 reliable, Subpart H requires the licensees to
4 establish management measures. Some examples of
5 management measures I'll show you in just a minute.

6 On this slide and the next slide I'll just
7 briefly go over what the performance requirements of
8 Subpart H are. I'm sure most of you are already aware
9 of this. First of all, the licensees are required to
10 identify all credible accidents that can occur at
11 their facility.

12 Once they have done that, the licensees
13 need to ensure that certain accident sequences are
14 highly unlikely. These would be the ones that result
15 in the following consequences. For the worker, a dose
16 greater than 100 rem or a chemically caused fatality.

17 For a member of the public located outside
18 the controlled area which you don't think of as the
19 site boundary, the limits are 25 rem. A soluble
20 uranium intake of greater than 30 milirems or
21 irreversible chemical injury. This is for a member of
22 the public outside the site boundaries.

23 MR. POWERS: Since this is an intention to
24 integrate together a number of safety disciplines
25 including environmental safety discipline, they are

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1 there no environmental contamination constraints in
2 this definition?

3 MR. FARAZ: There are and I'll get to that
4 in the next slide.

5 MR. LEVENSON: I have a question. Under
6 the worker you say chemical caused fatality. Is that
7 intended to exclude OSHA type physical mechanical
8 fatalities?

9 MR. FARAZ: Yes. There are certain
10 accident sequences that are required to be unlikely.
11 We just talked about the highly unlikely ones. Now
12 I'll talk about the ones that need to be unlikely.

13 For a worker this would be a dose between
14 25 rem and 100 rem or irreversible chemical injury.
15 A member of the public would be between 5 and 25 rem
16 or a chemically induced transient illness.

17 For the environment it would be 24 hour
18 average air concentration outside the restricted area
19 which you can think of as the fence line which may or
20 may not be within the site boundary. The air
21 concentration there if it's greater than 5,000 times,
22 Table 2 of Appendix B of 10 CFR Part 20.

23 Incidentally, if you can word that the 24-
24 hour air concentration to a dose, it ends up being
25 about 1 rem. If you compare this to the member of the

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1 public residing outside the controlled area it's less
2 and you're talking about a dose at the fence line or
3 the restricted area which is within the site boundary.

4 MR. GARRICK: Is that 1 rem due to
5 inhalation?

6 MR. FARAZ: Yes. It's a 24-hour dose.
7 Really this would be the controlling mechanism.

8 MR. GARRICK: But you don't get a
9 contribution from any ground shine or any other
10 source?

11 MR. FARAZ: No.

12 MR. POWERS: Could you explain to me how
13 these things come up? Why 5,000 times and not 3,000
14 times?

15 MR. FARAZ: We went through a fairly
16 lengthy process of coming up with Part 70. It was a
17 participatory rulemaking process. This was something
18 that all the stakeholders, including in our city,
19 agreed upon as being a reasonable level.

20 Now, I was involved in that process but
21 this is something that was already included in the
22 rule. I think there might have been something in the
23 statement considerations that might shed some light on
24 that. These are levels that all the stakeholders
25 including NRC thought were reasonable. That's why

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1 they were established in the rule.

2 MR. POWERS: I guess what I'm trying to
3 understand is what leads one to conclude that these
4 are reasonable? I mean, there must be some thought
5 process.

6 MR. FARAZ: Right. I'm sure that went
7 into the rulemaking process which is, as you know, a
8 very lengthy process.

9 DR. KRESS: This air concentration outside
10 the restricted area, is that meant to be a maximum in
11 case atmospheric conditions make it jump over
12 locations?

13 MR. FARAZ: It's a 24-hour average.

14 DR. KRESS: It's a 24-hour average where?
15 Right at the --

16 MR. FARAZ: At the fence line.

17 DR. KRESS: At the fence line.

18 MR. FARAZ: Right. But you're right,
19 somebody can argue that theoretically there could be
20 an elevated release or buoyant release --

21 DR. KRESS: That's what I had in mind.

22 MR. FARAZ: -- that might go with the
23 fence line and come down on the site boundary. In
24 that exceptional case, it would not be the controlling
25 factor.

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1 DR. KRESS: Does this performance
2 requirement come with a specification on what
3 analytical models are to be used?

4 MR. FARAZ: No.

5 DR. KRESS: Does it talk about means or
6 uncertainties in the calculation?

7 MR. FARAZ: No.

8 DR. KRESS: It just specifies a number?

9 MR. FARAZ: Right. Right.

10 MR. GARRICK: So when you say average, are
11 these average atmospheric stability conditions or are
12 these for a special set of atmospheric conditions such
13 as F?

14 MR. FARAZ: Yes. I think when the
15 licensees look at their accident sequences and try and
16 estimate the consequences, I'm sure they would build
17 in the conservatism that is reasonably required for
18 coming up with air concentrations.

19 I think generally what the licensees do
20 and what the NRC accepts, the staff accepts, is a
21 conservative estimate at the fence line. We would
22 look at whether they are using annual average type
23 meteorology or are they using fairly conservative
24 data.

25 MR. LEVENSON: Is there a rationale for

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1 why one of those is outside the controlled area and
2 the other is outside the restricted area because they
3 are both public.

4 MR. FARAZ: Yes. That's a good point. As
5 I said, I wasn't really involved in the development of
6 the rulemaking process. I would tend to think that
7 with member of public maybe thinking about the nearest
8 resident.

9 The question may have come up is that
10 members of the public can come into the controlled
11 area because sometimes these facilities have roads and
12 there is really nothing restricting anyone coming up
13 to the fence line.

14 In that case, they could be exposed to the
15 environmental contamination while they are in that
16 area. That's why maybe the environmental requirement
17 came in. That's why I said the restricted area and
18 not the control area.

19 MR. YATES: I have a question. My name is
20 Carl Yates. I'm with BWXT in Lynchburg. A comment
21 really. We have been using the restricted area in our
22 analyses of our accident scenarios to mean the
23 radiological restricted area which is much closer than
24 the site boundary or the controlled area boundary.

25 MR. FARAZ: Right.

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1 MR. YATES: So we have been looking at air
2 concentration levels on site to the restricted area
3 fence line.

4 MR. FARAZ: Right.

5 MR. YATES: Also, I had a question. We
6 were also wondering does it say air in the regulation?
7 We were wondering if it also included liquid releases
8 because Table 2 gets both air and liquid
9 concentrations. We were looking at some accident
10 scenarios involving liquid releases and whether or not
11 we needed to apply that 5,000-times limit to that.

12 MR. FARAZ: I'm not absolutely sure if it
13 specifies air or not.

14 MR. YATES: Okay.

15 MR. FARAZ: That's a good point. That's
16 something I'll need to look into.

17 DR. DAMON: My name is Dennis Damon. I
18 was involved in the process by which the Part 70
19 evolved. My memory of why the distinction between
20 controlled area and restricted areas is there were
21 some facilities that we had been looking at.

22 It turns out not to be the facilities that
23 are being regulated under this but facilities that
24 might come under it where they had very large
25 controlled areas. They control the whole Hanford

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1 Reservation.

2 The idea was we didn't think it was
3 appropriate to contaminate a very, very large area of
4 the landscape to these kind of levels. That's why it
5 was made the less restrictive definition. I mean, the
6 air concentration gives you one rem and the one above
7 gives you 5 rem so it's kind of backwards from what
8 you've just said is the ratio.

9 DR. DAMON: I think all I'm saying is that
10 we didn't want our licensee to simply be able to use
11 the fact that they controlled an area to permit them
12 to contaminate it to these levels. In other words,
13 you see what I'm saying? They move the control area
14 out and inside that they don't need to -- they can
15 exceed this limit. The point was to deny -- to
16 prevent that.

17 The other factor that I would point out
18 about these is that these are all fairly high levels
19 of consequences. They are not low levels like you
20 would normally talk about in the context of
21 environmental contamination and so on.

22 There was, I believe, a consideration to
23 make that environmental requirement more comparable to
24 those other requirements for workers and the public.
25 These are very substantial accidents. These are not

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1 insignificant ones.

2 I think the rationale there is it was
3 desired that the requirement not be applied to very
4 low levels of accidents because they are sort of like
5 a cost benefit consideration there. The licensees had
6 enough to do to just consider the more severe things.
7 I think that concept comes in here.

8 DR. KRESS: That brings to mind another
9 question. These do look like high-level -- could I
10 call them safety goals? They relate to the safety
11 goals for operating reactors, or do they? Do they
12 have any relationship at all to those?

13 MR. FARAZ: I'm not sure how they would
14 relate to the reactor safety. Dennis, are you
15 familiar with --

16 DR. DAMON: I mean, there's no discussion
17 that I can remember in the evolution of the rule that
18 related them to the reactor safety goals. One other
19 thing. These are not goals. These are requirements
20 in the sense that they are required to make them a
21 certain likelihood level.

22 DR. KRESS: I understand. I understand
23 that.

24 DR. DAMON: So they are not at a goal
25 level.

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1 DR. KRESS: The rationale I was thinking
2 of is if the safety goals were to be requirements,
3 which they are sort of ambiguous right now whether
4 they are or not and, therefore, a summation of
5 sequences.

6 You could view fuel fabrication plants as
7 an essential part of nuclear power so it seems to me
8 like an essential part of nuclear power the cost
9 benefit type of assessment would tell you the safety
10 goals ought to be about the same because it's the same
11 benefit so you ought to be able to accept the same
12 risk.

13 Since these are for individual sequences,
14 they must be some fraction of that safety goal. I
15 don't know what fraction it is. It depends on how
16 many essential sequences you have in the unlikely
17 category and in the other category.

18 My question was to see if there was some
19 rationale process it went through to show that these
20 are indeed of the nature that might be equivalent to
21 the safety goals.

22 MR. GARRICK: I think it's obvious they
23 did not go through an apportionment process or an
24 allocation process.

25 DR. KRESS: That would be an allocation.

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1 MR. GARRICK: I wanted to ask who decides
2 the restricted area and can it be a variable? Is that
3 the licensee?

4 MR. FARAZ: The licensee would decide
5 where the restricted area is and they would present
6 that to the analyses staff. Then the analyses staff
7 would determine whether it's okay or not. They would
8 establish the area and that would be part of their
9 submittal to the NRC.

10 MR. GARRICK: And that's something that
11 probably wouldn't change. I guess the licensing
12 process allows for a change if they have a sufficient
13 justification for it?

14 MR. FARAZ: Yes.

15 MR. GARRICK: There are still a lot of
16 questions on that. Go ahead, Milt.

17 MR. LEVENSON: An incidental question is
18 how do these definitions of likely and unlikely
19 compare with those in the proposed Part 63?

20 MR. FARAZ: I'm not very familiar with
21 Part 63. Go ahead, Dennis.

22 DR. DAMON: They really have nothing to do
23 with it. We had a discussion with Tim McCartin and
24 the Division of Waste Management about the issue of
25 whether there needed to be consistency and we saw no

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1 need for there to be a consistency.

2 The term unlikely and other qualitative
3 likelihood terms appear many different places in the
4 regulation. I was going to point out some of them in
5 a presentation later today.

6 They certainly are not used in any
7 consistent manner except to the extent the English
8 language meaning of the word. They are used in that
9 sense consistently but there's no definite numerical
10 probability or anything associated with them.

11 MR. LEVENSON: Of course, it explains part
12 of the problems we have communicating with the public
13 when we use different definitions for the identical
14 words in different regulations.

15 MR. GARRICK: But you do have guidelines
16 that indicate what those mean.

17 DR. DAMON: Certainly in the case of Part
18 63 that's what they are going to do. They are going
19 to tell the public exactly what the staff thinks it
20 means. In the context of Part 70 here it was not
21 stated in the rule but the Standard Review Plan
22 indicated what the staff thought.

23 MR. GARRICK: Yes, this was 10 to the
24 minus 5 and 10 to the minus 4 for unlikely and highly
25 unlikely.

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1 MR. FARAZ: What I'll do is we'll hear
2 some of the management measures that I talked about,
3 some examples of management measures that are needed
4 to ensure that the IROFS have really been reliable.

5 You have the configuration management
6 program, training, QA, procurement, maintenance,
7 functional testing, surveillance calibration
8 procedures, signs, tags, shipping, storage, human
9 factors. The list goes on and on.

10 What I'll do next is I'll try and give you
11 a brief overview of where --

12 MR. POWERS: Let me ask you a question
13 about it. You've listed down a host of things with no
14 indication that this is complete. What am I supposed
15 to drive from this list?

16 MR. FARAZ: Let me just get to it. Okay,
17 yes.

18 MR. POWERS: There are 10,000 things here
19 and there are probably 10,000 that are not listed on
20 it. Are these the things that NRC proposes to control
21 and regulate?

22 MR. FARAZ: These are management measures
23 that the licensees are required to establish and that
24 they will provide to the NRC when they complete their
25 ISAs. The NRC would look at them and review them and

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1 determine if they are okay or not. What I want to do
2 is give some examples of management measures that will
3 be included in their ISAs.

4 MR. POWERS: I guess I'm a little --
5 suppose they have a written policy and procedure for
6 tags? I supposed NRC could review it. How do they
7 decide that is a good one or a bad one?

8 MR. FARAZ: There's no definite criteria
9 for what is okay or not. I think the NRC would look
10 at the entire management program as a whole and then
11 determine if they are good management measures or not.
12 If they determine that additional management measures
13 are required or needed to assure safety, then the NRC
14 would ask licensees to revise or change those
15 management measures.

16 MR. POWERS: So if the NRC did not like
17 the workload that the management was imposing on an
18 individual, they would say don't do that?

19 MR. FARAZ: If the licensee says that
20 overtime is authorized up to \$100 a week for an
21 individual that is relied on for safety, then clearly
22 that is something the NRC staff would question. There
23 are things like if the NRC staff sees there's some out
24 of the ordinary management measurement being proposed,
25 then we would look into it and question it.

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1 MR. MARKLEY: How is this being links to
2 the risk-informed oversight process, or is it?

3 MR. FARAZ: You mean the whole ISA
4 process?

5 MR. MARKLEY: Well, the oversight process
6 which is your inspection and verification process and
7 what they've done in looking at cornerstones of safety
8 with the reactor program. I understand they are doing
9 some of that with the fuel cycle programs as well. It
10 seems to me like most of these types of verifications
11 would fall within an oversight process of some sort.

12 MR. FARAZ: Right. They would be included
13 in their license application all the ISA. That's
14 something that the licensing group would be reviewing.
15 Then once the licensing group feels that they are
16 fairly good management measures in place, then the
17 inspection process would confirm whether they are okay
18 or not.

19 DR. DAMON: This is Dennis Damon again.
20 The key thing to focus on in this slide is that first
21 top bullet, "Measure to assure that IROFS are
22 available and reliable and needed." There is actually
23 a requirement. If you read the rule language, the
24 requirement statement in the rule language, this is
25 actually almost a quote from it.

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1 It says, "The licensee must establish
2 these measures to assure that IROFS are available and
3 reliable when needed in the context of the 70.61
4 performance requirements."

5 What the staff intended that to mean was
6 you had to do these things that are on this list to
7 whatever extent was sufficient to achieve highly
8 unlikely for high consequence accidents and so on.
9 That's the direct requirement statement.

10 If the accident is highly unlikely given
11 the whole ensemble of all the things that they do in
12 this thing with respect to that one accident, then
13 that is sufficient so the staff cannot make them do a
14 better maintenance program just because they like
15 better maintenance programs. It has to be tied
16 directly to the highly unlikely issued.

17 Then the other thing is it says "when
18 needed." It's obvious that was to preclude the idea
19 that you have to have these programs in place and
20 everything has to be done all the time. Like I say,
21 this whole thing is tied -- the whole idea of the rule
22 was to tie these programs to the items relied on for
23 safety that come out of the ISA analysis. It's that
24 linkage that is the key thing that the staff had.

25 The reason was because some of these

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1 programs that some licensees had not been part of
2 their formal license commitments. Some licenses did
3 not have configuration management program descriptions
4 in their licenses with commitments as to what they
5 would or would not do and the same with maintenance.

6 This is an attempt to compel that be done
7 uniformly across the industry that licenses will
8 contain descriptions of these various programs. Then
9 the content of those programs should be tied to the
10 results of the ISA and should be done in a manner
11 sufficient to achieve the highly unlikely by
12 performance requirements.

13 MR. GARRICK: So these are more in the
14 context of examples of measures that could be taken?

15 MR. FARAZ: Exactly.

16 MR. GARRICK: Rather than necessarily
17 prescriptive.

18 MR. FARAZ: Exactly.

19 MR. GARRICK: It would be very facility
20 dependent and serve the systems that do surveillance,
21 dependent, and so on.

22 MR. FARAZ: Exactly.

23 MR. LEVENSON: I have a question. You
24 said that basically the metric is to make sure that
25 the accident is highly unlikely. Does that mean that

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1 if there are accidents by their inherent nature are
2 highly unlikely you don't need to identify IROFS
3 related to those accidents because you're already at
4 the cutoff put?

5 MR. FARAZ: Yes, that's true. What the
6 licensees would do is they would look at all the
7 accidents that can occur that are credible for their
8 facility. If an accident is not credible, then it
9 won't require IROFS.

10 MR. LEVENSON: Are you using the word
11 credible and highly unlikely to be identical?

12 MR. FARAZ: It's very hard to exactly
13 quantify credible and highly unlikely.

14 MR. LEVENSON: My whole point was if I'm
15 trying to do this, how do I know where my cutoff is
16 for preparing IROFS? That should be fairly clear.

17 DR. DAMON: It's described in Chapter 3,
18 the one that we'll get to, the chapter on ISA. The
19 issue of credibility is discussed there. The language
20 in the rule is the licensee is required to identify
21 all credible accidents and to make them -- if they are
22 high consequence make them highly unlikely. It's that
23 kind of language.

24 The way it was understood by the staff and
25 which is explained fairly carefully in chapter 3 is

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1 that to be credible means not to be included in the
2 ISA at all in a sense. This certainly doesn't have to
3 show up in the summary or whatever. The staff's
4 interpretation is that credibility must be obvious.

5 It must be obviously something that
6 doesn't need to be considered. Things that do need to
7 be considered because you maybe need to estimate their
8 frequency or make some judgement about them, they
9 ought to be -- they would be considered in the ISA and
10 documented in the process of doing them.

11 Credibility, in other words, is a
12 criterion for whether it's considered and documented,
13 whereas highly unlikely is a criterion for once you've
14 considered it, you've made it sufficiently unlikely.

15 In other words, what I'm saying is in
16 doing an ISA you would consider accidents that would
17 be far more unlikely than highly unlikely because of
18 natural reasons like an extreme earthquake or
19 something. You should have thought about that in
20 doing the ISA. It's part of the process.

21 It's just that you don't need to do
22 anything about it so you don't need to write down an
23 item relied on for safety on your list so there's
24 nothing for the facility to do. I think it should be
25 included in the process that you went through when you

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1 considered all the accidents.

2 MR. LEVENSON: So you're saying we require
3 analysis and regardless of the outcome of that
4 analysis, you don't do anything with the results so
5 why do it?

6 DR. DAMON: Well, it shows completeness.
7 What I'm saying is if something is obvious that it
8 does need to be considered, yeah, they don't need to
9 put it in there. But if you're talking about
10 communicating with like, say, future people at your
11 own plant or with the NRC staff, it's important, I
12 think, for a licensee to document what they did
13 consider in doing their ISAs.

14 If they thought about earthquakes and they
15 said, "Okay, this earthquake is one sufficient to do
16 the damage we're worried about here," but is too
17 infrequent to worry about because of the specifics of
18 that site, they should write that down in their
19 documentation so that the next time somebody does this
20 type of analysis, they don't have to replicate that
21 whole process over again. It's that kind of thing.

22 In other words, how does the staff know
23 that you've considered all accidents unless you have
24 considered all accidents because that's what the rule
25 requires, that you identify all so the staff needs to

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1 understand that the licensee did try to look for
2 everything.

3 Then there's a subset of that that they
4 found. I think the language is stated they don't have
5 to tell us in the ISA summary about ones that they
6 found that didn't meet the credibility criterion or
7 whatever, or didn't even meet the highly unlikely
8 criterion.

9 They only have to tell us about ones that
10 did meet that threshold. But in their own process
11 that they went through at their plants, I don't see
12 how you can do that process without documenting
13 everything you've thought about.

14 DR. KRESS: Are sabotage events excluded
15 from this and put into some other category?

16 MR. FARAZ: Yes, sabotage is not something
17 that is typically included.

18 MR. GARRICK: Maybe you had better
19 proceed.

20 MR. FARAZ: Okay. What I'll do now is
21 I'll kind of give an overview of where the fuel cycle
22 licensing branch stands in terms of ISAs.

23 As of April 18, 2001, all the licensees
24 had submitted ISA plans. These are plans that will
25 give the ISA approach that the licensees are going to

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1 follow. The processes at their facilities will be
2 analyzed and a schedule.

3 DR. KRESS: Each process that the licensee
4 decides to analyze has to meet these performance
5 measures?

6 MR. FARAZ: Exactly.

7 DR. KRESS: So a lot may depend on what
8 the licensee selects as a process.

9 MR. FARAZ: Well, they have to look at all
10 their processes. In the ISA plan there may be a
11 chemical process that's away from their license
12 material.

13 DR. KRESS: Is there a firm definition of
14 what the process is?

15 MR. FARAZ: No, there's not.

16 DR. KRESS: So the licensee just decides
17 this is a separate process and this is a separate
18 process and I'll do the ISA for each of these?

19 MR. FARAZ: Right. Right. I would think
20 of the process as, for instance, if they do
21 decontamination activities, there might be a building
22 and all the decontamination activities would come
23 under the decontamination process. They would look at
24 all the various processes and integrate them all
25 together as part of the ISAs.

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1 MR. GARRICK: So when you say approach,
2 you must be looking for something different than the
3 guide or the Standard Review Plan?

4 MR. FARAZ: That's right. As the name
5 implies, it says to guide. If they want to follow it,
6 fine. If they want to propose something different,
7 that's fine, too.

8 MR. GARRICK: Okay. Thank you.

9 MR. FARAZ: We've already reviewed and
10 approved BWXT's ISA plan as well as NSF's. The other
11 reviews are ongoing,

12 As far as Subpart H is concerned, one of
13 the submittals that are required to be made, as I
14 mentioned before, by October 18, 2004, all the
15 currently operating licensees are required to have
16 their site-wide ISAs completed and submit to the NRC
17 their ISA summaries.

18 In addition to that, by the same date the
19 rule requires all the licensees to identify and
20 correct any deficiencies that may have been identified
21 as part of doing the ISAs.

22 However, Subpart H also allows an
23 extension to that date as long as sufficient
24 justification is provided to the NRC, acceptable
25 sufficient justification.

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1 I will just mention that we anticipate
2 submittals to begin as early as spring of next year
3 because, as I mentioned before, some of the licensees
4 are ahead of the ballgame. That will give a good
5 opportunity for both the licensees and the staff
6 because this really hasn't been done before to this
7 extent.

8 This will give the licensees and the staff
9 a good opportunity to actually get into the thick of
10 things and conduct and review an actual ISA. None of
11 the licensees appear to be behind and don't appear to
12 be in danger of exceeding the enroll date.

13 Some of the challenges that we are
14 currently facing and that we expect to face are listed
15 in the slide. The first one that I've listed is the
16 SRP itself. Last month we finally reached an
17 agreement on the contents of the entire SRP by
18 reaching agreement on what is required to be or what
19 is needed to be in Chapter 3.

20 We're in the final stages. We hope to
21 finalize an issue of the SRP within the next couple of
22 months. This was a very lengthy process. It was a
23 multi-year process. The stakeholders were very
24 heavily involved; NEI, the licensees, the public.
25 Finally we have come to a point where we think that we

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1 can finalize the SRP.

2 Another challenge that I've listed is
3 guidance on failure rates. This is something that we
4 intend to work with again the stakeholders on and it
5 is information that would be helpful in determining
6 what's unlikely and what's highly unlikely.

7 These would be failure rates of hardware
8 systems. We really haven't begun this process but
9 once we issue the SRP and finalize the SRP, we hope to
10 get into that as well.

11 MR. POWERS: It seems to me that it would
12 be very complex guidance to give because you have over
13 here a fairly lengthy list and any failure rate that
14 is high can be compensated for by a lot of other
15 things. It looks like it's very challenging to set up
16 guidance.

17 MR. FARAZ: It will be challenging. We
18 will go through pretty much the same process that we
19 followed for the SRP. In other words, we would engage
20 the stakeholders on this. It's at its infancy and the
21 picture is not very clear right now.

22 Another challenge would be for the
23 licensees to conduct the ISAs and for the NRC to do
24 the reviews of the ISA summaries as well as the ISAs.
25 As I had mentioned before, it could be as early as

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1 April 2002 that the NRC staff begins reviewing some of
2 these ISA summaries and ISAs.

3 A very important challenge that I see is
4 to risk inform the staff's licensing reviews and
5 inspections and enforcement actions once the site-wide
6 ISAs are approved.

7 MR. GARRICK: Are you comfortable that the
8 ISA process will achieve that last bullet?

9 MR. FARAZ: I'm not sure if we will reach
10 100 percent but clearly it will be a major, major
11 improvement and a major step forward. Clearly in risk
12 informing our licensing reviews and inspections and
13 enforcement, the ISA process is a great help and a
14 necessity.

15 MR. GARRICK: Okay. Thank you.

16 MR. FARAZ: Are there any other questions?

17 MR. GARRICK: Questions from the
18 committee?

19 MR. FARAZ: I'll ask Dr. Dennis Damon to
20 provide his presentation.

21 MR. GARRICK: Thank you.

22 Dennis, I trust, our questions
23 notwithstanding, you will organize your presentation
24 to meet our schedule of 10:15. We are very pressed
25 today to stay right on our schedule. I guess we have

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1 a break scheduled at 10:15.

2 DR. DAMON: Yes. My intention was not to
3 present everything that's in the big thick handout
4 there. That material is something you have already
5 seen.

6 It was presented back in January but I
7 included the whole thing because I'm going to proceed
8 to talk about one of the examples near the end and
9 then proceed on to other things. I don't think we're
10 in any danger of running too long.

11 MR. GARRICK: Thank you.

12 DR. DAMON: Maybe I can start talking and
13 when he gets the slides going, I can proceed with the
14 stuff that's on the slides. My intention was there's
15 two parts to the presentation. One of them is based
16 on what's in the Standard Review Plan, Chapter 3,
17 which is the ISA chapter.

18 More specifically it's Appendix A to that
19 chapter which I wrote. Appendix A is an example of
20 one method that the staff would consider an acceptable
21 way of documenting and presenting an ISA and ISA
22 results. That's what Appendix A is all about.

23 Appendix A, as you remember, basically
24 describes a method where each accident sequence if it
25 is identified is laid out as such just basically with

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1 the same exact meaning of the term accident sequence
2 as you would have in a PRA which is a sequence of
3 events, an initiating event followed by subsequent
4 events, and ending in consequences.

5 The licensee will identify these accident
6 sequences and lay them out. In the example in
7 Appendix A they are displayed in a tabular form with
8 each accident sequence and one row on the table. Then
9 it uses a scoring method that basically is a log
10 rhythm of the failure rates, outage times,
11 unavailability.

12 Whatever probabilistic information appears
13 in that sequence is converted into order of magnitude
14 index that reflects either the frequency of the
15 initiating event or the probability of failure or the
16 probability of occurrence of some subsequent event.

17 It's an index method. The indices are
18 added up and that's your metric of whether you are
19 highly unlikely or unlikely in the language of the
20 rule.

21 That's what the Appendix A method is. Since that
22 presentation in January BWXT and NSF have both
23 submitted ISA plans in which they describe their
24 approach to doing ISA.

25 In my second handout, the short one, what

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1 I've done is put some information related to the BWXT
2 method which also is an index scoring method for
3 evaluating systems.

4 What I would like to do in the
5 presentation is point out some subtle differences
6 between the two index methods to show you what these
7 methods are like and what they do for you and what
8 they don't do for you and so on.

9 Then one other thing I intended to present
10 was to discuss the last example that's in the large
11 handout which is -- there are three examples in there
12 and the last one is an example of something I chose
13 because it's very characteristic of a large number of
14 processes in these facilities.

15 It's kind of a situation where you can, in
16 fact, imagine the accident but what is very difficult
17 to do is to quantify it. It's an example of an
18 accident where I believe that the reason why having
19 the accident is highly unlikely is because of a subtle
20 interaction between having a very large safety margin
21 and an absence of a reason for why you would exceed
22 such a large safety margin.

23 It's a very difficult thing to quantify.
24 I wanted to show the members of the committee why it
25 is that there's reluctance to mandate across the board

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1 quantification for its own sake, but rather to focus
2 on qualitative characteristics of processes because a
3 very large fraction of the processes of the facilities
4 are kind of like this one that I describe in the
5 example, and that is they have qualities about them
6 that will convince you that it is highly unlikely to
7 have an accident but it's very difficult to put a
8 number on them.

9 That's not to say I'm against using an
10 index method to categorize these things. I think
11 that's a useful thing to do is to identify qualities
12 that would convince you that something is sufficiently
13 unlikely and then when it has those qualities you put
14 it in that category of being something you think is
15 highly unlikely. What I'm trying to communicate is
16 how difficult it can be to actually come up with
17 numbers for some of these things.

18 On the other side of the coin, there are
19 processes that are no different from reactor
20 subsystems. They are automatic hardware safety
21 controls.

22 On the other side of the coin there's many
23 situations in these facilities that involve human
24 actions that are also no different from things that
25 are very characteristically analyzed in human

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1 liability engineering.

2 There are things very clearly you could do
3 a good job quantifying things, and there are other
4 things that are very -- that need work. They need I
5 don't know what, standardization or something.

6 MR. GARRICK: Of course, the concept that
7 allows quantification of the reactor scenarios is the
8 notion of uncertainty and the characterizing of those
9 uncertainties in some form such as a probability of
10 density function if it's for a fixed variable or
11 something like a frequency of exceedence curve if it's
12 for a variable measure of risk such as fatalities or
13 injuries or what have you.

14 Has there been any consideration for the
15 accidents that are really important to carry it a
16 little further than, say, the index method?

17 DR. DAMON: You mean something further
18 like --

19 MR. GARRICK: Like actually doing an
20 uncertainty analysis.

21 DR. DAMON: I think that's a good idea for
22 the staff to consider when they are developing this
23 guidance document. In fact, if I remember, the early
24 drafts -- Yawar is working on this thing, this
25 guidance. He characterizes it as guidance on failure

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1 rates.

2 What I would sort of characterize it is
3 more guidance to the staff in general about how to
4 review the quantitative likelihood aspect of these
5 ISAs. In that context, yes, uncertainty is something
6 he's considering.

7 The issue, I think, is to communicate to
8 the staff member to give him guidance how to identify
9 things that he perhaps ought to take a more careful
10 look at.

11 Something that triggers his -- you know,
12 if the staff reviews to serve any function at all, I
13 think one of the functions it can do is an independent
14 technical review of whether, in fact, these systems
15 are adequately safe. Do they meet highly unlikely or
16 not?

17 Now, I don't think the staff has the
18 resources nor the information to do that for every
19 single process. I would envision it considering the
20 uncertainties involved.

21 I mean, as a simple example, my own view
22 is if the licensee comes in and claims that a given
23 piece of hardware, whether it's passive or active
24 safety hardware, has an extremely low failure rate, 10
25 to the minus 3 per year or something like that, the

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1 challenge there is that if they are wrong, they can be
2 wrong by -- let's take 10 to the minus 4 per year.

3 If they are relying on that for safety and
4 you're saying it's a once in 10,000 year type failure
5 rate, you're basically placing a very heavy reliance
6 on that item.

7 Yet, there is no way to verify whether
8 that assignment is correct or not based on subsequent
9 events at the facility because you don't expect to see
10 any events at the facility if the facility won't have
11 events occurring.

12 Whereas the licensee says, "I expect this
13 type of failure once every 10 years," or says
14 something equivalent to that, and the uncertainty in
15 that is a lot less.

16 The staff should take that into account
17 that there are certain things where they need to focus
18 on where they need to review what the licensee has
19 done and other places where you can rely on the fact
20 that the licensee has a corrective action program and
21 if they're wrong, those failures will occur more often
22 and they will be picked up in the system.

23 MR. GARRICK: Dennis, are you satisfied
24 that the ISA process is a building block towards a
25 PRA?

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1 DR. DAMON: Well, I think it's a building
2 block towards using the thought processes, the
3 conceptual structure that is used in PRA. And to
4 using PRA, I think eventually -- there are licensees
5 who have used quantitative risk analysis.

6 It comes up in some context where they
7 feel it's to their benefit to do so but not
8 comprehensive across the plan, every single process
9 basis, when they have one particular thing.

10 I can think of two examples. One of them
11 was a license amendment and they thought because of
12 the complexity of the hardware involved it would be
13 more convincing to submit quantified fault tree model.

14 The other case was a case where a
15 violation was being proposed and the licensee felt
16 that this was such a low risk situation that it
17 shouldn't be a serious violation so they presented a
18 quantitative risk analysis argument that the risk of
19 what happened was very low. They do this sort of
20 thing.

21 What I think is interesting about Part 70
22 is in developing the language of the regulation
23 itself. What was abused the architecture of a risk
24 based argument. That's what held the whole structure
25 together. The conceptual structure is there.

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1 What I would hope would happen in the
2 future is that we would all learn to talk the same
3 language between the licensees and us. As of now it's
4 not fully there but over time that's what I would hope
5 to see happen is that you evolve to a point where you
6 are talking the same language.

7 MR. LEVENSON: You mentioned that some
8 thoughts or guidelines on when the staff might decide
9 to go a little farther, etc., based on things like
10 probability. Would it make sense instead of things
11 like that to use as guidance when to go farther only
12 those accidents that have potentially significant
13 consequences?

14 DR. DAMON: Yes, that's the kind of
15 thought process I'm talking about. I see a big
16 difference in the thought process between someone who
17 has become fluent with risk concepts like you
18 mentioned. You know, think about the severity of the
19 consequences of what you're talking about and people
20 who don't. There's a tendency on the part
21 of the staff sometimes to get concerned about issues
22 that don't relate to risk. They've just lost sight.
23 They've lost the bubble there. I think that's the
24 point here. I mean, later today when we talk about
25 the Risk Task Group's charter and so on and SECY-99-

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1 100 that's what that's all about.

2 Both the NMSS staff and the licensees in
3 this process we would like to encourage people to all
4 start understanding the conceptual logic of risk so
5 that they can start talking about the things that are
6 being required to be done in a way that directly
7 addresses consequences and likelihood and
8 identification of all accident scenarios, risk
9 concepts like that.

10 This is just the presentation that you
11 have seen before that Yawar has talked about. There's
12 one thing that is important to keep in mind. The
13 chemical acts and consequences are obviously very
14 carefully restricted to the things that are -- those
15 chemical accidents that relate to the license
16 material, not to chemical accidents in general.

17 MR. GARRICK: Of the chemical accidents
18 that relate to licensing material, is there any tie
19 between that and EPA standards on chemicals such as
20 come up in the RCRA process?

21 DR. DAMON: There are -- what do they call
22 those? AEGLs. The language that was put into the
23 regulation mimicked the qualitative language that
24 described the emergency action guidelines that EPA
25 uses.

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1 The intent was -- it was a one-time
2 thought that those guidelines would be prescribed in
3 the rule. It would say in there, "This is what you
4 use a threshold for defining what is a high
5 consequence event, one that is life threatening," and
6 use the exact language of EPA. Then it was decided
7 that had disadvantages in that these guidelines don't
8 exist. For example, you have six so that is one
9 disadvantage. Also it's a little too
10 prescriptive so it was left at the qualitative
11 language level, life threatening as high consequence
12 and permanent or serious injury, I think, is the
13 language that goes with the other one. The intent was
14 to point directly at the AEGLs and say, "This is
15 really what we mean by this."

16 MR. LEVENSON: The second triangle you
17 have up there defines that only HF that comes from UF6
18 is involved. If I've got a plant I'm using HF. Some
19 of it is maybe recycled from UF6 and some is what I
20 buy for makeup. Do I have to differentiate and keep
21 track by inventory and records as to which is what.

22 DR. DAMON: Well, there's not a
23 requirement to track it. The point is when you do the
24 ISA analysis and identify accidents that can happen,
25 the material that is perhaps in a storage location is

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1 not intimately connected with the process that the NRC
2 staff has responsibility for. That would not be
3 included in this even though it's used in the process
4 eventually.

5 MR. LEVENSON: No, no. But if the source
6 of the -- way that reads is even if this is in a
7 warehouse a mile away, if the HF came from
8 decomposition of UF6, I have to consider it quite
9 differently and independently of purchased HF. Is
10 that correct?

11 DR. DAMON: That's right. In other words,
12 anything that's connected with the UF6 since the
13 enriched uranium is the license material, anywhere
14 that licensed material, whatever chemical form it's
15 in, that's fair game. That has to be considered in
16 the ISA analysis, any accidents in UF6 storage. Not
17 just the processing of it, the storage of it. Any UF6
18 on site would be --

19 MR. LEVENSON: I understand that but I'm
20 talking about the HF separated from UF6.

21 DR. DAMON: Once it's separated and not
22 actually intimately involved in some process, then
23 it's not within the -- then it doesn't need to be
24 considered in the ISA.

25 MR. LEVENSON: But that's not what this

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1 says. It says "chemicals produced from licensed
2 material." If I'm decomposing UF6 then HF is a by-
3 product that's produced from licensed material.

4 MS. ROCHE: Dennis, may I?

5 DR. DAMON: Yes.

6 MS. ROCHE: I'm Lydia Roche, Section Chief
7 for Licensing. In response to your question, January
8 1986 there was an accident at Sequoia Fuels in which
9 a UF6 cylinder ruptured and killed a worker. What
10 killed the worker primary was the HF. If it is
11 licensed material, yes, it's part of the ISA. It's
12 part of the process that we regulate.

13 MR. LEVENSON: I understand and I am
14 familiar with that accident. This is very ambiguous
15 because what you're talking about is a chemical
16 produced during an accident and that is quite
17 different than what is produced in a processing plant.

18 MR. FARAZ: What I would say in response
19 to that the language may be a little misleading. You
20 are correct that if it's part of the accident and --

21 MR. LEVENSON: Part of the accident I
22 understand but one of the routine processes sometimes
23 used from UF6 to decompose it down to UF4 is to make
24 by-product HF. If HF is produced from licensed
25 material, it seems to me that should not be covered.

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1 MR. FARAZ: It's not covered. If a
2 licensee has a process to extract HF from licensed
3 material and then stores the HF a mile away from the
4 site and then there's an accident there, that would
5 not be included.

6 MR. LEVENSON: This wording does not make
7 that clear.

8 DR. DAMON: Right. I mean, certainly the
9 words you can fit on a view graph are very few. This
10 is like a succinct statement. The MOU has extensive
11 guidance and there's guidance in the chemical section
12 of the Standard Review Plan as to what things should
13 be considered and what shouldn't.

14 That doesn't mean that all issues have
15 been resolved. I mean, there probably are some cases
16 where that issue will have to be discussed in the
17 context of what's done. I think between the staff and
18 the licensees I think we have a reasonably close
19 common understanding of which ones should be in and
20 which ones are out.

21 It's mostly the idea that, like you say,
22 HF evolved from UF6 during the course of an accident
23 or MOX or something. We don't want you saying,
24 "That's not your licensed material that's causing the
25 fatality." Then items relied on for safety, this is

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1 just to point out how broad this is. Activity of
2 personnel is underlined up there. That will come up
3 as I get further in here.

4 This is just to point out that if you read
5 the Standard Review Plan chapter on ISA, the Appendix
6 A that has this index method in it and so on and so
7 forth, that is an appendix.

8 What is stated in the body of the chapter
9 as acceptance criteria is much more qualitative and
10 it's really stated in terms of getting down to the
11 fundamentals of whether an adequate job is done.

12 There's many more aspects to it than just
13 whether you use a scoring method and what exactly the
14 scoring method is and so on. It's really important
15 that there be completeness of accident identification
16 because that was really one of the major reasons for
17 asking that ISAs be done.

18 That's just to point out that's what is
19 dealt with in the body of the chapter is completeness
20 of accident identification, correctness of consequence
21 evaluations, and then finally you do get to the
22 adequacy of likelihood evaluations.

23 Again, Appendix A is just an example. It
24 was really not intended as "use this method." It was
25 intended as an example of something that had the

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1 structure of something that you might use. The reason
2 it was stated that way is because the NRC staff could
3 not, nor could a licensee, I think, anticipate how any
4 given scoring method would end up being applied as
5 they went through all the diverse processes in their
6 plant.

7 It was envisioned that a licensee would
8 establish a qualitative method defining what is
9 adequately unlikely and what isn't, but that process
10 would evolve as they went through their facility and
11 identified different types of situations that needed
12 to be dealt with.

13 This just is talking about doing an ISA.
14 NUREG-1513 has been published. That was the ISA
15 guidance document. It focuses primarily on process
16 hazard analysis and on the sort of project management
17 level of what is involved in an ISA. That has been
18 published.

19 It has in it one key thing, I think. It
20 has a flow chart for selecting an appropriate method
21 for identifying accidents. I think that is probably
22 the most important single thing in that guidance
23 document. If you use a "what if" method for a very
24 complex process, that's just not appropriate. I think
25 you need a method that is appropriate to the

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1 complexity of the process.

2 There is also NUREG/CR-6410 is the
3 Accident Analysis Handbook. It's about this thick.
4 It gives a lot of guidance on doing the kind of
5 consequence evaluations that come up in the context of
6 the fuel cycle facility.

7 It's actually fairly rare that one would
8 actually need to do very many quantitative
9 calculations of off-site consequences for a number of
10 reasons. In an uranium facility it's very difficult
11 to cause a release of material.

12 The material has such a low specific
13 activity and such a non-volatile form most of the time
14 that it's very difficult to give off-site radiological
15 consequences that reach the thresholds we were talking
16 about because we're talking about 5 rem off site to
17 the public.

18 For chemical consequences likewise it
19 usually is not that necessary to actually do
20 quantitative evaluations. If you did need to do one,
21 it can get -- these chemical transport models can get
22 quite involved because UF6 is a very heavy gas so the
23 6410 has some guidance on that kind of thing.

24 MR. GARRICK: You might be a little
25 generous in saying that you have defined some of these

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1 thresholds quantitatively because I think in the risk
2 world when we think of something -- when we think of
3 a quantitative result, we don't think of a number.

4 We think of a probability distribution
5 because it tells much more of the story than is told
6 by the number. I'm just saying that because one of
7 the issues we're always dealing with in the risk
8 informed world is the consistency of the language.

9 DR. DAMON: Well, this reminds me -- the
10 issue of consequences reminds me of something that
11 came up in Yawar's presentation. The question was --
12 he was talking about off-site consequences and whether
13 those had to be calculated for average conditions or
14 whatever, that issue.

15 The point is actually they have to be
16 calculated for the most extreme possible condition
17 that could ever occur. In other words, all we're
18 saying is if there is a spectrum of possibilities and
19 if one of those in that spectrum, even if it's a far
20 outlier exceeds the thresholds of the rule, then to
21 that segment of the spectrum of everything that can
22 happen must be addressed.

23 The fact that it would take extreme -- it
24 might take extreme weather conditions or whatever to
25 cause a 5 rem dose or whatever, they would have to

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1 consider that.

2 MR. GARRICK: Then, again, there's an
3 inconsistency in the jargon of what we mean by risk
4 because what you're suggesting here is that your
5 basing your risk-informed results on the basis of
6 bounding analysis and extremely conservative
7 assumptions.

8 Again, that is kind of a contradiction of
9 the whole concept of risk assessment which was
10 invented in order to have a mechanism by which we
11 could have what is our best shot at what the risk is.

12 We want that because that gives us a
13 baseline against which to know how conservative, for
14 example, we should regulate it. It's a philosophical
15 point but it's one that both the ACRS and the ACNW is
16 constantly working on.

17 DR. DAMON: What I was meaning to say
18 about that, and it actually says this in the Standard
19 Review Plan ISA chapter, when it talks about
20 consequences I recognize in writing that that you have
21 this question. You have a release.

22 Well, a release could be large ones, some
23 small ones, the weather conditions could be different,
24 the wind could blow in one direction or the other.
25 The question is what do you need to consider. What it

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1 says in there is that if there is any scenario that
2 would exceed the threshold of the rule, then that
3 needs to be considered.

4 The unlikeliness of that can then be
5 credited in evaluating whether it is highly unlikely
6 or not. All I'm saying is there's a spectrum of
7 things. I don't think it's appropriate to say I get
8 to select the average thing that could happen and if
9 that average thing doesn't trip the threshold, I get
10 to throw away and I don't need to consider or limit
11 that or regulate that risk at all.

12 No, you look at the tail and you have to
13 go all the way out. Could you ever exceed these
14 threshold and then you can credit yourself. We all
15 know stability class F and so on doesn't occur very
16 often and they can credit that in their likelihood
17 evaluation.

18 Like I say, it doesn't come up very often
19 that they have to worry about these things. This is
20 getting into what I said earlier, is that the Appendix
21 A method talks about -- uses this index scoring
22 method. It's a tradition, a standard, an industry
23 consensus standard within the criticality community to
24 try to achieve whenever possible a thing called double
25 contingency.

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1 This is the statement of double
2 contingency. You can see the community in the
3 criticality safety, which is one of the predominant
4 things that could cause a fatality among all the
5 accidents identified, the community already is using
6 what I call risk-based language.

7 They are talking about independence and
8 unlikely and redundancy and these characteristics.
9 Usually their understanding of these things is not
10 exactly the same as someone who comes from a
11 quantitative background. That's what I say, I would
12 like to start talking the same language.

13 This is an example of what I mean by the
14 fact the index method in Appendix A really just lays
15 out an accident sequence. This is for a system of two
16 active redundant controls. The equation for the
17 frequency of the accident, namely the accident being
18 the two things happen, is expressed this way where the
19 lambda's are the failure rates and the U's are the
20 unavailabilities.

21 You have two controls, control 1, control
22 2. There's two different ways you can have an
23 accident. Control 1 can fail first and then while
24 it's out, while it is unavailable the control 1 can
25 fail or vice versa. You have this equation and that's

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1 what the method of Appendix A does. It explains that
2 is what these indices mean, that they refer to these
3 concepts.

4 MR. POWERS: Does it deal with common mode
5 failures?

6 DR. DAMON: Common mode failures? It
7 alludes to them in the thing. If the common mode
8 failure is something explicit that they can identify,
9 it should be a separate item.

10 MR. POWERS: We usually have trouble
11 identifying common mode failures.

12 DR. DAMON: That's certainly true.

13 MR. POWERS: I don't know that you can
14 excuse them by saying we can't identify it so it's not
15 there.

16 DR. DAMON: There's a whole discussion in
17 Appendix A on the question of independence which
18 involves common cause. I think it is one of the most
19 important things and it is discussed in there that you
20 can't treat this cost of independence lightly.

21 It comes up even more strongly when you
22 start talking about the fact that many of these
23 processes are operated by human operators. If you've
24 got requirements on the operator as to the correct way
25 of operating a process, when can you count on mistakes

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1 being independent of one another?

2 That's a serious question. We might get
3 into that in the guidance document that Yawar is
4 talking about. There are certain standardized ways of
5 looking at that issue as to what is sufficiently -- I
6 mean, for example, one of the criteria would be that
7 human errors are independent if they are committed by
8 people on two separate watches, two separate shifts.

9 In other words, you don't ever count human
10 errors as being independent if they are committed by
11 two people who are communicating with one another
12 because they are standing the same shift together.

13 It's like the incident that happened with
14 the submarine off Hawaii. They had a redundant system
15 there. The captain is supposed to look through the
16 periscope and look for ships on the surface and the
17 sonar watch is supposed to be looking for them, too.

18 But the guy who was plotting the sonar
19 watch heard the captain look around with his periscope
20 and said there was nothing there. He said, "Gee, I
21 think there is something there," but I'm not going to
22 say anything. He's the captain. That's not
23 independent. It's not an independent failure. That
24 kind of thing I think is extremely important in the
25 way these --

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1 DR. KRESS: On that particular side is T2
2 something that is knowable ahead of time because of
3 frequency of inspection or test or something like
4 that?

5 DR. DAMON: Right. That's what I'm trying
6 to point out here. We are expanding the
7 unavailability number out here, the U2, into lambda 2
8 times T2. That's done deliberately in the method in
9 Appendix A to point out to people exactly what you
10 just said, which is you should often know what that
11 outage time is because you will have a surveillance
12 interval or you will know something about the process.
13 It will tell you it's not as indefinite as a failure
14 rate is.

15 DR. KRESS: The lambda 2 is a failure rate
16 that -- does it count things like the fact that they
17 did maintenance on it and the maintenance caused it
18 not to be operable for some reason the next time? Is
19 that included in the failure rate?

20 DR. DAMON: They should.

21 DR. KRESS: Count all failures.

22 DR. DAMON: Yes.

23 DR. KRESS: So it needs a database ahead
24 of time for this failure rate.

25 DR. DAMON: Well, the kind of facilities

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1 we're talking about people don't usually have anything
2 that would amount to a database but they have to rely
3 on their own memory. They do keep track of things
4 that have happened at their facility.

5 In fact, in the PHA methods for how you do
6 a PHA, one of the things that is mentioned is you
7 should go back -- when you're doing the PHA on a
8 particular process, you go back and retrieve whatever
9 performance history you have on this thing, what have
10 been the maintenance failures.

11 Has somebody done maintenance and failed
12 to restore the system or do a post maintenance test
13 and that kind of thing. That guidance is given to
14 them so that is something they should consider.

15 I can remember going to BWXT and that's
16 one of the first things they showed me. They marched
17 through their methodology and that is a standardized
18 part of it, you know, Chapter 1.6 or something and
19 that's it. That's what they do.

20 DR. KRESS: In a PRA they would have used
21 $\lambda^2 \text{ times } T_2 \text{ over } 2$. I guess in this kind of --

22 DR. DAMON: Yeah.

23 DR. KRESS: It's such a small difference
24 that --

25 DR. DAMON: That's why the approximation

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1 sign is in there.

2 DR. KRESS: It's probably not worth
3 worrying about.

4 DR. DAMON: All I'm saying this is what
5 was laid out in the Appendix. It's just a direct
6 translation of how you quantify an accident sequence
7 approximately.

8 DR. KRESS: Why is it felt that inviting
9 up these things like frequency of occurrence into
10 units of a factor of 10, why is it thought that is a
11 sufficiently small unit to divide it up?

12 DR. DAMON: I would say -- I mean, in
13 retrospect I would say it's probably -- I mean, I
14 could be easily convinced that you would use half
15 orders of magnitude would be a little better. At the
16 time --

17 DR. KRESS: It's sort of a finite
18 difference in approximation of sorts.

19 DR. DAMON: Yeah. I hadn't had much
20 experience in actually doing quantitative analysis of
21 fuel cycle type systems at that point so I put it as
22 single integers.

23 In retrospect after having done a little
24 bit of this as an exercise to see how things work, I
25 am convinced it would be worth going to half orders of

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1 magnitude but not much beyond that because of the way
2 things are being treated here these are --

3 DR. KRESS: Maybe about as close as you
4 can get them.

5 DR. DAMON: Yeah. Considering the range,
6 the uncertainties involved in these things, there's
7 not much point in going further than that.

8 DR. KRESS: If you had a set of identified
9 accident sequences and most of them fall up near the
10 10 to minus 4 if your range was minus 4 to minus 5,
11 would you treat that differently than a case where
12 most of them fell down near the 10 to the minus 5?

13 DR. DAMON: I'm not sure what you're
14 saying.

15 DR. KRESS: Would you give it more of a
16 regulatory look at it? Would you consider it more
17 problematic if you were very near -- most of them were
18 very near the one edge or the other so the summation
19 of all of them might look differently.

20 DR. DAMON: There was some discussion of
21 that in the Standard Review Plan as to how to deal
22 with that. It's somewhat -- how do I put it? It
23 would be somewhat problematic as to the regulatory
24 status of trying to pursue that argument because of
25 the way the darn rule was written.

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1 It's written as per accident sequence. It
2 was understood at the time that it was written that's
3 a problem to state it that way. Given that you're not
4 going to require quantification, then you can't
5 require accumulating risks from different accident
6 sequences together in some other way. It was a
7 dilemma you're stuck with with this kind of
8 intermediate --

9 MR. GARRICK: So what you're end up with
10 is a -- the word integration needs an asterisk because
11 you're integrating horizontally but not vertically.

12 MR. LEVENSON: I have a question.
13 Appendix A provides guidance and examples for
14 determining likelihood. Is there somewhere else
15 guidance as to how to estimate consequences?

16 DR. DAMON: There's discussion in the main
17 body of the appendix. There's a consequence section
18 that talks about evaluating consequences and some of
19 the issues that will come up in the process of doing
20 it. But it doesn't get into the technical details of
21 what constitutes a realistic model that the staff
22 would find acceptable or not acceptable.

23 That's discussed in this NUREG/CR 64-10,
24 that accident analysis handbook gets into what the
25 staff thinks about the adequacy of the current state

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1 of models as of about three or four years ago when
2 that thing was published.

3 MR. LEVENSON: Since that is published
4 three or four years ago means it was written maybe
5 five years ago. Is there any risk-based significance
6 in that guidance or is it pretty much all historical
7 empirical?

8 DR. DAMON: I'm not sure. I mean, mostly
9 what it talks about is methods for calculating or
10 estimating the consequences of accidents whether
11 chemical or radiological so it's standard atmospheric
12 dispersion, wake effects.

13 MR. LEVENSON: Yeah, yeah, yeah, but a lot
14 of the stuff done five or six years ago had somewhere
15 from two to four orders of magnitude of over
16 estimation in the methods which is not exactly
17 compatible with risk-based analysis.

18 DR. DAMON: This method here -- I mean,
19 the Part 70 structure again, like I say, is pretty
20 rigidly risk-based. It's not encouraging people to do
21 anything that's what I would call bounding analysis or
22 conservative.

23 It really is one that is focused on
24 managing the risk by identifying what are the
25 consequences that could happen really and really

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1 identifying what you think of the likelihood. None of
2 the language in here is -- there is a use for bounding
3 consequence evaluations in doing an ISA which is if
4 you can -- it can be used as a screening method but
5 it's not embedded in the regulation as a screening
6 method.

What I mean by that is you can
7 think of very extreme case release of material if you
8 show that even the most extreme case does not exceed
9 the threshold specified in the rule for off-site
10 consequences.

11 Then you just can wave your arms and say
12 I don't need to consider off-site consequences for any
13 releases of that type in the plant because I bounded
14 it by this one evaluation. You can use screening
15 analyses like that. That also is described in the
16 Chapter 3 how that's to be done.

17 It is actually I think in the consequence
18 section the idea of using screening analysis, but it's
19 also explained that if it comes out the other way,
20 namely an extreme case does exceed the threshold of
21 the rule, then you need to have considered that.

22 I would like to kind of get on to --

23 MR. GARRICK: Yeah, you've got about five
24 minutes.

25 DR. DAMON: Let's see if I can get to the

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1 end of this thing. I've got here -- I just wanted to
2 talk a little bit about BMXT is one of the two
3 licensees that have submitted an ISA plan and
4 described their approach and it has been approved by
5 the staff. I thought I would briefly go over what
6 they did so you can see how that relates to what this
7 Appendix A thing.

8 BMXT uses various hazard identification
9 methods, PHA type methods. The hazard office uses it
10 very frequently which, if you are familiar with it, is
11 a very structured rigorous way of going through a
12 piping system that has things about it like flow,
13 temperature, pressure and marching through these
14 various parameters and asking yourself what happens if
15 this parameter is on the high side or the low side and
16 so on. It's a nice structured method for dealing with
17 certain types of systems that frequently occur in the
18 plant so they use it a lot.

19 The BWXT method does use -- has used
20 integer indices for consequence very unlikely
21 evaluations. They categorize consequences in various
22 bins. Two of those bins are highly unlikely and
23 unlikely, but their system is actually more -- goes
24 beyond that on both sides. They consider less severe
25 events which they have reasons why they want to

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1 consider that in managing their plant.

2 They also consider ones that are more
3 severe than the ones that are in the rule but it
4 includes the two that are in the rule. Like I way,
5 they have a consequence index and they have a
6 likelihood index or score.

7 Then the combination of the two defines
8 which -- that matrix of consequence indices one way
9 and likelihood indices the other way defines a matrix
10 full of squares and they define which of those are
11 acceptable risk.

12 Basically, for example, one of the ones
13 that concerned us was high consequences in their
14 system requires a score of minus 4 in likelihood.
15 That's basically the method they use. Of course, it
16 facilitates a direct translation for us into whether
17 that's compliance with the rule.

18 The likelihood index that they use, the
19 one that I described to you in Appendix A, the number
20 of factors or number of indices that could be added
21 together would depend -- it would be situation
22 dependent. It would depend on how many events in
23 sequence had to happen, how many outage times, and so
24 on.

25 The BWXT method is simplified down to

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1 really only two indices, an initiator index and a
2 protection factor index. The initiator index is --
3 again there are tables of qualitative criteria. Here
4 is one of the tables for the frequency of initiating
5 events. There are qualitative criteria.
6 You can call them qualitative or quantitative or
7 whatever you want to call it but there are criteria to
8 get a score for the initiating event part of the
9 score. Like I said, it's used --

10 MR. GARRICK: Dennis, I know there's quite
11 a bit of effort given and some of it is certainly
12 quite creative given to establishing these indices and
13 what I might call utility functions or scores or what
14 have you.

15 Mathematically often what we are trying to
16 do here is scalarize a vector, something that
17 describes a system in terms of specific elements
18 because people sometimes have trouble grasping and
19 making decisions on the basis of multiple elements try
20 to transfer that into some functional form or a
21 utility function such that it accommodates a simple
22 ranking system.

23 I believe in our business, in the safety
24 business, it's very important for us not to obscure,
25 if you wish, what is really happening in terms of the

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1 accident sequence.

2 Whenever I'm involved in reviewing an
3 accident analysis of any kind whether it's a HAZOP
4 based on or a PRA based one, I'm not comfortable until
5 I really see what's going on phenomenologically and
6 how you get from the initial condition or the
7 initiating event to the end state or the consequence.

8 I trust that the NRC is not getting too
9 wrapped up in what I would call this tail end exercise
10 of casting these results into pretty much a
11 dimensionalist unitless form. I'm basically against
12 those in this business but I can understand and
13 appreciate why that's being done. It has a nice clean
14 structure to it.

15 If you read the Harvard Business School or
16 the Stanford Business School reviews you'll find that
17 a lot of the papers in there are on just this, on how
18 to establish utility functions for decision making.
19 That's not, in my opinion, something we want to give
20 too much emphasis to.

21 We really don't want to allow ourselves to
22 get into the position of not asking what's behind this
23 and the kind of physical terms and physical processes
24 and calculations that really give us a firm grasp on
25 what's happening. That's a long comment and speech

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1 but I think it does represent sort of something that
2 we want to be very much on guard for in licensing
3 these facilities.

4 DR. DAMON: I certain concur with that.
5 I think the licensee's professional safety staff, the
6 people that do this stuff and the ones that use it,
7 they also have that concern.

8 I think it's actually, to tell the truth,
9 my belief -- which I don't know how credible this is
10 but my belief is it's at the root of their concern
11 about using PRA is that they are afraid it will be
12 used in this sufficial way.

13 I think they don't realize that in general
14 people who have been using PRA long enough, they have
15 learned that lesson that you have to -- this is not
16 just a game of putting numbers on things. It's a game
17 of focusing on the reality of what's going on. I know
18 I learned that lesson. I spent a lot of years doing
19 maintenance on hardware and one of my beliefs is that
20 failure rates
21 -- how do I put it? Failure rates are made, they are
22 not born. They are made by the staff of the facility.
23 In other words, there is no inherent failure rate to
24 a piece of equipment. It's how you operate it and
25 maintain it.

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1 MR. GARRICK: All right. We've got to
2 wrap this up. Dana, since I overtook my time on
3 questioning, I'll allow the committee, of course, to
4 ask whatever questions they want.

5 MR. POWERS: The most striking thing about
6 this, giving an example, a redundant system not to
7 include the concepts of common mode failure is
8 striking.

9 MR. GARRICK: Yes.

10 MR. POWERS: I'm not sure how illuminating
11 it is to tell people to multiply two small numbers
12 together to get a much smaller number. That won't be
13 very helpful in understanding how the system avails
14 itself.

15 The general difficulties of uncertainties
16 and these numbers seem to be handled better by the
17 scale than I had anticipated. I mean, if we're only
18 working in decade scales whether you've quantified the
19 distributions of a particular parameter accurately or
20 not may be less consequential than perhaps I'm used
21 to.

22 The common mode failure, I just don't
23 think you can ignore that. It's just misleading to
24 multiply 10 to the minus 2 times 10 to the minus 4 and
25 get 10 to the minus 6 and then walk away happy.

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1 Milt.

2 MR. LEVENSON: Well, I just am not at all
3 sure that the very significant part of this whole
4 issue which is consequences has had anywhere near as
5 much attention as the probability.

6 For instance, if I look at the example in
7 Appendix A in Table A-12, I think there's probably
8 orders of magnitude of conservatism. Nobody is
9 studying the probability of the consequence. In
10 essence, now likely is the proposed consequences?

11 For instance, if you drop UO2 on the floor
12 and there's some water, the model says it stays
13 critical for an hour. I don't think there is any
14 place in the physical world where that kind of
15 critical mass doesn't disassemble itself in fractions
16 of minutes.

17 I just think that the whole area of
18 consequence -- maybe I'm wrong but my perception at
19 this point is that the issue of consequence has not
20 been addressed nearly as adequately as the matter of
21 probability.

22 MR. GARRICK: Tom.

23 DR. KRESS: Well, I agree with what I've
24 heard so far. One thought is this is an overall risk
25 allocation process of accident sequences. I've yet to

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1 see a real over-arching philosophy on how you go about
2 doing that.

3 Include things like uncertainty, risk
4 contribution of each accident sequence and how those
5 uncertainties, contribution, and defense in depth in
6 general add up to an overall risk acceptance criteria.
7 That over-arching philosophy to me is not transparent
8 anyway. It may be there.

9 The indexing process, while it is clever
10 and doesn't look to me like it has any technical
11 problems with it other than this common cause thing
12 that Dana brought up, does in my mind tend to do what
13 you said. It obsticates the real issue to some
14 extent. I worry about that, although I think you
15 could deconvolute the numbers and treat it like
16 individual parts.

17 MR. GARRICK: You only read two-thirds of
18 the report.

19 DR. KRESS: Yeah, that bothers me. A
20 third thought I had is I think in terms of
21 quantitative risk with uncertainties, pretty much like
22 you do, and here we have a process that is some sort
23 of approximation of that. I wonder if any thought has
24 been given to taking the natural ISA out of some
25 facility and doing both an ISA and a quantitative risk

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1 analysis as a sort of validation of the process.

2 I'm sure the ISA is intended to
3 approximate the PRA in a sense that it is a
4 conservative approximation. It would be nice to know
5 what the margins are and how conservative is it. The
6 only way I know to do that is to compare it to a real
7 PRA.

8 In that sense, I think there is still a
9 need for overall summation risk acceptance criteria as
10 contracted to the individual sequence risk acceptance
11 criteria. I see those as not exactly being there.
12 That is the only way I know how to make a
13 correspondence with the PRA type of analysis.

14 I worry about selection of accident
15 sequences and selections of processes as being a way
16 to manipulate the system.

17 MR. GARRICK: It's a selection in
18 partitioning of sequences.

19
20 DR. KRESS: I worry about that to some
21 extent, too. Basically that's the thoughts I had.

22 MR. GARRICK: Okay. Dennis, thank you
23 very much. I think we'll take a 15-minute break and
24 that will put us about 13 minutes behind.

25 (Whereupon, at 10:28 a.m. off the record

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1 until 10:40 a.m.)

2 MR. GARRICK: Can we come to order? Our
3 next talk is going to be given by Felix Killar. He'll
4 introduce himself and tell us what he's up to, as well
5 as make a presentation.

6 MR. KILLAR: Thank you. As John said, I'm
7 Felix Killar. I'm with Nuclear Energy Institute.
8 I've been involved in this process and, as I go back
9 and talk in my presentation with the history of it,
10 I'm part of the history of it I've been involved with
11 it for so long.

12 What I'll do this morning is give you a
13 history of the rulemaking, how we got to Chapter 3
14 which is the focus of today's meeting. What are some
15 of the future actions which, from this morning's
16 presentation, it's a little bit of repeat.

17 And the integration of the safety program
18 which is important because there's some aspect here I
19 think they haven't touched on and I want to talk about
20 that. Then specifics on Chapter 3.

21 The history goes back to 1986, the Sequoia
22 Fuels event, which you touched on this morning.

23 MR. GARRICK: It just seems like it was in
24 the 1800's.

25 MR. KILLAR: I know. In fact, I was

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1 looking at some of this the other day and I said it
2 seemed like it was just the other day that this
3 happened and it was that long ago.

4 Anyway, as was touched on this morning,
5 that was actually a chemical event. There was a
6 subsequent event there at Sequoia Fuels about 1987,
7 '88, where they had another chemical event.

8 There was a lot of issues raised as far as
9 the NRC's responsibilities and authority in relation
10 to EPAs and OSHAs. There was a lot of work done to
11 try and help clarify the responsibilities and make
12 sure that there isn't either an overlap or a gap.

13 Part of this came out in 1990 with the
14 update of the OSHA memorandum of understanding with
15 the NRC as part as chemical events and clarification
16 with EPA as far as responsibility on site and off site
17 and what have you. That was sort of the basis for
18 where we started on the rulemaking and changed the
19 Part 70.

20 Then in 1991 there was an event at the
21 General Electric facility. This was viewed from two
22 sides, very different perspective. From the NRC staff
23 perspective this was a near criticality and major
24 event.

25 From the industry's perspective this was

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1 an upset condition which they understood and they knew
2 what was going on and they knew how to control it, but
3 the information was not clear to the two sides and
4 they were never able to really connect and understand
5 that.

6 As a result of that, they needed to come
7 up with a better way of understanding how the licensee
8 runs their facilities and is comfortable with the
9 safety of their facilities.

10 They started a process back then of taking
11 a group, a task force, that went out to the
12 facilities, all the major licensees including some of
13 the radio pharmaceuticals and things on that line and
14 said, "If we had to regulate these guys from scratch
15 with a blank piece of paper, how would we do it? How
16 would we change our existing systems? How do we go
17 out to make sure that we're looking at the right
18 things?" And what have you.

19 In 1992 they came out with NUREG-1324 and
20 that was a synopsis of this study that they did on how
21 to regulate the facilities. There are a number of
22 findings. The principal findings were, first of, the
23 NRC staff needed better training and understanding of
24 the facilities.

25 Secondly they felt there needed to be an

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1 integration of the various safety programs. There
2 were reports done back in the '70s and '80s on the
3 risk of these facilities. The primary risk of these
4 facilities is a fire. Nuclear criticality risk is
5 further down the road. Radio protection for the
6 workers is down the road and things on that line.

7 Looking at the risk of these facilities
8 and when you're focusing primarily on the nuclear
9 safety, nuclear criticality, and radiation protection
10 second, you weren't really focusing on maybe what was
11 the major risk of the facilities.

12 We wanted to determine a process for
13 integrating the various forms of risk whether it's a
14 chemical risk, a fire risk, a nuclear safety risk,
15 radiation protection risk, things on that line.

16 When we started a process of talking about
17 integration and the ISA, this is what we were talking
18 about is the integration of those various programs.
19 We had a number of go-arounds back and forth with the
20 staff in the mid-'90s to try and explain that and why
21 it needed to be done even though the 1324 kind of
22 pointed that out.

23 Finally in 1996 we petitioned for a
24 rulemaking to explain specifically what we wanted to
25 have in these integrated safety assessments and why we

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1 needed this integration. Our rulemaking was accepted
2 with some modifications and then we began working on
3 and revising the Part 70 rule to reflect this. The
4 rule was finally released in October of 2000 after a
5 number of iterations.

6 The staff proposed several different forms
7 of the rule which we found were not meeting the intent
8 of what we felt we needed and was not meeting the
9 intent of what we felt was the initiating events back
10 in '86 and '92. We went back to the commissioners and
11 various people and got the staff to kind of focus down
12 on the issue that we were really trying to resolve.

13 Finally after going through several
14 iterations October of 2000 we came up with the NRC
15 finalized rule initiative. They issue it without the
16 SRP which is the thing that's been kind of ongoing
17 since then.

18 As alluded to this morning, April of 2001
19 the licensees had to provide their plans for
20 submitting the ISAs to the NRC and all the existing
21 licensees have done that.

22 What are the future actions? By March of
23 2002 the NRC needs to approve the ISA plans submitted
24 by licensees. As mentioned this morning, they have
25 already approved two of them, NSF's and BWXT's.

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1 There is a total -- I'm trying to remember
2 the number off the top of my head. I think there are
3 like eight facilities that have submitted these plans
4 so they've got about six to go. That's changing
5 because of consolidations and shutdowns at some of
6 these facilities.

7 The NRC is currently working on some
8 industry guidance or some guidance on facility change
9 process which is 70.72 and a backup provisional which
10 was also in 70.76. We've are kind of indifferent on
11 those.

12 We felt that there's value in those but,
13 at the same time, for the most part the licensees have
14 already gone through and implemented their change
15 processes to 70.72 so additional guidance may help but
16 we really don't see a whole lot of need for it.

17 Similar in the backup provision. The back
18 fit provision comes in once you have your ISA
19 approved. We don't feel that there's a big need for
20 the guidance for the backup provision but it may be
21 helpful having it there.

22 Come October of 2004 all existing
23 licensees must have completed their ISAs and submit
24 the ISA summaries to the NRC for approval of the ISA
25 summaries. We're working on that schedule. As the

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1 staff mentioned this morning, some of those will be
2 submitted prior to that so the NRC will be working on
3 those.

4 Also in 2004 anything that is identified
5 as an unacceptable performance deficiency must be
6 either corrected or a plan for correcting that
7 deficiency must be completed.

8 These are the various chapters of the
9 Standard Review Plan. I left out Chapter 1 and 2.
10 Chapter 1 is just a general description of the site.
11 Chapter 2 is a description of your organization.

12 These make up what I would call the meat
13 of the licensing application with Chapter 3 being the
14 new chapter on Integrated Safety Assessment, and
15 Chapter 11 being the new chapter on Management
16 Measures. Those two came out of the two events as I
17 mentioned.

18 How do you integrate the various safety
19 aspects of it and how do you manage those safety
20 aspects to assure they will be performed when they
21 need to?

22 The other things, radiation protection,
23 nuclear criticality safety, chemical safety, fire
24 safety, emergency management, protection
25 decommissioning, they have not substantially changed

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1 in years. We've done tweaks and modifications and
2 stuff but they have not substantially changed in
3 years. These two chapters, 3 and 11, are the two
4 chapters that came out of the events in this time to
5 process it.

6 What are the issues that we have with
7 Chapter 3? We have very few issues with Chapter 3.
8 Because of this process that we went through to get to
9 the rulemaking and as we've gone through with the
10 staff working on the Standard Review Plan, we do not
11 have any problems at all with the Standard Review Plan
12 and with the rulemaking at this point in time.

13 Our issues now are what we call
14 implementation issues and the implementation issues
15 are what is acceptable. We've only had two ISA plans
16 submitted so far. We have not had a full ISA summary
17 submitted and approved by the staff so we are out
18 there trying to make sure the package we are putting
19 together is acceptable to the staff.

20 Some of the issues we have is how detailed
21 does the ISA summary need to be? That has been the
22 biggest stumbling block that we've had in this whole
23 process.

24 In fact, a number of times we threw up our
25 hands and said, "Hey, look. If the staff isn't happy

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1 with our ISA summary, come and look at the whole ISA
2 or we will put the ISA, the full ISA, on a CD-ROM and
3 ship it to you and you can sit there and look at it
4 all you want because we cannot come to terms on what
5 the level of detail needs to be in the ISA summary."
6 I think we have come to terms but now it's a matter of
7 do we really understand the terms we've come to.

8 How quantitative does it need to be? I
9 think Dennis gave you some of that this morning. The
10 industry is basically a chemical industry. Part 70
11 facilities are basically chemical industry that
12 handles radioactive material.

13 As Dennis alluded to also, a lot of the
14 work is done on HAZOP because HAZOP is what the
15 chemical industry typically has used for years and
16 what this industry has used for years for doing their
17 typical safety analysis for the chemical safety of the
18 facilities and they've taken that and expanded that to
19 look at nuclear safety radiation protection.

20 We don't do a whole lot of quantitative
21 type analysis. Ours is more qualitative type analysis
22 so we have a question about where the -- how
23 quantitative it needs to be. There are certain areas
24 in the plant where a quantitative analysis will make
25 sense.

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1 It's a unique situation, a very integral
2 component or operation where you have to go through
3 and look at it. For a lot of the operations at the
4 plant a very basic type analysis, even what-if type
5 analysis, will be adequate for evaluating those
6 processes.

7 I might allude, too, I talk about
8 evaluating processes. One of the things I want to
9 point out is that when we talk about a process, that
10 process can be defined as just changing it from this
11 table to that table or the complete process from
12 beginning to end to get it from one form to another
13 form.

14 It's a function of the detailness or
15 sensitivity of that process in the analysis that we
16 do. When we look at processes, it can be chopped up
17 in individual steps in the process it we can look at
18 the whole nine yards.

19 DR. KRESS: I'm trying to decide on the
20 reasoning behind NRC thinking an ISA summary is
21 sufficient. Is that just to save time in their
22 review? You have the full ISA. How big is it? Is it
23 huge?

24 MR. KILLAR: They are fairly huge. BWXTs,
25 I think they're probably in the order of about eight

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1 to 10 three-ring binders so they are similar to back
2 at the FSAR stages.

3 DR. KRESS: Back in FSAR.

4 MR. KILLAR: Back in those days. And they
5 are rather detailed. One of the concerns and reason
6 why we went to the submittal of the ISA summary rather
7 than the ISA. What we found with our facilities is
8 that they are very consistent but they change every
9 day.

10 The basic process stays very much the
11 same. We make UO2 to F2 routinely every day. For
12 today we may tweak this parameter or we may tweak that
13 parameter and tomorrow or next week we may go a
14 different direction.

15 The process still has changed but we've
16 tweaked these things in here and we need to have the
17 ability to look in and say as we change or tweak this
18 thing, what impact does that have on safety without
19 having to go back through and do a complete ISA and
20 submit a complete ISA to the staff for their review
21 and consideration.

22 The other thing that we want to get out of
23 all this program is that one of the biggest issues the
24 NRC and the licensees have is timely license renewal.
25 Part 70 licenses run anywhere from five to 10 years.

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1 Under the Part 70 rule when we submit a
2 license application for our license renewal
3 application, we can continue to operate under existing
4 license until that renewal application is finalized.
5 In some cases that renewal application has lingered in
6 the organization in getting it completed for four to
7 five years.

8 We felt, and the NRC probably felt, that
9 this was not the way to do business, so one of the
10 things we want to do with this process with the new
11 Part 70 and with the ISA process is keep a living
12 license. When our nine or 10 years are up, five years
13 are up, whatever the time period is, they have kept
14 abreast of the changes in the facility.

15 We will keep them abreast of the changes
16 with the ISA summary. There should not be any major
17 program changes so we would think that the
18 programmatic programs such as radiation protection,
19 nuclear criticality will not substantially change. It
20 should be a fairly simple license renewal at that time
21 period. That's one of the major benefits we see in
22 going through this program.

23 And just to touch on a last point here,
24 how do all safety programs together. That's the issue
25 that we have is that we want to make sure the

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1 understanding is how the safety programs work
2 together.

3 If we want to put more emphasis in this
4 area because we feel it's more important to spend more
5 time and resources on fire safety than it is on
6 nuclear safety or radiation protection, we should be
7 able to demonstrate the balancing of those between
8 themselves as far as safety to the facility and to the
9 public.

10 That's my quick pitch here this morning
11 because, like I say, we don't really have any major
12 issues with Chapter 3 right now.

13 MR. GARRICK: Questions? Is this issue of
14 the scope of the ISA summary resolved now in your
15 opinion?

16 MR. KILLAR: Yes and no. It's resolved in
17 our understanding of what the expectations are. Until
18 we actually have an IGA summary submitted and approved
19 by the staff it's still an open issue. We do not have
20 an ISA summary that has been submitted and approved by
21 the staff according to the new rule.

22 We have had some ISAs that were done for
23 parts of facilities prior to the rule that have been
24 approved so we have an idea, but now the rule has
25 changed a little bit of the basis and things on that

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1 line.

2 One of the things that we did with the
3 April notifications is identify what changes had to be
4 done from what the previous ISAs we submitted in order
5 to meet the new rules but we have not had an ISA
6 summary that has been submitted and approved under the
7 new rule yet. Until we get through that process, we
8 still have that question in our minds.

9 DR. KRESS: My interpretation of what you
10 said earlier is that the licensee is more or less
11 committed to the summary as its licensing basis as
12 opposed to the full ISA. Is that an interpretation
13 that is correct?

14 MR. KILLAR: That's borderline. The way
15 the rule reads is the NRC does not approve the ISA.
16 They approve the ISA summary. But the way they
17 approve the ISA summary is that they look at the ISA
18 summary, look to see if there are any questions in
19 there about what they've done based on their knowledge
20 of the facility or knowledge of operations and things
21 on that line. If there are questions, they
22 have the ability to go down and do a vertical cut of
23 the ISA itself at the facility to see how part of that
24 is reflected in the ISA summary. They quasi approve
25 the ISA by approving the ISA summary. Per the rule,

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1 they are only approving the ISA summary.

2 MR. GARRICK: One of the problems I've
3 observed in the application of the PHA technology in
4 some plants is it's not always easy to make the
5 connection between the individual contributors and the
6 end results or the end state results of the sequences.

7 What some of the people that are heavily
8 engaged in using this kind of technology are doing is
9 beginning to look at specific contributors that pop up
10 as important in more detail and, in fact,
11 probabalistically building a little PRA model of those
12 contributors.

13 In a sense, that is proven to be very
14 constructive. It provides some of the things that Tom
15 was talking about earlier of baselining the difference
16 in results you might get from an ISA and a PRA but at
17 a level that is not quite the commitment that you
18 would have if you would try to do it for the whole
19 report.

20 MR. KILLAR: Let me address a couple of
21 points. That reminded me of a point that was brought
22 up earlier this morning. One of the things that the
23 industry was concerned about is that our facilities
24 are not connected and interconnected similar to a
25 reactor facility.

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1 Like I talked about earlier, when we
2 review a process we can either chop it up in pieces or
3 we can do the whole process because if this piece
4 fails it has zero impact on the rest of the operation
5 up there. It has zero impact on it as far as
6 radiation protection, criticality safety or anything
7 along that line.

8 We can look at these as individual pieces
9 or we can look at the whole process because they are
10 not interdependent as far as the safety is concerned.
11 Now, there certainly could be some interdependence.

12 If this causes a fire, it may impact those
13 operations down there. As an independent device, as
14 an independent operation, the operation safety does
15 not necessarily require this operation here as well.

16 Secondly, in some of the facilities I've
17 gone through and did the ISAs, they've put together
18 ISA teams and they felt that -- they found a lot of
19 value of putting these ISA teams together because of
20 some of the issues you just brought up.

21 Some of the things that the nuclear
22 criticality guy is sitting there working on and
23 thinking about, he may not have thought about in
24 radiation protection.

25 I said, "Hey, did you think about this?"

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1 He said, "No, I need to put that in there because of
2 what ifs or whatever and stuff." The teams have help
3 provide more depth and more understanding of their
4 facilities, a better handle of the safety of their
5 facilities.

6 To the other extent, one of the things one
7 of our members found is that they got into doing a lot
8 of the analytical type analysis and things on that
9 line and they found that they got distracted because
10 they were focusing on the numbers and not the real
11 life.

12 They said, "Oh, gee. Is this 10 to the
13 minus 4th or 1.3 times to the minus 4th?" In the crux
14 of things it didn't make any difference but they were
15 focusing so much on that they were kind of getting the
16 picture.

17 MR. GARRICK: But PRA is not to do that.

18 MR. KILLAR: Right.

19 MR. GARRICK: You are supposed to focus on
20 what can go wrong and keep the attention on the
21 scenarios if you wish. People that tend to get hung
22 up on the numbers, they themselves are not practicing
23 the art the way it was intended.

24 MR. KILLAR: And that is exactly the point
25 I was trying to make. There was a concern when some

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1 of the members said they saw the ISA team getting
2 involved in the numbers and not really looking at the
3 understanding of what they were doing and stuff and
4 they corrected that.

5 There was another point I was going to
6 mention but I can't recall off the top of my head what
7 it was.

8 MR. GARRICK: Any other questions? Okay.
9 Thank you. Thank you very much.

10 I guess we are now going to hear from the
11 NRC staff. We'll ask each member to introduce
12 themselves and tell us a little bit about their job
13 and proceed with their presentation.

14 MS. BAILEY: Good morning.

15 MR. GARRICK: Good morning.

16 MS. BAILEY: I'm Marissa Bailey. I'm a
17 Senior Project Manager in the Risk Task Group. I'm
18 here this morning to basically -- turn on the mic --
19 give you an overview of our activities, our risk
20 informing activities in the Risk Task Group.

21 I and Dennis Damon will be doing this
22 presentation because our section chief Lawrence
23 Kokaiko doesn't have a voice today.

24 MR. GARRICK: Sounds like an excuse to me.

25 MS. BAILEY: Basically our activities in

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1 the Risk Task Group fall into three categories;
2 supporting the risk initiatives and risk related
3 activities in the different NMSS divisions, developing
4 and implementing risk related training, and then
5 developing and implementing a framework for risk
6 informed regulation in the materials and waste arenas.

7 What I want to do is just go very briefly
8 over the first two bullets. I and Dennis Damon will
9 then spend most of the time going over the status of
10 the third bullet as far as where we are in
11 implementing risk informed regulations and conducting
12 the case studies, and also developing safety goals.

13 As far as assistance to the divisions in
14 NMSS goes, this is a list of some of the activities
15 that we have been involved in or that we expect to be
16 involved in during the next year.

17 I think most of you have heard this
18 before, but basically our goal here in our assistance
19 and peer review activities is to ensure that risk
20 methodologies are applied consistently, to basically
21 make sure that the staff's regulatory positions are
22 consistent with their risk significance, and also to
23 just provide general guidance and assistance on the
24 use of risk information and risk assessment methods.

25 In regard to training, we have implemented

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1 several training courses or we are developing or they
2 are in the development phase. At this point there are
3 three introductory courses in risk assessment that's
4 being offered. There's one for the technical staff,
5 one for the technical manager, and then one for the
6 administrative staff.

7 We are offering a course on quantitative
8 frequency analysis for fuel cycle. We are in the
9 process of developing a training course on the use of
10 the by-product material risk study, and also
11 developing a handbook for that. And we are assessing
12 other risk-related training with the technical
13 training center.

14 DR. KRESS: Are those courses held here in
15 White Flint?

16 MS. BAILEY: Yes. Or in the region.

17 DR. KRESS: Or in the region.

18 MS. BAILEY: Now I want to basically get
19 into what's been I would characterize the major
20 activity in the Risk Task Group over this last year.
21 Basically that is implementing and developing a
22 framework for risk-informed regulation in the
23 materials and waste arena.

24 SECY-99-100 and the SRM for that has
25 really provided the basis and guidance for what we've

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1 been doing in the Risk Task Group for the last year.
2 The first phase of that has involved conducting case
3 studies. Just very briefly, let me go over Secy-99-
4 100.

5 This was issued by the staff back in March
6 of 1999. In this commission paper we proposed a
7 framework for risk informed regulation in the
8 materials and waste arenas. That framework also
9 involved a five-step process for moving forward with
10 risk-informed regulation.

11 In that five-step process the first step
12 was to identify candidate applications that would be
13 amenable to risk-informed regulation. Although in
14 NMSS we are probably -- there are areas that are
15 further along in this five-step process, in general we
16 are in step one of this five-step process. In other
17 words, we are still pretty early in the process of
18 trying to identify candidate regulatory applications.

19 IN the SRM SECY-99-100 which was issued
20 back in June 1999 the commission approved the proposed
21 framework. They also directed the staff to develop
22 materials and waste safety goals that would be
23 analogous to the reactor safety goal.

24 DR. KRESS: Did they give you any guidance
25 on what the word analogous meant?

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1 MS. BAILEY: No.

2 DR. KRESS: You have to do that yourself?

3 MS. BAILEY: I think we're feeling our way
4 through it. Dennis will be talking about where we are
5 in this process as far as development safety goes as
6 soon as I'm finished here.

7 So basically what we've done is we have
8 developed draft screening criteria to help us identify
9 those candidate regulatory applications that are
10 amenable to risk informed regulation which, again, was
11 step one of that five-step process.

12 We also adopted a case study approach to
13 help us test the draft screening criteria and also
14 help us begin to process and develop safety goals.
15 The case studies would be retrospective looks at a
16 spectrum of activities in the materials and waste
17 arenas.

18 Individual and cumulatively they should
19 tell us or illustrate for us what has been done in the
20 materials and waste arenas with respect to using risk
21 information. To what extent have our activities been
22 risk informed or not risk informed.

23 The objectives of the case studies were to
24 test the draft screening criteria and produce a final
25 version, to examine the feasibility of safety goals.

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1 If they are feasible, develop a first draft.

2 Then the subsidiary objectives of the case
3 studies were to gain insights on how we could risk
4 inform our regulatory processes and also gain insights
5 on what tools, data, methods, guidance we would need
6 to implement the risk-informed approach.

7 MR. GARRICK: Now, the Risk Task Group
8 came into being after the ISA process was pretty well
9 developed. Is that not correct?

10 MS. BAILEY: Lawrence, can you answer
11 that?

12 MR. KOKAIKO: I have a little voice. Just
13 not a sustained one. The ISA process had already
14 started before the Risk Task Group had come together.
15 With Dennis Damon we followed the activities of it.
16 We revisited BWXT and Global Nuclear Fuel and were
17 aware of what's going on. We have not been in charge
18 of development of the SRP Chapter 3.

19 MR. GARRICK: Okay. I'm just trying to
20 get focused on what the Risk Task Group really is
21 doing to risk inform the office given that the ISA is
22 kind of the driver of the analysis effort and that it
23 has already been pretty well established.

24 MR. KOKAIKO: The ISA is the driver in
25 fuel cycle for fuel fabrication facilities.

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1 MR. GARRICK: I see.

2 MR. KOKAIKO: But in other areas of NMSS
3 other things will have to be utilized. NMSS is a
4 broad regulatory spectrum from moisture density
5 gauges, gamma knives, all the way to the repository.

6 MR. GARRICK: Thank you.

7 MS. BAILEY: These are the AK study areas,
8 the areas that we conducted the case studies on, gas
9 chromatographs, static eliminators, fixed gauges,
10 uranium recovery, the decommissioning of the Trojan
11 Nuclear Plant, transportation to the Trojan reactor
12 vessel, the seismic exemption for the dry cast storage
13 facility for the TMI defuel debris and INEL, and the
14 seismic upgrades for the Paducah gaseous diffusion
15 plants.

16 Now, these areas or activities were chosen
17 as case studies because we felt that they had elements
18 of risk informed decision making in them, or because
19 it was felt that these were activities that could
20 benefit from risk-informed decision making.

21 I guess I would like to point out that at
22 this point in time we have completed our case studies.
23 In fact, last month we held the last of the series of
24 stakeholder meetings on the case studies.

25 During that meeting we presented the

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1 insights that we gained from the case studies and also
2 tried to get some feedback on how we could integrate
3 the individual results of the case studies and move
4 forward with risk informing our regulatory processes.

5 Now, at this point I would just like to
6 summarize for you some of the general insights that
7 we've learned or that we've gained from the case
8 studies.

9 With respect to the screening criteria, we
10 basically found that they did encompass the relevant
11 considerations for what we ought to be thinking about
12 or what we ought to be considering as we try to decide
13 whether an activity can be risk informed.

14 We did find that there should be
15 considerations rather than criteria. That's really
16 just to reflect the fact that the screening
17 considerations is a decision-making tool. It's not to
18 be a check list that gives you a black and white
19 answer and that forces you to go down a certain path
20 if the answer happens to be yes or no.

21 MR. GARRICK: It's kind of in the spirit
22 of being more risk informed and less prescriptive, I
23 would say.

24 MS. BAILEY: Okay. Yeah. Basically the
25 outcome of the screening considerations is just

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1 another factor you ought to be taking into account
2 when you try to make your decision.

3 Let me just go back to that slide. The
4 other thing I did want to point out was that we did
5 find that the screening considerations is a useful
6 decision-making tool and we're pretty much ready to
7 finalize it.

8 However, we did find that the application
9 of it can be very subjective and guidance on how it
10 should be applied needed to be developed. We are also
11 in the process now of trying to develop guidance for
12 how to use the screening considerations.

13 Screening considerations themselves are a
14 series of seven questions that we would ask. The
15 first four questions basically addresses the agency's
16 strategic goals of maintaining or improving safety,
17 improving efficiency or effectiveness, reducing
18 unnecessary burden, helping or enhancing public
19 communications.

20 The fifth criterion addresses the
21 availability of sufficient information to risk inform.
22 The sixth criterion basically asks whether a risk-
23 informed approach could be implemented for a
24 reasonable cost.

25 Then the seventh addresses other

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1 precluding factors. Given that an activity meets the
2 first six, is there anything else that would or should
3 stop us from risk informing a process.

4 This next slide just gives you the exact
5 wording of the screening considerations.

6 As far as safety goals go, which is the
7 second objective in the case studies, the case studies
8 showed us that it is feasible to develop safety goals
9 and that a multi-tiered structure, similar to the
10 reactor safety goals, is more possible approach, and
11 if we did take that approach, we would have to develop
12 subsidiary objectives for each program area.

13 We also found some implicit and explicit
14 safety goals in the case studies. We also found some
15 examples where decision making could have been
16 facilitated if a clear set of safety goals existed.
17 Dennis will go into the safety goals in more detail as
18 soon as I'm finished.

19 As far as the value of using risk
20 information, the case studies showed us that the use
21 of risk information, at least in those eight
22 activities, did help the staff to make decisions that
23 were in retrospect consistent with the agency's
24 current strategic goals. They also found that the
25 risk information can be useful in helping us identify

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1 shortcomings in our regulations or regulatory
2 processes.

3 However, for us to fully realize the
4 benefits of a risk-informed approach. there are
5 probably several things that we need to do in the
6 future. One, we need to continue with staff training.

7 We probably need to introduce or develop
8 risk-informed guidance on rulemaking and licensing and
9 inspection and enforcement. We have to develop safety
10 goals. We probably need to recognize that zero or
11 zero risk is not possible, that it's impossible in the
12 real world. And we need to address human reliability.

13 With regard to tools and information and
14 methods and guidance, the case study showed us that it
15 exist in varying degrees. In some cases there are
16 tools and methods that would support a risk-informed
17 decision making. But, in some areas, some would have
18 to be developed or some would have to be further
19 developed. Whatever tools and methods are out there,
20 they all shared a common weakness of the human factor.

21 As far as where we go from here, we've
22 completed our eight case studies so now we're on that
23 yellow block. We're in the process of trying to
24 integrate the results of the case studies.

25 By December we hope to put out an

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1 integration report that would have the final screening
2 considerations, have a first draft of safety goals,
3 and could address some of the process improvements
4 that we could make in the materials and waste arenas.

5 Also by December we hope to have developed
6 guidance for how screening considerations should be
7 applied. Early next year what we want to do is start
8 applying those screening considerations systematically
9 to the program areas within NMSS and start trying to
10 identify what areas could be risk informed. In
11 parallel with that, we also want to further develop
12 and refine the safety goals with the help of the
13 Office of Research.

14 I think that pretty much concludes my
15 part.

16 MR. GARRICK: Questions? Thank you.

17 DR. DAMON: Good morning. I guess I
18 didn't introduce myself before. My name is Dennis
19 Damon and up until two years ago I had been working in
20 the Division of Fuel Cycle Safety and Safeguards. One
21 of the things I worked on was the Part 70 rulemaking
22 and the ISA chapter, the Standard Review Plan.

23 Then about two years ago I became part of
24 the Risk Task Group which at that time was under John
25 Black. Currently now it's under Lawrence Kokaiko.

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1 I've been now involved in this broader spectrum of all
2 the different risk-informed activities in NMSS since
3 that time.

4 What I wanted to do here was to try to get
5 fairly quickly to some of the interesting issues that
6 come up when you talk about safety goals on the
7 nuclear material side.

8 I don't want to de-emphasize the
9 importance of having done these eight case studies
10 because if you go off and you try to develop safety
11 goals in the abstract without looking at very specific
12 cases, there's a danger that what you develop just
13 doesn't apply to the real world of what these people
14 are dealing with.

15 That was the purpose of the eight case
16 studies was to look at risk information in the context
17 of eight very specific cases and see does this all
18 make sense. The idea would safety goals be useful to
19 anybody in this NMSS area.

20 One of the conclusions from looking at
21 case studies was, yes, it is sometimes. It's not
22 always a useful thing to have but quantitative
23 measures of what is safe enough which would be a
24 safety goal, a quantitative measure that would be a
25 useful thing in certain specific situations that come

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1 up.

2 Then I just want to make it clear that I'm
3 sure you gentlemen haven't been probably involved in
4 the reactor safety goal side understand what is meant
5 by a safety goal but I wanted to communicate that what
6 the Risk Task Group's understanding of it is and this
7 addresses that.

8 It is a level that is safe enough but, as
9 you notice in the third bullet, it's a level of risk
10 that is low enough without explicit consideration of
11 whether it's possible to achieve that value. This is
12 our understanding of it. It's a level of safety that
13 is inherently safe enough, not one that's conditional
14 on whether you can achieve it or what it would cost to
15 do that.

16 The purpose of these safety goals is to
17 facilitate risk management. It is important to
18 remember, and this is often forgotten once you start
19 to get right into this risk management.

20 When you start using risk information to
21 manage safety, it very quickly assumes this flavor
22 that these goals you're setting for yourself are
23 requirements. Like I say, by the definition of what
24 I think they are supposed to mean, they are not
25 requirements.

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1 MR. POWERS: Can we go back over this?
2 Define how safe is safe enough without any economic
3 considerations? Why did you conclude that?

4 DR. DAMON: Oh.

5 MR. POWERS: I'm not sure what you're
6 driving at here.

7 DR. DAMON: What I'm driving at is that
8 there are different concepts for what is safe enough.
9 One concept is in one aspect of being safe enough,
10 it's the thing I should be. I should be this safe.

11 When you say you should be that safe, that
12 implies it's possible to achieve it, it's reasonable
13 to achieve it. It's that kind of thing. There are
14 requirements in the regulations like ALARA that that
15 is the concept. It's a level of safety that is a
16 reasonable level to require that you achieve.

17 A safety goal is not -- my understanding
18 of a safety goal is not based on reasonableness. It
19 is based upon an inherent look at the risk itself and
20 a consideration that level of risk is in some sense --
21 in some higher sense it's safe enough. It's not
22 conditional on whether you can achieve it or not.

23 MR. POWERS: Let me explore a little bit
24 because I'm not really sure what you're driving at.
25 When we think about adequate protection, we do not

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1 take into account economic consideration.

2 When we think of a ALARA, we do because
3 there's a point at which we say, well, it's not
4 reasonable to achieve because it cost too much money.
5 Then we put a specific number on that, a dollar
6 figure.

7 When we think about safety goals, we've
8 said once you achieve this level of safety, the public
9 interest has no -- the public has no interest and you
10 would be safer to go to expenses to which you have a
11 greater level of safety. They don't say you can't but
12 you can. I'm not absolutely sure what you're driving
13 at here.

14 DR. DAMON: I think you're saying the same
15 thing as what I'm getting at.

16 MR. POWERS: Okay.

17 MR. GARRICK: So you are saying that the
18 ALARA principle applies here? At least the principle.
19 If you can make something safer with very little cost,
20 and even though you have met the safety goal, why not
21 do it?

22 DR. DAMON: That's one of the interesting
23 questions. That's the kind of stuff I think is useful
24 to talk about because --

25 MR. POWERS: Because I thought he was

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1 capping the ALARA.

2 DR. DAMON: That's what I'm saying. Some
3 people will say this consummate of safety goes a four
4 to ALARA and other people say no, it's not. That's
5 what I'm saying. It's a very interesting point to
6 bring up.

7 MR. POWERS: Let me encourage you very
8 much to cap ALARA because otherwise it just hamstring
9 you because I can always consider a way to do things
10 with less radiation dose. No matter what you come up
11 with, I can always think of another way to do that.
12 What you want to say is there's a point regardless of
13 whether it be done at zero cost that you quit thinking
14 about those things.

15 DR. DAMON: Well, that's what I say.
16 We're early on in the stages of analyzing and talking
17 about safety goals, but some of the people involved,
18 like myself and Bob Bari and Viuod Mubayi at
19 Brookhaven, have been doing this a long time so they
20 know there are these issues out there.

21 What we're trying to do is elevate this
22 stuff, put it out in public and start reexposing
23 people to it and clarifying these things. Some of the
24 things seen in reactor safety goals, a reactor is just
25 one particular kind of device and situation. Because

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1 of that, it's possible to simply the consideration of
2 safety goals.

3 When you get to NMSS with the broad
4 spectrum of things they deal with, one of my views is
5 you have to be sure that the set of safety goals
6 you're coming up with are covering everything that you
7 want to and that you need to deal with.

8 Like the second bullet up here, "To
9 identify proper safety roles, to identify risk metrics
10 to manage," is kind of getting to this. We've got to
11 make sure that we were addressing the things that they
12 really have to worry about in NMSS. That means it has
13 to be -- what I would like it to be is a complete set.

14 What this slide is intended to call out,
15 and maybe it doesn't do it quite well enough, is that
16 safety goals, as I've said before, they are
17 aspirations, not limits. But there are risk-based
18 requirements in the regulations right now and they
19 come in in two different ways is the way I look at.

20 One way they come in is really as an
21 explicit risk-based requirement. The performance
22 requirements of 7061 that we were just talking about,
23 the highly unlikely for high consequence, that's what
24 I mean by that. It's an explicit risk-based
25 requirement. It's a requirements that something about

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1 the licensee has to meet.

2 10 CFR 32.23 and 24 also have such a risk-
3 based requirement so that's one type, a risk-based
4 requirement statement. It's a requirement stated in
5 terms of risk, likelihood and consequences.

6 The other type of what I would call a
7 risk-related requirement statement is something like
8 ALARA. The way I think of this is as a conditional
9 risk-related requirement. It's a requirement that you
10 continue to lower risk conditional on what it cost and
11 whether it's feasible and other considerations.

12 Safety goal is, like I say, something
13 different from that. That's why I'm trying to draw
14 this distinction that we understand. This is just to
15 emphasize the fact that the statement I made before
16 about the fact that the case study showed that
17 quantitative risk information be useful.

18 The first one up there, transportation,
19 has to do with the Trojan reactor vessel shipment. In
20 that study a quantitative risk analysis was done.
21 What they calculated -- one of the things they
22 calculated -- they calculated two interesting things.

23 One of them was the probability of an
24 accident that would exceed the design conditions of
25 the transport vessel and shipment package. In other

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1 words, a collision that you could not be sure that the
2 reactor vessel would not be breached.

3 They calculated probability of these very
4 severe accidents and they got a number about 10 to the
5 minus 6. Well, the only trouble with that is they
6 calculated it but nobody was telling them 10 to the
7 minus 6 was acceptably low. They made that decision
8 on their own.

9 It would have been useful if they had
10 quantitative guides telling them, "Yes, this is an
11 acceptable value." The only problem is they didn't
12 calculate consequences. They just calculated
13 probability of whether the accident would be severe
14 enough that it would possibly lead to consequences.
15 That's one thing they did.

16 Another thing they did in the context of
17 that study is they calculated -- that's a probability.
18 Basically since a shipment is a one-time only thing,
19 this is a one-time only probability of a one-time only
20 consequence.

21 The other interesting thing they
22 calculated was they calculated the cumulative person
23 rem to both the workers who were preparing this
24 shipment package and also to the public incident to
25 making the transport. The transport package was a

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1 reactor vessel in its internals in a shipment package
2 so there is some shielding. There is some dose
3 involved in preparing that package for shipment.

4 The interesting thing that came out of the
5 study was is that this cumulative total person rem
6 figure was actually lower for shipping it by the barge
7 method which is what they proposed.

8 To me what was an interesting example of
9 is why I said before it's useful to have all the risk
10 metrics identified that you're trying to manage so
11 that when you tell somebody to do a risk analysis that
12 they analyze -- they calculate the risk with respect
13 to all those metrics because otherwise you get this
14 biased picture if you only calculate one risk metric
15 and you don't look at the other ones.

16 That's one of the things I think we learn
17 from this is look at all the different risks involved.
18 This is pointing out that the gas chromatographs,
19 which is one of the other case studies, the regulation
20 that applies to them is 10 CFR 32.23 through 27.

21 I'm going to show you what that looks
22 like. This is what it looks like. This is what I
23 call a risk-based requirement. This is what they are
24 required to do. If you look down at not the last row
25 but the row that says "whole body" there. This row

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1 here, "whole body."

2 This applies to gas chromatographs which
3 are a device which is a typical thing that NMSS
4 regulates. Devices or pieces of equipment that are
5 used by certain persons in the public. This is normal
6 use and disposal. This is normal storage.

7 This is really intended to address the
8 manufacturing facility and the warehousing and the
9 distribution of the things where they might be present
10 in large numbers. This is the case where a user has
11 got one of these things out in a lab somewhere using
12 it.

13 There's 1 millirem. It must be unlikely
14 in one year for that person. For this person who
15 works at the facility where they are manufacturing or
16 storing these in a warehouse, 10 millirem must be
17 unlikely in one year. These are requirements, not
18 safety goals.

19 Out here one unit in one location. As we
20 march what we're doing is marching out in consequences
21 along this whole body dose thing. Half a rem, 15 rem.
22 Half a rem probability is low. 15 rem probability is
23 negligible.

24 What I see here is a risk-based
25 requirement statement. It raises all kind of

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1 interesting questions when you're trying to formulate
2 safety goals. Why should this be different from this.
3 This guy gets -- it's the same unlikeliness and this
4 guy gets 10 times more.

5 I think the reason is because they are
6 treating this guy as a worker, a radiation worker. He
7 works for a manufacturer of radioactive material and
8 this person is being regarded as a member of the
9 general public. That would be the way I would
10 interpret that. That's why they did the difference.

11 All I'm saying is there's a lot of risk-
12 related requirements and reasoning that is already
13 embedded in the regulations and that's why we're
14 having to go through these case studies, to tease this
15 stuff out and then try to figure out how that relates
16 to safety goals.

17 On the previous slide it said right down
18 here, "15 rem probability must be negligible." They
19 have interpreted this right in the regulation. This
20 is a direct quote, "Negligible is defined to be not
21 more than one such failure per million units
22 distributed."

23 There's a flaw in this reasoning. They
24 say negligible probability. Well, what if you got a
25 million units in your warehouse. There is sort of

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1 inherent logic flaw in the way they stated this.
2 That's why I say there's a virtue to going through
3 this safe goal stuff to try to explain to people how
4 to formulate these safety requirements.

5 It was also identified that safety goals
6 might have helped in some of the other case study
7 areas that they worked on. Safety goals might be
8 useful in these areas. There's dry cask storage which
9 you'll hear about later.

10 This is really a much more interesting
11 slide. One of the things we did was we -- one of the
12 issues to consider in formulating safety goals is why
13 should there be more than one. What is it that makes
14 you have more than one safety goal.

15 In the reactor site they identified
16 individual societal. What we did was we went around
17 and looked and tried to figure out what are all the
18 other factors that would cause you to have more than
19 one safety goal.

20 Certainly individual versus societal is
21 one of them and I'll talk about what I think it means.
22 Maybe you can tell me what you think it means.
23 Anyway, that is one parameter that causes you to have
24 two different kind of safety goals.

25 Then there are all the different factors

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1 that influence the population at risk. In other
2 words, you might need to have a different safety goal
3 for different populations. One rationale for that
4 being voluntary versus involuntary.

5 One example of voluntary versus
6 involuntary is worker versus public. With the outside
7 public person the facility is plunked down next to
8 them and they derive only a general benefit from it.
9 Nothing specific, yet they are inflicted with all the
10 risks. Whereas the worker, in a certain

11 sense, it's voluntary that he assumes the risk of
12 working in a facility that handles radioactive
13 material. Since there's a difference in -- and that's
14 embedded in our 10 CFR 20.

15 That concept that there should be a
16 difference is embedded in 10 CFR 20 which is a
17 requirement statement, 5 rem for a worker, 100
18 millirem for a member of the public. As a unit would
19 that be reflected in a safety goal, that difference.

20 MR. POWERS: I have frequently questioned
21 whether the workers are voluntarily assuming risks
22 when they go to work at a radiation facility. The
23 reason I question that is if we compare the education,
24 we provide the workers on the radiation risk to the
25 kinds of statements that doctors ask you to assign

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1 when you have an operation or some medical process
2 operated on you, there's no comparison.

3 The education on risk can consist of
4 telling you there's no problem, whereas the doctors
5 tells you, "You're going to die on this operation that
6 I'm going to perform on you and it's horrible beyond
7 belief and nobody in his right mind would ever do
8 that. Do you want to do this?" So it's always been
9 an open question to me whether one ought to make this
10 distinction or not.

11 DR. DAMON: Well, that's the kind of
12 questions and comments we're looking for. We're just
13 in the early stages. We haven't even really -- we
14 haven't fully aired this in public. We did present
15 this slide in a public meeting but that's the kind of
16 issue that -- I mean, I wrote a little paper talking
17 about this.

18 Voluntary is, like you say, yeah, it's
19 voluntary but if he doesn't go to work there, he
20 doesn't get paid either. It's not like 100 percent
21 voluntary.

22 Then there's another reason why it might
23 be appropriate to allow him to be exposed to higher
24 risk and that is he gets a benefit out of it. He does
25 get that salary. In fact, that's not on this slide

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1 but what I was going to say is individuals/societal
2 and voluntary/involuntary are just two parameters. We
3 consider 13 parameters -- no, 15.

4 There's 15 different parameters that could
5 influence whether you give somebody higher or lower.
6 One of them is benefit. In the case, like you said,
7 the guy who is getting an operation, the reason he is
8 willing to take that risk is he's going to get a
9 benefit from it. It's a risk benefit trade off.

10 It points out what the real difference
11 here is between worker and public where one of the
12 other differences is a different difference, and that
13 is the worker gets a benefit; namely, he gets the pay.
14 The public guy's benefit is at a very remote level
15 from that thing.

16 When you do a risk benefit trade off kind
17 of thinking about these things, the worker might say,
18 "Oh, yeah. I get more morasses. That's too bad but
19 I get paid." The interesting thing is all this risk
20 benefit trade off thing comes up at two other ends of
21 the spectrum.

22 It comes up at the end of the medical
23 spectrum, of course, where there's a risk that if you
24 undergo a procedure that involves radioactive
25 materials, you might get -- you are subject to the

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1 risk of misadministration, not of the dose that you
2 are supposed to get but that they would screw up and
3 actually kill you with the radiation.

4 There's a risk there but there's a big
5 benefit to trade off. A huge benefit and a
6 substantial risk. At the other end of the spectrum,
7 there's risk benefit trade off in that there are
8 safety devices that have radioactive material in them
9 like smoke alarms.

10 An infinitesimal radiological risk traded
11 off against the benefit of having smoke alarms that
12 work according to that principle. All these 13
13 factors come into as issues to consider in formulating
14 safety goals. We have gone through and thought some
15 of this through but, like I say, we're still in the
16 early stages.

17 This is an interesting one. There are
18 chemical risks, nonradiological risks. Also it's
19 interesting to think bout long-term risk which comes
20 up, of course, in waste disposal sites. It induces
21 difficulties in how do you deal with this.

22 MR. GARRICK: I know there's an
23 environmental impact statement, but have you
24 considered at all bringing environmental impact into
25 the safety goal domain?

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1 DR. DAMON: We have considered doing
2 environmental and property damage. These are some of
3 the risk things we are considering here. We are
4 considering a tiered structure like they used in
5 reactor safety goals where the top level is
6 qualitative and then is quantitative down here.

7 Environmental and property damage are two
8 things. In addition to risk to individuals and
9 societal risks, there is environmental and property
10 damage being considered. Like I say, we're very early
11 stages in trying to think about what the heck can you
12 do with this thing.

13 MR. GARRICK: Yeah, I was curious
14 particularly about the quantitative part, what you
15 might be thinking about there.

16 DR. DAMON: The individual versus societal
17 one, I would like to make a statement in case somebody
18 wants to object to what I say. In my mind there's a
19 very dramatic difference between individual and
20 societal risk the way I think of them.

21 Individual is a question of justice that
22 derives from the idea that -- it really, I think,
23 derives from the other end of the spectrum; namely, a
24 case where a facility would say -- local a facility
25 which would subject someone to a risk of 50 percent of

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1 being killed due to them locating there.

2 Just a gross risk imposed on some innocent
3 bystander would be intolerable. Since that is
4 obviously unjust, they are driving the benefit, that
5 person is driving the risk and there's an injustice.
6 It's a goal to lower that down to some level.

7 When you reach a lower level that's low
8 enough, that's okay. If you lower it to zero you lose
9 all flexibility in society. You can't do anything
10 because everything you do imposes a risk on somebody.
11 Somewhere in between is a concept that that level of
12 injustice is something we have to live with in order
13 to allow society to function.

14 The other one, societal risk, in my mind
15 is a total grand integral of all risk associated with
16 something and it comes into the process of thinking
17 whether that process is being conducted in a way where
18 there's a net -- how do I put it? It's a net benefit
19 kind of a reasoning.

20 In other words, risk is one of the
21 disbenefits you get when you do something and you
22 would like to keep it down. Since you are getting
23 this benefit from doing the thing, you are probably
24 going to continue to do it and the question is how low
25 a value is this total risk impact going to be.

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1 It's not an issue of justice because
2 you're already -- if you've complied with an
3 individual safety goal, then this thing is already --
4 it's not a question of justice to the individual.
5 It's simply a societal question of whether we are
6 willing to incur this level of risk associated with
7 this type of activity.

8 MR. POWERS: You might want to think also
9 in terms of general uncertainty. When we tried to
10 formulate a worker protection goal for some of the DOE
11 facilities, we quickly ran into the problem we don't
12 where the guy is.

13 In most of your individual risk things you
14 can say he's at the site boundary or somewhere beyond
15 there so you can kind of locate him. You really can't
16 locate him when you are trying to do a worker sort of
17 thing.

18 You could in that scenario gravitate
19 toward a societal goal for the society of workers
20 because of the uncertainties of where they are
21 located. You can integrate over the population but
22 you just can't do one individual.

23 There is some of that built into larger
24 societal goals in that you don't know which members of
25 society might be particularly receptive to radio or

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1 chemistry or something like that. You create societal
2 goals to compensate for that uncertainty.

3 You quickly find that societal goals
4 suffer from extrapolation to the limit because you
5 start getting things like one gram of plutonium
6 dispersed in the atmosphere will kill three people
7 when you integrate over a million population and
8 things like that.

9 You might think of it in terms also of
10 just uncertainty of what's going on in this population
11 of individuals.

12 DR. DAMON: I think I can generalize what
13 -- that's a very interesting observation because you
14 can generalize that in saying that some of the things
15 I have seen about -- how do I put it?

16 When you look at a safety requirement or
17 a regulation, and it may be stated in terms as either
18 an individual risk limit of some kind, or it might be
19 stated as an integral measurement, it's not always
20 true that is actually what they are trying to manage.

21 It may be that it's done that way for
22 practical reasons. Like you say, you can't measure it
23 so we're going to average or some reason like that.
24 It's very important, I think to tease out what they
25 really are trying to do. What is really the purpose

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1 of this regulation.

2 Yucca Mountain is kind of an example of
3 that. They are regulating to an individual risk
4 limit. But why did they locate it in a remote
5 location where there's few people? Because the risk
6 limit to an individual doesn't have anything to do
7 with how many people there are. You have to be
8 careful that you understand why people are using it.

9 What I would say is that's one of the
10 reasons for subsidiary objectives down here is there
11 are practical working level quantitative tools,
12 whereas I would hope to try to keep these things --
13 the higher up you go, the more you should be based on
14 something that's stated in terms of strict principles
15 and general principles and things that would always be
16 true.

17 This is especially true in NMSS because
18 there are so many diverse things going on that you
19 want to keep this stuff as general as you can.

20 MR. KOKAIKO: Dennis, excuse me. Dr.
21 Powers, I appreciate your comment on that. I agree
22 with you. in NMSS we have real life applications
23 where this happens and the most obvious is a
24 construction site. You have one radiation worker but
25 everyone there is involved in the enterprise of

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1 construction. Yet, they are all assuming a part of
2 that risk. I appreciate that comment.

3 MR. POWERS: It's the same. I mean, your
4 construction sites are the same as new facilities.
5 You have a few guys doing the actual manipulation but
6 then you've got all the secretaries and the janitorial
7 force and construction workers getting their share of
8 the risk, but you don't know who is getting what so
9 you just integrate over the whole population.

10 It actually works very well for those
11 kinds of finite populations because you can do things
12 to reduce the societal -- that small societal risk.
13 It makes sense and you can think about how to do them,
14 whereas you can never figure out how to protect an
15 individual from doing something stupid. I mean,
16 there's a limit to where you can go on something
17 really stupid.

18 The other thing to bear in mind on the
19 subsidiary goals is you call them practical. One of
20 the problems you have with very high-level goals is
21 you can calculate them. You can calculate them but
22 you can't calculate them without controversy.

23 Sometimes those controversies become
24 irresolvable or the cost to resolve them is so high
25 you just don't want to go there. I mean, that is

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1 certainly what happened with CDF, core damage
2 frequency.

3 We have evolved. The technology that we
4 generally all agree is you can get a core damage
5 frequency. Nobody can agree how to calculate the
6 actual risk. We use a working goal that everybody
7 thinks is about right.

8 They come to why they think it's about
9 right by circuitous invariable routes but they all
10 agree the number is about right and avoid calculating
11 the actual risk because nobody can ever agree on
12 whether they've got that calculation right.
13 Technologies are not routinely available to calculate
14 that. That's another way to look at your subsidiary.

15 DR. DAMON: So here is something Bob Bari
16 laid out showing over here is reactors and this is
17 materials and waste and we are trying to use the same
18 tiered structure is what he's trying to say. Down
19 here at this level we're trying to think of what types
20 of safety goals would apply.

21 Another interesting thing about safety
22 goals and NMSS is, you see, it might be one of the
23 reasons for safety goals. There are two reasons why
24 I think safety goals are a valid concept. It's not
25 that there's just a level of risk that's

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1 insignificant. Yeah, you can say that. That's
2 like relative to other things. There are two other
3 reasons besides that. One of them is the cost benefit
4 thing. That is eventually you go down so low that you
5 are probably tripping ALARA cost benefit criterion
6 anyway. But the other one is what they call secondary
7 effects. What I mean by secondary effects

8 was something alluded to my Lawrence, and that is in
9 the NMSS side when you impose a requirement on
10 somebody to do something to manage the radiation risk,
11 you're actually perturbing the process that they do in
12 their everyday work.

13 If they work at a construction site where
14 the construction risk is like -- the risk of getting
15 killed in a construction accident is about 2.5 times
16 10 to the minus 4 or something like that. It's a
17 substantial risk.

18 If you perturb that and you double that
19 while you are minimizing some radiation risk, what
20 have you accomplished? The point is is NMSS
21 applications run into this real world where if you try
22 to make things too safe, you are actually making
23 people unsafe.

24 MR. GARRICK: What do you mean on this
25 chart under tier 3 under materials and waste by

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1 chronic? I know what chronic means but I want to know
2 what you mean here.

3 DR. DAMON: That is operational health
4 physics. That's 10 CFR 20.

5 MR. GARRICK: Why would you put that in
6 this category? I mean, reactors have operational
7 health physics, too. That's something you can
8 calculate in advance and determine in advance. If
9 it's too high, you won't build the facility. It's not
10 a disturbance. It's not an upset.

11 DR. DAMON: Right. Well, is the question
12 the same as before? In Part 20 there's an ALARA
13 requirement. The question is is there a flaw on
14 ALARA. That's what he means by that.

15 Here's what Bob Bari came up with. That
16 we got individual and societal goals and the only
17 difference here -- there are a couple differences but
18 I'll point out one. The worker was put in here in
19 this individual one. That's different than reactor.
20 The reactor one doesn't have that.

21 That breaks down to five QHOs in this list
22 and then there's another one on the next page. What
23 I'm pointing out here is there's an individual public
24 acute, individual public latent, and individual worker
25 acute, and individual worker latent.

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1 You don't have to necessarily do things
2 this way. The United Kingdom combines these two
3 together. The United Kingdom has safety assessment
4 principles in which they put out quantitative limits
5 and quantitative goals for different types of risk.
6 They add these together. That's like saying there's
7 no difference between whether you are acute or latent
8 fatality. They add them together and they --

9 Now this one here, like I say, this is
10 just an early first draft proposal. Up here in the
11 public risk area, the QHOs for that we use the same
12 thing that was used in the reactor, one-tenth of one
13 percent of the corresponding risk from other things.

14
15 For acute it's other accidental
16 fatalities. This is the 3.5 times 10^{-4} which
17 is one-tenth of one percent of that. Then this QHO
18 here is one-tenth of one percent of the sum of cancer
19 fatality risks which are 2×10^{-3} per
20 year.

21 Down here for workers there are different
22 ways you can do this one. The U.K. uses basically 10^{-6}
23 to the minus 6, I believe, as their one. It's not
24 tied to a relative scale. What we're saying is here
25 is one way of tying it to a relative scale.

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1 This one-tenth of occupational fatality
2 risk. Or you could do it the same way and say why
3 should this be different than the nonworker. Let's
4 use the same one up here, a tenth of a percent of
5 prompt fatality risk from all other accidents.

6 The difference here is occupational
7 fatality risk is very low. Dying on the job is not
8 the way people get killed accidentally. You get
9 killed in your car, you know, or you fall down and
10 break your neck. Occupational fatality risk is only
11 5 times 10 to the minus 5 per year. One percent of
12 that is five times 10 to the minus 6.

13 MR. LEVENSON: Is it intended that that
14 apply to accidents that are nuclear type? Because, as
15 worded, again are you saying that they should be only
16 one percent of industrial average?

17 If they're working in that plant and there
18 were no radioactive material in it, you are requiring
19 that plant to be 100 times as safe as any other plant.
20 I think it's intended to mean that the radiological
21 aspects should not add more than one percent rather
22 than that being the total risk.

23 DR. DAMON: Yes, that's what intended. In
24 other words, yes, this is the increment added by the
25 part the NRC regulates.

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1 MR. LEVENSON: Right. Not because of the
2 operation of the facility.

3 DR. DAMON: Right. We're not saying that
4 you need to do this. This is not a requirement. It's
5 just saying if it was one percent of occupational
6 fatality risk, which is already a very low number, why
7 would anybody object.

8 You would say we're only adding one
9 percent to your risk of getting killed. You still
10 have all this other 100 percent risk. When you work
11 in a nuclear facility you don't forgo the other risks.
12 They are just added.

13 In fact, people get killed in these
14 facilities from these other risks. Like I say, this
15 is just an early first draft of the thought process of
16 imitating what happened for public. We're imitating
17 that for here and asking people what do you think.

18 What I really think this last one is a
19 much more problematic thing, societal risk. What I
20 managed to convince Bob Bari, I think, is societal
21 risk goal has two components.

22 One is that risks from nuclear
23 applications be low relative to other risks in
24 society. Well, I can tell you right now that risks
25 from all nuclear applications all added up together

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1 are infinitesimal compared to the risks of all the
2 other risks. 90,000 people a year die by accident in
3 this country. 90,000.

4 MR. GARRICK: Half of them from
5 automobiles.

6 DR. DAMON: Yes, half from automobiles.
7 That's an enormous number. There's no way nuclear
8 applications are going to start approaching that. So,
9 you know, fine.

10 What's the other one? The other one was
11 the risk from a nuclear power plant should be
12 comparable to competing methods of generating like --
13 you know, viable competing methods of generating
14 electricity. Well, we tried to apply that
15 analogy in NMSS and I don't think it works very well.
16 Some of the applications don't have viable competing
17 technologies or they are different in some way.

18 The other one is it goes of scale at both
19 ends of the spectrum. At one end of the spectrum is
20 the smoke alarm. Suppose you've got a smoke alarm and
21 the nuclear risk from that is trivial. Why should you
22 make it any lower just because it happens that there's
23 a non-nuclear smoke alarm. Okay?

24 I don't see the rationale for that. At
25 the other end of the spectrum I don't think it works

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1 either. Suppose you have a nuclear application where
2 the risk is phenomenal. It's extremely risky, but the
3 competing technology is even worse. "Are you okay?
4 I met my safety goal. I'm lower risk than all of
5 competing technologies." I don't think so. I think
6 societal risks we need something here.

7 DR. KRESS: I think you're right. The
8 problem I have with it is now you have to have common
9 units for the denominator end of the numerator. The
10 only one I see in common is dollars.

11 You have to reconstruct your risk in terms
12 of dollars and you have to reconstruct your benefit in
13 terms of dollars. It looks like a difficult task to
14 me but it makes a lot of sense.

15 DR. DAMON: Yes. In effect, that's the
16 issue. You see, what bothers me is it is clear to me
17 that we are regulating to societal risk because it's
18 the reason for remote siting of facilities and it's
19 the reason why we don't dissolve our nuclear waste in
20 the public drinking water supply and dilute it down.
21 We are using this as a consideration in regulating.
22 The question is what is a level that is low enough.
23 I say it's a difficult question.

24 MR. KOKAIKO: Dennis, may I compound the
25 problem even further? We may have another health

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1 objective between worker latent and worker acute.
2 Also in NMSS you have applications that can cause
3 severe burns radiologically. In fact, a radiographer
4 just recently received a very high exposure to his
5 hands. We've gotten some feedback to say that perhaps
6 we should also be looking at that risk as well and try
7 to quantify that which is somewhere between your
8 worker latent and worker whole body dose that would
9 kill you.

10 DR. KRESS: It's comparable to just what
11 you would call injuries.

12 MR. KOKAIKO: Yes.

13 MR. GARRICK: Well, you're right that they
14 can get very complicated if you try to calibrate this
15 in too fine a detail. Some people don't even like to
16 go as far as using dose. The cutoff ought to be
17 fatalities.

18 There's all kinds of ways to make this
19 unmanageable and I think you have to be very astute as
20 to what you end up with as your metrics. To the
21 extent that it's applicable you also ought to be
22 guided as much as possible by precedence.

23 DR. DAMON: I certainly concur with that.
24 Anytime we can find something like this one that's
25 been well worked over, we're just going to buy off on

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1 it. It's only when we come to something that it just
2 doesn't seem to work for what's going on in NMSS that
3 we need to worry about anything else.

4 DR. KRESS: That's one reason I like that
5 bottom one on there is because you can actually
6 include things like injuries. If they are all put on
7 a dollar basis you could include it all in that
8 bottom.

9 DR. DAMON: This is another one that is
10 tough. I don't even know if this meets -- I mean, it
11 was expressed in the first public meeting that
12 environmental -- how do I put it? Protecting the
13 environment was not done for human benefit or
14 something to that effect. Different people have quite
15 a different view about what environmental objectives
16 might be.

17 MR. POWERS: Have you chatted at all with
18 the Swedes on this? They come out and they just say,
19 "Okay. Thou shalt not contaminate the land with more
20 than X amount of cesium." That's their safety goal.
21 Don't worry about people. Just don't contaminate the
22 land.

23 I don't know what rationale by which they
24 came to that conclusion but it might be interesting to
25 chat with them just to find out because maybe that

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1 gives you some insight on how to handle this sort of
2 thing.

3 DR. DAMON: This one we haven't even begun
4 to hardly think about. It's just a very --

5 MR. POWERS: Of course, the other way is
6 to call up Dr. Kress and ask him for the dollar value
7 of human life, take his number, and then you can come
8 up with a dollar equivalent for environmental
9 contamination.

10 DR. KRESS: It's worth thinking about.

11 MR. POWERS: Well, you spend a lot of time
12 and, in fact, Bob Bari's group did it, on surveying
13 what regulations ascribe to the value of a human life
14 in order to set our ALARA limits so he's acutely
15 familiar with it. That may be the way to handle it.
16 Just make them equivalent dollar values.

17 DR. KRESS: That's the only metric I see.

18 MR. POWERS: Those were all quickly
19 controlled.

20 DR. KRESS: -- what value they assign to
21 human life.

22 MR. POWERS: That's an argument I've made
23 for a long time. I think you're right.

24 DR. KRESS: It's the one we got dribbled
25 on the floor and booted out.

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1 MR. POWERS: Yeah, kicked right out.

2 DR. KRESS: Kicked out of the office on
3 that one.

4 MR. LEVENSON: I'm afraid that doesn't
5 solve the problem because even if we all agreed on the
6 dollar value of the human life, what we're talking
7 about here are very low doses and no agreement as to
8 whether any human lives are involved or not.

9 MR. GARRICK: It might even extend life.

10 DR. KRESS: The contamination of land --

11 MR. POWERS: It's going to cost so much.

12 DR. KRESS: -- will cost so much it will
13 control everything.

14 MR. GARRICK: Okay. Let's move along.

15 DR. DAMON: I think we're done. You
16 mentioned chronic risk. I mean, we don't -- we
17 haven't really had a conversation on this one. I
18 think 2 millirem is used as a chronic risk goal
19 objective by the United Kingdom. That's where the 2
20 comes from. I've seen people use 1. I've seen them
21 use this. Maybe it shouldn't be an absolute number.
22 Maybe it should be relative to something.

23 MR. GARRICK: Well, maybe one thought
24 would be to not necessarily try to start with
25 everything included but start with something that you

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1 have high confidence in that allows you to add to it
2 as you figure out what these other things ought to be.
3 In other words, phase in your safety goals is a
4 possibility.

5 DR. DAMON: And the second one here, Bob
6 Bari has been working on -- he's been working on two
7 things. He's been tabulating these things. These are
8 different NMSS applications. These were different
9 frequency or probability values that might be used to
10 manage these sort of analogous to CDF. These are CDF
11 analogs for different things.

12 The other thing he's doing is he's
13 quantifying -- he's going to the NUREG/CR-6642 and
14 other risk assessments that have been done in NMSS and
15 he's putting down the -- we are trying to estimate
16 with the risk assessments that exist what are the
17 risks in these different areas.

18 We are doing a bunch of stuff but I can't
19 show it to you all because it's sort of in the middle
20 of being developed. That's the kind of thing we're
21 doing. We're looking at safety goals, what should be
22 considered in principle, what are the options to pick
23 from, what are the considerations, and then also
24 trying to quantify what the risks really are so we can
25 get some feel about where we're at.

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1 MR. KOKAIKO: Dennis, if I might just
2 point out, this is really just sort of a strawman.
3 This is subject to radical revision.

4 MR. GARRICK: Well, it also looks like
5 it's more than just an analog with core damage. It
6 looks like it's analog with core damage plus
7 containment release or containment failure.

8 MR. KOKAIKO: Yes, sir.

9 DR. DAMON: Yes, that's true. It is more
10 analogous to large or early release.

11 MR. GARRICK: Any more comments? This
12 helps us a great deal to get an insight on where you
13 are and what you're doing. Does the Risk Task Group
14 operate on a meeting basis? Do you get together
15 periodically or how does it operate? Can you answer
16 in a very short time how it functions?

17 DR. DAMON: I mean, the Risk Task Group is
18 a regularly functioning unit. It's constant.

19 MR. GARRICK: So it's a group.

20 DR. DAMON: It's a real organization.

21 MR. GARRICK: It's not an ad hoc?

22 DR. DAMON: No, it's not ad hoc thing that
23 gets together irregular or vague intervals. No, we
24 work daily together.

25 MR. KOKAIKO: It's our day job.

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1 MR. GARRICK: Very good. Thank you very
2 much.

3 If there's no further questions, we will
4 adjourn for lunch and be back at 1:00.

5 (Whereupon, at 12:10 p.m. the meeting was
6 adjourned for lunch until 1:00 p.m.)
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A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

1:02 p.m.

MR. GARRICK: The meeting come to order.

Our next topic is going to be the Risk Assessment for Dry Cask Storage, and we will have Messrs Guttman and Rubin to start off, and I understand there's going to be a team. Why don't you introduce yourselves and tell us where you work, etcetera.

MR. GUTTMAN: I'm Jack Guttman. I'm the Chief of the Technical Review Section B in the Springfield Project Office in NMSS.

MR. RUBIN: I'm Alan Rubin. I'm a Section Chief in the PRA Branch in the Office of Research which is conducting this dry cask PRA in response to a user need from NMSS.

MR. GARRICK: Okay. Proceed.

MR. GUTTMAN: I'm very pleased to introduce some excellent in-house activities to develop a spent fuel dry storage PRA. I hope this meeting will convey the outstanding technical contributions and analytic capabilities that various entities within the Office of Research and the Spent Fuel Projects Office have developed and continue to enhance.

In the future, we plan to solicit your

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1 comments, expertise and support of the findings from
2 this important program. This is an important
3 initiative for several reasons which I will highlight
4 in my introduction.

5 MR. POWERS: In our research report,
6 didn't we characterize this research as some of the
7 most important that was being done?

8 DR. KRESS: We did.

9 MR. POWERS: Preaching to the choir, at
10 least two members of the choir.

11 MR. GUTTMAN: As a brief background, the
12 Spent Fuel Project Office issued a user's need letter
13 to research to develop a dry storage PRA. In support
14 of this effort, the Office of Research and the Spent
15 Fuel Projects Office and NMSS established a task force
16 comprising of a group of experts in various fields.
17 The ground rule was to develop a generic PRA using a
18 certified cask for which the staff has readily
19 available information, thereby optimizing our limited
20 resources. The PRA would then be used by the Spent
21 Fuel Projects Office as appropriate. The PRA is being
22 developed in-house with limited contractor assistance
23 such as human factors considerations.

24 The Spent Fuel Projects Office planned use
25 of the PRA includes to risk inform 10 CFR Part 72, to

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1 support NMSS risk task group activities such as safety
2 goal evaluations and development, to risk inform our
3 inspection programs, to maintain safety, to enhance
4 public confidence and to reduce unnecessary burden.
5 Enhancing public confidence has taken a significant
6 role as the staff is being requested to meet with
7 local concerned citizens on the safety of dry cask
8 storage. This program will assist our interactions
9 with the public. Performing the analysis in-house
10 enhances our technical and regulatory credibility.

11 MR. POWERS: That really is true. If
12 you're going to have to explain this to the public,
13 you've got to have the expertise to answer the
14 questions in real time. You can't say well, I'll get
15 back to you on that. You really do need to do this
16 when you're in-house, don't you?

17 MR. GARRICK: One of the things I think
18 the committee would be very interested in as we go
19 along here would be what that influence has meant in
20 terms of the way in which you're doing the PRA. Has
21 it led to any fundamental change in how you do it?
22 I'm talking about the business of involving the public
23 and trying to enhance public confidence. What are you
24 doing specifically to do that besides interact with
25 the public?

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1 MR. GUTTMAN: Typically, the Spent Fuel
2 Projects Office is requested and is becoming more
3 frequent by state representatives and the utilities
4 and local communities to come to local public meetings
5 and explain the regulations and the reasons why a
6 utility should be permitted to remove their spent fuel
7 from the pools and store it in dry casks. This is
8 becoming a more important activity as more reactors
9 are decommissioning and unloading their fuels from the
10 pools.

11 MR. GARRICK: Or the pools are just simply
12 filling up.

13 MR. GUTTMAN: The pools are just simply
14 filling up. That's correct.

15 MR. GARRICK: Yes. Okay.

16 MR. GUTTMAN: As I highlighted, the PRA is
17 performed in-house. A task force of Research and
18 Spent Fuel Projects Office technical experts was
19 established for that purpose. The task force consists
20 of the following technical expertise. Project
21 management, PRA, structural dynamics, material
22 sciences, seismic, criticality, thermal, consequence
23 analysis, statistics and human factors.

24 DR. KRESS: Is each one of those a
25 different person or is one person all of those?

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1 MR. GUTTMAN: Each one is a different
2 person.

3 MR. POWERS: There are no Tom Kresses.

4 MR. GUTTMAN: Actually, there are several
5 people for each category.

6 MR. GARRICK: Is the PRA category or
7 structure dynamics category or where are you with
8 count for external phenomena?

9 MR. GUTTMAN: The PRA practitioners would
10 basically come up with the eventries and faultries.
11 Let's say for example, if they're moving a cask and
12 there's a potential for drop, then the structural
13 people will perform dynamic analysis. We're using,
14 for example, ANSYS/LS-DYNA. Identify the stresses and
15 loads on the casks. Then the structural people look
16 at the results and determine if there's a potential
17 for a failure and try to quantify that.

18 MR. LEVENSON: For something like a cask,
19 are there ever conditions where the seismic loads
20 exceed the drop loads?

21 MR. GUTTMAN: No. Drop loads are in the
22 order of 45 to 60 Gs.

23 MR. LEVENSON: I know. That's why I
24 wonder why we have a seismic category and do a bunch
25 of analyses when it's clearly subsumed within --

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1 MR. GARRICK: Because the public would
2 ask, why didn't you consider seismic?

3 MR. LEVENSON: You say it's not nearly as
4 severe as dropping it.

5 MR. GUTTMAN: With that introduction, I
6 would like to turn to Alan Rubin for the technical
7 overview.

8 MR. RUBIN: Thank you, Jack. I just
9 wanted to just go back and remind you that back in May
10 of last year, 2001, I presented a proposed plan and
11 approach to this joint subcommittee on what we were
12 going to do on the dry cask PRA project. At that
13 time, work had not begun. We were getting the team
14 together. So what you're going to hear today is a
15 work in progress. We're probably at the mid-point,
16 maybe somewhat past the mid-point of this project. So
17 you'll hear some conclusions in some different areas
18 of the work and you'll hear some status and approach
19 in other areas. And then in the future when we're
20 finished with our integrated results and analyses, we
21 will present that information to the subcommittee at
22 the time.

23 MR. GARRICK: When do you expect to
24 finish? You're going to tell us that, I guess.

25 MR. RUBIN: I'll tell you that. You're

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1 jumping to my last slide at the end of the day, but
2 basically --

3 MR. GARRICK: It's a bad habit of mine.

4 MR. RUBIN: Our schedule now is to have a
5 draft report to NMSS in the late spring or early
6 summer of this year.

7 This is an overview of what you're going
8 to hear today following my introduction. These are
9 the different steps and the people who are involved in
10 those tasks are going to be giving these detailed
11 presentations.

12 First is an overall modeling approach of
13 the code that we're using, the Sapphire code, which
14 we're using to do the PRA to model the dry cask.
15 You'll hear about then the external events that are
16 considered in the dry cask analysis and how we've
17 calculated the initiating event frequencies for those
18 events.

19 You'll hear in particular one of the
20 events which is a fire scenario and how the thermal
21 loads were developed based on modeling of fire, the
22 dry cask fire resulting from an aircraft crash.
23 You'll hear about those analyses, both of thermal load
24 from the fire, are calculated in determining what the
25 temperature conditions are on the cask. You'll hear

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1 results and discussion on the mechanical loads. What
2 loads are imposed on the cask for mechanical events,
3 be they drops, impacts from tornado-generated
4 missiles, or drops or tip-overs.

5 DR. KRESS: Does this include what happens
6 internally to the fuel itself?

7 MR. RUBIN: There is some fuel failure
8 modeling that is going on. It's not completed yet.
9 But the fuel itself is contained in a canister, a
10 multi-purpose canister, and that is encased into an
11 overpack, a large concrete structure, in the storage
12 pad. You'll hear more about that with the structural
13 analysis. The real focus is for things to cause
14 problems, the multi-purpose canister has to fail, and
15 that's what the focus is of both the thermal and
16 mechanical failures.

17 And then once we have those loads, both
18 the thermal loads, the temperatures and time
19 conditions, as well as the stresses from the different
20 mechanical impacts, we'll have a presentation on how
21 those go into the calculation of the probability and
22 likelihood of cask failure. Each of them tie into
23 different sequences.

24 Then there is some consequence analysis in
25 terms of how we're going to look at the source terms

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1 and evaluate the overall risk to the public,
2 integrating the consequences and the frequencies in
3 our PRA. At the conclusion of these detailed
4 presentations, we'll tell you what the next steps are,
5 where we are in the analysis, and I've already given
6 you one bottom line of our schedule for the draft
7 report.

8 These are the objectives taken from the
9 user need from NMSS. First, the dry cask PRA has not
10 been done before, so there is really a first of a kind
11 project. The intent was we wanted to develop a
12 methodology for performing such a PRA on dry casks.
13 You hear a lot about that today.

14 DR. KRESS: Since you got decay going on,
15 do you pick out a specific decay time for these or do
16 you do a time variable PRA?

17 MR. RUBIN: We're doing a nominal analysis
18 where the fuel, first of all, is aged five years
19 before it's put into the cask.

20 DR. KRESS: So you picked out five years.

21 MR. RUBIN: You pick out a time and then
22 look at the decay heat following that. But we're also
23 looking at scenarios if there's misloading of fuel
24 from human error. We'll get into some of that. What
25 impact that could have.

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1 DR. KRESS: What I was wondering is there
2 may be motivation to start getting that stuff out of
3 the spent fuel pool faster and would your PRA be
4 amenable to backing up, say, one year?

5 MR. RUBIN: Yes, it would. We would put
6 in different decay heats and the consequence analysis
7 we put in different source terms. Yes.

8 MR. GARRICK: But you might end up with
9 mixed stages for the fuel. Different fuel of
10 different ages, as long as it met the five year
11 requirement, but it could be 10 year, eight year, six
12 year.

13 MR. RUBIN: It's realistic to take five
14 years but certainly the fuel could be 10 years old and
15 then you're going to have lower decay heat so the
16 impacts are going to be less.

17 MR. GARRICK: But I mean you could have
18 fuel elements that are of different age.

19 MR. RUBIN: Absolutely. Yes, and you
20 would.

21 MR. GARRICK: In the same cask.

22 DR. KRESS: Which brings me to another
23 question I had. Say you've got 10 of these casks. Is
24 the source term coming from all 10 or what would come
25 from any one of them?

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1 MR. RUBIN: We're doing an analysis of one
2 cask and assuming that that cask has got five year old
3 fuel, and you'll hear some more about that. And then
4 typically the kinds of events, initiating events. If
5 they are not common mode cause failure, they're going
6 to impact one cask.

7 DR. KRESS: One cask at a time.

8 MR. RUBIN: A seismic event could impact
9 a number of casks on a pad. So that's where you look
10 into different levels of consequences, depending on
11 whether you have a common cause failure or not for
12 multiple casks. So as Jack Guttman said, we're doing
13 a pilot PRA and the specific cask that we're looking
14 at is called a Holtec HI-STORM cask and the reason
15 that was picked is because of its availability of
16 information as well as the likelihood that that cask
17 will be used at a number of different reactor sites in
18 the country. We're looking at a BWR site for our
19 analysis.

20 Our final objective is to look at the
21 potential risk to the public from dry cask storage and
22 to identify what those dominant sequences are. This
23 will hopefully provide a lot of information, useful
24 information for risk informing NMSS activities.
25 Again, we can apply the same methodology to different

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1 sites.

2 Jack mentioned the broad scope of the
3 participants involved in this project. I won't read
4 off all their names but they're listed here, and
5 you're going to hear from a lot of them this
6 afternoon. These team members include members from
7 the PRA Branch, section chief and the overall
8 management of the project is our responsibility in the
9 PRA Branch as well as the PRA modeling. The analysis
10 of initiating events and the fire analysis.

11 This project involves all three divisions
12 in the Office of Research, so it's a cooperative joint
13 program, joint effort. In the Division of Engineering
14 Technology, the Engineering Research Applications
15 Branch is responsible for the analysis of mechanical
16 loads and the same division, Engineering Technology,
17 the Materials Engineering Branch is involved with the
18 failure analysis for both thermal and impact loads and
19 mechanical loads on the casks. This is a mouth full.
20 The Safety Margins and Systems Analysis Branch of the
21 Division of Systems Analysis and Regulatory
22 Effectiveness are doing the calculations of the
23 thermal loads on the cask, the consequence analysis
24 and criticality.

25 As my final slide, I just want to give

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1 some perspective on the overall scope of the study so
2 you'll see what's included and what's not included.
3 There are three phases of the cask that are being
4 looked at. The first one is the handling phase which
5 takes place in the reactor building where fuel is
6 loaded from the spent fuel pool into what's called the
7 multi-purpose canister, and you'll see a picture of
8 that diagram in the next presentation.

9 That canister is then dried, inerted and
10 sealed before it's inserted into an overpack, which is
11 the large concrete structure that holds the spent fuel
12 in the storage pad. This cask is then transferred on
13 site from the reactor building to the storage pad.
14 It's called the transfer phase, and we're looking at
15 accidents that can occur during that phase. And
16 finally, looking at events that can occur during 20
17 year storage. Twenty years is the nominal license for
18 these dry casks.

19 What is not included in the scope is
20 probably equally as important as what is included.
21 First of all, the fabrication of the cask. We're
22 assuming the cask is built as it's designed, so
23 fabrication errors are not covered. Off-site
24 transportation is a different PRA than the
25 transportation studies and modal studies being handled

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1 looking at risk from transportation, and acts of
2 sabotage are also not included in this PRA.

3 MR. POWERS: How about aging?

4 MR. RUBIN: Aging of a cask over 20 years?
5 I don't think there's any particular effects looking
6 at aging. We're looking at errors at drying and
7 inerting the cask which could cause some different
8 problems on the materials. That is part of it. But
9 if the cask is sealed and dried and inerted as the
10 procedures say it should be, then I don't think
11 there's any aging problems that we're looking at.

12 DR. KRESS: In developing a frequency for
13 handling, you assume every five years you load up the
14 cask?

15 MR. RUBIN: Cask could be loaded more
16 frequently than that.

17 DR. KRESS: More frequently than that.

18 MR. RUBIN: Depends on the site, depends
19 how much fuel is being moved into the storage pad. It
20 could be a number of pads over the license period for
21 the reactor.

22 DR. KRESS: But you have a number for
23 that.

24 MR. RUBIN: Well, we will have a number
25 for that. You're not going to hear that today. The

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1 handling phase is being covered in analysis of the
2 liabilities analysis being done by a contractor. We
3 don't have the final results yet to present today. We
4 will in the final report. But that's looking at
5 errors that could cause a cask to both drop because of
6 human error as well as potential mechanical failures
7 of the crane.

8 DR. KRESS: You don't include the effects
9 of the drop if it drops into the pool itself?

10 MR. RUBIN: No, that's different. That's
11 a heavy loads analysis.

12 DR. KRESS: That goes with the operating
13 reactor.

14 MR. RUBIN: Correct. We're looking at the
15 effects of the drop on the cask but not the effects of
16 the cask dropping on other equipment in the reactor
17 building or over the taurus, for example, the BWR.

18 So if there are any further questions, I
19 will be happy to answer them. I will continue on with
20 the presentation. Will the next two members come in.
21 The next presentation is going to be done by Chris
22 Ryder. Why don't the next two people come up. Brad.

23 MR. RYDER: Good afternoon. My name is
24 Chris Ryder, and I'm going to be talking to you today
25 about the methods that we're using to determine the

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1 risk of dry cask storage.

2 I'll give you a little bit more details
3 about the system that we're studying. The cask
4 consists of three components, a multi-purpose canister
5 that contains the fuel, the transfer cask which
6 provides shielding inside the reactor building, and
7 the overpack which provides protection and shielding
8 during storage.

9 DR. KRESS: When you say multi-purpose,
10 that means it's good for dry cask storing and
11 transportation and sticking in Yucca Mountain?

12 MR. RYDER: Yes. The canister can be
13 pulled out of the overpack which in this case is just
14 good for on site storage and put into another
15 container and then shipped off site. That's why it's
16 called multi-purpose.

17 Here are some dimensions that you can look
18 at at your own leisure.

19 MR. LEVENSON: What's that word mean?
20 Leisure?

21 MR. RYDER: This is the system. Here's
22 the multi-purpose canister. This is where the fuel is
23 placed. This is placed into the transfer cask which
24 is used for handling. Both are put in the spent fuel
25 pool where the fuel assemblies are loaded. The top is

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1 put on the shielding. It's brought out to another
2 area for preparation and there it's dried and sealed,
3 inerted and sealed up and then this transfer cask is
4 placed on top of the overpack. With the stays, the
5 MPC is lifted off of the bottom lid and the MPC is
6 inserted into the overpack. The overpack has four
7 vents on the bottom, four on the top. Air enters the
8 bottom vents, pulls the MPC and exits the top vent.

9 MR. POWERS: What's the electrical
10 chemical potential between the lead and the steel?

11 MR. RYDER: Say it again, please.

12 MR. POWERS: The electrical chemical
13 potential between the lead and the steel?

14 MR. RYDER: I don't know.

15 MR. POWERS: Doesn't corrode though?

16 MR. RYDER: I couldn't answer that at this
17 time. In the transfer cask, it's steel/lead/steel
18 water jacket, and that's used just temporarily for the
19 handling operation. There's no long term storage for
20 that.

21 MR. POWERS: Concrete. Just concrete?

22 MR. RYDER: Say it again, please.

23 MR. POWERS: Concrete. Just concrete?

24 MR. RYDER: Just ordinary concrete. It
25 has no structural support at all. The structural

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1 members on the overpack is the steel.

2 MR. POWERS: Steel.

3 MR. RYDER: And the concrete is just for
4 shielding.

5 MR. POWERS: And there's nothing specified
6 about the aggregate, other than size?

7 MR. RYDER: It's just ordinary concrete.
8 I don't know the specifications of it.

9 MR. POWERS: What about the PSI concrete?
10 Just ordinary sizing on the stones and things like
11 that?

12 MR. RYDER: But the structural members
13 themselves is the steel.

14 MR. LEVENSON: What's the little wedge
15 shown blown up on the drawing?

16 MR. RYDER: This?

17 MR. LEVENSON: Yes.

18 MR. RYDER: That's just a section showing
19 that this is the steel. This is the concrete.

20 MR. LEVENSON: It's not a wedge going into
21 a hole?

22 MR. RYDER: Any other questions about
23 this?

24 DR. KRESS: I see this thing is cooled by
25 natural circulation.

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1 MR. RYDER: Yes, it is.

2 DR. KRESS: Is loss of cooling accident
3 one of the PRA --

4 MR. RYDER: That's one of the initiators
5 which I'll get to.

6 You heard about the three phases of the
7 operation handling transfer and storage. Here are
8 some of the steps. Loading of fuel, lifting it from
9 the spent fuel, the issue you heard before. We find
10 it convenient to talk about these because this is how
11 we actually structure our PRA around those three
12 phases.

13 DR. KRESS: Going back to this natural
14 convection cooling. Is there just one inlet vent or
15 is there a ring of them?

16 MR. RYDER: There's four of them. Four in
17 the bottom, four in the top.

18 DR. KRESS: And then they're baffled so
19 that they --

20 MR. RYDER: And then there are channels on
21 the inside which help to support or align to keep the
22 multi-purpose canister from tipping and the air passes
23 between the channels and along the MPC. Also, if the
24 cask were to tip over, the channels collapse and so
25 they provide some cushioning.

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1 DR. KRESS: Okay. And is there just one
2 outlet vent or is there?

3 MR. RYDER: There's four inlet vents on
4 the bottom, four outlets on the top. There's a screen
5 over them to keep out debris and inside the vents are
6 baffles to keep radiation from streaming out.

7 DR. KRESS: Okay. Thank you.

8 MR. RYDER: There are two possible
9 approaches that we could have done in conducting our
10 PRA. We could have looked at all initiating events,
11 no matter how low their frequencies or we could do a
12 screening analysis, and to use our resources
13 effectively, we chose to do the screening analysis.

14 What we did was we began by compiling a
15 list of initiating events and we began with the
16 external events in the PRA procedures guide. Then we
17 looked at plant procedures. We observed some of the
18 operations, talked to NMSS staff and looked at the
19 design and we added our own initiating events.

20 With that complete list, we can then apply
21 that to other plants if we need to. But in applying
22 this to a particular site, we started looking at
23 eliminating events by various criteria. To begin, we
24 looked at which events were not applicable to the
25 site. For example, if it's not in a seismic reaction

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1 region or a volcanic region or subject to Tsunamis, we
2 can eliminate those events to begin with.

3 Then we also did engineering analysis to
4 look at what events would have no effect on the cask,
5 and we eliminated those. And then we are in the
6 process of looking at events which have low risk. By
7 that, we mean low frequency or low probability of
8 occurrence.

9 MR. GARRICK: What was your frequency cut-
10 off? Did you have a cut-off?

11 MR. RYDER: Nominally, we're taking 10^{-8} ,
12 but this is a screening study and we're going to look
13 at our results and, if need be, revisit that.

14 In the handling phase, we have mechanical
15 events. You can drop the cask when it's open. You
16 can drop it when it's sealed. In the transfer phase
17 we have mechanical events and thermal events. The
18 cask can be dropped. It can be tipped over. The
19 thermal events can occur if, for example, the transfer
20 vehicle, if the fuel were to catch fire in that and
21 eat the cask.

22 MR. POWERS: Would that happen if
23 lightning strikes?

24 MR. RYDER: That's coming up.

25 MR. POWERS: During transfer, I mean.

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1 MR. RYDER: Say it again, please.

2 MR. POWERS: During handling part of it.

3 MR. RYDER: Say it again.

4 MR. POWERS: Do you have lightning strikes
5 during the handling part of it?

6 MR. RYDER: During handling, that's inside
7 the reactor building.

8 MR. POWERS: That wouldn't count the
9 outside --

10 MR. RYDER: Transfer is outside. We don't
11 consider that there. The procedures call for the
12 transfer being done only when there's good weather
13 conditions. So if there's like rain in the forecast
14 for the afternoon, either they'll put the operations
15 off until the next day or they'll try to move them up,
16 so they'll start earlier in the day to be sure that
17 they're finished before hand. So if there's inclement
18 weather, the cask is not moved.

19 MR. POWERS: It must be something they're
20 worried about. What is the concern?

21 MR. RYDER: I think they just don't want
22 to --

23 MR. POWERS: Zap a worker or something
24 like that.

25 MR. RYDER: Say it again, please.

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1 MR. POWERS: Zap a worker.

2 MR. RYDER: Yes, basically. They also
3 just want to have the workers working under ideal
4 conditions.

5 In the storage phase, you can have
6 mechanical events due to tip-overs, strikes by heavy
7 objects, explosions from gas main, a passing truck or
8 a barge.

9 DR. KRESS: Excuse me, Chris. Are these
10 initiating events you've identified or are these the
11 ones that have survived the screen?

12 MR. RYDER: No. These are ones that we've
13 identified. We are eliminating many of them. I'm
14 just here giving you some examples of the ones that
15 occur. We have a list of about 50 in detail.

16 Thermal events. You could have vent
17 blockage. Like I say, from flood waters or from
18 debris. Mechanical thermal events would be the
19 effects of an accidental strike by an aircraft and
20 then there's lightning.

21 MR. GARRICK: The lightning is just a
22 people problem, isn't it?

23 MR. RYDER: We believe so at this time.
24 There is some speculation that there might be some
25 effects on the concrete and the overpack, and we're

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1 also continuing to look into what could happen to the
2 MPC, but we believe right now that the current will
3 just pass through it.

4 MR. GARRICK: You don't know how good a
5 Faraday cage it is.

6 MR. RYDER: That's the primary concern is
7 for worker exposure for the workers, but no, I don't
8 know that at this time.

9 MR. LEVENSON: Is the vent blockage
10 including concern for rodents and insects and birds
11 which are probably much more likely than floods?

12 MR. RYDER: Yes. Actually, one of the
13 initiating events which we are going to be looking at
14 is long-term accumulation of insects or debris
15 accumulating inside the vents.

16 MR. POWERS: Squirrel nests.

17 MR. RYDER: I mean it's a warm environment
18 and so it would tend to attract creatures.

19 Method of analysis is, of course, the
20 event trees. We're using fault trees to look at the
21 human errors and some equipment failures. Then we
22 have other analyses going on. I have a stylized event
23 tree in the package here. The event trees are much
24 simpler than you would see in reactors. I'm not going
25 to go through this. You can look at it on your own.

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1 But they're nowhere near the detail that you see the
2 power plant PRAs.

3 Inputs to the event tree are the
4 initiating event frequencies. Some of those you'll
5 hear about later on. We have the probability of MPC
6 failure. To do that, we have analyses that determine
7 mechanical and thermal loads on the cask and then
8 those results go into a fracture mechanics analysis to
9 give us the probability. We also are looking into the
10 ability of the reactor building to isolate, the
11 ventilation system to isolate, and then we have our
12 consequence analyses, too, and you'll be hearing more
13 about those.

14 DR. KRESS: Does the fracture mechanics
15 part of this start out with some postulating cracks
16 and crag distributions in the cask?

17 MR. RYDER: Yes, and you'll be hearing
18 about that. There are flaws and welds that normally
19 occur and which are acceptable.

20 MR. GARRICK: Chris, before you do the
21 risk assessment. Did you do any threshold analysis?
22 That is to say, did you try to get a handle on what
23 kind of forces and impacts and temperature conditions
24 you'd have to get to even get a problem?

25 MR. RYDER: We did some of that. We

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1 looked at the submittal, of course, and then we had
2 Jason doing some calculations as well. But it was
3 limited in that respect. We basically postulated
4 various events that could occur and then we asked
5 other analysts if they could tell us if these could
6 indeed happen.

7 MR. GARRICK: Well, there's two ways to do
8 this. You establish a scenario and see what the end
9 state of that scenario is in terms of the effect. But
10 the other way, in order to kind of get a sense of the
11 magnitude and also very helpful in the screening is to
12 analyze it in terms of what the threshold values are
13 for getting any kind of a release condition.

14 MR. RUBIN: We're doing that along the way
15 as we go. You'll hear some of the results on the
16 interim analyses looking at, for example, what
17 temperatures can cause the MPC to fail.

18 MR. GARRICK: Right.

19 MR. RUBIN: And if no temperature scenario
20 or sequence will reach that temperature, then it's not
21 going to go into the PRA model.

22 MR. GARRICK: It's a very useful exercise
23 to keep the problem under reasonable management.

24 MR. RUBIN: That's exactly what we're
25 doing, and it's an iterative process.

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1 MR. RYDER: And I would ask some of the
2 people if the cask experience, this initiating event,
3 what would happen to it, and they would give me some
4 kinds of judgments in which case we would pursue it in
5 more detail.

6 With that, that ends my portion.

7 DR. KRESS: Is somebody going to talk
8 about the consequences later?

9 MR. RYDER: Yes. That concludes my
10 discussion.

11 MR. POWERS: I may be leaping ahead in the
12 presentation and, if so, I'm willing to wait for the
13 answer, but do we have information that would tell us
14 what kind of fracturing and fragmentation of fuel rods
15 would happen given a mechanical insult at various
16 levels?

17 MR. RYDER: I'm going to leave that to
18 that discussion.

19 MR. GARRICK: That's kind of what I was
20 trying to get at, Dana, too. Threshold for a source
21 term.

22 MR. POWERS: I know that the
23 transportation folks have wrestled with that problem
24 and it strikes me that if we do have information, it
25 may not be applicable to the higher burn up flags that

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1 we would encounter in the future.

2 MR. GARRICK: Yes. Out in your laboratory
3 20 years ago or so, they did train impact and truck
4 impact tests on fuel casks.

5 MR. POWERS: They didn't stick a bunch of
6 fuel rods inside it.

7 MR. GARRICK: They were very impressive in
8 terms of establishing some sort of --

9 MR. POWERS: A lot of people over-
10 interpret those just a tad.

11 MR. GARRICK: They were expensive tests,
12 too.

13 MR. POWERS: They were expensive tests and
14 they were done for particular purposes, not
15 necessarily what people want to use them for today.

16 MR. RYDER: Are there any other questions?

17 MR. GARRICK: Questions? Okay. Thanks,
18 Chris.

19 MR. POWERS: I guess one of the questions
20 that comes up. You've been following the PRA
21 procedures guide probably because that was what was
22 available when you started this work. Can you derive
23 anything useful that's appeared since the procedures
24 guide came in?

25 MR. RYDER: I'm not prepared to answer

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1 that right now. I could get back to you on that.

2 MR. POWERS: I mean I happen to be a big
3 fan of the procedures guide.

4 MR. RYDER: We used the procedures guide
5 to get a list of initiating events and then, through
6 our own study, we added other events to it and
7 discussions with the NMSS staff.

8 MR. POWERS: So it's not likely to be
9 anything.

10 MR. RUBIN: We also looked at all the
11 initiating external events, for example, analyzing the
12 IPEEEs. We included them in this study as well in our
13 list. It's fairly comprehensive.

14 MR. POWERS: I mean since we've been going
15 to this effort to produce standards for PRAs, I just
16 wondered if there was anything out there.

17 MR. RUBIN: We went through a lot of
18 effort and discussions with the user office, the spent
19 fuel project office and ourselves, to make sure we had
20 an all inclusive list. It seemed to the point of
21 almost getting a little bit ridiculous in some points.
22 We went overboard in being inclusive rather than
23 excluding events.

24 MR. POWERS: Did you add volcanism?
25 That's the question.

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1 MR. RUBIN: We did, but some sites don't
2 have a volcano.

3 MR. POWERS: But they might.

4 MR. RUBIN: But if it did, it would be a
5 block vent scenario with debris build-up, and we have
6 that analyzed. So I'd say we could cover that if we
7 knew the initiating event frequencies of the volcano.

8 MR. POWERS: Talk to the guys at Yucca
9 Mountain. They seem to find volcanos where other
10 people can't find them.

11 MR. RYDER: Brad Hardin will now continue
12 the discussion.

13 MR. HARDIN: Good afternoon. I'm going to
14 talk to you about our analysis of the external events
15 of the initiating frequencies. This is a list of the
16 events that we looked at.

17 MR. GARRICK: Are these essentially based
18 on the reactor's PRA?

19 MR. HARDIN: No. I wouldn't say just
20 that. I think we considered this particular
21 application and we actually looked at some things that
22 maybe for reactors we don't look at too much any more.
23 I guess for the IPEEE we had gone through a number of
24 these types of things just fairly recently here and in
25 the case of the dry cask storage, I think maybe Chris

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1 and Alan both said we tried to be very inclusive at
2 first and then we tended to look at things that were
3 very unlikely. We screened those out. But we started
4 with a pretty long list of things. Accidental
5 aircraft crashes and then tornados. We were
6 interested in determining what the likelihood would be
7 of the cask sliding during a tornado from the high
8 winds and perhaps striking other casks and then
9 tipping over onto concrete pads. What kind of damage
10 might we get from that? What's the likelihood of it?

11 I'm not going to talk to you about any of
12 the damage areas because other people coming up after
13 me will talk to you about the analysis of the
14 potential for failing the multiple container and then
15 flooding and lightning.

16 DR. KRESS: All these things are site
17 specific?

18 MR. HARDIN: Yes.

19 DR. KRESS: One would do a site specific
20 PRA.

21 MR. HARDIN: That's right. For this
22 particular site.

23 MR. GARRICK: Yes. That's why I was
24 asking the question because the reactor is site
25 specific, too.

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1 MR. HARDIN: I'll talk to you a little bit
2 about the data. This one has a lot of interest.
3 Looking at it from the viewpoint of accidental
4 aircraft crashes in this case. We put in an equation
5 up here, partly to show you an example of the type of
6 analysis that was done on most of these external
7 events. The form of the equation is fairly similar
8 where the analysis result that we would like to get
9 is, in this case, the number of crashes per year into
10 the site where we might get damage.

11 The summation takes place over the four
12 local airports that are in the area of this particular
13 site. We did an analysis of the likelihood of a crash
14 during take-off and landings in some detail because we
15 had good data for that. We attempted to also analyze
16 fly-overs, but it's been very difficult to get data
17 for the number of flights flying over the area. It's
18 somewhat complicated and even today we learned of a
19 new reference where we might be able to get some
20 information on that. But at any rate, right now I'm
21 just going to talk to you about the take off and
22 landing analysis.

23 There are four airfields that are in the
24 vicinity of this particular site.

25 MR. POWERS: Is C_a a generic term?

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1 MR. HARDIN: It's a generic term that's
2 been derived from analyzing crashes all over the
3 United States, and it depends on the distance from the
4 site to the particular airfield. In this case, each of
5 the airfields was fairly distant from the site. They
6 ranged in distance from 16 miles to 29 miles, and the
7 data that we had, when you try to look at something as
8 far as 16 miles, it's a very, very small number. It
9 would be a better analysis if we had airfields that
10 were closer to the site. It turns out that the C is
11 the same for each of the airfields because they're all
12 fairly distant ranging in distance from 16 to 29
13 miles. These airfields were identified --

14 DR. KRESS: Is that a circular area?

15 MR. HARDIN: That's the way it's analyzed,
16 as if a plane --

17 DR. KRESS: With the center at the
18 airfield and the end of the radius at the plant?

19 MR. HARDIN: Yes.

20 DR. KRESS: What you said earlier is you
21 really don't have good information on direction of the
22 flight so that you could narrow that.

23 MR. HARDIN: For this particular analysis,
24 when we did the first run at it, we tried to do a
25 little bit fine tuning to take into account direction

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1 and we did get a little bit of information that
2 indicated that the one airfield that we were most
3 interested in because it had larger planes landing and
4 taking off, that the flights tended to come in all
5 directions except from the east. The eastern quadrant
6 didn't have that many flights coming into it. So
7 we've done a little bit of analysis along that line,
8 but it didn't change the number very much. It just
9 ended up making it a little bit smaller by reducing
10 that quadrant.

11 The term that summed the multiplication of
12 $C_a \times N_a$ which is the number of operations in and out
13 of the airfields might be considered to be like a
14 crash density and then if you multiply it times some
15 equivalent area, then you get the total number of
16 crashes that you might expect.

17 MR. POWERS: Is it the target area that
18 you want to do there or the area that an aircraft
19 crash occupied?

20 MR. HARDIN: I'm sorry, Dana?

21 MR. POWERS: I mean I slam an airplane
22 into the ground. It creates a damage circle so big
23 which I think is bigger than the cask.

24 MR. HARDIN: That's right.

25 MR. POWERS: So it's that area that you

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1 want to use, not the cask area, isn't it?

2 MR. HARDIN: That's right. There's a
3 skidding area that's typically added, depending on the
4 terrain, and we used I think a distance of about 100
5 feet for that and then the projected area of the pad
6 with the casks on it was used and then we added 100
7 feet to that to come up with an area. The final
8 result in this case was something on the order of 10^{-9}
9 crashes per year. It was a pretty small number.

10 While we're talking about aircraft
11 crashes, we needed to pick a particular type of
12 airplane to analyze in terms of the results of the
13 potential for damage to the cask and we were given
14 pretty good information from the Federal Aviation
15 Administration in the area of the site. They were
16 able to tell us how many operations were at each
17 fields, which fields were used more commonly, and what
18 type of aircraft used them.

19 It turns out that the aircraft are limited
20 by whether the runway is long enough. Of course, some
21 of the larger planes just can't land at certain
22 airfields because the runway is not long enough. Out
23 of the four airfields, there was only one airfield
24 that had a large enough runway that all of the planes
25 that used those areas could land at that one

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1 particular place. So we sort of focused our analysis
2 on that.

3 MR. POWERS: You're going to be worried
4 about 20 years from some time.

5 MR. HARDIN: Yes.

6 MR. POWERS: There's a substantial
7 evolution that occurs in aircraft over a 20 year
8 period. That usually is not in the direction of
9 smaller. Did you try to correct for that?

10 MR. HARDIN: We asked the people at FAA
11 that were familiar with these airfields if they
12 thought that would change very much in I don't
13 remember how many years, but it's possible that this
14 would have to be returned to and re-analyzed at some
15 point if there are some major changes there. But
16 right now they thought the data they gave us was
17 pretty good, at least out to I think maybe 10 years or
18 so. The Lear Jet 45 was one of the planes that was a
19 larger one that had a fairly large amount of fuel of
20 all the ones that landed at these four airfields. It
21 was not the largest plane, but we chose it to analyze
22 because the two planes that were larger than it were
23 restricted in which fields they could land at because
24 of this runway distance and so we thought that the
25 Lear Jet 45 would be a good one to start with to see

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1 and knowing the weight of the thing. Is that right?

2 MR. HARDIN: I think that Khalid should
3 answer that. He's the one that did the details on it.
4 He'll be up here in a few minutes.

5 DR. KRESS: We'll wait for that.

6 MR. GARRICK: Approximately what's the
7 center of gravity of a full --

8 MR. SHAUKAT: That is correct. It is
9 based on drag force and friction.

10 MR. GARRICK: What's the center of gravity
11 height? The height of the center of gravity
12 approximately on a fully loaded cask and approximately
13 how wide are these casks?

14 MR. SHAUKAT: I can answer that question.
15 It's slightly higher than the mid height of the cask.
16 It's 878 inches from the bottom.

17 MR. GARRICK: How wide are these casks?

18 MR. SHAUKAT: The cask is about 11 feet in
19 diameter. The overpack I'm talking about, not the
20 MPC. It's about 11 feet in diameter.

21 MR. HARDIN: Well, the highest recorded
22 tornado in the United States to date has been about
23 300 miles an hour. We were given a good bit of help
24 and information from the Wind Science and Engineering
25 Research Center in Lubbock, Texas. It's operated by

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1 what we would get from that. So you're going to hear
2 some results of that analysis.

3 DR. KRESS: And even though it's 10^{-9} , you
4 decided to go ahead with the rest of the analysis even
5 though it likely would have been screened out based on
6 the screening criteria because you needed the
7 methodology or the consequences anyway. Probably some
8 sites that may not screen it out.

9 MR. HARDIN: Yes, and because we had a
10 team of people working on this and we started all of
11 these analyses some time ago --

12 DR. KRESS: In parallel.

13 MR. HARDIN: -- we weren't sure sometimes
14 what kind of probabilities we were going to get at the
15 time and so some of the consequence areas were looked
16 at also.

17 For tornados, looking first at likelihood
18 of sliding and tipover. Khalid Shaukat, who's going
19 to talk to you a little later, did an analysis and
20 determined that in order for the cask to slide, we
21 need to have 400 mile per hour wind during a tornado
22 or greater and for a cask to tip over, it would
23 require a 600 mile per hour wind or greater.

24 DR. KRESS: These analysis are rather
25 simple drag versus frictional resistance to sliding

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1 Texas Tech University. And so we tried to get some
2 feeling from them about what's the likelihood of
3 getting wind speeds and tornados reaching 400.

4 MR. POWERS: After they stopped laughing,
5 what did they say?

6 MR. HARDIN: Well, they indicated that
7 this data hasn't been taken for I think it's maybe 15
8 years or 10 years, and so they can only speak for that
9 time when they've had fairly reasonable data. But
10 they don't think there's any physical phenomena that
11 would limit it to go slightly above 300 but there are
12 some people, experts, that think that it would be
13 unlikely to get wind speeds that go much higher than
14 400.

15 DR. KRESS: I don't think you can get the
16 temperature difference between the layers of air that
17 would generate that much energy. I think it would be
18 that sort of consideration.

19 MR. HARDIN: Well, to analyze the
20 probability of getting up to 400 miles an hour, we
21 used the data that we had that went up to a little
22 less than 300 and we did a regression analysis on it
23 to get a curve so that we could extrapolate it out to
24 400, and we did that recognizing that we really don't
25 know what accuracy we have in doing that. But we came

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1 up with a value of something like 10^{-9} again for the
2 likelihood of having a tornado that would result just
3 in sliding and so for tip over, since it takes a
4 considerably higher wind speed, we presume that that's
5 also a very small number.

6 DR. KRESS: Did you look at tornado
7 generated missiles?

8 MR. HARDIN: Yes. That's the next slide.

9 DR. KRESS: I'm sorry. I didn't look
10 ahead.

11 MR. POWERS: You pretty quickly get the
12 conclusion here, Tom, that no matter what we think of,
13 you've got an answer for it. This is frustrating.

14 DR. KRESS: That's frustrating.

15 MR. POWERS: You've got to leave some
16 blanks for us to jump into to feel like we've
17 accomplished something.

18 MR. HARDIN: As far as tornado generated
19 missiles, the design basis tornado of 360 miles an
20 hour in the standard review plan has a number of
21 different items that you would typically look at.
22 Utility pole, 12" schedule 40 pipes, steel rods, and
23 automobiles. And in looking at these, it was
24 predicted that there would be no penetration of the
25 concrete shell and no MPC failure. Again, I'm not

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1 intending to talk too much about these kinds of
2 results. If you have questions about that, someone
3 else can answer.

4 MR. POWERS: Is there enough impulse
5 provided by any of these projectiles to cause the
6 thing to tip over?

7 MR. HARDIN: No. Not without a very, very
8 low probability. It would take a very high wind
9 speed, again, to create a missile with enough speed to
10 do that.

11 MR. GARRICK: In the maintenance of these
12 casks, is there anything that people could do
13 accidentally or intentionally or whatever that would
14 make them more vulnerable?

15 MR. RUBIN: If that would occur, it would
16 be during the handling phase because there's really
17 not much going on other than surveillance when it's in
18 storage. So, for example, if there's a misloading of
19 fuel over the long-term, what effect could that be if
20 it was improper drying or inerting, sealing the cask?

21 MR. GARRICK: I was just thinking of
22 things like the cap being loose or something and 300
23 or 400 mile an hour wind creates quite a Bernoulie
24 effect.

25 MR. RUBIN: Are you talking about the top

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1 being lifted off?

2 MR. GARRICK: Yes.

3 MR. RYDER: The overpack top is bolted on
4 and the MPC is sealed for the 20 years. It's got
5 redundant sealing, redundant welds. It's supposed to
6 be just a passive system that is placed on the storage
7 pad and, except for surveillance to check the vents,
8 there's nothing really --

9 MR. GARRICK: They don't do any
10 maintenance that would require them to remove the cap?

11 MR. RYDER: No. It's meant to be placed
12 on the storage pad for 20 years and left there.

13 DR. KRESS: How do they inspect these
14 things?

15 MR. RYDER: So far, we've learned that
16 it's just visual observation of looking to be sure
17 that there's no debris on the vents.

18 DR. KRESS: You just look at the outside
19 of the vent.

20 MR. RYDER: Look on the outside.

21 MR. HARDIN: We conclude that because of
22 the low likelihood of getting high enough winds that
23 the frequency of occurrence of a missile failing the
24 cask is very small.

25 Flooding has been screened out also

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1 because the topography in the area of the site is such
2 that rain water, even during the maximum precipitation
3 that we look at during the IPEEE review, would not
4 have any way for water collecting. It would drain
5 away from the particular site. The elevation of it
6 also precludes having river-related flooding including
7 dam breaks. We weren't able to actually calculate
8 anything on that. We didn't have the kind of data
9 that we might have needed. There have been some
10 calculations done by the licensee and those numbers
11 that they calculated were very small. I think 10^{-8} or
12 something like that.

13 This is the last one. It's lightning.
14 Lightning is monitored in the United States by the
15 National Lightning Detection Network which includes
16 about 100 sites spread out around the country and this
17 network is operated by a company called Global
18 Atmospherics. They sell data for particular areas.
19 You can get data down to one-tenth of a mile. And so
20 we bought data from them for 10 years from a tenth of
21 a mile out to three miles, and we were able to
22 calculate a density of occurrence of lightning flashes
23 in the area that we could then, using a target area
24 for strike of the casks, we estimated about a 10^{-2}
25 strike per year frequency of lightning strikes.

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1 DR. KRESS: That's one every 100 years?

2 MR. HARDIN: I'm sorry, Tom?

3 DR. KRESS: That's one strike every 100
4 years?

5 MR. HARDIN: Yes.

6 DR. KRESS: It's not like my place. I get
7 one every year.

8 MR. POWERS: That explains a lot about
9 you.

10 MR. GARRICK: I think you started out by
11 saying that these have a 20 year life.

12 MR. RUBIN: Twenty licensed. The life
13 time could be longer but the license is for 20 years.

14 MR. GARRICK: That's my question. What
15 kind of life do these casks have? Do they last 100
16 years?

17 MR. RUBIN: I'll leave that to Jack
18 Guttman to answer.

19 MR. GUTTMAN: We license it for 20 years
20 and we have ongoing a license renewal program. We
21 just issued a standard review plan and the first
22 application for license renewal is expected next year.
23 The vendors are saying it will last approximately 100
24 years or so, but we haven't performed any calculations
25 to identify the length of number of years that a cask

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1 would be acceptable.

2 MR. GARRICK: Have you done enough
3 analysis to know what part of it ages the fastest?

4 MR. GUTTMAN: At this point with the data
5 that we've received through research from the INEO,
6 casks that were monitored and instrumented, we did not
7 see any active degradation occurring at this point and
8 those casks are approximately 17 or 18 years old.

9 MR. HARDIN: If you don't have any
10 questions on this, Moni Dey from the PRA Branch is
11 going to talk to you now about the fire analysis that
12 was done.

13 MR. DEY: Thank you, Brad. I'm going to
14 cover the fire analysis and Jason Schaperow following
15 me will present the thermal analysis that utilizes the
16 results that will be developed.

17 I'll start off with the statement of the
18 problem. As Brad mentioned, we're going to be
19 analyzing the fuel spillage from Lear Jet 45 aircraft.
20 The assumptions are to ensure that we're conservative,
21 that the dry cask remains upright and is totally
22 engulfed in a fire. We're analyzing the effects of
23 the fire on one dry cask. Normally there are 12 casks
24 on a pad but to be conservative, we're analyzing the
25 effects of the fire on just one.

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1 As was mentioned, the dry cask, the
2 outside diameter is 11 feet and 19.3 feet high, so
3 it's a fairly massive object. The amount of fuel in
4 the Lear Jet 45 is 6,080 pounds. So that's the amount
5 of fuel that could be spilled in fire.

6 The objective of the fire analysis is 1)
7 to determine the duration of the fire, assuming all
8 the fuel leaks out and secondly, to determine the
9 temperature distribution of a hot gas from the fire
10 surrounding the dry cask. Specifically, the
11 temperature of the hot gas near the inlet and outlet
12 vents which Chris described earlier.

13 A brief presentation of the analysis for
14 the duration of a fire. In order to estimate the
15 duration, one needs to postulate the way the fuel
16 spills. The duration of the fire will obviously be a
17 lot less if there's a very big leak as a result of a
18 crash and the fuel spills all at once. So in order to
19 be conservative, a minimum spill rate was chosen so
20 that the 1) the dry cask will be totally engulfed in
21 the fire. So in that sense, this is a worse case fire
22 effects analysis, worse case in the assumption of the
23 leak size.

24 Therefore, in order to determine the
25 duration of the fire, one can estimate the equilibrium

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1 diameter of the fuel pool that would be related to the
2 spill rate and the burning rate, and the burning rate
3 for fuel is available. Various measurements have been
4 made and this data is available in fire protection
5 handbooks. The burning rate for this particular type
6 of fuel is about 4 mm/minute. I've attached some data
7 at the end of the slides if you're interested in
8 looking at some of the curves from the handbooks.

9 As I mentioned, assuming the fuel pool
10 size that's needed to engulf the fire is approximately
11 twice the diameter of the cask so about 22 feet
12 diameter fuel pool that would burn. Based on this,
13 one estimates that the duration of the fire would be
14 about 24 minutes for the fuel spillage.

15 The next question is what is the
16 temperature of the hot gas that Jason will use in his
17 analysis. I had two sources of information that I
18 used for this. One is over the last decade, several
19 plume models have been developed and secondly,
20 recently there were some tests done at Sandia on
21 horizontal transportation casks where temperature was
22 measured and the temperatures measured near the cask
23 and this was near the ground level. It was
24 approximately 1,800 F.

25 Secondly, the plume models, as mentioned,

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1 several plume correlations developed over the last two
2 decades and the temperature and velocity in the plumes
3 have been measured. Typically, the plume is divided
4 into three regions. First region right above the
5 burning area is a consistent flame region followed by
6 an intermittent flame region and then just a plume of
7 hot gases with no flame in it. And these different
8 regions produce different temperatures and velocities.
9 I've attached some figures that document these
10 measurements that have been made in empirical plume
11 models.

12 Based on these correlations and the height
13 of this particular dry cask, the entire dry cask would
14 be in the consistent flame region. The temperature of
15 the hot gas around the dry cask is estimated to be
16 about 1500 F. What I recommended was using a
17 temperature of 1832 F for the hazard analysis which
18 Jason will cover.

19 Finally, the conclusions of the fire
20 analysis for this type of jet. The duration of the
21 fire is estimated to be about 24 minutes and the inlet
22 and outlet vents, both of them will be exposed to hot
23 gases at approximately 1830 F.

24 MR. GARRICK: Did you look at any extreme
25 of values like if you had 10 times as much jet fuel?

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1 Six thousand pounds is about one hour driving time for
2 a 747 jet engine. Did you try to examine supposing
3 you had 10 times as much fuel what that do to the
4 environment?

5 MR. DEY: Well, basically 10 times more
6 fuel that you mention that would be in a 747 would
7 increase the duration of the fire by a factor of 10.

8 MR. GARRICK: And what about the
9 temperatures? Would they be pretty much the same?

10 MR. DEY: The temperatures would be pretty
11 much the same.

12 MR. GARRICK: So it would increase the
13 duration probably to hours. Right?

14 MR. DEY: Yes, about four hours.

15 MR. GARRICK: Yes. Okay.

16 MR. GUTTMAN: I'm not sure that if you had
17 a larger amount of fuel that you actually can
18 extrapolate that to hours. You'd have to have a small
19 trickle.

20 MR. GARRICK: Yes.

21 MR. GUTTMAN: If the plane crashes in,
22 probably the entire fuel will be spilled all over the
23 place and using this conservative bounding analysis
24 that it sticks within a diameter or so of circling the
25 cask is a very conservative assumption.

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1 MR. GARRICK: So you think the 1800
2 degrees -- well, the 1800 degrees is not in dispute.
3 It's just the duration.

4 MR. GUTTMAN: Yes. Much bigger.

5 MR. GUTTMAN: Thank you.

6 MR. SCHAPEROW: I'm Jason Schaperow from
7 the Safety Margins and Systems Analysis Branch. The
8 objective of my analysis was to assess cask heat up to
9 allow the structural people to evaluate the cask
10 failure probability. The approach we took was to look
11 at three scenarios for the HI-STORM cask. We looked
12 at a blocked vent scenario, buried cask and external
13 fire.

14 Our conclusions are for the blocked vents
15 and the buried cask scenarios, the heat up is slow due
16 to the low decay power of this fuel and for the
17 external fire scenario, we saw that the temperature
18 rise was limited by the fire duration.

19 This next slide shows the HI-STORM cask.
20 This is taken from the safety analysis report for the
21 cask. This cask consists of a sealed metallic
22 canister, as we mentioned a couple of times already.
23 This shows it partially inserted into the overpack.
24 This MPC is the confinement boundary and the overpack
25 which is steel and concrete provides the mechanical

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1 protection and radiological shielding and, as has
2 already been mentioned, this concrete and steel
3 overpack has air ducts in it. There's actually an
4 annular region between the MPC and the overpack, and
5 there are some so-called channels in there to kind of
6 keep the MPC centered in the overpack, but there's
7 basically an annular region in there.

8 The approach we took was to assess three
9 scenarios. This is to develop a range of conditions
10 that can be used to evaluate the cask failure
11 probability. For the blocked vent scenario, we
12 estimated the heat up resulting from blocking all four
13 of the intake vents and with the one-dimensional model
14 that we used, that shut off flow through the vent.
15 For the buried cask scenario, we again shut off the
16 vents but we also put the cask in a condition where
17 there's no heat transfer from the outside surface, no
18 conduction of radiation off the outside surface of the
19 cask which is a very extreme condition.

20 Finally, for the exterior fire scenario,
21 we calculated the heat up from the external fire which
22 Moni provided the boundary conditions for. We applied
23 the MELCOR code to assess cask heat up. MELCOR is an
24 integrated accident analysis code for severe reactor
25 accidents. It can be used for thermal hydraulics, as

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1 we've used it for here. It's also got modeling for
2 core melt progression and fission product source term
3 which we are planning to use in the consequence.

4 DR. KRESS: Is this thermal hydraulics or
5 is this strictly conduction and radiation heat
6 transfer? Is there a natural convection inside the
7 cask itself?

8 MR. SCHAPEROW: In the nodalization I've
9 chosen here, you'll see there's nothing inside the
10 MPC. For the fire scenario, I'm allowing natural
11 circulation of the hot fire gases through the annulus.
12 For the first two scenarios, no, no flow. This is
13 just conduction and radiation but for the third
14 scenario, we're allowing flow of hot gases through the
15 annulus.

16 The major inputs to this code. The
17 thermal hydraulic input for the control volumes, the
18 flow paths and the heat structures and finally, the DK
19 power which is the heat input. I've noted on this
20 slide the DK power we use in our analysis. This is
21 important because this is a very small number, and
22 this is what drives the calculation for the block vent
23 in the buried cask scenario.

24 DR. KRESS: When you say each assembly.
25 That's each fuel assembly.

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1 MR. SCHAPEROW: That's correct so for the
2 whole cask it's about 21 kilowatts. This is a BWR-
3 type canister and holds 68 BWR assemblies. About one-
4 eighth of a core.

5 This slide shows the nodalization we used
6 with the MELCOR code. I would like to mention this is
7 simple. It has only five elements. Three control
8 volumes and two heat structures. As Tom pointed out,
9 we're not considering convection within the multi-
10 purpose canister. It's one volume. No flow.

11 This next slide gives the MPC shell
12 temperatures we calculated for the scenarios which
13 only had DK heat. That is the block vents in the
14 buried cask scenarios. We just ran it out in time out
15 to about a million seconds. It takes a long time to
16 heat up with the low DK power here.

17 DR. KRESS: This is the temperature on the
18 shell?

19 MR. SCHAPEROW: That's right. This is the
20 boundary of the multi-purpose canister shell. This is
21 the boundary for fission products.

22 DR. KRESS: Does this have a maximum fuel
23 temperature inside that's calculated also?

24 MR. SCHAPEROW: I did not calculate a fuel
25 temperature inside. I didn't even put fuel in here.

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1 I just have helium.

2 DR. KRESS: Oh, you just had the heat
3 going --

4 MR. SCHAPEROW: Helium with a constant
5 density heat source. Just uniform heating of the
6 helium. We are developing a MELCOR input file. We're
7 going to be doing some calculations. We're actually
8 putting fuel assemblies in there.

9 DR. KRESS: Your focus here was on what
10 would happen to the cask.

11 MR. SCHAPEROW: That's correct. Whether
12 it would rupture or not. This is going to be used by
13 the structural people to estimate failure probability.

14 DR. KRESS: When you get time involved in
15 it, you will go back and say I've got so much time to
16 do corrective actions to get the failure probability
17 or something like that. You'll have a temperature at
18 which you don't want to exceed and then you'll have so
19 much time to get there.

20 MR. SCHAPEROW: I don't know how they're
21 going to handle that.

22 MR. RUBIN: This might be where some of
23 the risk informed insights might come into play in the
24 results of this in terms of procedures and other
25 things, looking at the time before you run into

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1 problems and what could be done.

2 MR. SCHAPEROW: This was an issue on the
3 spent fuel pool risk study from last year. This is
4 heat up just based on slowly draining pool. People
5 have days to take care of it.

6 DR. KRESS: Do you have a temperature that
7 you don't want to exceed yet based on structural
8 analysis?

9 MR. SCHAPEROW: I'd have to turn to the
10 structural people for that. Ed.

11 DR. KRESS: The question is do you have a
12 limiting temperature that you want to say that you
13 don't want to exceed yet?

14 MR. HACKETT: This is Ed Hackett,
15 Materials Engineering Branch and Research. I think
16 Doctor Kress asked a question about limiting
17 temperature. We were looking at, I believe -- I
18 didn't do these analyses. I'll be subbing here later
19 today for Tanny Santos. I think we were looking at
20 about 1,000 F. as sort of the ball park answer. There
21 was not a whole lot of damage that was contributed in
22 a creep mechanism before 1,000 F.

23 MR. GARRICK: And the damage is where that
24 you were most worried about?

25 MR. HACKETT: The damage would be largely

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1 to the areas like the welds, for instance.

2 DR. KRESS: Does the helium get internally
3 pressurized at these kind of temperatures? That would
4 be significant pressure.

5 MR. SCHAPEROW: That's correct. The
6 structural analysis used both the temperature and
7 pressure results from these calculations.

8 DR. KRESS: Okay.

9 MR. GARRICK: Let's pull out all the water
10 from the concrete?

11 MR. SCHAPEROW: We didn't consider water
12 in the concrete as the -- this is for the multi-
13 purpose canisters. It's only the helium and the fuel
14 inside that pushes outward.

15 We also ran a test using a temperature of
16 1830 F. for the environment. This was my attempt to
17 simulate a fully engulfing external fire, and it's
18 described --

19 DR. KRESS: That's the maximum temperature
20 you would get in combusting jet fuel in a
21 stoichiometric mixture with air or what?

22 MR. GARRICK: It's about 1500 degrees I
23 think was your maximum, wasn't it?

24 MR. DEY: Yes. The temperatures that have
25 been measured typically for various fields, it doesn't

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1 vary very much. It's around 1500 degrees. Just to
2 get some margin, I recommended using 1830 because
3 there have been some measurements.

4 DR. KRESS: That's when you take a
5 stoichiometric mixture of combustion and put all the
6 heat back into the mixture. You get 1500 or something
7 like that.

8 MR. GARRICK: See, really what you're
9 ending up with here is not so much a risk assessment
10 as a bounding analysis because we don't really know
11 what the answer is to the question. From this
12 analysis, we don't know the answer to the question
13 what is the risk? We know some other answer.

14 DR. KRESS: We know that the risk is less
15 than some value.

16 MR. GARRICK: Yes.

17 MR. POWERS: In the engulfing fire, you're
18 heating from the outside through the concrete and
19 through the flow through the ducts. Right?

20 MR. SCHAPEROW: That's correct. All I've
21 done in this calculation is very straightforward. I've
22 just changed the boundary condition as the environment
23 is now very hot.

24 MR. POWERS: In this concrete field
25 region, is it vented?

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1 MR. SCHAPEROW: No, it is not and I think
2 that issue was discussed as far as the concrete giving
3 off steam. I'm not sure how that was resolved. I'd
4 like to refer back to the PRA Branch.

5 MR. RYDER: We're not looking at the
6 effects of the overpack. Our concern is the
7 confinement boundary which is the MPC.

8 MR. POWERS: I think we'll get to that.
9 Suppose that I indeed pressurize that outer package.
10 How does the steel deform? Does it deform into the
11 overpack or does it just all push outwards?

12 MR. RYDER: We have not looked at that in
13 our analysis. Our focus has been on the MPC and the
14 pressurization.

15 MR. POWERS: I suspect you'll find out
16 that it'll all deform outward, but it's worth looking
17 at because at these kinds of surface temperatures, if
18 someone were to use limestone concrete, you'll get
19 some fairly impressive pressures within the concrete
20 fill regime. It's a little tricky to figure out
21 exactly what it is because in fact the CO₂ pressure
22 will get so high it'll keep the limestone from
23 decomposing. But it'll be impressively high
24 pressures.

25 MR. LEVENSON: And I think the reason you

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1 can be almost sure the bulge will be out is the inside
2 steel is nowhere near these temperatures. It may be
3 700 - 800 degrees or 1,000 degrees lower. I mean if
4 the MPC inner canister only goes to 260, then the
5 inside part of the overpack only goes to 260.

6 MR. SCHAPEROW: That's temperature rise.

7 MR. LEVENSON: Right. So if the inside is
8 260 and the outside is 1800, it's going to bulge out.

9 MR. SCHAPEROW: That's 260 plus the
10 initial temperature.

11 MR. LEVENSON: It doesn't matter.

12 MR. SCHAPEROW: It isn't going to make any
13 difference.

14 MR. LEVENSON: It's 300 versus 1800.

15 MR. POWERS: I'm not so good at these
16 complicated structures deciding which things move
17 where. It's worth looking at because you may get some
18 impressive pressures.

19 MR. SCHAPEROW: That concludes my
20 presentation.

21 DR. KRESS: I wasn't quite clear earlier
22 on how you estimated the fire duration. Is that
23 saying the jet fuel is in a pool of a certain
24 dimension and the rate of burning off of the pool or
25 something like that?

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1 MR. DEY: That's correct.

2 DR. KRESS: You get four-tenths of an hour
3 out of that, and then you did the four hour as a
4 sensitivity study.

5 MR. SCHAPEROW: That's correct. Just say
6 well, what if it's 10 times as great. How would that
7 affect it. Basically it goes up proportionately, the
8 temperature. It's a linear rise at this point.

9 MR. GARRICK: Okay. Thank you. We are
10 supposed to be having a break now, but I'd like to get
11 through this next presentation.

12 MR. SHAUKAT: I am Khalid Shaukat from
13 Research Applications Branch and I'm going to talk
14 about mechanical loads on the dry casks and the
15 stresses on the MPC. There were two objectives for my
16 work, the first one being testing the mechanical loads
17 on the cask system for all the scenarios during
18 handling, transfer and storage phase of this
19 operation.

20 The second objective is to determine the
21 stresses in the multi-purpose canister and those
22 stresses would eventually be used for estimating the
23 probability of failure of MPC or the consequences to
24 the public.

25 For the handling events, we looked at the

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1 drop of the MPC and on the refueling floor when the
2 cask is moved horizontally like so, hung from the
3 crane, it is usually 12 inches above the floor. We
4 tried to calculate that if it falls down due to any
5 fault of the crane, would it tip over or not? We
6 found out no, it will not tip over. So then we
7 calculated what height would it require to fall from
8 that it could tip over.

9 DR. KRESS: Doesn't that require you
10 knowing some sort of angle at which --

11 MR. SHAUKAT: Some sort of an angle, so
12 the bounding case is an angle of 20 degrees tilt from
13 the vertical.

14 DR. KRESS: Where did that come from, that
15 curve?

16 MR. SHAUKAT: That angle came from the CG
17 and the geometry of the cask.

18 DR. KRESS: It would tip over if it fell
19 at that angle.

20 MR. SHAUKAT: Yes. The CG of the cask
21 falling outside the tipping edge of the cask would
22 cause it to tip over. That angle we have calculated
23 to be about 20 degrees from the vertical and that
24 angle can not be reached unless the fall is more than
25 28 inches from the ground.

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1 DR. KRESS: That's what I don't
2 understand. Doesn't that depend on the way the thing
3 fails or something?

4 MR. SHAUKAT: No, no. If it fails, then
5 it will drop down. But we calculated that as long as
6 the cask is 28 inches above the floor and it falls at
7 a tilt, its one edge would touch first and the CG of
8 the cask would still be inside that edge so it would
9 just rest like this. It will not tip over.

10 MR. HACKETT: If it's higher than 28
11 inches.

12 MR. SHAUKAT: If it's higher than 28
13 inches--

14 DR. KRESS: Its momentum wouldn't carry it
15 on over the other way?

16 MR. SHAUKAT: If it's higher than 28
17 inches, it could tip over. Now, the load is such that
18 it will not sway in the other direction. It's very
19 heavy, 360,000 pounds weight.

20 DR. KRESS: My question is is there ways
21 for this carrier device to fail so that it lands at a
22 bigger angle than that? Is it held up with two straps
23 or one strap?

24 MR. SHAUKAT: It is hung with a -- which
25 has two sides holding on it.

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1 DR. KRESS: And if one of them fails?

2 MR. SHAUKAT: If one of them fails, we
3 have not looked into that situation yet. Then we
4 tried to calculate the stresses on the MPC for various
5 drop heights.

6 DR. KRESS: No. The question is if it
7 tipped over, is that a problem?

8 MR. SHAUKAT: If it tips over?

9 DR. KRESS: Is that a particular problem?

10 MR. SHAUKAT: A non-mechanistic tip over,
11 for example, just falling and then because of the tilt
12 it falls over, the non-mechanistic tip over we have
13 calculated is not a problem.

14 DR. KRESS: Not a problem. Okay.

15 MR. GARRICK: And that's a handling
16 accident.

17 MR. SHAUKAT: That's a handling accident.
18 Then we tried to calculate what would be the stresses
19 on the MPC for various drop heights and we found out
20 that the height could be during that transfer phase of
21 the MPC from HI-TRAK into the overpack could be a
22 great height like about 80 feet or so and then we
23 tried to --

24 DR. KRESS: There you don't have to worry
25 about an angle.

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1 MR. SHAUKAT: There you don't have to
2 worry about the angle, but we said we wanted to
3 calculate what would be the stresses on the MPC for
4 various heights and we found out that a threshold
5 value of 62 foot drop could cause the stresses in the
6 MPC very close to the buckling strength of the
7 material which is 64,000 psi so that is a 62 foot
8 threshold value. And in that case, the
9 circumferential stresses on the MPC shell are very
10 small.

11 DR. KRESS: My recollection is is they
12 took these casks and dropped them off the top of
13 cranes that were higher than 62 feet.

14 MR. SHAUKAT: And nothing happened.

15 DR. KRESS: Nothing happened. That's what
16 I thought I remembered.

17 MR. SHAUKAT: We calculated the buckling
18 strength reaching up to the ultimate strength of the
19 material. We're not saying it would fail at that 62
20 feet height.

21 During the transfer of the MPC from HI-
22 TRAK into the overpack, it's a direct vertical drop of
23 20 feet which is the height of the overpack. So it
24 goes inside the overpack and we calculated what will
25 be the stresses on the MPC for that fall, and that is

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1 11,000 psi.

2 Now we go to the transfer events when the
3 overpack is being carried by a crawler from the refuel
4 building to the concrete pad outside, and we
5 calculated if the crawler vehicle is traveling at its
6 maximum speed and if it drops the overpack, would it
7 tip over? During this procedure, the crawler is
8 carrying the cask only 11 inches high from the ground
9 so we calculated that if it falls either on the
10 asphalt or gravel or even the concrete pad, it would
11 not tip over.

12 We also calculated that if the cask fell
13 on the ground and the crawler operator fails to stop
14 the vehicle, what would happen? The finding was that
15 the cask weighs about 360,000 pounds and the crawler
16 weighs 158,000 pounds. It can not push it. Its track
17 would start slipping.

18 DR. KRESS: That requires you to have a
19 coefficient of friction between the track and the road
20 itself.

21 MR. SHAUKAT: We checked those different
22 coefficient frictions.

23 DR. KRESS: Are these tracks like a
24 tractor? Do they have treads?

25 MR. SHAUKAT: Yes, they're like tractor

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1 and they would slip. They could not push it forward.
2 We also calculated if the overpack digs into the
3 asphalt or the gravel surface and the crawler pushes
4 it, would it tip over? And it doesn't.

5 Last area in this case we looked was the
6 crawler carrying the cask near the concrete pad and
7 hits another cask on the pad, what could happen to the
8 stresses in the MPC? We found out that if it hits
9 another cask, the struck cask will not slide or tip
10 over and the stresses in the MPC would be very, very
11 small.

12 Then we go to storage events and we looked
13 into the seismic and we found out that almost no
14 sliding would be for the design earth quake of .015 G.
15 Then we performed some sensitivity analyses to show
16 that it would take 10 times design earth quake to move
17 the cask up to half the separation distance, assuming
18 that during the earth quake the two casks adjacent to
19 each other move in the opposite direction, although
20 this is a very unusual phenomena, but this is the
21 worse case it could ever happen, it would move in the
22 opposite direction. So we said okay, if the two casks
23 move up to the half of the separation distance, we can
24 conclude that it would not collide and we found out
25 that up to 10 times of design earth quake, it will

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1 still not collide and no tip over could occur at any
2 earth quake level up to 10 times of design earth
3 quakes.

4 MR. HACKETT: Can I just interject. This
5 goes back to Doctor Garrick's point at the beginning
6 of the presentation.

7 MR. SHAUKAT: The threshold events.

8 MR. HACKETT: These are obviously very
9 much bounded by the drop events for the most part,
10 mechanical impact.

11 MR. GARRICK: It makes me wonder where
12 we're going with the PRA approach here, and I'm not
13 one to ever say we shouldn't do a PRA, but if there
14 was ever a case that we may be able to standardize
15 something and design it such that it was site
16 insensitive and perform one comprehensive safety
17 analysis, it sounds like this might be it.

18 MR. HACKETT: I think Alan mentioned at
19 the beginning --

20 MR. RUBIN: You'll find a lot of things,
21 phenomena, sequences, will be screened out based on
22 frequency, initiating events or lack of impact on the
23 cask, and you're seeing those today. There are,
24 however, some instances of sequences which are not
25 screened out yet. We particularly don't have the

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1 human error factored into this yet, and you'll hear
2 some more about that later. But the PRA portion will
3 be probably very simplified.

4 MR. GARRICK: Yes. Okay.

5 MR. RUBIN: But we had to do this analysis
6 to come to that conclusion.

7 MR. GARRICK: Right.

8 MR. SHAUKAT: We looked into the aircraft
9 impact. We chose the largest aircraft that could go
10 in one of the four airfields nearby in that area
11 within 30 miles radius and Lear Jet happens to be the
12 largest aircraft and we calculated that at its landing
13 or take off speed of 140 miles an hour, it would not
14 slide or tip over the cask. Then we calculated at
15 bounding value what speed impact would cause sliding
16 or tip over of the cask, and we found out about 235
17 miles an hour speed could cause a tip over or slide.

18 MR. LEVENSON: Was that done with an
19 assumption that the 20,000 pound weight of the jet was
20 a solid piece of metal with no energy absorption
21 capability?

22 MR. SHAUKAT: Right. Based on the
23 assumption it's just a solid piece of --

24 MR. LEVENSON: So you've got two orders of
25 magnitude in that.

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1 MR. HACKETT: Probably a lot.

2 MR. LEVENSON: At least that. Yes.

3 MR. SHAUKAT: Tornados. As Brad Hardin
4 mentioned earlier, tornado velocity of 400 miles per
5 hour could slide the cask and the probability of that
6 is 10^{-9} . This was calculated based on the drag force
7 and the coefficient of friction between the cask and
8 the pad. A tornado velocity of 600 miles per hour
9 could tip over the cask and it was estimated that it
10 would be orders of magnitude less than 10^{-9} to have
11 that kind of tornado.

12 Tornado-generated missiles. We have
13 calculated all missiles that are in the vicinity. We
14 found that none of them could penetrate the cask. The
15 worst one for the automobile would be the worst one to
16 check for the sliding or tipping over, and we checked
17 that automobile as a tornado missile will not slide or
18 tip over the cask.

19 DR. KRESS: I'm intrigued by these
20 calculations, if you don't mind.

21 MR. SHAUKAT: And this is based on certain
22 coefficient frictions we have taken. We have taken a
23 range of coefficient friction. WE have found that the
24 smallest coefficient of friction would be governing
25 for the sliding case and the highest coefficient of

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1 friction would be governing for the overturning case
2 and we found that it would not tip over or slide for
3 different ranges.

4 DR. KRESS: Going back to the airplane
5 crash and tip over analysis. My first thought on that
6 would have been I would get the momentum of the plane
7 and then I would look at how much potential energy it
8 takes in getting the center gravity of the cask to tip
9 over. Is that what you did?

10 MR. SHAUKAT: Yes. Exactly.

11 DR. KRESS: So it seems all the momentum
12 goes into tipping it over.

13 MR. SHAUKAT: As if one ball for the total
14 weight of the aircraft hits it.

15 DR. KRESS: Okay. That's a pretty
16 conservative analysis.

17 MR. LEVENSON: That's what I was saying.

18 DR. KRESS: That's what you were saying
19 about absorbing some of that energy in the jet.

20 MR. LEVENSON: An airplane does not do the
21 same damage as a wrecking ball.

22 DR. KRESS: Mostly it's the engine that
23 does the --

24 MR. RUBIN: You'll find this is typical,
25 that the approach we tried was to do either simplified

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1 calculations. If we need to do more detailed
2 calculations later on because we could not eliminate
3 events, then we would do that.

4 DR. KRESS: I don't fault that. I think
5 it's the way to go.

6 MR. RUBIN: So that's generally the kind
7 of approach we've taken.

8 DR. KRESS: Yes. I think that's what you
9 ought to do.

10 MR. RUBIN: I just wanted to clarify that.

11 MR. SHAUKAT: Shock waves. We located
12 that the nearest natural gas pipeline is about four
13 and a half miles from the site and an explosion from
14 such a distance would not affect the structural
15 integrity of the cask.

16 DR. KRESS: That's not much of a surprise.

17 MR. LEVENSON: But what restrictions are
18 there that would prevent over the next 20 years
19 somebody putting a natural gas pipeline? Did you do
20 the other case? How far away does it have to be
21 before it doesn't do any damage?

22 MR. SHAUKAT: No, we have not done that
23 case.

24 DR. KRESS: It would have to be on the
25 site, I think.

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1 MR. POWERS: It would have to be under the
2 cask.

3 MR. SHAUKAT: For flood we did the
4 bounding calculations. What kind of flood would it
5 take to slide or tip over the cask? And we found that
6 a flood velocity of 25 feet per second or 17 miles per
7 hour will not slide or tip over the cask. And this is
8 very small probability to have such kind of flood.

9 MR. POWERS: On your airplane impact in
10 this cask analysis, you've looked at the airplane
11 hitting the cask. What if it hits the ground
12 underneath of it?

13 MR. SHAUKAT: The bounding case would be
14 the airplane hitting near the top of the cask. We
15 have taken that case.

16 MR. POWERS: Why wouldn't it be gouging a
17 hole right in under the corner of the cask?

18 MR. SHAUKAT: That would not put such a
19 heavy impact on the cask as --

20 MR. POWERS: -- going down from under and
21 it tips over.

22 MR. SHAUKAT: If it does not hit directly,
23 then it is a non-mechanistic tip over. A non-
24 mechanistic tip over, we have found that it's no
25 problem. A mechanistic tip over when it hits and tips

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1 over, that could be a problem. But a non-mechanistic
2 tip over that it falls down because something is
3 digging here would not impose high stresses in the MPC
4 to cause it to fail.

5 MR. POWERS: What does it do to the fuel
6 inside?

7 MR. SHAUKAT: We have not looked into the
8 fuel inside.

9 That finishes my presentation.

10 MR. GARRICK: Okay. I think we'd better
11 take our break now. We've got how many more?

12 DR. KRESS: Two or three.

13 MR. RUBIN: Two more and then a brief
14 summary.

15 MR. GARRICK: I unfortunately will not be
16 here when we reconvene, but the able co-chairman here
17 will take over the meeting. But we'll take a 15
18 minute recess.

19 (Off the record at 2:44 p.m. for an 18
20 minute recess.)

21 DR. KRESS: Can we get started again,
22 please. I'll turn it back to you. Where are we?

23 MR. HACKETT: I think what we're onto is
24 moving on from what Khalid talked about and structural
25 evaluation. This is sort of the response of the cask

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1 as a materials and structural system to the loadings
2 that he talked about. I'm Ed Hackett and I'm
3 Assistant Chief of Materials Engineering Branch. I
4 guess all I get is some of the managerial credit for
5 this work. The other two folks on here did all the
6 work.

7 DR. KRESS: Take all the credit you
8 want.

9 MR. HACKETT: Okay. Thank you. This is
10 a nice piece of work. Again, as Jack and Alan led off
11 with, all this work was done in-house in MED and they
12 did a very nice job. Tanny Santos and Doug
13 Kalinousky.

14 Just in terms of I think Jason had the
15 larger overview of this thing as a system, but what
16 you're looking at with the cask is really a stainless
17 structure which is a good thing from a fracture
18 material response perspective because it tends to be
19 a very forgiving material as regards potential for
20 brittle fracture, other things we've talked with the
21 ACRS about on many occasions and some other systems.

22 So we considered three failure mechanisms:
23 fracture, limit load and then creep rupture. Creep
24 rupture obviously in response to the high temperature
25 scenarios. Limit load is really a gross section

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1 failure of the cask, the cask wall in that kind of
2 case. What Tanny did was to create failure models for
3 those three mechanisms with an Excel spreadsheet and
4 what they call this at risk add on module which
5 basically performs Monte Carlo simulations on the
6 material properties. So that's the way things were
7 done.

8 In terms of some more general information
9 that's provided in your packages, there's really two
10 scenarios that were addressed. One is the situation
11 with the mechanical accidents that's been discussed
12 extensively already today. In that case, you have
13 basically the drop accidents from handling and tip
14 over. In that case, you really only have the two
15 failure mechanisms which are really fracture or limit
16 load failure of the cask.

17 DR. KRESS: When you're looking for, say,
18 the loads and stresses on a drop cask, I envision an
19 initial contact with something. Your forces, you've
20 got momentum being offset by impulse, integral forces
21 times time. Somehow you have to get those forces out
22 of this, and that depends on how things deflect and
23 deform including what it lands on.

24 MR. HACKETT: Right.

25 DR. KRESS: Did you just neglect what it

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1 lands on and say it didn't deform at all?

2 MR. HACKETT: I'll turn to Khalid for the
3 detail. I believe that's the case. I believe it was
4 assumed as a --

5 MR. SHAUKAT: Yes. We considered that the
6 actual case is such that there is a shear wall below
7 the concrete floor going diagonally in the area where
8 this could fall and we considered that because of the
9 presence of the shear wall, it is more rigid. But any
10 impact would have to be absorbed by the flexibility of
11 the floor and the shear wall. But we considered it as
12 rigid.

13 MR. HACKETT: This builds on also, Doctor
14 Levenson mentioned the aircraft impact, and the crush
15 of the aircraft structure was not modeled. Probably
16 the most sophisticated analyses of that sort that are
17 done are the ones that are done with automobile
18 crashes. So you could do that, and there would be a
19 different distribution of forces resulting from that,
20 but that wasn't done, at least not yet.

21 The other side of this chart really talks
22 about the thermal situation where you'd have the
23 blocked vents, the cask being buried or an external
24 fire that have been discussed. There are stresses
25 there. Some discussion earlier from the internal

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1 pressurization from the inert atmosphere. In that
2 case, you add a failure mechanism in the form of creep
3 rupture if you get the temperatures high enough to
4 cause deformation of that sort.

5 So just to run through these real quick.
6 First one is fracture mechanics which is basically
7 assuming that you've got a structure with a flaw. In
8 most cases, that's a pretty good assumption. Most
9 engineering structures. The flaw parameters. There
10 was some discussion of that earlier, and I know we
11 talked to the committee extensively, at least the
12 ACRS, about the flow distribution for reactor vessels.
13 For instance, in pressurized thermal shock. We used
14 the program from that also on here. This program
15 called Prodigal, which is an expert code that
16 basically from weld fabrication parameters will yield
17 the distribution of flaws that may be expected in that
18 type of structure. So the flaw parameters did come
19 from Prodigal. Again, that was done in-house.

20 There were some assumptions here that were
21 conservative, the assumption being that those flaws
22 from the Prodigal analysis were assumed to be surface
23 breaking which would be again a conservative
24 assumption. Toughness and strength properties in that
25 case were also taken from the literature and were

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1 sampled per a Monte Carlo type routine.

2 For the next failure mechanism limit load
3 which is very often stainless structures will fail in
4 a limit load fashion, and I know we've also been
5 before the committee talking about a lot of examples
6 of that. Most recently, probably the control rod
7 drive mechanism housings, for instance, would likely
8 fail in a limit load scenario. They're an osstonimic
9 material.

10 So really what you're saying is by the
11 time you get to a limit load scenario, the structure
12 is behaving like it doesn't care whether there are
13 flaws there or not. You're into gross plastic
14 yielding of the structure. In this case, we just did
15 something as simple as -- or Tanny did -- looking at
16 applied stress exceeding the flow stress where the
17 flow stress was calculated as you see it there, taking
18 into account bending and membrane stresses so
19 basically you ended up with a scenario that's
20 considering sigma flow at about three-quarters of the
21 combined yield and ultimate material properties.

22 Creep rupture is more complicated because
23 you're now considering another dimension to the
24 problem. In addition to stress and temperature,
25 you're considering the time variability of the

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1 properties with the temperature.

2 DR. KRESS: You use constant temperature
3 in there.

4 MR. HACKETT: Yes. I know that came up.
5 I think that's the bottom bullet. What Tanny did is
6 he assumed that the initial steady state temperature
7 was applied. This say for 40 years. It might have
8 been 20. I'm not sure. But at any rate, that's what
9 he did. He didn't project ahead for the heat decaying
10 with the decay in the fuel. The creep rupture
11 strengths were obtained from the literature.

12 The evaluation procedure in this case is
13 very much like what you do for fatigue damage. You're
14 basically using a dimensionalist parameter like
15 Larson-Miller and your summing damage fractions to get
16 to a creep damage. When the sum adds up to greater
17 than one, you're assuming you have a failure from
18 creep rupture.

19 So that's sort of background on how it was
20 done and then in terms of some results.

21 DR. KRESS: When you use the Larson-
22 Miller, doesn't that imply you're using the transient
23 temperature?

24 MR. HACKETT: Larson-Miller actually as
25 far as the input goes, the input temperature would

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1 have been considered steady but it is then a transient
2 case -- you're right -- in terms of the Larson-Miller
3 analysis.

4 MR. POWERS: Wasn't Larson-Miller's work
5 done for isothermal conditions?

6 MR. HACKETT: I don't know.

7 MR. POWERS: I think we have extrapolated
8 it substantially in going to the transient cases.

9 MR. HACKETT: I know Doctor Powers is
10 getting into an area that was disputed when we did
11 some work previously on -- Alan probably remembers
12 this -- on Three Mile Island vessel where we looked at
13 stress control versus strain control and there was
14 some debate there also in terms of the transient case.

15 MR. POWERS: Significant debate.

16 MR. HACKETT: I remember some discussions
17 with Doctor Rashid, for instance.

18 MR. POWERS: I mean Rashid's contention is
19 that we just don't have the really empirical data-
20 based work at those kinds of temperatures and kinds of
21 bi-axial stresses and things like that.

22 MR. HACKETT: And I think you have to
23 admit that's very true in terms of the data. There's
24 no question.

25 In terms of results that they achieved--

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1 MR. POWERS: Probably ought to quit
2 investigating irradiated heavy section steel and start
3 looking at bi-axial strain and heavy section steel.

4 MR. HACKETT: Another level of complexity.

5 We did look at the failure probability,
6 just to share with you a few of the results here, and
7 there's still some work in progress. These slides
8 show the failure probability as a function of time and
9 temperature for at least two of the thermal scenarios.
10 I think Moni Dey mentioned earlier the fire duration
11 was considered to be 25 minutes. In this case, the
12 conclusion was that was not long enough to cause
13 failure of the MPC, so you're looking at the case of
14 the fire is actually over here in the red. You can
15 get, as you can see, some very high temperatures from
16 the fire and pretty much above -- I think this is
17 shown above about 1,200, probably really anywhere from
18 1,000 above you're transitioning from sort of a
19 fracture-dominated mode to a creep-dominated mode or
20 maybe even creep crack growth in between. I think by
21 the time you're up in this range, you're probably
22 looking at a pure creep type behavior, at least a
23 stage one or stage two creep. Below 1000 F. you're
24 probably looking at a fracture-dominated scenario.

25 For the blocked vents or the buried cask

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1 over on the other side in blue, you're looking at a
2 situation again that's dominated by fracture or
3 fracture controlled up to 1000 - 1100 F. and then
4 creep control beyond there if those temperatures get
5 that high. And then you can move over to the axis to
6 look at the kind of failure probability you're talking
7 about.

8 DR. KRESS: Just to give you a test,
9 what's this little hump in the curve?

10 MR. HACKETT: The one at 1120?

11 DR. KRESS: Yes.

12 MR. HACKETT: I would assume what's going
13 on there is probably a disconnect. At some point,
14 there's not a smooth transition between those two
15 types of failure mechanisms.

16 DR. KRESS: Oh, you're right.

17 MR. HACKETT: I don't know if it's exactly
18 a step function.

19 DR. KRESS: It's the transition between
20 failure mechanism.

21 MR. HACKETT: Exactly.

22 MR. LEVENSON: Is that little X that says
23 1000 F. way over on the right hand side of the first
24 chart, is that a point?

25 MR. HACKETT: I'm just looking at that for

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1 the first time here. I should have paid more
2 attention to that. Yes, that's right. So that is
3 just one data point and it is actually that low. As
4 I recall a conversation with Tanny, it is actually
5 that low in the failure probability.

6 DR. KRESS: Sure.

7 MR. HACKETT: The next slide shows the
8 vertical drop for the transfer cask. In this case,
9 dropped from looking at from zero to 100 feet. I
10 think it's also fair to say that this graph beyond
11 about 60 feet is probably more than a bit but it's not
12 exactly the most certain part of the analysis at this
13 point. I think up to 60 feet you're looking at again
14 probably largely a fracture-dominated scenario with
15 some aspect of limit load. Beyond that, I'm sure
16 you're probably talking probably complete crush or
17 limit load gross plastic deformation of the walls. So
18 the upper part of that curve, if it is indeed correct,
19 is going to be limit load-dominated, and then you can
20 see the failure probabilities will go up significantly
21 when you increase that drop height in terms of gross
22 plastic failure of the wall.

23 And the last one we have that Khalid
24 mentioned earlier was the 20 foot drop in this case
25 into the overpack when it's being transferred which

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1 again would drop straight down into the overpack. The
2 maximum applied stress was calculated at about 11 ksi.
3 All the failures in that case would be predicted to be
4 a fracture-dominated scenario if they happened at all,
5 and those failure probabilities are down around the
6 10^{-4} range. So not a very severe situation for the
7 cask.

8 That's what we have to date. There is
9 some more work under way like the previous slide.
10 We're finding some of that upper area from the higher
11 level drops, but that was basically the task of the
12 Materials Engineering Branch was to take the loads
13 that Khalid generated and apply them to the structure
14 through use of finite element modeling and some
15 assumptions made on the variation in the material
16 properties and see what would result. So far, I don't
17 think there's any real surprises there from what we've
18 seen.

19 That pretty much concludes what I had to
20 say. If there aren't any questions, Jason is going to
21 continue on with the consequences.

22 MR. POWERS: You have not looked at all
23 the behavior of this outer shell when it's heated in
24 the engulfing fire.

25 MR. HACKETT: In terms of the material

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1 properties or --

2 MR. POWERS: Yes. What I'm thinking of is
3 okay, you're going to heat this outer shell to 1800 F.
4 It is going to be pressurized inside. Milt assures me
5 that this is going to expand outwards. I presume it
6 will rupture. The concrete all falls out. Does that
7 change the temperatures on the inside?

8 DR. KRESS: Lowers them probably.

9 MR. POWERS: Why is it going to lower
10 them?

11 DR. KRESS: Because you already got that
12 temperature going up through the annulus and now
13 you've changed it from a flow up to an annulus to just
14 being surrounded by the temperature. I'm guessing
15 based on what I thought the analysis was. Probably
16 lowers it.

17 MR. POWERS: Let me make sure I
18 understated. We're getting this gas from someone from
19 a state where pi has the value of three. Right?

20 DR. KRESS: That's right.

21 MR. POWERS: So I want to put this in
22 perspective where this gas is coming from.

23 DR. KRESS: Where road kill is legal.

24 MR. HACKETT: I don't know how much of
25 that Jason -- Jason addressed some of it earlier. I

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1 don't recall the gap between the MPC and the overpack.
2 I think it's on the order of half an inch.

3 MR. SCHAPEROW: Two and a half inches.

4 MR. HACKETT: Two and a half inches.

5 MR. SCHAPEROW: It's all the way around.

6 MR. HACKETT: I think then again these are
7 things we haven't analyzed but just to respond to that
8 sort of line of questioning, by the time the shell
9 expanded to fill that gap two and a half inches, they
10 would have to be --

11 MR. POWERS: It's on the outside. Bill
12 tells me it's going to expand on the outside.

13 MR. HACKETT: Right, so this is the MPC
14 expanding into the overpack.

15 MR. POWERS: No, no. What I was thinking
16 of is this overpack expands.

17 DR. KRESS: It disappears.

18 MR. POWERS: And presumably it breaks.
19 The concrete inside is powder at this temperature. It
20 falls out. Engulfing fire is still going on. Does
21 that cause -- I mean it's got to happen pretty quick.
22 You haven't got a lot of time, but does it have any
23 effect?

24 MR. HACKETT: As of right now, I guess
25 that's an unanalyzed condition.

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1 DR. KRESS: I would just look at the heat
2 transfer coefficient you get for natural convection up
3 that annulus and then look at the heat transfer
4 coefficient you get from natural convection around the
5 thing if it were unconstrained and see how much
6 different those are. They're probably about the same.

7 MR. LEVENSON: There's only 24 minutes of
8 fire. You probably deteriorate all that concrete.

9 MR. POWERS: It may be since we're free to
10 adjust the fire burning rate, maybe we change from the
11 24 minute to the slower leak with a 44 minute fire.

12 MR. LEVENSON: More importantly, without
13 getting into the details, I think your point, which I
14 agree with, is somebody needs to look at the overpack
15 which hasn't been looked at.

16 MR. HACKETT: Yes. Where that would have
17 gotten considered would have been Jason's analysis,
18 and that has not been addressed.

19 MR. SCHAPEROW: No. The previous project
20 manager, who I understand is on sick leave right now,
21 had thought of this issue. He identified this issue,
22 and I am kind of thinking that he had done something
23 to resolve it, but I'm not sure. We'll have to go
24 take another look at that.

25 I'm back up here for one more shot before

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1 I quit.

2 DR. KRESS: Here's where we're going to
3 get a source term. Right?

4 MR. SCHAPEROW: Well, first I need to know
5 what scenario fails the cask.

6 DR. KRESS: Oh, okay.

7 MR. POWERS: -- independent of that.

8 MR. SCHAPEROW: So this is going to be a
9 very, very short talk. I just wanted to say a few
10 words about the consequence assessment. The objective
11 of this work is to assess the consequences for dry
12 cask storage accidents, and we intend to and we have
13 been applying the MACCS reactor accident consequence
14 code.

15 MR. POWERS: Let me ask you a question
16 about that. For this particular analysis, you've got
17 a cask setting out in the middle of this flat plane
18 where there's there's nothing around. I mean this is
19 a completely isolated cask. But the guy that actually
20 has casks for a living, they never have that. He has
21 casks surrounded by lots of other casks. Is there
22 going to be any difference between a MACCS calculation
23 and what happens when you're in a field of casks?

24 MR. SCHAPEROW: If one cask fails and it's
25 sitting in an array or a field of casks, as you

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1 suggest, you might expect a little more dispersion
2 than if it's a single cask because you've now got the
3 wind blowing past an array and so you've got a bigger
4 wake than if you just had one cask. Based on the
5 limited work we've done so far, I suspect that our
6 source from uncertainty is going to be much bigger.
7 I think that's where we're going to have some troubles
8 with the source term. You already suggested that
9 earlier today.

10 DR. KRESS: Let me ask you a more
11 philosophical question. I have 10 casks on the site.
12 I have a probability of failing one due to some of
13 these accident sequences or cumulative frequency of
14 failure and I have a source term for that cask and I
15 calculate a consequence, so I've got a frequency and
16 a consequence which I can convert to a risk. Now, if
17 I've got 10 casks, is my risk 10 times what I just
18 calculated?

19 MR. SCHAPEROW: I would expect that most
20 accidents, the ones we're considering, would only
21 affect one cask. It would have to be something that
22 hit all the casks at the same time. So it would be
23 very conservative to multiply it by 10. Probably
24 unwarranted to do such a thing unless what it was
25 affected all of them at the same time.

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1 DR. KRESS: That's because these are mass
2 stoichiastic events.

3 MR. SCHAPEROW: There's a separation.
4 These casks are separated on the pad. In the spent
5 fuel pool or reactor, all the fuel is right there
6 together, but in this situation they're separated.
7 They're in separate containers spaced with whatever
8 spacing they have between them. So it would have to
9 be big enough to hit all the casks at the same time.

10 DR. KRESS: And you can't drop all the
11 casks at the same time because you're only moving one
12 at a time.

13 MR. SCHAPEROW: That's correct. Typically
14 inside the building is where they're handling it with
15 a crane.

16 DR. KRESS: I think you're right.

17 MR. LEVENSON: I think there's a
18 philosophical question as to whether all of the
19 accidents inside the building which are precursors to
20 loading the cask ought to be called cask storage
21 accidents because they really aren't. I mean storage
22 implies what happens when it's being used as a storage
23 container and dropping the multi-purpose container
24 before it's even in the cask shouldn't really be
25 called a cask --

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1 MR. RUBIN: It's just part of the
2 operations to get the fuel into the cask, and it's
3 included in the scope of work. I understand what
4 you're saying.

5 MR. LEVENSON: The context of the question
6 is when people start adding up is cask storage safe or
7 not and you've included a bunch of accidents that are
8 irrelevant to the use of a cask, is dropping something
9 into the pool going occur whether you do or don't use
10 dry cask storage?

11 MR. RUBIN: You have to go back to what
12 the objective is from the user office as to where some
13 of the priorities for looking and inspections or where
14 the risks are for the dry cask storage system.

15 MR. LEVENSON: I think all of these things
16 are worth looking at, but we've got to be careful what
17 we call them.

18 MR. HACKETT: I think that's a good point
19 when you call it storage. I think that shows how
20 effective NRR was in handing this problem off to NMSS.
21 That really does fall under the category of the
22 operating plant and where you make that transition.
23 Interesting point.

24 MR. RYDER: When I do my analysis, I'll be
25 able to distinguish between the operations at handling

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1 and transfer and storage and break those out, and it
2 would be up to me to communicate those various risks
3 clearly and not just lump them all together as you're
4 saying.

5 MR. LEVENSON: That would be fairly
6 important.

7 MR. RYDER: Yes, very much so.

8 MR. SCHAPEROW: The approach we took was
9 to use the MACCS code which we use for reactor
10 accident consequences and adapt it by revising the
11 input to be representative of cask accidents. As part
12 of this work, we are examining the effect of what we
13 are considering to be the important parameters and
14 consequences.

15 DR. KRESS: Did you include some sort of
16 emergency response in that MACCS code or did you just
17 say there's no emergency response needed and we'll
18 just look at the consequences without it?

19 MR. SCHAPEROW: The initial calculations
20 that I've done have basically left that stuff alone.

21 DR. KRESS: Good.

22 MR. SCHAPEROW: As a starting point for my
23 calculations, I'm using a fairly well known survey
24 large early release calculations that actually come
25 with the code, and I've basically left that alone.

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1 DR. KRESS: Oh, you did, so that does
2 happen. It has evacuation and some emergency response
3 in it.

4 MR. SCHAPEROW: I'm assuming emergency
5 response. We're doing this at a facility which is an
6 operating reactor, so they have all that stuff in
7 place. This is a cask storage of spent fuel in dry
8 casks at an operating reactor facility. They may not
9 need that.

10 DR. KRESS: Yes, but it would never
11 trigger the emergency response protective action
12 guidelines probably.

13 MR. SCHAPEROW: That's right. If the
14 release is small enough, you would not exceed the
15 dose.

16 MR. LEVENSON: How valid are the release
17 fraction assumptions in that code?

18 MR. SCHAPEROW: That's an input. That's
19 something that we've been thinking about what to put
20 in for release fractions. A lot of work was done on
21 release fractions last year for transportation
22 accidents by Jerry Sprung at Sandia and some others,
23 and they did quite a bit of analysis to look at the
24 releases of fuel finds, releases of what's considered
25 volatiles, ruthenium and cesium at fuel burst

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1 temperature. So they looked at a lot of that. We'd
2 like to adapt some of that where appropriate but right
3 now we don't have a scenario where we're having a
4 release. So so far the stuff I'm getting from the
5 level one analysts is that this is screened out and
6 that's screened out. So we've done some calculations,
7 but I'm kind of in a holding pattern right now.

8 DR. KRESS: Sort of like a pebble bed
9 modular reactor.

10 MR. SCHAPEROW: You probably have a little
11 higher decay heat in one of those.

12 DR. KRESS: I said that just for Dana's
13 benefit.

14 MR. POWERS: When we go through the ATWOS
15 and those, we'll not only have decay heat. We'll
16 actually have power spiking events. That'll give you
17 a unique source term.

18 MR. SCHAPEROW: Anyway, the MACCS code
19 treats atmospheric transport, accumulation of dose to
20 individuals off-site, and we do allow for mitigation
21 or relocation and evacuation. Based on all this, it
22 performs estimates of the health effects. Cancer
23 fatalities and -- fatalities.

24 DR. KRESS: Do you guys do that here?

25 MR. SCHAPEROW: Pardon?

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1 DR. KRESS: Did you guys exercise MACCS
2 here?

3 MR. SCHAPEROW: Yes. It executes in about
4 a minute or so. It's a fairly straightforward code to
5 use. In our analysis, we are trying to look at what
6 may be the important parameters. We're doing analysis
7 on inventory of the fuel, release fractions, release
8 start time and duration, initial plume dimensions and
9 the plume heat content. With respect to the site,
10 we're also examining population densities and site
11 specific weather.

12 I'd now like to briefly discuss what I
13 believe are the two most important parameters in this
14 analysis: inventory and release fractions. First I'd
15 like to note that a cask does have a lower inventory
16 than a reactor for two reasons, one of which is there
17 are fewer assemblies in a cask than in a reactor,
18 about a factor of seven less for a PWR as shown here
19 and about a factor of eight less for BWR.

20 Also, the fuel is not put in the cask
21 until it is at least five years old, so we have
22 opportunity for a bit of decay and, as I note here in
23 the last bullet, of the 60 isotopes we normally use
24 for reactor accident consequences, only 16 of those
25 are still there for cask accidents.

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1 MR. POWERS: Curious nomenclature because
2 they're always there.

3 MR. SCHAPEROW: Well, at levels that would
4 influence the --

5 MR. POWERS: There's a level problem.

6 DR. KRESS: But the half life, they're
7 always there.

8 MR. POWERS: Every isotope.

9 MR. SCHAPEROW: Finally, I'd like to
10 mention a little bit about source term. There are
11 three important parameters that affect the source
12 term. Again, these were strongly considered and
13 discussed in the work on the transportation risk
14 study. That's the fraction of the rods failing, the
15 release fractions for an individual failed rod, and
16 the deposition in the cask. This concludes my
17 presentation.

18 DR. KRESS: Okay.

19 MR. POWERS: When your guys come back and
20 tell you, oh my god, you've analyzed this engulfing
21 fire and come up with a scenario that's going to bust
22 this thing wide open like an egg. How do you handle
23 the plume? I mean it's a really funny looking plume.
24 You've got a fire plume. Then you've got the plume of
25 radionuclides coming out.

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1 DR. KRESS: Fire plume probably dominates.

2 MR. POWERS: And you just treat this one
3 as kind of a leak into the --

4 DR. KRESS: That's what I would do.

5 MR. LEVENSON: Because there's no other
6 source of energy.

7 MR. POWERS: The fire plume goes out at 24
8 minutes, I'm told.

9 DR. KRESS: Then just forget it because
10 I've got an on-site release.

11 MR. LEVENSON: You've got no transport
12 mechanism.

13 DR. KRESS: I don't think you have enough
14 energy to drive it.

15 MR. POWERS: I cracked this think open
16 like an egg.

17 DR. KRESS: And you got radioactive decay
18 energy driving it? You've got no krypton or xenon
19 left.

20 MR. POWERS: What I have is heat wave
21 coming in.

22 DR. KRESS: Restored energy. There would
23 be a certain level of that.

24 MR. LEVENSON: Not much. The transport
25 time through concrete is pretty damn slow.

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1 DR. KRESS: My guess is you don't have to
2 worry about that end of it, but it needs looking at.

3 MR. POWERS: Because the transport time is
4 going to be dominated by the plume of liquid water,
5 isn't it?

6 MR. LEVENSON: What liquid water?

7 DR. KRESS: In the concrete.

8 MR. POWERS: Every time I've heated up
9 concrete, the back side of it got wet with hot water.

10 DR. KRESS: It'll do that.

11 MR. LEVENSON: That's not rapid. Not for
12 the quantity of heat you need --

13 DR. KRESS: -- to loft a plume. Yes. I
14 suspect you're right.

15 MR. MARKLEY: Mr. Ashe, you're back on
16 line now.

17 MR. ASHE: Thank you.

18 DR. KRESS: We can't see you but you can
19 see us.

20 MR. ASHE: Well, actually I can hear you.
21 I can't see you.

22 MR. HACKETT: Alan had some summaries.

23 DR. KRESS: I guess, Jason, you leave us
24 to wait for developments on these three things here
25 and we'll hear more about them later.

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1 MR. SCHAPEROW: It's kind of hard for me
2 to do too much without a scenario.

3 DR. KRESS: You have to have some sort of
4 driving force, don't you?

5 MR. SCHAPEROW: And I think once the
6 scenario is established, then the source term is going
7 to be the all important parameter for the
8 consequences. The release fractions from the cask to
9 the environment are going to be critical.

10 DR. KRESS: You plan on using the stuff
11 that Jerry Sprung is developing for that?

12 MR. SCHAPEROW: If we can reach those
13 conditions. His conditions were quite severe. He had
14 a train crash with a fire. The train crash had up to
15 120 miles an hour with a fire and also the kind of
16 cask he had had a bolted lid on it so the bolts bent
17 a little bit and that provided the opening for the
18 fission products to come out. This is a very thick
19 weld. I don't know how thick it is.

20 MR. HACKETT: It's three-quarters of an
21 inch on the structural lid and then there's also a
22 shield lid so it's double sealed.

23 MR. SCHAPEROW: So this is going to have
24 a less severe accident impacted on it probably and it
25 also seems to have a much stronger closure.

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1 DR. KRESS: Have you considered working
2 backwards and saying what is my acceptance criteria
3 and see what release fraction I need for that and say,
4 isn't no way I can get that.

5 MR. SCHAPEROW: We don't really have one
6 for consequences. We're going to have to do the
7 combination of frequency and consequences.

8 DR. KRESS: You're going to get a
9 frequency eventually.

10 MR. SCHAPEROW: Okay. When we do get
11 that, then we'll apply it. If it's appropriate, we'll
12 apply the consequences to that.

13 DR. KRESS: Thanks.

14 I guess we'll move on to you, Alan.

15 MR. RUBIN: I'll be fairly brief in just
16 wrapping this up. what I'd like to do is you've heard
17 where we are and what we've done, and I'm going to
18 just briefly tell you what we're going to be doing to
19 finish up this project. These are the items, the
20 types of analyses that we're going to be doing. You
21 haven't heard about the human reliability analysis.
22 That's ongoing work. It's looking primarily at the
23 handling phase of the accident.

24 DR. KRESS: Question. You're using
25 ATHENA for that?

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1 MR. RUBIN: Yes. ATHENA THERP.

2 MR. RYDER: I think they're doing both,
3 but that work is ongoing.

4 MR. RUBIN: I think it's modeling with
5 THERP.

6 MR. POWERS: To quote the esteemed
7 chairman of the ACRS, if you've done what you're
8 advertising to be doing in that work, you will have
9 wowed him.

10 DR. KRESS: Yes. I guess the
11 advertisement was at a recent conference somewhere.

12 MR. POWERS: It's something that was put
13 out on what they were trying to do with the ATHENA.

14 MR. RUBIN: Part of the work, there's been
15 a close look at the procedures and observations during
16 actual fuel loading of the cask, looking at events,
17 what could be the likelihood of misloading fuel, of
18 improper drying or sealing the cask or inerting the
19 cask or events that could cause tip over in the fuel
20 handling building or in transfer to the storage pad.

21 We were looking at coming up with
22 probabilities of cask drops, both from human errors,
23 human actions as well as equipment failure, crane
24 failures. In the mechanical loads, the work that's
25 continuing is looking at drop heights of greater than

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1 60 feet.

2 DR. KRESS: Why is that? Do you have to
3 lift these things up that high to get them up?

4 MR. RUBIN: There's an elevation distance
5 when the track vehicle is at one elevation in the
6 reactor building and the overpack is at the lower
7 elevation. There's something like a 98 foot elevation
8 difference between the height and there's a shaft or
9 opening where that cask is dropped. It's lowered.
10 It's not dropped.

11 DR. KRESS: Lowered.

12 MR. RUBIN: Take that off the record.
13 It's lowered slowly. This is a very slow process.

14 DR. KRESS: Slow drum.

15 MR. RUBIN: Slow motion lowering into the
16 overpack. One of the other mechanical loads is
17 looking at a drop from the crawler which is the
18 transfer vehicle to take the cask to the pad onto a
19 yielding surface. The analysis, as you've heard
20 before, has been done to a rigid surface and we're
21 looking at drops or most of the transfer distance is
22 over asphalt or gravel.

23 DR. KRESS: Why are you doing that?

24 MR. RUBIN: Because we haven't got a low
25 enough -- there's some probability of cask failure

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1 onto a yielding surface. It's not zero, it's not 10^{-6}
2 number.

3 DR. KRESS: You just want the number so
4 you don't have such a bounding analysis.

5 MR. RUBIN: Don't have such a bounding
6 analysis and also it's going to be difficult for us.
7 We're not looking at coming up with frequencies or
8 probabilities of drop of the cask from the transfer
9 vehicle. That would require a whole different kind of
10 separate analysis. So if we can eliminate this event
11 from doing a more realistic analysis of the likelihood
12 of failure of the cask and if it won't fail because
13 it's impacting a yielding surface, then we have means
14 to eliminate or screen out that sequence.

15 DR. KRESS: I'd be interested in seeing
16 that analysis because this surface, it's asphalt. Not
17 only does it yield, it flows. That would be
18 interesting. It's a non-Newtonian fluid. It would be
19 an interesting analysis which may or may not be
20 needed.

21 MR. RUBIN: But that's what we're doing
22 and why. Thermal loads. Jason is going to be doing
23 more detailed nodalization for the cask itself.

24 DR. KRESS: And Dana would like to add one
25 for you to look at the overpack.

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1 MR. RUBIN: We got that message. The
2 effect of temperatures on the overpack, the concrete,
3 and we need to look at that. There was some
4 preliminary discussions, not discussions but looking
5 at what the impact of higher temperatures would be on
6 the overpack. I think it was primarily though from a
7 rapid heat up from lightning, not a long-term sequence
8 or a 30 minute sequence from a fire. The lightning
9 was not the source, but we have not addressed that
10 question.

11 MR. POWERS: I have no idea what will
12 happen, but it's one that just comes to mind that
13 probably didn't take too long to go chew on.

14 MR. LEVENSON: An early step might be to
15 try to estimate the failure mode of the overpack.

16 MR. RUBIN: To escalate the failure mode?

17 MR. LEVENSON: To estimate.

18 MR. RUBIN: Oh, estimate.

19 MR. LEVENSON: Estimate the failure mode
20 because that might eliminate a lot of need for various
21 types of analysis. The worse case, which I think is
22 probably not credible but nevertheless, if the fire
23 generates steam inside and the failure mode is an
24 explosive rupture of the inner liner, it might damage
25 the MPC.

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1 MR. RUBIN: We have to go back and also
2 look, with the limited resources and looking at going
3 back to the initiating event frequencies which you
4 heard which are the aircraft impact. If it's at 10^{-9}
5 frequency, maybe we don't spend our resources and do
6 that. It's an interesting question for sure, but
7 that's something we need to determine. But we hear
8 the message but that's not part of what we looked at
9 right now. The longer term potential impacts on
10 thermal loads from not drying or inerting the cask
11 adequately according to the procedures.

12 There's also been some development work
13 going on on looking at fuel failure models from both
14 thermal and mechanical loads that you've heard about
15 today. You've heard about the mechanical and thermal
16 loads. You haven't heard about the fuel failure model
17 because that work has not been done yet.

18 DR. KRESS: Are those designed to feed
19 into maybe a source term calculation?

20 MR. RUBIN: Yes. Rather than assuming
21 it's in the transportation study 100 percent of the
22 fuel has failed, if we can come up with gee, based on
23 a certain drop height, for example, 50 percent of the
24 fuel failed or less. That would be where that input
25 would feed into our overall source term and

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1 consequence analysis.

2 DR. KRESS: Generally in the reactor area
3 we would have looked upon the difference between 100
4 percent and 50 percent as not worth worrying about,
5 but if it's a way to look at what the fuel looks like
6 in order to estimate a source term from all the fuel,
7 assuming all of it looks like that, then it's a
8 different story.

9 MR. RUBIN: We're going to see if we can
10 do a little more than what was done in the
11 transportation study in this area.

12 DR. KRESS: It might be useful.

13 MR. RUBIN: We don't have a train car
14 impacting on this cask. The cask is also surrounded
15 by two and a half feet thick concrete.

16 One of the things we didn't talk about I
17 just wanted to mention that's also going on is an
18 accident during fuel handling. If the cask were to
19 tip over and the lid were not sealed and you had a
20 spill and release of radioactivity in the reactor
21 building, then typically normally you would have
22 secondary containment isolation. But we're looking at
23 what the probability would be given that sequence. If
24 the HVAC ventilation system is not isolated and
25 normally you would then initiate the stand-by gas

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1 treatment system and vent through a charcoal filter
2 and if that failed also. So that's the sequence that
3 we'd be looking ta in the fuel handling building,
4 looking at both the probability of failure to isolate
5 secondary containment as well as decontamination
6 factors that could affect the source term.

7 DR. KRESS: Is this a manual isolation
8 because I can't see any other way that sets it off?

9 MR. RUBIN: I think with the radiation
10 trip, I think there's a signal on radiation.

11 DR. KRESS: I don't know if you're ever
12 going to get that high from this accident.

13 MR. RUBIN: But it's part of trying to be
14 complete in our analysis so we don't over-estimate the
15 consequences from this and, of course, you've heard
16 the work on source term consequences will be going on.
17 Once we have all these pieces, we will be able to
18 finally complete the PRA model and run it to look at
19 where we're getting the overall risk.

20 DR. KRESS: I'll tell you what the answer
21 is going to be. Focus on the handling.

22 MR. RUBIN: I think that was my
23 inclination from the beginning.

24 MR. LEVENSON: Tom, you could get there if
25 this plane crashes into the handling building and you

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1 get the fire and the operator is so nervous he then
2 drops the cask from 80 feet into the fire. You might
3 get a release.

4 DR. KRESS: You're right.

5 MR. RUBIN: There's not a cask always
6 being lifted, by the way. It's only a once in a while
7 event. So that's the work that needs to be done to
8 finish this. I'll call it the screening study. As I
9 mentioned earlier, we'll have a draft report in the
10 June 2002 time frame which will then undergo a peer
11 review. If there's any need for additional analysis,
12 it will be determined at that time and we will issue
13 a final report. And we hope to be back to you again
14 when we have results and this draft report. We'll let
15 you know what we found.

16 MR. POWERS: When you began this
17 presentation, you indicated that you had not
18 considered flaws in the fabrication of the casks.

19 MR. RUBIN: Other than flaw distribution,
20 for example, that you heard about. Yes. It's
21 supposed to be two and a half inch gap or the concrete
22 or steel wall is supposed to be half inch thick and if
23 it's the wrong dimensions or something else, those are
24 not part of it.

25 MR. POWERS: In light of the relatively

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1 low probabilities that you're getting for all these
2 things that you've looked at so far as far as the
3 storage, doesn't that cause you pause to think well,
4 maybe I better go look at the flaws in manufacture now
5 as the quasi-initiating event?

6 MR. RUBIN: As far as the dry cask, that
7 could be. First we want to finish up the handling and
8 transfer phase to look at where the impact of human
9 reliability is. It's a question of how far do you go
10 in terms of looking at the really fine detailed
11 analysis of the dry cask system when you have the
12 whole fuel cycle. How much resources do we want to
13 spend on this? That's probably a decision to be made
14 I think in conjunction with the Office of Research and
15 NMSS if we go further along those lines.

16 DR. KRESS: Generally, risk acceptance
17 criteria end up having a time at risk in it. You're
18 assuming how long for these casks for just the dry
19 storage part? How long are they going to sit there?
20 Have you got a number for that and does that factor
21 into your risk assessment at all?

22 MR. RUBIN: Well, there's going to be risk
23 during the handling and transfer phase.

24 DR. KRESS: I'm forgetting about that.

25 MR. RUBIN: It's an annual per reactor per

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1 year basis.

2 DR. KRESS: It's on a per year basis.

3 MR. RUBIN: Yes.

4 DR. KRESS: But you're going to say this
5 is acceptable based on some number or some criteria.
6 My criteria would have said how long is it at risk?

7 MR. RUBIN: I think you heard this morning
8 some discussion of work going on in NMSS on developing
9 safety goals.

10 DR. KRESS: That would be part of your
11 safety goal. That's right.

12 MR. RUBIN: When we started the study and
13 still there are no safety goals that we have to say
14 okay, this is a low enough number or a good enough
15 number. That's something we're going to be working
16 closely with NMSS.

17 DR. KRESS: That's another aspect. Right
18 now we're just getting what the number is.

19 MR. RUBIN: Correct. Whether that number
20 is below a certain value so you can say it's okay,
21 that piece is not part of the study but it's being
22 done separately.

23 DR. KRESS: I understand.

24 MR. RUBIN: I think you heard about some
25 of that this morning.

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1 DR. KRESS: So we will consider this part
2 a briefing of the status. You don't need any more
3 feedback from us.

4 MR. RUBIN: Other than the comments we got
5 which were helpful during the meeting. We're not
6 looking for any written comments from the committee.

7 MR. POWERS: I think I offer one comment.
8 You just have to be awfully impressed about the
9 horsepower of the team that they put together for
10 this.

11 DR. KRESS: Yes, and I also offer the
12 comment that this was a worthwhile effort.

13 MR. POWERS: It's a worthwhile effort and
14 it seems to be being done awfully well by a very
15 competent group of individuals.

16 DR. KRESS: I think those are both good
17 comments, and we appreciate the briefing.

18 MR. RUBIN: It's nice to hear those kind
19 of comments.

20 MR. POWERS: I don't know that they get
21 said enough because we've had some people making
22 comments about the capabilities of research and the
23 staff and what not and they ought to sit in on some of
24 these things and see what's going on. Maybe it would
25 change their mind a little bit.

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1 MR. LEVENSON: Maybe if there's marginal
2 reasons for writing a letter, it might be worth doing
3 just so it could incorporate a comment like that
4 because otherwise it doesn't get anywhere.

5 MR. POWERS: I think we target this June
6 report. Bear in mind that we do that because I mean
7 you and I are familiar with some of these comments
8 that we took a little umbrage at and this just gives
9 us a little more ammunition.

10 DR. KRESS: Sure does.

11 MR. RUBIN: And I think you're saying that
12 the Office of Research is getting involved more in
13 areas in addition to reactors which we've been
14 involved in for many years in supporting NMSS
15 activities, and this is a high priority task for the
16 Research Office. It really is. We've put the
17 resources and the manpower on it and think it's going
18 well.

19 DR. KRESS: So are there any additional
20 comments from anybody? If not, I'm going to declare
21 this meeting adjourned.

22 MR. MARKLEY: Tom, I'd suggest if you
23 wanted to pass around or ask for comments or see if
24 the staff had any other remarks. Some of the earlier
25 presenters, if they wanted to say anything.

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1 DR. KRESS: I thought I did that. I
2 didn't see any hands raised when I looked around.

3 MR. MARKLEY: Lawrence.

4 DR. KRESS: I didn't look far enough, I
5 guess.

6 MR. KOKAIKO: Good afternoon. Our
7 presentation this morning by the Risk Task Group on
8 the Risk Task Group activities to date as well as some
9 of the work that we are doing on safety goals. If you
10 had any feedback, we would like to hear from you on
11 that.

12 DR. KRESS: Our intention is for the
13 subcommittee to get together and see if we can come up
14 with some sort of letter on that one to give you some
15 feedback.

16 MR. KOKAIKO: I appreciate that.

17 DR. KRESS: We haven't decided what that
18 is yet. We haven't gotten together, but we might have
19 a letter on that.

20 MR. KOKAIKO: I appreciate it. Thank you
21 very much.

22 DR. KRESS: With that, I'll declare the
23 meeting adjourned again.

24 (Whereupon, the meeting was adjourned at
25 3:52 p.m.)

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