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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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SOURCE TERM APPLICABILITY PANEL

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THURSDAY

FEBRUARY 21, 2002

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ROCKVILLE, MARYLAND

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The Panel met in Conference Room 4-B-6,
One White Flint North, Rockville, Maryland, at 8:30
a.m., Brent Boyack, moderator.

PRESENT:

- BRENT BOYACK
- BERNARD CLEMENT
- JIM GIESEKE
- TOM KRESS
- DAVID LEAVER
- DANA POWERS
- JASON SCHAPEROW

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8:40 a.m.

MR. BOYACK: Let's begin the meeting this morning. While I'm booting up, Steve Lavie has, as he gently said, has talked to some of his staff, cohorts and they have declined to come and talk to us but he has all the information you could ever want.

Why don't you go ahead and download that for us.

MR. LAVIE: What I heard from the people I talked to at Racka Systems is that the situation isn't as quite as easy as it has been characterized. GE is getting the power increases by largely moving higher enrichment fuel into periphery areas around the core in an effort to flatten flux.

However, in plants that have adequate margin of critical power ratio, they are not having to do that. They can raise the overall power of the core without approaching the critical heat flux. It isn't as easy as -- it isn't just all across the board flattening the flux. Some plants are getting the same shape. Some are getting certain degrees of flux flattening. It varies from reactor to reactor.

Now, one of the points that was pointed out to me, however, is because of the need to get flat

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1 flux in the periphery of the core is fuel assemblies
2 are not staying in the core more than two cycles at
3 the present time so these assemblies will never get
4 high burnup. They're not going to be there long
5 enough. I don't know how that factors into our
6 discussions here.

7 The individual I talked to, unfortunately
8 these people don't get involved with the severe acts
9 of aggression calculations. Jason is the best person
10 to get along with those folks. They questioned how
11 the decay heat is calculated in these codes. If decay
12 heat was calculated more of an average method, there
13 may be no change.

14 Similarly, the parallel, I think, here is
15 on the core inventory. The origin code calculates an
16 average flux across the core. It's based on the total
17 power averaged across the core. We then apply peaking
18 factors for those analysis where we're not taking all
19 of the assemblies. In LOCA, however, we're just
20 taking the average.

21 My initial concern I expressed is that I'm
22 not sure that the flat flux -- the flux flattening
23 will have a significant impact. It was also pointed
24 out that when the source term work was done, they
25 picked representative reactors and that our fleet of

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1 reactors varies from the small units such as Oyster
2 creek to large units such as Quad Cities.

3 There is more than a 20 percent power
4 difference. There's a factor of four difference in
5 some of the sizes of some of these reactors. Yet, we
6 only have one source term. So the people who did the
7 1465 must have done something to massage that
8 difference on the core degradation based on power. I
9 know it doesn't answer the question and it probably
10 throws more questions into the mix. That's what I was
11 able to find out.

12 MR. KRESS: That's the only thing that
13 affects is the timing. It doesn't affect very much
14 the fractional releases most of the time.

15 MR. LAVIE: I think the decay heat is --
16 you know, if you track back, at least to the fission
17 products, it's largely going to be due to diffusion
18 pellet as it mounts. That is directly related to
19 temperature. If the total Q in the core -- you know,
20 we string it out flat and the Q has gone up but I'm
21 not sure that those extra pieces of the periphery that
22 we've now brought in will add that much to diffusion.

23 MR. KRESS: The source term in 1465 is
24 real and almost totally by the oxidation in burnup.
25 Decay heat doesn't enter into it. It enters in the

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1 house as long as it takes you to get there. That may
2 be different when you get to the high burnup and MOX
3 because we're talking about releasing earlier and
4 lower temperature. In that case, you start releasing
5 significant quantities due to decay heat so you have
6 a qualitatively different view of the source term.

7 MR. LAVIE: Because of the current core
8 designs, these assemblies will not be in the core more
9 than two cycles. If you look at the older fuel
10 management schemes in the three region cores, we are
11 removing the stuff burned out further and further on
12 the periphery. I think this approach is putting fresh
13 stuff on the periphery.

14 MR. KRESS: I think they will start doing
15 those and being innovative with burnable poisons.
16 It's expensive to take that fuel in and out like that.

17 MR. LAVIE: The problem with the burnable
18 poisons is that they start to have problems with some
19 of the factors that lead into their double limits.

20 MR. KRESS: But it's real expensive for
21 them to change out fuel often. Anything they can do
22 to stretch that out, I think they will do it.

23 MR. LAVIE: The GE fuel bundles now are
24 unique. They are designed specifically for those
25 positions.

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1 MR. KRESS: That gets real costly.

2 MR. LAVIE: They already have some
3 burnable poisons in them. We have extra water
4 channels in the interest of trying to flatten the flux
5 and get higher burn.

6 MR. KRESS: That is one of the things we
7 learned is reload to the core to recalculate all of
8 them. There's no such thing as a standard core.

9 MR. LAVIE: Nuclear engineers in GE plants
10 have much more to do than the ones at PWR plants
11 because these are calculations that are done
12 throughout the cycle. They change the rod withdrawal
13 and exertion sequence depending on where they are.

14 MR. KRESS: So it's not simple, is it?

15 MR. LAVIE: It's not a simple issue.

16 MR. BOYACK: All right. Thank you, Steve.
17 You've taken just enough time for me to get back
18 online because I certainly wasn't there. I'm still
19 struggling here.

20 MR. SCHAPEROW: Are we ready to change the
21 agenda yet?

22 MR. BOYACK: No, I'm just trying to
23 survive here for a moment. We're ready to go now.

24 Okay. Let's talk a little bit about what
25 we plan to do for the rest of the meeting. We'll go

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1 until approximately quarter to 12:00 today working on
2 the remaining four MOX groups. At that time we'll
3 take a lunch break. There's a little uncertainty.

4 They are trying to go ahead and keep it so
5 we don't have to pack up things and move out of the
6 room here. The reason we have an hour and a half
7 lunch currently scheduled is that, as I mentioned
8 yesterday, there's a group that's coming in for an
9 hour and a half, Toast Masters.

10 Evidently there is a room available
11 upstairs and Martin is trying to get the Toast Masters
12 switched upstairs which would leave us free us which
13 means we can go to 12:00 and come back at 1:00. We
14 just have to wait and see on that.

15 Now, what we're going to do after lunch
16 when we come back at 1:00 we're going to go ahead and
17 try to summarize and come to some points about what we
18 learned out of the process here. You may have had
19 better words for it and you're welcome to go ahead and
20 give those.

21 The idea is to reflect upon what we've
22 done, what we've learned, to go ahead and get those
23 points listed and made available. They would be
24 cleaned up for language because, as you know, we do
25 things online here quickly. Then they would be made

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1 available to Moshen as part of conclusions in the
2 final report.

3 We'll finish the meeting at about quarter
4 to 3:00. At least one of us will finish the meeting
5 at quarter to 3:00. That's what I have to do to be
6 able to make the flight and get through BWI security
7 lines. Our ACRS colleagues can stay here and wrap up
8 whatever else because they don't leave until late
9 tomorrow.

10 Any questions or comments about how we
11 plan to proceed? Okay. Let's go ahead now. Before
12 we begin actually turning back to the release
13 fractions for these last four groups, there was some
14 discussion yesterday, preliminary discussion that says
15 we've got the easy step done and now it's time to move
16 on to the harder elements.

17 I wonder if -- it would be well for the
18 record to have a little bit of that captured as to
19 some of the challenges that we face and how we might
20 go about dealing with them.

21 I know there were comments. Bernard had
22 some and Tom had some. Would you be willing to just
23 comment?

24 MR. KRESS: My point was we were able to
25 deal with these earlier ones because they are

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1 essentially all released from a MOX fuel. Then when
2 we get down to the barium, strontium, noble metal
3 cerium groups, then you've got fractional releases at
4 some level.

5 The only data we have to pin that down as
6 to relative amounts compared to the other things is
7 the data we've seen from France. We don't have enough
8 of that available to us to make a judgement in my
9 mind. It would be almost wholly a guess.

10 Most of these things we are guided by
11 knowledge and knowing something about it and having
12 good data to guide our judgement. We just don't have
13 that for these barium, strontium, noble metals and
14 cerium for MOX fuel.

15 I frankly would be at a loss to figure out
16 how to quantify those at the moment without more
17 access to the data on those, data such as in RT-7
18 where they re-irradiated the fuel and got some online
19 transient measurements of the releases of some of
20 those lower altered material.

21 My problem is I don't have any -- there
22 are no models appropriate for MOX that I know of.
23 There are no -- there's not enough I've seen to guide
24 my judgement so I have no real basis for establishing
25 numbers. What I would like to do is say to be

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1 determined in those areas and put that off until a
2 later meeting beyond which time if these negotiations
3 with prince people work out and we get to look at
4 their whole range of data.

5 I think that's enough data that I can
6 guide my judgement and intuition and even make a
7 printable primitive model. I could then come to some
8 believable judgement about what those levels might be.
9 That was my thoughts on it. I just don't have the
10 basis for making any numbers in those columns there.

11 MR. BOYACK: Jim.

12 MR. GIESEKE: I agree. What we've done so
13 far has been driven by other source events rather than
14 -- I don't know what to call it. Release chemistry
15 perhaps the way to describe it. It's more like the
16 accident progression that you surmise that we even
17 defined yesterday that's been driving all the releases
18 to this point.

19 Now we're down to the point where the
20 nuances in fuel chemistry and such can have an
21 overriding effect. As Tom had pointed out, those
22 things show up when we have data and you can
23 understand then when you have some data.

24 I think all we have if you look at what's
25 been handed out to us, what we have are lot

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1 qualitative statements like the barium is low
2 volatility release. We could put that up there but
3 that's not a number.

4 We can get qualitative statements derived
5 from what we have been given in our handout but there
6 are no numbers there, I think, to give us much to go
7 on. It would be most useful to have a look at some
8 data so we can draw analogies and extrapolate or what
9 needs to be done.

10 MR. BOYACK: So are you in sort of the
11 same position as Tom that at this stage -- I think
12 your words were difficult, impossible, unprofessional,
13 or whatever to --

14 MR. KRESS: All of the above.

15 MR. BOYACK: -- to actually come up with
16 numbers or are you somewhere else?

17 MR. GIESEKE: Yes. Pick one of those
18 words. I don't know. If you force people to pick
19 numbers, I suppose people could pick numbers but they
20 won't have no sense at all and ascribe no credibility
21 to them which may lead people astray.

22 MR. BOYACK: I'm going to ask Bernard a
23 question. If at some future time the French data
24 becomes available, the data that you currently have,
25 do you think that would be sufficient for a panel such

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1 as this after a review of that data to move forward in
2 these areas?

3 MR. CLEMENT: I think having this data
4 things could be done. Data are not enough. You need
5 them in an analysis of the letter and not take the
6 chance and measure the value and say that's the same
7 for the reactor. You need to go further.

8 I must say that our analysis process is
9 not yet finished. If today we had to put numbers, I
10 cannot use those same numbers for two reasons. First
11 of all, the agreement for releasing the data is not
12 yet done. Then we are at the stage where the analysis
13 is not finished.

14 The only thing I could do is to put flags
15 saying this we will have to look at with more
16 attention on some elements. That is the only thing I
17 could do today.

18 MR. BOYACK: Well, that was quite the
19 information I was seeking.

20 Dana.

21 MR. POWERS: I certainly agree that the
22 kinetics that influences the release, the gases,
23 iodine, and cesium, is the kinetics of damage
24 progression. We don't know exactly how that happens
25 in MOX fuel. The ground rules kind of dictated those

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1 releases.

2 Now to get the rest of these fission
3 products kinetics actually counts and we have the data
4 to draw straight lines. We do have some qualitative
5 indications to suggest that the fuel is somewhat more
6 oxidizing than low enriched uranium. You kind of
7 suspect that.

8 MR. LEAVER: Higher oxygen potential?

9 MR. POWERS: Higher oxygen potential. So
10 you say, okay, that suggest that noble metal releases
11 go up a little bit and the barium and strontium come
12 down a little bit and the cerium and lanthanum are
13 about the same. The ruthenium moves around on you.
14 You can certainly put numbers in that reflect that.
15 This one's a little higher. Okay. You put in a
16 number and say it's a little higher.

17 MR. KRESS: I think the barium is a lot
18 higher compared to the O2 type level. It bothers me
19 to say a little higher.

20 MR. CLEMENT: For barium I would say
21 independently on the MOX issue you still have data
22 from PHEBUS and data from VERCORS which are not
23 consistent. We have some hypotheses about that, about
24 interactions with zirconium, with elements coming from
25 stainless steel that have not yet been confirmed.

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1 There is still a question about barium for
2 thermochemistry and things like that that could defer
3 in MOX fuel and you already have the question for
4 future fuel.

5 MR. KRESS: Antimony, for example. It
6 goes all over the place. I don't understand it.

7 MR. POWERS: Fortunately the inventories
8 on the antimony are so low.

9 MR. KRESS: It was just an example.

10 MR. BOYACK: David.

11 MR. LEAVER: I think most of these points
12 have been made but I'll just kind of summarize it.
13 For the volatiles even though there were some
14 conflicting experimental results, it was, I think, in
15 my mind hard to ignore RT-2, even though we couldn't
16 explain why we didn't see that result for HT-1 versus
17 RT-7 so there was a data point.

18 In addition to the volatiles with an LEU
19 core assemblies were releasing most of the inventory
20 from the fuel. It was possible to make reasonable
21 estimates for the MOX. Even if we're wrong, we're not
22 very wrong.

23 For the low volatiles there's two
24 problems. One is we don't have -- we essentially have
25 no data even though we may suspect that there is some.

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1 I would be surprised if the differences were
2 significant between LEU and MOX but we don't know
3 that.

4 There certainly is this issue of at least
5 possibly higher oxygen potential. Just how
6 significant that turns out to be I don't know.
7 Bernard made an excellent point about the fuel
8 microstructure being different and that as an impact.
9 So no data.

10 Secondly, the LEU releases are very low
11 fractions so there is room if one believes the
12 different phenomenon could have an impact. It could
13 have a significant change in the release. For both
14 those reasons I think we are not -- we really don't
15 have a basis at this point in this meeting to even
16 make judgements on this.

17 MR. GIESEKE: I think the differences
18 might be significant in some cases. Right now if you
19 forced me to put a number, say, on early in-vessel
20 barium, I would look at the order of magnitude that we
21 have there.

22 MR. KRESS: Yes, order of magnitude.

23 MR. GIESEKE: That's about where I'd guess
24 it but there's no firm basis for that. That, I think,
25 is significant. I may be wrong.

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1 MR. KRESS: And just as a comment on that,
2 I would probably do each one up an order of magnitude
3 in spite of the fact that some go one way and some go
4 the other way. That's not good enough.

5 MR. BOYACK: As I listen to sort of the
6 comments here, let me just sort of tell you what I
7 have heard in the pooling. There are perhaps three of
8 you, Dave, Tom, and Bernard that say it's just too
9 early to do anything by way of numbers.

10 MR. KRESS: Other than upping the order of
11 magnitude.

12 MR. BOYACK: Well, that was my second one.
13 I basically heard Dana say that he would establish a
14 trend line at least. I guess I've heard a little bit
15 of that, but the nature of the trend line sounded
16 quite different to me, where Dana has said, "Well, I
17 think I have a sense of which way to go." The others
18 I just heard, well, it was almost an uncertainty
19 statement. "Since I'm uncertain, I'm going to give it
20 a larger number."

21 MR. KRESS: There is certainly a lot to be
22 said about Dana's trend lines but I've been surprised
23 too often in the past when the data comes in and goes
24 the opposite direction. I would err on the
25 conservative side by upping the amount, even though I

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1 know some of them probably are not going up at all
2 like the cerium. Some may go down maybe. I would
3 just err on -- what I would do is err on the
4 conservative side and up them all by another
5 magnitude.

6 MR. BOYACK: So it's this sort of going
7 around the table and hearing the view that suggest to
8 me that trying to create numbers creates more problems
9 than solutions for these groups at the present time.

10 MR. LEAVER: That would be my view. It
11 does create more problems because I think people would
12 have to probably increase these release fractions
13 significantly and across the board probably it's not
14 right. Then what do you do with it? It's really not
15 something you can use.

16 MR. KRESS: I think upping the barium and
17 strontium an order of magnitude, which is what I would
18 do, has significant consequences in terms of source
19 terms, particularly for the strontium.

20 MR. LEAVER: Twenty percent release is
21 trying enough.

22 MR. KRESS: That's a lot and that has lots
23 of consequences.

24 MR. LEAVER: You keep talking about barium
25 and strontium. You did that yesterday and that's

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1 because you're looking at the release rate for the
2 cesium and RT-2. Why are you focused on sparing the
3 strontium so much?

4 MR. KRESS: I'm looking at the data and
5 the slides that Bernard made.

6 MR. LEAVER: You mean the less than 15
7 percent statement? What data are you talking about?

8 MR. KRESS: The other one is the RT-7
9 data. He had some qualitative statements that I used.

10 MR. LEAVER: Okay. Right.

11 MR. KRESS: Then I'm also factoring in
12 what I know about relative volatilities and how those
13 might behave relative to the alkali metals. For
14 example, I have some metal volatilities in my mind.
15 If I up the alkali metals a certain amount and up the
16 barium and strontium a certain amount relative to them
17 because I have this model in my mind and it goes up an
18 order of magnitude in my mind.

19 I mean, as a guess it probably doesn't go
20 up maybe five times or three times. What I'm saying
21 is what I would have to do is make it an order of
22 magnitude to be conservative because I don't don't how
23 to refine it to that level.

24 MR. LEAVER: I guess that's the problem.

25

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1 MR. KRESS: The other thing, just for the
2 record, in all these source terms we have arbitrarily
3 constrained ourself to make these things add up to one
4 because of release fraction type things. I think
5 that's a real mistake.

6 We shouldn't have done that because it
7 really limits your ability to define a design basis
8 source term that is applicable over a whole range of
9 accident conditions. I, for one, would rather not
10 constrain myself to having to say is that up to one.
11 I would double count lots of places.

12 For example, the late in-vessel, I would
13 base it on those sequences that have a lot of
14 deposition and I would get a big number. Early in-
15 vessel I would base it on those sequences that don't
16 have a lot of deposition so I would be double
17 counting.

18 I think we made a mistake in not doing it
19 that way but that's the way the old 1465 was done and
20 we're being consistent with it. People always
21 question, "How can you do that? It adds up to more
22 than one."

23 MR. CLEMENT: With what we did in France,
24 we based on source term evaluation on sequences with
25 low deposits so we've got a set of values for that.

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1 Now we are processed for treating the revaporization
2 processes that could be important in other sequences
3 as a sensitivity for delayed source. It's another
4 approach.

5 MR. KRESS: That's the right way to do it.

6 MR. CLEMENT: That's another approach.

7 MR. POWERS: I guess one of the questions
8 I would ask goes like this. Suppose you don't put
9 numbers in there but people are going to have to do
10 some analysis. They are going to have to put some
11 numbers in. Somebody has a gun at their head so let's
12 get the analysis done and get it submitted. Is it
13 less misleading to give them nothing to guide that by
14 or something to guide it by?

15 MR. KRESS: My proposal is to put it in
16 later at a later meeting after we get another data to
17 guide our judgement.

18 MR. POWERS: I guess what I would ask is
19 at your later meeting is starting with a light table
20 better than starting with a table that had some
21 preliminary thoughts in it.

22 MR. GIESEKE: We talked about the time
23 requirements and it was like a year and a half before
24 anybody wanted to use these numbers. That's not true?

25 MR. LEAVER: Well, Steve Nesbitt said they

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1 were going to submit the schedule to submit the
2 license amendment at the end of 2003 which would mean
3 they probably ought to be doing calculations in the
4 spring of 2003 which is roughly a year from now.

5 My sense was, and, Steve, correct, me if
6 I'm wrong, this group if it were to go along the lines
7 that Tom said which is try to get some data. I don't
8 know what that process is but can we have six months
9 or something like that to assemble this French data
10 that we would be able to provide some numbers. I
11 certainly think Dana's point is a good point. I mean,
12 in some respects a blank table is maybe --

13 MR. KRESS: What Dana is saying is we
14 could go around and get these. For example, when you
15 got to me I would up the order of magnitude and Dana
16 wouldn't. He would be changing some of them up and
17 changing some of them down and holding some of them
18 steady based on his chemistry model.

19 I don't know what the rest of you guys
20 would do. We could put numbers in there and maybe put
21 an asterisk for those explaining that these are
22 subject to review and change or something. That would
23 be one option.

24 MR. BOYACK: Richard Lee commented
25 yesterday, I believe. He made a statement about

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1 process, I believe, that led me to believe that the
2 NRC was close.

3 MR. POWERS: They've been close for five
4 years.

5 MR. BOYACK: You would take exception with
6 close then?

7 MR. KRESS: The trouble I see with Dana's
8 concept, one trouble is that too often I've seen when
9 you put them down on the table, that's it. It never
10 gets changed and people disappear with it and we have
11 no more meetings and they never get changed. That's
12 a danger inherent in that.

13 MR. BOYACK: When I first approached this
14 activity, since I don't approach it much from an
15 expert rather than just a facilitating approach, it
16 was interesting to hear the initial dialogue regarding
17 the PWR source term. There was some question in the
18 minds of the people I talked to about whether the
19 panel would be willing to go ahead and put numbers
20 down and you've done that.

21 Then in a quick fashion we went through
22 and did the BWR. Now we come to this area where there
23 is less data for the MOX fuel and you went through a
24 good portion of the table. When you came to the point
25 that we are now, these last four groups, and there was

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1 some discussion about that, it gave me pause for
2 thought that the panel has been willing to do it to
3 this point because you felt good enough about doing it
4 that you could proceed. When we came to this point,
5 you have a different perspective.

6 I wanted to make sure we dealt with that
7 perspective because I tend to hold the view that once
8 you get these numbers down, they are very hard to
9 change because if nothing else, if somebody goes ahead
10 and finds a way through the process with those
11 numbers, then even if they've got better numbers,
12 until they get further down the path, they say, "Okay,
13 we got through the process once. Let's just do it
14 again even if it causes some pain."

15 Eventually if there's enough data around
16 and there's cost benefits to it, then they will go
17 through the process once again.

18 MR. LEAVER: Would it be -- somehow if we
19 could make this happen. I'm not sure how but maybe we
20 could. It's a pretty significant enterprise that we
21 all got together here for three meetings and it's
22 costing certain organizations money to do that. I
23 presume that people are going to pay some attention to
24 what we say.

25 I think one of the things we need to say

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1 loud and clear is let's get this data. Maybe people
2 have been sort of trying to do that for several years
3 and it hasn't happened. Well, damn it, it's really
4 important because we're sitting here and we're being
5 asked to make judgements. We're saying we really
6 can't do that unless we have this data. What is the
7 most effective way we could give that message to the
8 right people? Maybe the right person is sitting right
9 here.

10 MR. SCHAPEROW: That is one of the reasons
11 I wanted to have a little discussion later about what
12 are some of the themes -- overriding themes from the
13 meeting. This is one that comes out loud and clear.
14 Mark's data is very important.

15 MR. LEAVER: And Dana's point is a good
16 point. I mean, we've been hearing apparently that
17 this data is going to come for years and years and it
18 hasn't come. In fact, it's going to take a lot longer
19 to get it. Our plan here isn't going to work because
20 we're not going to have anymore information than we
21 have now.

22 MR. BOYACK: There are two sides to a
23 negotiation from the release of data. Those who have
24 and those who have to provide something to receive it.
25 We all have individual perspectives but my feeling is

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1 since so much has been invested in this activity
2 today, a blank table will have more incentive to go
3 out and negotiate seriously than a numbered table.

4 MR. LEAVER: I think that's right.

5 MR. SCHAPEROW: Would the panel be
6 amenable to providing a range for each of these
7 values?

8 MR. NESBITT: Can I make a comment here?
9 It's something that I don't know that everybody has
10 thought about but I certainly have. First of all, I'm
11 very sensitive to the concept of if you put numbers
12 down, they take on a life of their own and it gets
13 very difficult to modify them later, even in the
14 presence of better information. I've seen it time and
15 time again. I see no reason why that trend is going
16 to change.

17 The second point is everything that has
18 gone on in this meeting is going to be used in a
19 licensing proceeding against us. There's a formal
20 transcript. The intervenors are going to pour over
21 this transcript -- he just came in the door -- and we
22 will be fighting this in front of the Atomic Safety
23 Licensing Board.

24 I have heard that members of the panel
25 sort of bring different perspectives into this concept

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1 of giving some ratings now even though there's a
2 general feeling that there's an insufficient amount of
3 data to do that. One concept was sort of consistent
4 with what I would say NURGEG 1465 says which is we're
5 not trying to be conservative here. We're trying to
6 be representative and this is what I think is going to
7 happen.

8 Another concept is I just don't know so I
9 up everything significantly and that will have an
10 impact. I'm not saying either one of those concepts
11 is right or wrong but when you go in to this kind of
12 enterprise with different fundamental perspectives on
13 that and how you're going to do it, you almost
14 guarantee that the results are going to be misleading
15 and used inappropriately. That's my speech.

16 MR. POWERS: Would that I had a dollar for
17 everything that I've done that's been misused or used
18 inappropriately.

19 MR. BOYACK: So, anyway, unless the NRC
20 otherwise directs, I'm not inclined to push for
21 numbers.

22 MR. SCHAPEROW: I guess I didn't really
23 get any response to that question. Maybe I did.
24 Maybe a range of numbers.

25 MR. KRESS: I think it's just as hard to

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1 do a range as it is to give a range of numbers.

2 MR. LEAVER: I don't think that solves any
3 problems.

4 MR. POWERS: Let Tom give you his numbers
5 and I'll give you mine.

6 MR. KRESS: That's all right. That's
7 going to be arranged.

8 MR. SCHAPEROW: We don't want the cerium
9 numbers. That doesn't do anything for us.

10 MR. KRESS: Believe me, I'm not saying
11 we're going to be overly conservative when I up these
12 things.

13 MR. POWERS: You don't even want them to
14 add up to one.

15 MR. KRESS: That's right. I don't want
16 them to add up to one. If I had to say right now for
17 the barium and strontium, I would put .1 which is
18 likely it will remain to.

19 MR. POWERS: That's not such a bad number.

20 MR. KRESS: Yeah.

21 MR. POWERS: .1 could be released from the
22 fuel pretty easily actually.

23 MR. KRESS: That's what we're basing it on
24 and Dana might do the same thing. For the nobel
25 metals, I don't think they matter that much so I just

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1 up the order of magnitude on general principles. Dana
2 would probably disagree with that even though they --
3 I don't think when you get down to the noble metals,
4 cerium, and lanthanides, up in those numbers there an
5 order of magnitude makes any difference.

6 MR. SCHAPEROW: How about the ex-vessel
7 releases? I've heard discussion before about those
8 are typically driven by niobium burst.

9 MR. KRESS: The ex-vessel releases I would
10 probably keep the same.

11 MR. SCHAPEROW: Oh, then we can put it a
12 little more on the table then. I hear we're mostly
13 focusing on the in-vessel right now.

14 MR. LEAVER: The gap and early in-vessel
15 is what NRC and the licensee need to do, radioactive
16 design basis accident calculation. If you can't do
17 that, you really haven't solved the problem.

18 MR. LAVIE: Does it focus -- the ability
19 to just position the ex-vessel even for a qualitative
20 statement may be useful in focusing the negotiations
21 or additional research on the areas where we need the
22 data worse as opposed to just a blank page.

23 MR. LEAVER: You need the data during in-
24 vessel core damage progression. That's what you need.

25 MR. BOYACK: Were you here yesterday,

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1 Steve? We had given the panel members an action item
2 to try an individual letter on research needs which
3 will be included in the report.

4 MR. LAVIE: One thing I wanted to throw
5 in. Steve has pointed out his time schedule. It
6 needs to be noted that the agency is already working
7 on the environmental impact statement for the fuel
8 fabrication facility. Part of that environmental
9 impact statement has to address the indirect effects
10 which includes the use of fuel in the reactor.

11 Bob Martin, who isn't here, has taken a
12 stab at writing that section. It's logic qualitative
13 and as time goes on I'm sure we're going to get pushed
14 in the direction of making those harder numbers. It
15 isn't just 2008 we're looking at.

16 MR. LYMAN: May I make a statement? I
17 think I got the gist of this. Duke is requesting that
18 you not put any numerical values down?

19 MR. BOYACK: Absolutely not. That's not
20 even close.

21 MR. SCHAPEROW: No. This panel is
22 operating independently of Duke.

23 MR. BOYACK: Just read the transcript when
24 it comes out. The net of this is that we started out
25 based upon some discussion late last night and this

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1 morning with a concern by individual panel members
2 that there was insufficient data for these last four
3 groups for them to go ahead and create numbers. Duke
4 had absolutely no statement until you came in and
5 there's been now approximately 45 minutes of
6 discussion on the transcript about this issue.

7 MR. LYMAN: However, they are crucial. I
8 did an analysis of the sensitivity of the consequences
9 in a severe accident to the actinide release fractions
10 from MOX fuel and there is a substantial effect. The
11 fact is if you have a large range because the
12 uncertainties, that is something that you state so the
13 public is aware.

14 MR. LEAVER: That has been stated. We've
15 been talking about that the last 45 minutes and the
16 end of the day yesterday.

17 MR. BOYACK: The real key here, Jason, is
18 at this point I don't make any decisions other than to
19 try and draw from the panel a perspective that would
20 tell us where to go. Now, with respect to PWRs, BWRs,
21 and the first increment of MOX we've been able to go
22 forward to the point where we put either eclectic or
23 individual numbers down.

24 My hearing of what's been said thus far is
25 that it's difficult. The numbers that would be put

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1 down don't have an underlying database that would lead
2 people to put down numbers that had some sense of
3 value to them because they really did capture
4 underlying data.

5 It's just that I hear them saying the data
6 is partially out there, has to be analyzed, but if
7 it's analyzed and used, then it could lead us to a
8 place where they would probably be willing to put
9 numbers down even though that would still be a partial
10 database.

11 MR. SCHAPEROW: I guess I'm still
12 struggling with the value of tackling a gap in ex-
13 vessels. We might be able to make some progress in
14 those areas.

15 MR. LEAVER: I understand the point you're
16 making. The point I'm making --

17 MR. SCHAPEROW: I kind of agree with Steve
18 which is if we could really narrowly focus what the
19 research need is which is --

20 MR. LEAVER: The gap is already tackled.

21 MR. SCHAPEROW: I think there's no reason
22 to believe that there's going to be a gap, at least
23 for these groups.

24 MR. LEAVER: Okay. If each panel member
25 says that, that's fine. I want to get that on the

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1 record that they say to really focus the research.

2 MR. POWERS: I think yesterday we pretty
3 much agreed, at least two of us agreed formally that
4 if we do a LOCA test with MOX we ought to measure the
5 gap release.

6 MR. KRESS: That ought to be one of the
7 research items. I don't think I'm yet prepared to
8 zero all those columns for the gap.

9 MR. POWERS: You really want to put
10 something in for the last four?

11 MR. KRESS: No. I really don't. I would
12 like to have some data first.

13 MR. POWERS: What kind of data are you
14 going to get?

15 MR. KRESS: We're not going to get any
16 data.

17 MR. POWERS: Go ahead and multiply those
18 by 10, Tom, and that will make you happy.

19 MR. KRESS: You're making me feel really
20 good.

21 MR. POWERS: You have the order of
22 magnitude, he feels happy and we're happy.

23 MR. BOYACK: Let me ask the question this
24 way. Did I hear, at least, that either on gap release
25 or some of the later things it is possible to put

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1 numbers down but it's the early in-vessel that's the
2 big problem?

3 MR. KRESS: Let me talk about the gap
4 release. Dana has articulated this concept of the
5 islands of plutonium and some of them are located very
6 near the surface of the fuel where the gap is, or
7 places that could be considered part of the gap. When
8 there's fission you get recoil. You might kick either
9 some of the fission products into that gap and it's
10 not a diffusion process anymore.

11 It doesn't matter that these are low
12 volatiles. Some fraction of them are close enough to
13 the surface to be kicked into the gap. Maybe they're
14 not very mobile even and may not be releasible but
15 what you've got is these noble gases and the fuel gas
16 that can sweep things out that are in there. To my
17 mind, because this concept that you may have the
18 ability to get some of that in there, I am disinclined
19 to say it is absolutely zero.

20 I know it's a small level and you could
21 probably but some number on it based on the
22 distribution of PuO in the fuel. With the probability
23 of a recoil in that particular direction you could
24 probably come up with a number. I haven't done that
25 exercise but I don't thin it's zero.

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1 MR. POWERS: It's the same problem with
2 the entrainment modeling. You can agonize over how
3 uncertain you are on it, but you are uncertain on a
4 real, real tiny number.

5 MR. KRESS: That's right.

6 MR. POWERS: Being two orders of magnitude
7 uncertain on a 10 to the minus 10 release fraction
8 really doesn't bother me very much. It's like these
9 zeros that exist up here. Yeah, I know there's some
10 variant in there.

11 In fact, Dick Lorentz when he measured --
12 when he did those experiments in Oak Ridge he actually
13 reported -- I don't think he reported barium but he
14 reported a couple of others.

15 MR. KRESS: The question one asks is if he
16 put a number in there, does it make any difference?

17 MR. POWERS: It seems to me -- I mean,
18 there's no twist of fate in chemistry that I can see
19 that results in those numbers being --

20 MR. KRESS: And the real thing that I
21 would think there is not much chance of actinides
22 getting in there.

23 MR. POWERS: There's an inventory. I
24 guarantee you when you flow down the rock you carry
25 some atoms out but it's damn few atoms because the

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1 temperature is so low at the time of the gap release.

2 MR. KRESS: I guess we would be willing to
3 put zeros in the gap.

4 MR. SCHAPEROW: Does anyone not want to
5 put zeros in the gap?

6 MR. BOYACK: I'm quite willing to go
7 through the four tables and deal with what we can.

8 MR. KRESS: I'm willing to put zeros in
9 the gap and I'm willing to keep the ex-vessel just
10 about like it is because I don't think the difference
11 between the MOX and the regular fuel makes any
12 difference in excess.

13 MR. BOYACK: That information would focus
14 the attention.

15 MR. KRESS: Late in this I'm almost
16 willing to keep it the same because I don't think
17 there's enough of those things to play it out. The
18 one that bothers me that I don't really know how to do
19 is the early in-vessel.

20 MR. BOYACK: Might the ex-vessel change
21 because the inventory in the melt changes?

22 MR. KRESS: Of course it has an effect on
23 it.

24 MR. BOYACK: I mean, if you're going to
25 talk order of magnitude on some of those --

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1 MR. KRESS: But going from .02 to .01
2 doesn't make any difference.

3 MR. GIESEKE: It shouldn't change the
4 fraction, should it?

5 MR. POWERS: Fraction of the total so it
6 does screw around with the numbers a little bit.
7 Again, when you are releasing one or two percent, or
8 even 10 percent, it's not a big deal.

9 MR. KRESS: So basically I've come down to
10 the only one I'm really having a lot of difficulty
11 with is there an in-vessel.

12 MR. POWERS: I actually have some
13 heartburn about the ex-vessel simply because I put the
14 can of residual fuel. It comes in but there's only
15 one element that -- one group of elements that
16 bothered me there and that's the noble metals.
17 Everything else is about the same.

18 MR. BOYACK: Let's see where we go with
19 this. Panel members are obviously allowed to say they
20 don't feel they can agree with that number. Let's
21 see. Okay. We're going to go one by one through
22 these and we'll start again with Dave.

23 MR. LEAVER: I have nothing I can add to
24 this.

25 MR. BOYACK: No entry. How's that?

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1 MR. LEAVER: Yep.

2 MR. NESBITT: Excuse me just a second.
3 Didn't you say a minute ago that you thought it would
4 be zero?

5 MR. LEAVER: Are you only doing the gap?

6 MR. BOYACK: That's all I'm going to do.
7 Well, what we're going to do is go down each one.
8 We'll do it in turn.

9 MR. LEAVER: Are we talking ourselves into
10 coming up with numbers here?

11 MR. BOYACK: No. Well, I don't think so.
12 What I heard was people say -- Moshen, you didn't
13 speak but I heard several people say -- well, two,
14 right? -- that they would be willing to put down a
15 number for gap release.

16 I heard Tom then say on early in-vessel he
17 wouldn't put down a number. I heard him talk also
18 bout the ex-vessel and the late in-vessel. At this
19 point I'm just going to take a moment and see what
20 people are willing to do. I have no problem with you
21 saying no entry.

22 MR. POWERS: He knows where we are. He's
23 just worrying about the price.

24 MR. BOYACK: I'm not sure what to do with
25 that so I won't do anything.

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1 Jim, your thoughts?

2 MR. GIESEKE: No entry.

3 MR. BOYACK: Okay.

4 MR. GIESEKE: All capital letters.

5 MR. BOYACK: Dana.

6 MR. POWERS: Ten to the minus fifth.

7 MR. BOYACK: Really?

8 MR. POWERS: Zero.

9 MR. BOYACK: You wish to say any words
10 with that?

11 MR. POWERS: Gap release occurs when the
12 temperature is very low. These things are not very
13 volatile. There is some inventory. There is a gap in
14 these things but it's not going to vaporize at this
15 temperature. It pales in comparison to the curies I'm
16 getting from the noble gases, the halogens, and the
17 alkali metals. I'm dead serious about 10 to the minus
18 fifth. I actually think that's the number but why
19 even bother to force somebody to put that into a
20 spreadsheet.

21 MR. BOYACK: Tom?

22 MR. KRESS: Ten to the minus five. Zero.

23 MR. BOYACK: Any difference on the reason?

24 MR. KRESS: No. Exactly the same reason
25 Dana had. Exactly.

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1 MR. CLEMENT: No value but keep what I was
2 saying that these flags for differences for what was
3 expressed before and here is no flag.

4 MR. BOYACK: No flag. Okay. Early in-
5 vessel. David, can I just assume you're no entry on
6 all of these?

7 MR. LEAVER: No entry.

8 MR. BOYACK: I'll speak for Jim. Dana?

9 MR. POWERS: .01.

10 MR. BOYACK: Okay. Let's spin out a
11 little bit of rationale.

12 MR. POWERS: I think fuel is inherently
13 oxidizing. If I'm going to jack up the noble metals
14 releases in response to that oxidizing character, I
15 better suppress the barium releases, an equal response
16 to that oxidizing character.

17 I can be dead wrong on this because if the
18 M-5 clad is not heavily oxidized on the inner surface
19 and aggressively attacks the fuel, it produces a
20 substantially reducing environment and the barium
21 separates out as a distinct phase and it can be
22 extensively released.

23 All that is saying is that I need
24 information on how M-5 clad creates core degradation.
25 It's independent of the MOX. It's M-5 clad. So is

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1 that okay? Here's a number. Put a big star beside it
2 and say "stay tuned" because I recognize I could be
3 wrong, drastically.

4 MR. BOYACK: So you're saying your
5 confidence is not high.

6 MR. POWERS: No.

7 MR. KRESS: .1. Confidence is not very
8 high based on some observations, qualitative results
9 of the French data, and some observations made at Oak
10 Ridge in the past, and the fusion product release
11 model for MOX that I have in mind.

12 MR. LEAVER: Tom, I want to ask about this
13 again. One thing you said about this is you have in
14 your mind a correlation between the volatility of
15 cesium, for which we do have at least one data point,
16 and strontium and barium and that is something you are
17 thinking about.

18 The other thing you said is the French
19 data. I don't believe there is any French data that
20 suggest higher barium or strontium release. I don't
21 understand what you mean by that. I'm saying there's
22 nothing to suggest higher than LEU.

23 MR. KRESS: I don't recall if I ever saw
24 the data. It might have been at the last meeting.

25 MR. LEAVER: There is a statement on RT-7

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1 that says barium behaves as semi-volatile.

2 MR. KRESS: It's semi-volatile. That's
3 like .1.

4 MR. LEAVER: All right. Here I am trying
5 to say what Bernard's slides mean. Maybe you should
6 ask Bernard what they mean.

7 MR. KRESS: I have confidence in his
8 numbers. I'm interpreting things.

9 MR. LEAVER: If you just listen for a
10 minute to what Bernard has to say.

11 MR. CLEMENT: Two different flags for
12 barium. The flag is not specific to MOX, okay? I
13 could have said that before for high burnup fuel
14 because we have data from annealing tests and they are
15 giving high release of barium, and data from PHEBUS
16 giving low release of barium. We think this is linked
17 to interactions between barium and materials such as
18 zirconium oxide or transition metals. This is still
19 to be confirmed.

20 MR. KRESS: When you have conflicting data
21 you err on the high side.

22 MR. CLEMENT: So this is not specific to
23 MOX.

24 MR. LEAVER: That was my only point. The
25 same observation was made for high burnup fuel and we

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1 ended up at .02.

2 MR. KRESS: My feeling is MOX is a lot
3 like high burnup fuel in the way it behaves.

4 MR. LEAVER: Okay. But we did end up with
5 .02 for high burnup fuel.

6 MR. CLEMENT: For barium for the source
7 term maybe it's not so important. It could become
8 important if you want to know where is the decay heat
9 that has some effect. For strontium effects and so on
10 you put high or low values.

11 MR. KRESS: I think it's significant for
12 strontium.

13 MR. CLEMENT: For strontium I would say
14 the flag is that we have not yet analyzed in
15 sufficient details the results. This is just for
16 technical point. You know that strontium is not
17 measurable by gamma spectrometry so we have to analyze
18 the results of measurements.

19 MR. POWERS: And both barium and strontium
20 releases from the fuel substantially affect the late
21 in-vessel release, especially the strontium. It's
22 very nice because it involves heat and deposit as
23 opposed to the gamma which is spread all over God's
24 half acre.

25 There's another thing. You form a very

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1 stable urinate with the barium and strontium species.
2 It goes down on surfaces and just sits there and
3 collects. In itself it doesn't do anything but, boy,
4 it does things to everything around it. What we
5 succeed in doing is saying there's an order of
6 magnitude of uncertainty here.

7 MR. BOYACK: Okay. Ex-vessel. Dana.

8 MR. POWERS: .1.

9 MR. BOYACK: Comments?

10 MR. POWERS: It's driven by the zirconium
11 presence in the first initial transience. Zirconium
12 reduces everything down to barium metal and barium
13 metal vaporizes. It's really interesting because if
14 you do an experiment where you just take quarter
15 break, you know, UO₂, pour in a little barium, pour in
16 a little concrete and heat it up, you would get zip
17 barium.

18 You get none whatsoever because it will
19 form barium silicate that has a really low volatility.
20 Do the same experiment with some zirconium metal and
21 you'll have all the barium in your lap. It's
22 interesting. Makes life fun.

23 MR. CLEMENT: For strontium 10 percent of
24 the amount present in release strontium. Ten percent
25 of the amount present in release strontium. For

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1 barium 2 percent of the amount present in release
2 strontium. That's basically the same fractions as for
3 LEU fuel.

4 MR. POWERS: I think that's the right
5 answer. MOX has completely disappeared at this point.

6 MR. BOYACK: Okay. Late in-vessel.

7 MR. POWERS: Zero.

8 MR. BOYACK: Tom.

9 MR. KRESS: I've got quite a bit coming
10 out of ex-vessel. I would put .05 as just a number in
11 there.

12 MR. POWERS: It's entirely possible
13 because the variant urinate with hexavalent uranium is
14 actually a pretty volatile compound so if we get
15 enough flow over the piping system and you put some
16 stuff down, you can move things around. It's kind of
17 interesting. Strontium urinate with nexavalent
18 uranium are practically not volatile at all. The
19 barium is just polling radii.

20 MR. GIESEKE: Don't leave yet. I'm not
21 done this last table yet.

22 MR. BOYACK: Now you have something to
23 say. Let me go back.

24 MR. GIESEKE: That's what I said. I said
25 don't leave yet.

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1 MR. BOYACK: And I was gone, right?

2 MR. GIESEKE: I have to admit that
3 yesterday before I left here I went through and put
4 numbers on all these so I've made my statement today.
5 I'll give you yesterday numbers. I'll just read them
6 off from the top down.

7 MR. BOYACK: Before you do this, it will
8 be on the transcript.

9 MR. GIESEKE: That's fine. You can put
10 them on here. I think the important thing is that all
11 the statements have been made about the lack of
12 confidence or the lack of data to support some of
13 this.

14 Okay. From the top down what I had was 0,
15 .1, .1, and zero which it turns out was pretty close.

16 MR. KRESS: You did a good job.

17 MR. POWERS: Tom thinks you got those
18 numbers just about right.

19 MR. GIESEKE: Is that right?

20 MR. POWERS: And you're within my
21 uncertainty range.

22 MR. GIESEKE: I can't be the only one
23 without a number.

24 MR. POWERS: Yes, you can.

25 MR. KRESS: That may indicate you're the

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1 smartest one we've got.

2 MR. POWERS: You can just say all less
3 than one.

4 MR. KHATIB-RAHBAR: Jim, did you say zero
5 for ex-vessel?

6 MR. GIESEKE: Yeah. I could qualify that.

7 MR. KHATIB-RAHBAR: What did you say?

8 MR. GIESEKE: Late in-vessel I had a zero
9 yesterday. Ex-vessel is .1.

10 MR. BOYACK: Let me just announce we stay
11 here. That means we've got much more flexibility. We
12 don't have to pick up things and pack them off in the
13 corner.

14 MR. KRESS: I was looking forward to
15 moving.

16 MR. BOYACK: You can go upstairs one
17 floor.

18 MR. KRESS: We're overlapping then until
19 they let us out at quarter to 12:00.

20 MR. BOYACK: We'll excuse you. Or, as
21 another statement, we'll call your bluff. I have
22 another idea. Why don't we stay here and you can give
23 a toast here.

24 MR. KRESS: Yeah, but I'm not a master.

25 MR. BOYACK: We'll accept amateurs.

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1 MR. KRESS: Toast amateurs.

2 MR. BOYACK: Very good. I am ready to go
3 on to the next thing. Okay. Jim.

4 MR. GIESEKE: I'm going to go no entry on
5 all of these. I've run out of information.

6 MR. BOYACK: Dana.

7 MR. POWERS: Okay. Zero for the gap
8 release. Now here for the high burnup fuel we chose
9 to distinguish between molybdenum, technicium versus
10 rhodium ruthenium.

11 MR. BOYACK: You want to distinguish them
12 again?

13 MR. POWERS: I think that's probably a
14 valuable exercise to do.

15 MR. BOYACK: What was the first group?

16 MR. POWERS: Moly and technicium.

17 MR. BOYACK: TC.

18 MR. POWERS: And I put -- I have my
19 release fractions in the containment and 0.1 for
20 those. And for the ruthenium rhodium group I put that
21 at 0.08.

22 MR. BOYACK: Okay. You want to have any
23 comments?

24 MR. POWERS: The uranium matrix
25 surrounding the particles where fission products are

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1 because they end up there by recoil and then matrix is
2 substantially oxidizing and creates the volatile forms
3 of these.

4 MR. BOYACK: Uranium matrix surrounding
5 particle for fission products creates what did you
6 say?

7 MR. POWERS: Substantially oxidizing fuel
8 creates the volatile forms of these radionuclide.

9 MR. BOYACK: What I'll do is make it a
10 comment to go with the transcript where I really can
11 pick it up. This flags it. Okay. Let's see. We
12 started down so we might as well have you go through
13 the rest of them.

14 MR. POWERS: .01.

15 MR. BOYACK: Same thing here?

16 MR. POWERS: Same groupings but the number
17 is the same for both of them.

18 MR. BOYACK: Okay, .01.

19 MR. POWERS: 01.

20 MR. BOYACK: And late in-vessel.

21 MR. POWERS: Here for the moly .1. For
22 the ruthenium rhodium .01.

23 MR. KRESS: Does that imply the release of
24 the fuel as being .2?

25 MR. POWERS: At least .2.

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1 MR. KRESS: Okay.

2 MR. POWERS: Because that's what I was
3 going to use.

4 MR. KRESS: That's zero for me. I've
5 always considered moly and technicium as semivolatiles
6 because most of the time they get released under
7 oxidizing conditions. I would have put about a .1 in
8 there also.

9 MR. BOYACK: Are you going to want the
10 same two?

11 MR. KRESS: It doesn't matter. We'll put
12 .1 for both of them. I love things all together. I
13 like the .1 on the -- .01 on the ex-vessel because
14 I've got no reason to --

15 MR. BOYACK: For both of them?

16 MR. KRESS: Yes. I'll lump them together,
17 too. There I like the -- there's where I would make
18 a differentiation but I would use the .1 for moly and
19 technicium.

20 MR. BOYACK: And?

21 MR. KRESS: I have no basis for the other
22 one, the .01. I would have guessed that the ruthenium
23 oxide would be entirely volatile and not subject to
24 that much deposition and would have gone out early
25 anyway so the low number I like. I would keep it at

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1 .01.

2 MR. BOYACK: Any comments? Bernard?

3 MR. CLEMENT: Okay. No flag. Flag refers
4 to what I expressed in the numbers I've given for high
5 burnup fuel, not to the numbers of 1465.

6 MR. BOYACK: I'm sorry. I didn't quite
7 get that.

8 MR. CLEMENT: When I say no flag -- when
9 I say a flag, that means there could be a change
10 according to the numbers I have given for high burnup
11 fuel.

12 MR. BOYACK: Okay.

13 MR. CLEMENT: There's a flag according to
14 that and not to 1465. It should be fully clear.

15 MR. BOYACK: Okay. Got it.

16 MR. CLEMENT: No flag means if I had to
17 put a number, I probably would put the same as I had
18 given for the high burnup fuel. Flag means portion
19 maybe left to look at. I keep the separation between
20 the two groups. For moly technicium I will put a flag
21 and for rhodium no flag. That's preliminary for
22 within rhodium.

23 MR. LEAVER: Why no flag?

24 MR. CLEMENT: Because of the preliminary
25 analysis as compared to the numbers I have given for

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1 high burnup fuel and the time being without
2 preliminary analysis I don't see a big reason to make
3 a change. That's a long sentence. This is for the
4 total release. It will not separate. As I did in the
5 past for this group, I will not separate between in-
6 vessel, ex-vessel, and late in-vessel.

7 MR. BOYACK: Okay. So this is --

8 MR. CLEMENT: For early in-vessel that was
9 for total release. Just separated for barium and
10 strontium because release from MCCI are significant.
11 We think it's not the case for the others.

12 MR. BOYACK: So I've got total release for
13 the last one.

14 Dave.

15 MR. LEAVER: No entry.

16 MR. BOYACK: Okay. Dana.

17 MR. POWERS: Zero. Here would be the
18 distinction between the cerium neptunium group and the
19 plutonium group. Here I think that is probably
20 crucial to do it here for MOX fuel. The cerium
21 neptunium I take it as .01. For the plutonium .001.

22 MR. BOYACK: Okay.

23 MR. POWERS: That's okay. You got it
24 right. You read my mind. The last one you can make
25 zeros.

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1 MR. BOYACK: Me and Bill Gates.

2 MR. POWERS: That's an Apple you're
3 working on.

4 MR. BOYACK: Bill is ever present.

5 MR. POWERS: Omni present.

6 MR. BOYACK: I'll just add that to my
7 lexicon of misused words.

8 MR. KRESS: I'm going to cop out on you on
9 this one and say no entry. I think it is important,
10 though, to separate out the plutonium group there from
11 the cerium neptunium but I don't have any entry for
12 that.

13 MR. POWERS: You might want to put a
14 notation on there that I come up with this lower
15 plutonium release only because we're working on a low-
16 pressure accident sequence. If we were in a high-
17 pressure accident sequence, that plutonium would come
18 right back up because I have total faith in the
19 experimental investigations going on at Los Alamos
20 laboratory.

21 MR. BOYACK: Why the high pressure?

22 MR. POWERS: You get high pressure steam
23 in here and you'll start creating kerkorian vapor
24 phase hydroxides.

25 MR. SCHAPEROW: Don't forget about the

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1 vapor phase hydroxides by the high pressure steam.

2 MR. KRESS: Unparalleled in the area of
3 accelerator physics.

4 MR. BOYACK: What was the comment about
5 steam?

6 MR. SCHAPEROW: High pressure steam
7 reacting to form hydroxides.

8 MR. POWERS: Actually, all weapon systems
9 I've ever worked on have been livable weapon systems.
10 I'm only been up at Los Alamos twice in my life.

11 MR. BOYACK: Let's see. We're on ex-
12 vessel.

13 MR. KRESS: I am sure there are
14 observations having to do with MCCI when the early
15 zirc is present.

16 MR. BOYACK: When you take it and shake
17 them up and bounce them on concrete, it's pretty hard
18 to get less than 1 percent release.

19 MR. KRESS: I think that is probably my
20 impression of what you get from mechanical release.

21 MR. BOYACK: Late in-vessel?

22 MR. KRESS: Yes. It's mechanical release.
23 Those look like good numbers to me.

24 MR. BOYACK: For late in-vessel that's
25 okay?

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1 MR. KRESS: Late in-vessel I have no idea.
2 No answer at all.

3 MR. BOYACK: Bernard.

4 MR. CLEMENT: No flag here.

5 MR. BOYACK: Okay. No flag.

6 MR. CLEMENT: Then I keep separating
7 cerium and neptunium from plutonium. I put two flags,
8 one for cerium and one for plutonium. This is for
9 total release.

10 MR. BOYACK: Okay. Dave.

11 MR. LEAVER: No entry.

12 MR. POWERS: This is been an inverse Jean
13 Paul Sartre. Instead of no accent, there's no entry.

14 MR. BOYACK: Jim.

15 MR. GIESEKE: No entry. Post-modernism
16 existentialism. If you're a French existentialist,
17 you've got a depressed world view.

18 MR. BOYACK: Okay. You gentlemen realize
19 what this is? The last group. How fitting that Tom
20 starts.

21 MR. KRESS: I put zero in there. I would
22 for the ex-vessel put in the same thing I had for the
23 cerium group so I will put in ex-vessel. Same thing
24 as I had for the cerium group. There's some doubt
25 about whether the lanthanides are above the release.

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1 There are some volatile species you can get so I'm
2 just going to put no entry. I think the lanthanides
3 will be a little higher than the other release but not
4 very much higher.

5 MR. BOYACK: Dave.

6 MR. LEAVER: No entry.

7 MR. BOYACK: Jim.

8 MR. GIESEKE: No entry again.

9 MR. BOYACK: Dana.

10 MR. POWERS: 0.005.

11 MR. BOYACK: Any comments?

12 MR. POWERS: Yeah. It appears that these
13 lanthanides exhibit less volatility than the cerium
14 group. I'm just trying to reflect back. I can be
15 dead wrong on this.

16 One of my nearest and dearest friends is
17 LaO vapor species because when we were inspecting
18 VANESSA the people at Argonne told me that I had no
19 basis for hypothesizing such an obscure species so
20 motivated to show what horse's asses they would be, I
21 went back and did a complete literate search on LaO
22 and I found the first report of the particular
23 species. It's your volatile lanthanide. It was in
24 1924 so I accused Argonne of having a library that
25 hadn't been updated since 1924.

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1 MR. BOYACK: Okay. Now we move on --

2 MR. LEAVER: Hold it one second. Just so
3 I understand, the .005 you're saying is less
4 volatility. Did you mean for that number -- relative
5 to LEU that's a factor of 25 higher than the LEU
6 estimate. Is that what you intended?

7 MR. POWERS: Yeah, because those numbers
8 are horseshit.

9 MR. LEAVER: I'm not sure I understand
10 what you mean.

11 MR. POWERS: The lanthanide numbers that
12 they put in there were generated by pressure from an
13 analysis that was done by some people and they were
14 misinterpreted in some experiments.

15 MR. BOYACK: Ex-vessel.

16 MR. POWERS: .01 and zero.

17 MR. CLEMENT: No flag. Then I keep
18 separating lanthanum, europium, niobium and bromine
19 from the others.

20 MR. BOYACK: Help me on the symbols on
21 this.

22 MR. CLEMENT: Na, Eu, Nb, Br.

23 MR. BOYACK: Thank you.

24 MR. CLEMENT: From the others. I put flag
25 only on europium.

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1 MR. BOYACK: Okay.

2 MR. CLEMENT: That's for total release.
3 We already assumed in our numbers the higher release
4 so it is not inconsistent with your point.

5 MR. POWERS: Every time I try to calculate
6 europium releases I end up with high vapor pressure.
7 I could never understand exactly why.

8 MR. BOYACK: Okay. Well, that finishes
9 the tables. What I would like to do is take a 15-
10 minute break and come back at 10:25. By then we'll
11 figure out how to proceed.

12 (Whereupon, at 10:11 a.m. off the record
13 until 10:37 a.m.)

14 MR. BOYACK: Let's go ahead and talk a
15 little bit first about what we want to do for a
16 moment. First thing I'm going to leave in a few
17 moments and Jason is going to take over.

18 MR. KRESS: Chaos.

19 MR. BOYACK: In case it turns out that the
20 Mac approach to life is just too much for him, I have
21 transparencies and whatever so you can work with
22 those. Otherwise, he can go ahead and type here.

23 The thought here was that we would spend
24 the remainder of the meeting, maybe another eight or
25 10 hours, talking about conclusions and insights.

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1 Jason called them overriding themes but it did seem a
2 little stilted to put that in there.

3 You can do this sort of preform. We don't
4 have to be on any structure. If there are some
5 general comments regarding gap early in-vessel, ex-
6 vessel, fine. Or if they are specific to the
7 particular fuel type, then that's fine and we'll go
8 ahead and list them, too.

9 This thing will go on for a number of
10 pages depending on how much. The thought here is that
11 if we can go ahead and get some of these conclusions
12 and insight, it will help us to focus the report
13 better.

14 With that it becomes an open meeting. I'm
15 going to leave at 5 to 11:00. I guess you'll break at
16 noon for lunch. Come back at 1:00 and then we'll
17 finish up.

18 MR. GIESEKE: And you won't be back at
19 all?

20 MR. BOYACK: No. I'll be back at 1:00.

21 MR. GIESEKE: At 1:00.

22 MR. BOYACK: I'll be there to eat lunch
23 with you.

24 MR. GIESEKE: Oh, that's good. What are
25 we going to have?

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1 MR. BOYACK: I have no idea what's on the
2 menu here.

3 Okay. Anyway, if somebody would just
4 start.

5 MR. POWERS: The point I would make about
6 the gap release and connection with high burnup fuel
7 and with respect to MOX is if we do LOCA tests for
8 high burnup fuel or MOX, we really ought to measure
9 the fission product release and nail down the gap as
10 best we can. We'll lose what gets vented just in
11 reformulating the fuel, but you'll get some of that
12 material.

13 MR. BOYACK: Okay.

14 MR. KRESS: It's difficult to do those
15 tests. They are different than the tests you see that
16 VERCORS present. You're going to get a gap. You take
17 the fuel out of the reactor or irradiate it or
18 something and you can't bandage the clad.

19 MR. POWERS: In any kind of test you are
20 going to reformulate the fuel and you lose what you do
21 on the venting but I think you get insight into what
22 the gap release is.

23 MR. LEAVER: Is there a plan to do LOCA
24 tests? You guys have discussed that?

25 MR. POWERS: There's a French proposal to

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1 follow into the PHEBUS program to do what is called
2 PHEBUS LOCA. Bernard can probably tell you. Since
3 he's designing the program he can probably tell you in
4 great detail about it.

5 MR. LEAVER: Is this sirgraphsen test or
6 a true LOCA?

7 MR. POWERS: LOCA.

8 MR. LEAVER: ECCS type or some kind of
9 reflood.

10 MR. CLEMENT: LOCA includes reflooding
11 with ECCS. Not describing, not addressing every issue
12 for ECCS.

13 MR. BOYACK: What was the comment about
14 bundles with contrast to a few pellets? Is a bundle
15 test at all possible?

16 MR. POWERS: Yeah. These PHEBUS tests, I
17 think they use 15 rods.

18 MR. CLEMENT: For the time being we think
19 about two different configurations. There is one with
20 nine rods, one with 25 rods. In the interest of
21 performing bundle tests there are true interest but
22 not for source term. The first one is to have a good
23 gradual radio-temperature distribution. The second
24 one to see what is the effect of that reflooding.
25 That's not the source term, Masseur.

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1 MR. KRESS: The other comment is I think
2 there is need to confirm that M-5 pad behaves from the
3 standpoint of failure and mishap when the gap release
4 occurs to confirm that it behaves pretty much like
5 zirlo or zircaloy.

6 MR. SCHAPEROW: For the start of the gap
7 release phase?

8 MR. KRESS: Yeah. It may protect the
9 quantities because if it's more ductile, for example,
10 it may swell and give a path for release of the stuff
11 that's different from the others. It could affect
12 both quantity and the timing. It's just a
13 confirmation.

14 MR. GIESEKE: We talked a lot about the
15 duration of the gap release that might be different.

16 MR. BOYACK: But that was between what?

17 MR. GIESEKE: I think we need to take a
18 look at the M-5 cladding and more than just the first
19 opening of it, but also what we call the progression
20 of melting in it, if that differs, if it looks
21 different, because we've made pretty much an
22 assumption.

23 MR. KRESS: That doesn't have anything to
24 do with the gap. That's for something else.

25 MR. GIESEKE: The endpoint of the gap or

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1 the beginning of the early in-vessel, I guess. We
2 talked about matching these curves with different
3 slopes. That was kind of a fuzzy concept as I recall.
4 We talked a long time about that.

5 MR. BOYACK: What else?

6 MR. KRESS: For the early in-vessel I
7 certainly think it's very, very important to inquire
8 and analyze and understand. To me that is priority
9 No. 1.

10 MR. BOYACK: This is the VERCORS data?

11 MR. KRESS: Mostly VERCORS.

12 MR. LEAVER: FPT-2 would be nice.

13 MR. POWERS: It's not especially high
14 burnup fuel.

15 MR. LEAVER: FPT-2?

16 MR. POWERS: Yes. It's interesting.

17 MR. LEAVER: I guess good fission product
18 release data.

19 MR. CLEMENT: Not specific high burnup.

20 MR. LEAVER: Yeah, that's true. Just that
21 a test has been done 18 months ago and it would be
22 nice to see it.

23 MR. POWERS: You've got a ways to wait on
24 that one. It's four years after the report comes out
25 that you get to find out about it.

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1 MR. KRESS: And also on particularly the
2 early in-vessel, I think it's very important to point
3 out that data alone is not sufficient. You have to
4 translate that into a model and relate it to a whole
5 core accident. I think that's an insight that is very
6 important.

7 MR. BOYACK: So we'll translate data into
8 model and then --

9 MR. KRESS: Relate it to a whole core
10 accident.

11 MR. POWERS: It seems to me we need a
12 test, I mean, that determines the releases of the
13 volatile elements for the early in-vessel is the
14 corporate core-melting progression. We need a test in
15 which we are exposing fuel that has restructured at
16 the boundary. That means something with burnups on
17 the order of 60 to 75 gigawatt day per ton fuel.
18 Absolutely has to be over 55. Preferably 60 to 75.

19 MR. KRESS: I would like to see 70 at
20 least.

21 MR. POWERS: You said you have a
22 substantial restructure regime and see what it's
23 looking like. I don't know how that restructure
24 regime is going to interact with the clad. That could
25 be extremely different.

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1 It seems to me in the ex-vessel category
2 that the general feeling is that we have a fairly
3 good, at least qualitative understanding of the melt-
4 concrete release and it's not likely to benefit from
5 a whole lot more work. You could probably refine the
6 codes a little bit and get them up to the current
7 state of understanding.

8 The real issue is once you failed the
9 vessel, how does that fuel that remains in the core,
10 what does it do? Modeling perspective or experimental

11 MR. KRESS: I agree.

12 MR. SCHAPEROW: Some of these, actually
13 the one above it, maybe should go under high burnup.
14 You've got this under general, Brent?

15 MR. BOYACK: Yeah. You'll have to tell me
16 where to do that. I realized that some of that was
17 doing that and I was going to come back and ask about
18 that. That's a good point. It's easier to do now.
19 Do both of these go down under --

20 MR. KRESS: I think those are both
21 general.

22 MR. SCHAPEROW: One more.

23 MR. BOYACK: This one?

24 MR. SCHAPEROW: Yeah.

25 MR. KRESS: That's high burnup.

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1 MR. BOYACK: That was here, right?

2 MR. KRESS: I think Dana might talk about
3 needing the information on the effects of erbium.

4 MR. BOYACK: If you don't mind indicating
5 which area we're talking about here, okay?

6 MR. GIESEKE: We're talking a lot about
7 looking at the French MOX results. There should be
8 some kind of cross-check made to the US weapon's grade
9 fuel.

10 I don't know what that cross-reference is,
11 whether it's just sections to see if it looks the same
12 after some sort of -- maybe it could be qualitative
13 just to see that there's nothing really different. I
14 don't know. Is that going to be directly applicable?

15 MR. KRESS: Confirmed French data is going
16 to behave just like where the stuff is going into
17 Catawba somehow.

18 MR. CLEMENT: Once you've got that it's
19 quite easy to prepare how are the fuels, what are the
20 microstructures and so on and so on. The VERCORS fuel
21 is extracted from watts coming from a French reactor.
22 As far as I've understood, the MOX -- to the one that
23 was used in the French reactors. The check would be
24 easy.

25 MR. GIESEKE: I think it's important to

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1 take a look and see.

2 MR. KRESS: I don't know exactly what all
3 is in the French data but I think it's important that
4 it have a couple of experiments like RT-7 where you've
5 re-irradiated the fuel and run it through more than
6 one kind of temperature transient and back out of
7 that. You re-irradiated enough that you can get some
8 of the mid-volatile or low-volatile releases in order
9 to have a full spectrum of source term in more than
10 just one kind of temperature transient. Maybe two.
11 At least two.

12 MR. BOYACK: You had, I think, through the
13 course of the meeting some general statements about
14 the quality or characteristics of the data you needed
15 for model development.

16 MR. KRESS: What I need is re-irradiated
17 fuel so I can get the whole spectrum of fission
18 products. I needed to run through temperature
19 transients that are ramped and given rate and then
20 maybe held constant for a little while.

21 I would like to see tests done with a
22 faster ramp than we normally do because a lot of the
23 fission product release is driven by the high heat
24 upgrade of the oxidation. We never really get data
25 there. What we do is ramp up and hold and ramp up and

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1 hold but we never get a fast ramp.

2 I would like to see some tests with a fast
3 ramp because you get a different kind of release
4 characteristic with fast grams. I don't know how to
5 do those because it's hard to do with the invection
6 heating. You can do it but it gets difficult.

7 What I would like to see is faster test
8 with the fastest ramp I can get with the kind of test
9 you have to do. That's why I think it's also
10 important to look at the PHEBUS data because you do
11 run into the fast ramps there and reconcile the PHEBUS
12 with the out-of-pile test.

13 MR. BOYACK: Let me stop here for one
14 second. If you need to save, you can use Control S.
15 Yeah, just under file. That looks very much the same.
16 Use good English. Don't give them an opening to make
17 fun because they will get after you really easily.
18 They're a tough group. Anybody else here know how to
19 use a Mac? I do have the new Dell online.

20 MR. LEAVER: We want to make a point on
21 the early in-vessel that we should be breaking up the
22 radionuclide groups where appropriate primarily to
23 reflect where the elements in one of the existing
24 groups has a significantly different release fraction.

25 Also, we may want to take into account

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1 elements that have a significant biological effect.
2 Maybe that would be another reason to pull one out of
3 a group, one or two or more.

4 MR. CLEMENT: Maybe we could resize and
5 identify several groups to do that.

6 MR. LEAVER: Yeah, we identified where --

7 MR. CLEMENT: Cerium group, nobel metal,
8 lanthanides.

9 MR. LEAVER: Yeah, those three.

10 MR. TINKLER: The reason for having an
11 assorted number of groups at one time was to --

12 MR. LEAVER: Something like that.

13 MR. KRESS: That's right. You can stick
14 all of them in there you want to.

15 MR. TINKLER: We could probably have many
16 more.

17 MR. LEAVER: We've got 65 or 70 isotopes.
18 I don't remember the exact number but in our code we
19 could have instructions for all of them and it
20 wouldn't substantially change because you have those
21 conversion factors and the half-lives that are
22 different for all those, you have to take that into
23 account.

24 I agree with you, Charlie. I think it's
25 probably mainly historical that we did it that way

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1 because of computing limitations that really aren't a
2 big thing now. We also don't, of course, want to
3 break up the elements that imply that we know more
4 than we know. I mean, I don't want to over do it. We
5 made some suggestions in here and I think you really
6 should do that.

7 MR. TINKLER: I also want to make a point
8 about early in-vessel. This is something that we're
9 wrestling with now. This distinction of early in-
10 vessel on the basis of vessel failure, we know more
11 about source term than we did 15 years ago. We also
12 know a little more about melt progression and
13 interaction on the lower head and vessel failure
14 times.

15 I would generalize to say that our
16 convictions 15 years ago was not vessel failure.
17 Generally those calculations accelerated vessel
18 failure, notwithstanding the debates on industrial
19 pension. Even ignoring the argument about vessel
20 retention, I think it's true that the general state of
21 knowledge would suggest that we believe the vessel
22 will hold together longer.

23 Now if you tie that to a larger in-vessel
24 release simply because we're holding the vessel
25 together longer, we need to think about what is the

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1 significance of early in-vessel from a regulatory
2 point of view because, in fact, the revised source
3 term has been adopted for the early gap and early in-
4 vessel failures.

5 We need to think about how then we want to
6 apply this because if we stretch out the in-vessel
7 phase, is that really our intent to simply increase
8 the source term of the early in-vessel release?
9 Should we apply the same portion of the source term
10 for regulatory applications?

11 With boilers particularly some of these
12 predictions of vessel integrity are going to stretch
13 out and even for the PWRs. I don't know what you
14 think about the location or whether or not it's a
15 gradual process or a large coherent relocation.

16 MR. KRESS: A little bit of insight on
17 that, Charlie, is that whenever you undergo a core
18 damage accident and start releasing fission products
19 and then things melt and move down to the bottom head
20 and end up interacting with the bottom head to
21 eventually fail it.

22 My own view of that is you release the
23 fissions products while the fuel is still up there in
24 place. Once it moves down to the bottom head, you cut
25 off fission products. I don't care how long it takes

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1 that to melt through the vessel. Early in-vessel
2 release has already happened irrespective. I cut it
3 off at the time the relay takes the core down there.
4 That's when I cut off the early in-vessel.

5 You all can take a note of half an hour or
6 so to melt through the vessel. I don't care. I've
7 already released my early in-vessel. I separate the
8 failure of the vessel from the timing of the early in-
9 vessel release in my mind.

10 MR. TINKLER: So in your mind when you do
11 this you're actually --

12 MR. KRESS: Calling relocation.

13 MR. TINKLER: It does have some
14 implications because what burned up on late in-vessel,
15 some of that in terms of defining in-vessel failure
16 may start the rope line early in-vessel.

17 MR. KRESS: Yeah. Another point I made
18 earlier which I think is an insight that doesn't fit
19 in here is we can constrain ourselves to thinking that
20 early in-vessel, late in-vessel gap and ex-vessel kind
21 of add up to one including wherever you have residual.

22 I think that's an artificial constraint
23 that we shouldn't have done because it limits your
24 thinking on how to apply design basis accidents to a
25 whole range of scenarios. I think limiting yourself

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1 to make those things add up to one is a mistake in the
2 design basis space.

3 For example, the late in-vessel release I
4 would have those relate to those scenarios that
5 deposit a lot. Early in-vessel release I would have
6 those relate mostly to scenarios that don't deposit
7 much. I would be double counting.

8 I think it was a mistake not to view the
9 design basis in the first place. The 1465 did it that
10 way and to be consistent with 1465 we kind of
11 artificially restricted ourself to making those things
12 add up to one. If I were going to redo our file list
13 in the future, I wouldn't do a design basis space that
14 way.

15 MR. TINKLER: Some have larger in-vessel
16 releases and sometimes larger late in-vessel.

17 MR. KRESS: I would reflect that in my
18 design basis space and not just say this is a coherent
19 accident of some kind. I think the Fritz people kind
20 of do something like that with theirs.

21 MR. TINKLER: Dominant sequences rather
22 than --

23 MR. KRESS: That would be another concept
24 is dominant sequence, but there's more than one.

25 MR. TINKLER: It emphasize that part of

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1 the release.

2 MR. KRESS: But there is more than one
3 dominant sequence. You could use several. That makes
4 sense.

5 MR. SCHAPEROW: I'd like to ask the panel
6 to reflect a little bit upon the -- we've talked about
7 updating or reassessing the revised source term in
8 light of high burnup fuel. It seems to me that the
9 changes that were made when we did that were largely
10 predicated on better data and not necessarily on high
11 burnup. I was wondering if the panel would like to
12 draw any insights in that regard. That's an area of
13 conclusions that would be very useful for us on a
14 regulatory basis in the regulatory area.

15 MR. KRESS: The original 1465 you say you
16 changed for just LEU.

17 MR. SCHAPEROW: That's right. How much of
18 that would have been from better data and how much of
19 that is from high burnup.

20 MR. KRESS: That's a good point.

21 MR. POWERS: I don't think we have any
22 release data for high burnup fuel.

23 MR. KRESS: Pardon?

24 MR. POWERS: Do we have any release data
25 from high burnup fuel?

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1 MR. KRESS: Only from the French. That's
2 the only data I know of. Plus the stuff from the
3 Japanese.

4 MR. LEAVER: I guess knowing ahead of time
5 what we were getting into we could have prepared a
6 table of updated LEU for nominal burnups and then
7 said, "Okay, here's the delta." Probably that delta
8 would have been generally quite small. There didn't
9 seem to be any real smoking guns on burnup.

10 MR. KRESS: I don't know if we ever need
11 to --

12 MR. LEAVER: The implication of the high
13 burnup table is those changes are from high burnup.
14 Frankly, I think generally it's not. It's relocating.

15 MR. KRESS: That's what Jason was saying.
16 With the MOX fuel, we were generally thinking that's
17 moderate burnup, like 40,000 gigawatt. The question
18 is should we ever have to worry about the combination
19 of MOX fuel and high burnup?

20 MR. LEAVER: You've been saying right now
21 that they might want to do that. It gives you
22 flexibility in your fuel management.

23 MR. KRESS: I don't know if there are
24 synergisms there or not and if the effects of one
25 would be exactly the same as the other and you don't

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1 double them. I don't know what the combination does.

2 MR. LEAVER: I'm not sure there would be
3 any synergism, though, because you're talking about
4 assemblies. One assembly is an LEU high burnup and
5 the other is MOX with nominal burnup.

6 MR. KRESS: I don't know if you have the
7 combination of MOX and high burnup, if you have to
8 worry about it or if it would be different than just
9 MOX or just high burnup.

10 MR. LEAVER: I'm not sure why it would be
11 different. You mean if you were to come up with a
12 source term?

13 MR. KRESS: Yes. Having MOX tends to make
14 it easier to release. Having the high burnup tends to
15 make it easier to release. Does the combination
16 double that or do nothing to you? I don't have any
17 data on that. I don't know if it's important or not.

18 MR. NESBITT: First of all, I think it's
19 pretty clear, at least initially for the first several
20 years our use of MOX would be constrained in terms of
21 burnup as we discussed. We're not going to start
22 radiating significant amounts of MOX until 2008 at the
23 earliest. I think this is a real long-term issue.

24 The second thing I would mention is that
25 the French and Germans are looking at higher

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1 irradiation burnup levels for MOX fuel even as we
2 speak. My anticipation would be that before we were
3 to go there, it's very likely the Europeans would have
4 done the same.

5 I can't predict the future but I'm just
6 saying this is my best guess for 2002. I don't think
7 it's worth this panel's effort in trying to figure out
8 that issue at this time. I think that is something
9 that ought to be deferred until later down the road.

10 MR. CLEMENT: I could add about that. The
11 French activity has the intention to bring MOX to the
12 same burnup level as UO₂. I don't have the schedule
13 in mind but they are working on that. I don't know
14 how it will end but this is their intention.

15 MR. SCHAPEROW: A longer-term issue is
16 high burnup MOX. Does the panel agree with this?
17 Maybe?

18 MR. POWERS: If you take the
19 conscriptorial theory of the Government strategy to
20 use MOX in these reactors, it has nothing to do with
21 plutonium disposal. It's only setting up the first
22 step and going to reprocessing. Then, yeah, you've
23 got a long-term MOX issue. Quite frankly, that makes
24 a lot more sense to me than saying this is the answer
25 for getting rid of excess plutonium.

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1 MR. KRESS: I agree.

2 MR. SCHAPEROW: There is one thing I'm
3 kind of confused about is the issue of oxidation,
4 oxidizing versus reducing environments and effects.
5 Tellurium was the big one that really saw a big
6 effect. I was wondering if the panel would like to
7 draw some insights in that area for the NRC.

8 MR. POWERS: Great big capital letters.
9 I DON'T UNDERSTAND TELLURIUM. The inherent difficulty
10 is that --

11 MR. SCHAPEROW: In-vessel or in-vessel and
12 ex-vessel?

13 MR. POWERS: Ex-vessel, I understand. In-
14 vessel is where I don't understand. It's in the fuel.
15 The problem is that you are blind to it most of the
16 time. There's only a narrow window of time following
17 an irradiated experiment where you can see the
18 tellurium. In other words, you just go blind to it.

19 You can't find out where it is. Then it
20 decays away on you and then you really can't find out
21 where it is. Clearly the powers hypothesis -- if you
22 take the Oak Ridge hypothesis that the tellurium
23 interacts with clad, it must interact with the tin in
24 the clad.

25 Now you go to M-5. What implications does

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1 that have? If you take the powers hypothesis that is
2 interacting with the conclusions and the fuel, what
3 implications does MOX have on that? When I did 1150
4 my distribution was a 45 degree angle line and I just
5 threw up my hands at tellurium.

6 And tellurium itself is just no problem at
7 all. It's decay to iodine that's the problem. If
8 tellurium would just arrange not to turn into iodine,
9 we wouldn't -- well, if they would just ingest their
10 spectrum so they didn't get the 131 or 132 tellurium,
11 then we would be okay.

12 MR. KRESS: To test our fission products.

13 MR. POWERS: They just put some filters in
14 there. We've got stable chlorine.

15 MR. KRESS: It's my theory that the
16 reactors would be a lot safer if they wouldn't produce
17 fission products. Pretty soon Jim Gieseke is going to
18 raise his hand and say, "Being an expert on aerosol
19 behavior, I fail to see why we don't include the
20 release of the nonradioactive materials in our source
21 term."

22 MR. POWERS: We really need to provide
23 guidance on that one because that became an issue in
24 the AP600. Quite frankly, you and I came up with
25 wonderfully defended hypotheses. What it was is just

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1 that they were different.

2 MR. LEAVER: We do release nonradioactive
3 aerosols in our calculations but we've clearly stated
4 the basis for that. I mean, obviously one can debate
5 just what the right relevant amounts of fission
6 products was enough. We've looked at all the
7 experiments and come up with what we think are
8 reasonable estimates and they are somewhat different
9 for PWRs versus BWRs. It's an important number
10 because aerosol concentration is the sum of both the
11 fission product and nonfission product aerosol.
12 Generally the more nonfission product aerosol you get,
13 the faster everything is going to be removed.

14 MR. POWERS: Except for equipment
15 qualifications.

16 MR. CLEMENT: The problem is not only the
17 amount of unirradiated material that is released but
18 the timing of release because of possible chemical
19 reaction with fission products and different transport
20 and depositions. Timing, I would say, is more
21 difficult to calculate than the raw amount.

22 If your degradation calculation does not
23 relocate the control of raw material exactly at the
24 right level, you will not have the right evaporation
25 and the evaporation rate will be very sensitive to the

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1 relocation.

2 MR. POWERS: Get rid of the silver Indian
3 control rods because we can't calculate them. They
4 are expensive and hard to deal with and whatnot and
5 boeing carbide worked just fine.

6 MR. LAVIE: There was an issue that Tom
7 brought up yesterday and I followed up on this
8 morning, to what extent that core fuel management
9 strategies have on the source term. It probably
10 occurs to the gap and early in-vessel phase.

11 MR. SCHAPEROW: Would anyone like to
12 reflect on that? Anyone think it might be a
13 significant effect?

14 MR. LEAVER: I don't see a basis for
15 saying that's a significant effect. I guess I don't
16 understand that.

17 MR. TINKLER: Tom thought it was
18 significant. The argument was that the in-vessel
19 phase was in part or the magnitude of the release was
20 produced by the fact that the outer fuel assemblies
21 are colder, substantially so. The core reacts more
22 coherently and, therefore, more of the fuel releases
23 fission products during that early in-vessel phase.

24 MR. LEAVER: Right. That was my
25 understanding of his argument. It's just hard for me

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1 to imagine that we can make a coherent core damage
2 event.

3 MR. TINKLER: Or, at least, more so.

4 MR. LEAVER: Yeah. We've also based on
5 in-vessel release numbers, to some extent anyway, on
6 the concept of roughly 70 percent of the core having
7 undergone a thermal assault which means you've got
8 some portion that opens and some portion in the form
9 of debris with clad having failed and pieces of fuel
10 relocated. Even if you had more coherency, I'm not
11 sure how that model would change.

12 MR. TINKLER: My point was that you have
13 more coherency cladding.

14 MR. LEAVER: Right. It doesn't matter
15 whether it's more coherent or not.

16 MR. TINKLER: At some point it doesn't
17 matter.

18 MR. LEAVER: And relocation, I think,
19 someone said a little while ago, I think, that a good
20 view is that stops the race. You're going to form a
21 crust and you're going to cool the material pretty
22 fast.

23 MR. SCHAPEROW: Jim, we're discussing
24 something that you were interested in and I kind of
25 stuck your initials on something here. The effect of

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1 field management strategies on source term.

2 MR. GIESEKE: We also talked about related
3 to fuel management is the loading of the MOX in the
4 outer regions of the core.

5 MR. LEAVER: I think we abandoned that.

6 MR. GIESEKE: We abandoned that in our
7 considerations but it does have an effect on fuel
8 management I would think on release numbers if you're
9 going to deal with that.

10 MR. LAVIE: I think mutual wrongs is what
11 we've done reasonably bounding to handle all the fuel
12 management schemes. For instance, there used to be
13 this belief that you have these three regions. Yet,
14 we find that Westinghouse is currently wanting to
15 flatten the flux and is now putting thrice burned
16 decedents in the core. Is what was done in 1465 and
17 what we've done in these meetings here reasonably
18 bounding to address those type of effects?

19 MR. SCHAPEROW: This job is a lot tougher
20 than it looks. I'm in a lot of trouble on this one.
21 We're covering a lot of issues.

22 MR. LAVIE: Why don't we do high burnup
23 first.

24 MR. SCHAPEROW: Let's just do regular.
25 Let's do normal LEU. Does anybody believe that there

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1 is an effect of field management on the source term
2 tables we've produced? A significant effect.

3 MR. POWERS: An issue that I've always
4 been concerned about is how we get the high burnup
5 because there do seem to be two strategies. Whether
6 that has any bearing on the source term or not, it's
7 really on how you select fuel for doing the
8 experiments.

9 If you do a rapid burnup versus a long
10 slow burnup you'll have a mix of the two where it
11 burns rapidly at first and then you move out to a
12 lower burn rate. I will hasten to comment that I
13 think it is very much a second order effect.

14 MR. KRESS: My thinking on the burnup
15 thing is that normally when you talk about a burnup,
16 they're talking about an average burnup of the core
17 and the effect of burnup of fission product releases,
18 not linear.

19 If you take a piece of fuel that has this
20 added burnup and ready to release a fission product
21 and apply that to the whole core and say this is the
22 source term you're going to get on a whole core basis
23 is not a correct procedure. What you need to do is
24 have fission product releases a function of that and
25 then apply it across the core distribution.

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1 That was my point about how you do it,
2 burnup and then fuel management because the effect of
3 burnup of fission product release is not linear and
4 it's not appropriate in the average burnup. That's
5 basically my point.

6 MR. SCHAPEROW: Burnup dependence is seen
7 in a certain range, you think? There was suggestions
8 you didn't see it early on.

9 MR. KRESS: My own feeling is from burnups
10 from 20,000 up to 45,000 there's probably not much
11 difference because it's the same kind of release rate.
12 Then you've got 45 up to 60 and you go up through some
13 sort of transition where you get enhanced release. I
14 think when you get up above a certain level, it
15 probably levels off again.

16 There's not a linear relationship in
17 burnup to fission product release. Somehow you need
18 that whole curve of the effect of burnup on fission
19 product and then look at the core and say what sort of
20 distributions and burnups do I have and how do I
21 factor this dependence of burnup into my fission
22 product release on a whole core basis.

23 MR. LEAVER: Haven't we made some injuring
24 judgements here in coming up with the high burnup LEU
25 where we have more or less integrated these effects

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1 into our judgements that you're talking about?

2 MR. KRESS: Yeah, but we've tended to say
3 high burnup has one release and LEU has another and
4 factor in the radio and average --

5 MR. LEAVER: The numbers that we came up
6 with, let me try to say what I think they are. This
7 is important. For a core in which the licensee has a
8 license amendment. Is that what you need to get high
9 burnup fuel? It has a license amendment for high
10 burnup fuel.

11 We didn't come up with a course term for
12 only the high burnup fuel. We came up with a source
13 term for that core. We assumed that roughly a third
14 of it would be high burnup fuel. You're saying you're
15 not comfortable with that?

16 MR. KRESS: I don't even know what you
17 mean by high burnup. My guess was that we thought a
18 third of the core was a 70 gigawatt days per ton and
19 two-thirds of it were at 40. Well, that's not true.

20 What you need is a distribution of burnups
21 across the thing. If you want to get an average
22 burnup to give you the same release that the
23 distribution gives you, you have to do an integral
24 over the whole --

25 MR. LEAVER: Tom, we've never done that.

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1 MR. KRESS: I know we've never done that
2 but I think that is the appropriate way to do it.

3 MR. POWERS: Aren't you gilding the lily
4 a little bit?

5 MR. KRESS: Of course I am. Especially
6 when you're talking design basis space.

7 MR. GIESEKE: I think the impact would be
8 in the noise.

9 MR. POWERS: Yeah, I think I talked with
10 Jim that we dallied around in the second decimal place
11 and I don't believe in second decimal places.

12 MR. KRESS: I think if I view one-third of
13 the core as having 70 gouged days and the rest of the
14 core having 40, I'll get a source term that is higher
15 than reality. That's all right.

16 MR. LEAVER: That's probably true but not
17 by much and the effect wasn't that much anyway.

18 MR. POWERS: Before you say not by much,
19 what happens is people go through and they do this
20 analysis for some plant like an AP600 and they say,
21 "Ah, 25 rem at the site boundary and, look, we met
22 that. It's 23.67."

23 MR. LAVIE: But how would your analysis,
24 Tom, change if there were only two cycles. No longer
25 three regions but two regions. Try to capture in this

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1 bullet here, "Effect of higher burnup assemblies
2 dampened by fuel in core with burnup less than 45
3 gigawatt days per ton."

4 MR. POWERS: No. We have integrated those
5 things in our high burnup tables.

6 MR. LEAVER: Yeah, I guess you're right.
7 Since the numbers -- we put up numbers that we believe
8 may be the first digit but they get used in analysis
9 which they attach a significant third digit. The fact
10 that you're conservative and you say that's fine. If
11 they are less than 25 rem by one one-hundredth of a
12 rem, that's good enough because we --

13 MR. POWERS: It's a question of how these
14 things are used.

15 MR. LEAVER: We know how they're used. We
16 see it all the time. People come in and they are
17 really parsing the number out to a lot more
18 significant digits than the input numbers where we're
19 good to but it can never be worse than that. Then
20 you're okay.

21 MR. POWERS: A regulatory system that
22 really hasn't come to grips with realistic analysis,
23 that's all.

24 MR. LEAVER: Yeah, that's true, although
25 I think the source term is a step in the right

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1 direction but just not as big a step as maybe we could
2 have taken or eventually will take.

3 MR. POWERS: The alternate source term is
4 information that has come in for the last 30 years
5 that said that iodine wasn't the beginning and end of
6 everything. In fact, as far as the total dose of
7 things like that, it's not a huge effect. The amount
8 of radioactive is actually higher.

9 MR. LEAVER: You're measuring dose
10 differently now. You're doing a total effective dose
11 instead of just a whole body. That makes a
12 difference.

13 MR. POWERS: The total number of curies
14 that you put in the containment is higher now than the
15 GID source.

16 MR. LEAVER: That's right. You're also
17 recognizing more phenomenon in terms of deposition and
18 trying to do that more. In some cases it complicates
19 the analysis but that's the way nature is so it's good
20 to take those effects into account.

21 MR. SCHAPEROW: There was one thing that
22 I thought I heard somebody say earlier about the BWRs
23 went through the meteor tails fairly quickly as I
24 recall and they stayed about the same as the old BWR.
25 The changes weren't like huge from the original 1465.

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1 I guess I would like to capture that insight.

2 MR. POWERS: First place, the BWR is not
3 taking things to as high a burnup. Second of all,
4 everything gets dominated by the fact that you have
5 two times as much zirconium metal.

6 MR. SCHAPEROW: The atmosphere or the
7 environment inside the core is more reducing.

8 MR. POWERS: That little steam molecule
9 that shows up there gets molested severely. The
10 answer is if the ABWR becomes the wave of the future
11 by stalk and white chain, right?

12 MR. SCHAPEROW: There was one thing.
13 Tellurium? Charlie, maybe you can help.

14 MR. TINKLER: Okay. Actually, this is a
15 good intro. We increase the tellurium releases for
16 PWRs more than BWRs because we thought they were more
17 likely to see an accident. Do we really think that
18 the timing of the tellurium release is inconsistent
19 with those other volatiles in the early in-vessel
20 phase. Timing makes a lot of difference in regulatory
21 application of the source term in the early in-vessel
22 phase.

23 MR. POWERS: All you get is 1.3 hours or
24 1.5 hours. You don't have any time resolution.

25 MR. KRESS: We do the same thing with mid-

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1 volatiles. They come out at the end of that but we
2 spread them out.

3 MR. TINKLER: What I'm wondering is in the
4 PHEBUS should we make a little more distinction
5 between the early in-vessel and what I'll call late
6 in-vessel. I don't mean late in-vessel in terms of
7 post vessel failure.

8 When I looked at the PHEBUS, that's a
9 normal lodge to the active cladding. It looked like
10 you were oxidizing about 85 percent. That's 65
11 percent of the total. If it's 85 percent, we think
12 it's coming from that active cladding.

13 That's about as high up on the
14 distribution oxidation as we can ever imagine
15 calculating for a reactor. I don't have any doubts
16 that the upper part of the bundle is given up pretty
17 quickly. Over the lower parts of the bundle, you
18 would think that would be stretched out.

19 I don't want to go over old ground to
20 address this. I'm still wondering whether or not some
21 of that tellurium release doesn't happen a little
22 later as opposed to initial iodine.

23 MR. LEAVER: It lags cesium. We have a
24 plot from Bernard's presentation at the last meeting.

25 MR. CLEMENT: We have probably even

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1 oxidized more zircaloy. The onset of release for
2 tellurium is delayed as compared to iodine and cesium
3 and this is significant. Once tellurium starts to
4 release, you have a rather fast release.

5 Even at the end, it becomes a little bit
6 higher than iodine and cesium. That means at the end
7 of this phase probably you get the same thing. You
8 should be delighted that this doesn't mean that at the
9 end of this early in-vessel phase could not reach the
10 same kind of amounts.

11 MR. KRESS: That is extremely consistent
12 with what we have found.

13 MR. NOURBAKSH: But you still require the
14 oxidation. I think in the late phase you do not have
15 the steam to oxidize. I think the late release will
16 probably occur but it will occur ex-vessel.

17 MR. CLEMENT: In a big core you will have
18 different timing release of tellurium.

19 MR. KRESS: Most of the severe accident
20 sequences you're only in reducing conditions maybe 5
21 percent of the time when you have a lot of hydrogen.

22 MR. POWERS: You're always in reducing
23 conditions once you've gone through the escalation
24 because above that burning point --

25 MR. KRESS: Yeah, but that part of the

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1 release is fission products is my point. Below that
2 you're going into the oxidizing phase and reducing the
3 -- you know, the fission product releases see
4 oxidizing conditions most of the time in accident
5 sequence.

6 MR. POWERS: Most releases oxidize
7 conditions most of the time.

8 MR. KRESS: There are some exceptions to
9 that.

10 MR. TINKLER: My understanding is they
11 have some excess during most of that.

12 MR. KRESS: You can certainly run tests.

13 MR. TINKLER: I know we've only got so
14 many numbers.

15 MR. CLEMENT: At the outlet the oxidation
16 of cladding is where 50 percent steam hydrogen and
17 more fraction. Downstream the oxidation falls so it
18 was a fair excess of steam.

19 MR. LEAVER: FPT-1 was, I think, an
20 important data point for at least some of you on
21 coming up with the tellurium estimate. That was a
22 pretty big increase that some of you made in
23 tellurium. I think the plot that Bernard showed
24 tellurium actually overtook.

25 The release fraction actually overtook

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1 cesium at about 90 percent release or something like
2 that. It lagged most of the way. I mean, the
3 lagging, I think, is an interesting point.

4 Another point which Charlie made, which I
5 guess I hadn't realized, is you were oxidizing one
6 hell of a large fraction of the zirc which is kind of
7 hard to imagine that you could do that in a whole core
8 accident which probably had something to do with the
9 high tellurium release, all of which is, I guess, a
10 round about way of saying why I guess I was, and still
11 am, reluctant to do that big of an increase to
12 tellurium.

13 MR. CLEMENT: You have to make the
14 transposition of such data if you choose a curve value
15 shown for FPT-2. You could imagine then for one
16 region of the core so that it would undergo oxidation.
17 Then it will continue after it is oxidized to heat up
18 and then you will get this curve of tellurium.

19 MR. LEAVER: It's a level effect.

20 MR. POWERS: Suppose in a real accident
21 you don't oxidize maybe 35 or 40 percent of the clad.
22 What happens to the unoxidized clad? Well, it melts
23 and runs down so that fuel now is back being exposed
24 to steam as though its clad had been fairly well
25 oxidized.

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1 MR. KRESS: You can't divorce fission
2 product release from the melt behavior. That's why I
3 kept saying those tests on fission you have to
4 translate those into a model.

5 MR. TINKLER: I don't know. Maybe the
6 fact that the early release catches up with the end of
7 the stage. I just wanted to get the panel's views.

8 MR. SCHAPEROW: I think this is very good
9 to put in the summary. This is a good job. Oh, boy.
10 I wrote a lot here. Anybody want to volunteer to give
11 me a hand on this?

12 MR. LEAVER: I don't think you can say
13 that. That was true of the FPT-1. Is that what you
14 meant?

15 MR. SCHAPEROW: I'm not sure. I was doing
16 a lot of typing when you folks were talking.

17 MR. LEAVER: The FPT-1, what Bernard said
18 was by the end it actually catches up and it is
19 essentially all released.

20 MR. SCHAPEROW: Tellurium released from
21 fuel cesium. Once tellurium starts to release having
22 fast tellurium release. You want to change that
23 second sentence?

24 MR. KRESS: I would restrict FPT-1.
25 That's very consistent with what we saw.

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1 MR. CLEMENT: The graph I showed was FPT-
2 2. It was for FPT-1 but --

3 MR. LEAVER: FPT-2 you said there was
4 actually absorption that took place which you couldn't
5 quite explain.

6 MR. CLEMENT: For FPT-2 I'm speaking about
7 the release from the fuel zone.

8 MR. LEAVER: Okay.

9 MR. CLEMENT: Then you've got the
10 position. If you look at the release from the fuel
11 zone --

12 MR. LEAVER: FPT-2 is released part of the
13 time.

14 MR. CLEMENT: Yes, part of the time.
15 Should we say zirconium or zircoloy? This has been
16 seen with zircoloy cladding.

17 MR. KRESS: I would say zircoloy.

18 MR. SCHAPEROW: Do we want to try to
19 answer the question does timing make a difference in
20 the tellurium release for the in-vessel phase?

21 MR. POWERS: The answer is, yeah, timing
22 makes a difference because it changes your deposition
23 fractions. That's how you account for the fact that
24 you're getting a burst of releases at the end just
25 changing the amount of deposits in the reactor cooling

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1 system. If you want resolution below the one and a
2 half hour level, you've got to have more time frames.

3 MR. SCHAPEROW: How is that? I'm running
4 out of steam. This is a good place to quit. People
5 can think in the back of their heads over lunch break
6 of what other issues might be important to identify.
7 It was kind of good that we got started on this.

8 I propose we break until 1:00 and we'll
9 reassemble at 1:00. If anybody needs an escort, I'll
10 meet everybody downstairs at 1:00 in this building.

11 (Whereupon, at 11:49 p.m. off the record
12 for lunch to reconvene at 1:00 p.m.)

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1:06 p.m.

MR. BOYACK: I've had a tiring lunch and I thought maybe Jason could just go ahead and continue on.

MR. KRESS: He was doing so good.

MR. POWERS: He gained a renewed respect for your talents.

MR. BOYACK: That isn't what he told me. He told me, "This is the first time I've had any respect for your talents."

MR. SCHAPEROW: There's only so many things I can do at the same time.

MR. LEAVER: He also told us he now knows why you get the big bucks.

MR. BOYACK: Typist is what I call it.

MR. POWERS: What he doesn't realize is that Brent doesn't get the big bucks. Brent's supports services get the big bucks. Brent gets the little bucks.

MR. BOYACK: So just let me sort of get quickly updated here. Jason said briefly that he and Charlie had been asking a few questions and you had been responding. Obviously you've been listing those in the files here. At least, there's more than when

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1 I started.

2 Let me just take a quick look here.
3 You'll get dizzy following me but it looked like --

4 MR. POWERS: Can you read that fast?

5 MR. BOYACK: I'm looking for the blanks.
6 It looks like we haven't done anything with respect to
7 BWR.

8 MR. SCHAPEROW: I didn't put them in the
9 right spots. I was just typing. We'll have to move
10 them around later.

11 MR. BOYACK: It seems to me the area that
12 we have not touched on here that we have discussed in
13 the rest of the meeting is the need for experimental
14 data on the revaporization source terms.

15 MR. KRESS: Absolutely.

16 MR. BOYACK: And that's associated with
17 everything or just --

18 MR. POWERS: It's the same question and
19 it's appropriate for everybody. It's really telling
20 the PHEBUS bunch to get on the stick and finish up
21 their work.

22 MR. SCHAPEROW: When you say
23 revaporization, you refer to a couple different areas.
24 You're referring to revolatilization. You're
25 referring to resuspension.

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1 MR. POWERS: Really revolatilization.
2 Resuspension is an area that probably isn't that
3 important but we probably have an adequate modeling
4 for it.

5 MR. SCHAPEROW: The two areas in the
6 revolatilization that one is referred to as self
7 heating and the other one is more of a chemical
8 affect.

9 MR. CLEMENT: There are also all the
10 chemical effects including actions for substrates and
11 so on.

12 MR. SCHAPEROW: Chemical reactions and
13 self heating.

14 MR. POWERS: A revolatilization species
15 really your first concern are the cesiums and the
16 iodines. The iodines is really basically a conversion
17 of metal iodides and something that's volatile.
18 Cesium is understanding what the hell a surface
19 species is.

20 MR. BOYACK: Cesium was surface species?

21 MR. POWERS: Yeah.

22 MR. BOYACK: And the iodides were?

23 MR. POWERS: It's really oxidizing metal
24 iodides to create something volatile.

25 MR. BOYACK: Okay.

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1 MR. POWERS: Now, if we get the molys and
2 the rutheniums up there, moly I think we kind of
3 understand because it will be present as either
4 molytrioxide or the cesium ruthenate. ruthenium is
5 more of a mystery because it appears to reduce when
6 the deposits get to the metal. You have to reoxidize
7 it to get it back on.

8 MR. KRESS: I am convinced. How come
9 there are no leates? You've got to have ruth, you've
10 got to have lea, right?

11 MR. POWERS: That's exactly right.

12 MR. BOYACK: Okay.

13 MR. POWERS: Of course, one would be
14 interested in what to learn in the revaporization.
15 Since we can't figure out what tellurium is doing on
16 release, why the hell should we worry about
17 revaporizing. It would be nice to know.

18 MR. KRESS: I'm convinced you can't do
19 these little lab experiments. You have to do them in
20 something like PHEBUS where you've got everything
21 interacting.

22 MR. POWERS: That's what they've got.
23 They've got a plan that they expose to God's own
24 mixture.

25 MR. CLEMENT: Samples or some measurements

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1 still have to be made. Then after when you try to
2 make a transposition through models, you have to make
3 some hypothesis about what are the reactions involved
4 and what are the components involved. Sometimes it
5 could be needed to make additional experiments to be
6 sure. That is the process in order to finish having
7 validation model.

8 MR. POWERS: It's tricky work to do
9 because they expose these planchettes and then they
10 ship them off to laboratories. Things are changing
11 all the time. They've got a pretty good program of
12 mixtures of both transportation experiments and
13 Wagmere vaporization experiments.

14 It's going to give us the insights I think
15 we need. It's like all such test data. Once we've
16 got it, all you have is what happens on that
17 planchette. To apply it to the reactor accident
18 you've got to have some way to transpose it into the
19 reactor.

20 I'll comment that that is probably the
21 area where things like the MELCOR and, for that
22 matter, MAAP are probably weakest in their treatment
23 of chemical phenomenon.

24 MR. LEAVER: Revaporization being the
25 weakest?

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1 MR. POWERS: MELCOR locked itself in to a
2 pretty restrictive model. And MAAP, I haven't stayed
3 up to date on MAAP but at least the MAAP structure
4 originally just didn't devote much attention to it
5 even though some of the better calculations on long-
6 term revaporization have been done, it's not
7 chemically sophisticated. Marty Plies did Peach
8 Bottom and heavy vaporization going on for 51 hours

9 MR. BOYACK: Okay. Other observations?
10 Have you literally covered things? I mean, is there
11 anything to be added that is specific that you haven't
12 already got up above related to BWR?

13 MR. POWERS: Nobody understands BWR.

14 MR. KRESS: Except Steve Hodge.

15 MR. BOYACK: So the answer is not really.

16 MR. LEAVER: Brent, you know, one thing
17 you might want to do is maybe indicate some priority
18 on some of these things. I guess I'm a little
19 concerned that buried in here is the observation about
20 the need to get the French data and to get it fast and
21 along with other things which if they don't happen
22 probably won't matter. We want to make sure that in
23 our desire to be complete here that we don't miss the
24 few essential things.

25 MR. BOYACK: Okay.

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1 MR. LEAVER: I would be satisfied to
2 indicate which items are of highest priority.

3 MR. POWERS: I would list the top three or
4 four as separate items.

5 MR. LEAVER: I like that idea.

6 MR. POWERS: It seems to me it's easier to
7 do that.

8 MR. LEAVER: I don't think we should try
9 to do priority ranking for each one but maybe pull out
10 the ones that are the really import low-hanging
11 through here.

12 MR. BOYACK: Let's try something. We've
13 got to start over. What else would you have on the
14 list?

15 MR. POWERS: I think the acquisition of
16 the MELCOR data certainly pulls the category of high-
17 priority low-hanging. If I were going to take and
18 define the things that I think will have the biggest
19 impact on thinking, the next thing I would say would
20 be degradation of high burnup fuel and degradation of
21 MOX fuel.

22 MR. BOYACK: Are they listed here?

23 MR. GIESEKE: We talked about degradation.
24 I know that was very early today.

25 MR. BOYACK: I don't know who was typing

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1 but they obviously didn't use the word degradation
2 unless it's a matter of -- well, how about if we do it
3 this way. What is the word?

4 MR. POWERS: I would say core degradation
5 experiments with high burnup fuel and MOX fuel. Those
6 are not things you're going to do next week in your
7 spare time. You can't claim them to be low-hanging
8 fruit by any means but they have the potential of
9 changing their perceptions on what goes on in these
10 tests as much as anything.

11 MR. LEAVER: The way to realize this point
12 you're making would be, for example, to have a future
13 PHEBUS test be with high burnup fuel and with MOX.
14 That's what you're thinking?

15 MR. POWERS: Yeah.

16 MR. LEAVER: This is a good way to give a
17 message to the PHEBUS plan people, I guess. I mean,
18 if anybody reads what we end up with.

19 MR. POWERS: Top and moly up there would
20 be my highest priority except I'm not sure enough
21 doesn't already exist from the VERCORS. If enough
22 doesn't already exist, then more tests.

23 MR. CLEMENT: The kind of test you would
24 like just to have.

25 MR. SCHAPEROW: When you talk about the

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1 core degradation experiments with high burnup fuel,
2 that leads me to think also about overall use of code
3 like MELCOR or MAAP. The thermohydrolics and
4 treatment has been improved dramatically over the last
5 10 years.

6 We've only run a few calculations since
7 then. I'll put it out for the panel's consideration.
8 At least in the US we have limited experience with
9 using this improved thermohydraulic for severe
10 accident analysis.

11 When we did the work on 1150 with Jim
12 Gieseke and these people had this much reports of STCP
13 calculation. We did 50 sequences. I think at least
14 a partial reassessment of a lot of sequences would be
15 -- I'm not a panel member. I just want to put that
16 out for consideration.

17 MR. POWERS: It would be very useful but
18 I think the first step is to exercise -- start
19 exercising those curves against the PHEBUS experiments
20 that you already have.

21 MR. KRESS: I interpret it to be both the
22 PHEBUS experiment and to do something like that with
23 CORA with high burnup and MOX fuel. Remember the CORA
24 test?

25 MR. POWERS: Yeah, but the trouble with

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1 CORA is I don't think you go to enough damage.

2 MR. KRESS: They were able to -- they
3 stuck a heater rod up through the middle and that's
4 going to be tough.

5 MR. CLEMENT: Are you speaking about the
6 CORA in Germany?

7 MR. KRESS: Yeah.

8 MR. CLEMENT: There's a problem now, CORA
9 scrunch so you can make good things for low level of
10 degradation but not for high level of degradation
11 because they are not so high to use true so they are
12 zirconia pellets. As soon as your important
13 detractions, it's no more available. It's a pity.

14 MR. POWERS: And similarly you have got to
15 understand why you get differences between the VERCORS
16 and the in-pile test. We do see differences in the
17 release fractions.

18 MR. KRESS: I bet they have something to
19 do with something other than fuel.

20 MR. BOYACK: Now, to sort out all this
21 priority, at the present time I've only marked two.
22 One is require to analyze the French VERCORS high
23 priority data and Bernard is doing that so we can take
24 that one off the list.

25 MR. LEAVER: Don't we mean MOX data there?

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1 MR. KRESS: I would say definitely the MOX.
2 I would also like to have high burnup.

3 MR. LEAVER: Absolutely. But the MOX data
4 is what really hung us up for the low volatiles on
5 MOX.

6 MR. KRESS: Yeah, but even high burnup is
7 a problem because we were extrapolating to levels that
8 we didn't have data for. I would put both of them in
9 that category.

10 MR. SCHAPEROW: Are there any high burnup
11 tests?

12 MR. KRESS: Yeah.

13 MR. LEAVER: How high did you go, Bernard?

14 MR. GIESEKE: See third line down from the
15 bottom, Brent? It's the same sequence pertaining to
16 MOX fuel.

17 MR. KRESS: That one had to do with the
18 fact that the utilities may be using a different
19 specification of MOX than was in the test.

20 MR. LEAVER: There was one VERCORS test
21 that was a 60.

22 MR. GIESEKE: Come down a little further
23 to the third line from the bottom.

24 MR. LEAVER: VERCORS 6. That's the only
25 one. It's under the heading of MOX. It's getting

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1 confusing now because --

2 MR. BOYACK: All right.

3 MR. LEAVER: RT-5 is high burnup. What
4 bout RT-4, 3, 7 and HT-3? You can't tell. So it
5 looks like 60 might be as bad as we've got. You might
6 not see the effects.

7 MR. POWERS: 55 is kind of where you start
8 seeing restructuring.

9 MR. KRESS: I'd like to see it at 60
10 though I would rather it be higher.

11 MR. SCHAPEROW: Do you want to write that
12 burnup level next to that, 60?

13 MR. LEAVER: The four cycle. Do you know
14 what that is, Bernard? Is that 60 or is it higher
15 than 60?

16 MR. CLEMENT: I am not sure. Let me have
17 a look.

18 MR. KRESS: Brent, the very top of the
19 thing, if the French data does not have enough
20 transients, I kind of lump those first two bullets
21 together. They are related to each other. If the
22 French data doesn't have enough of that in it, I say
23 there's need for more data, more tests in that area.
24 To me that would be a high priority. I just don't
25 know how much already exist.

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1 MR. LEAVER: What would you be looking for
2 there that you didn't have in the existing core test?

3 MR. KRESS: Let's take RT-7. This is one
4 of these kind of tests. That is precisely what we
5 need. It's got one ramp rate and one whole and
6 another ramp rate. It does have a lot of the mid-
7 volatile release rates. I need to see the data for
8 those as a function of time.

9 Then I need to take that and take some
10 other kind of tips from the ramp to show that when one
11 uses a relative volatility scale that different
12 temperature ramps and different thermal transients can
13 be correlated with each other on a whole core basis.
14 I need a couple of tests, at least more than one. I
15 need a couple of tests to do that with.

16 They need to be different thermal
17 transients in order to test the hypothesis that you
18 can take the data for two or three fission products
19 that are along the volatility scale and extrapolate
20 into all the fission products because you don't have
21 data for real low volatiles.

22 MR. LEAVER: Remember this curve that
23 Bernard showed for RT-1 and RT-2 where you had the
24 ramp and then about an hour and a half hold and then
25 another ramp.

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1 MR. KRESS: But they're not really
2 irradiated fuel.

3 MR. LEAVER: Yeah, they are.

4 MR. KRESS: Are they?

5 MR. LEAVER: Because this is actually four
6 tests. It's RT-1, RT-2, RT-4. Oh, three tests.
7 Three tests, yeah.

8 MR. KRESS: Those are all the same
9 temperature transients. That may be enough. I'm not
10 sure. We don't have any high ramp-rate data.

11 MR. CLEMENT: A point to be taken into
12 account for future MOX tests is more than RT-2 or RT-
13 7.

14 MR. KRESS: Yes.

15 MR. CLEMENT: That's a point to be taken
16 into account in defining future tests.

17 MR. KRESS: I can certainly use all those
18 there and they may be sufficient to some extent right
19 now. You only get cesium with that and I've got
20 enough cesium data. What I want are some of these
21 other low-volatility and that's the re-irradiated
22 part.

23 MR. LEAVER: The reason you don't get
24 iodine here is just it's just too short half-life.

25 MR. KRESS: Iodine is a problem even with

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1 re-irradiated because you have to for a chemical
2 reason.

3 MR. CLEMENT: When this has been designed,
4 there are tests that have been designed, some with
5 irradiated addition and some without because with
6 irradiated addition it's much more expensive. So for
7 the tests without irradiation what was expected is to
8 get a normal amount of release of low volatile in case
9 you don't get the kinetics. You get the overall
10 integrated release along the transients.

11 MR. KRESS: I really need the kinetics for
12 this, the mid-volatiles anyway. I don't care about
13 the kinetics for the real low-volatiles too much.

14 MR. LEAVER: Are you talking about
15 strontium?

16 MR. KRESS: Strontium would be nice or
17 metedula. Somewhere in that range.

18 MR. LEAVER: Barium is easier than
19 strontium.

20 MR. KRESS: Barium would be nice.

21 MR. LEAVER: Bernard, what is OSIRIS mean
22 as opposed to SILOE? Under re-irradiation you have a
23 much of nos.

24 MR. CLEMENT: Oh, the name of the reactor.

25 MR. LEAVER: Okay. And then SILOE is a

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1 reactor?

2 MR. CLEMENT: Yes, because first VERCORS
3 irradiated in SILOE. That was convenient because the
4 reactor was in the same place and VERCORS when SILOE
5 was shut down and was not so convenient because they
6 are not in the same places. Transport problem and so
7 on.

8 MR. BOYACK: Okay. So basically we've
9 got --

10 MR. KRESS: Actually, that other bullet
11 right underneath there kind of belongs to that same
12 one.

13 MR. BOYACK: I was taking several points
14 but let's do it this way. Now we've got basically a
15 trail that talks about acquiring and analyzing French
16 VERCORS data. We've talked about the nature and type
17 of the data. If it proves to not address all the
18 issues, then it would be more data. Then there was
19 this exercise of the codes. Those are the three
20 things that we talked about thus far.

21 MR. KRESS: You'll notice that these fall
22 into a couple of categories. One of them is insights
23 and the other category is needs. We're kind of doing
24 what we were supposed to do with our letters.

25 MR. BOYACK: Yeah. You still need to do

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1 that.

2 MR. KRESS: We still need to do that?
3 Darn. I didn't know I was that transparent.

4 MR. POWERS: Just make a copy of this and
5 send it back to them.

6 MR. KRESS: I didn't know I was that
7 transparent.

8 MR. BOYACK: The real key is that you'll
9 think it through, you'll organize it, and I think it
10 will be better. It may be brief and you don't have to
11 do it red time if that makes it easier.

12 MR. KRESS: The blue I think definitely.

13 MR. BOYACK: Anything else by way of
14 priority statements? You know what you talked about
15 but otherwise you're just running through a bunch of
16 things. What about the issue of LOCA tests?

17 MR. KRESS: I don't think we added Jason's
18 comment that what could be useful to redo some of the
19 thermal hydraulic core melt behavior with codes just
20 to see if you've got new insights to it.

21 MR. BOYACK: I wasn't going to list it
22 until somebody made the statement to the panel because
23 he would refuse to accept it.

24 MR. KRESS: It depends on how extensive
25 the problem. It will take a few sequences.

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1 MR. POWERS: I would apply the codes, see
2 that you were getting roughly the same behavior as in
3 the PHEBUS test before I undertook the accident
4 sequence calculations. They really haven't been very
5 aggressive in either pre or post-test calculations of
6 the PHEBUS programs. They are doing some now but --

7 MR. KRESS: The problem with PHEBUS in
8 that respect is that they let things go down and in a
9 real core I think you do this. There's a little
10 difference in time and interpreting.

11 MR. POWERS: One of the issues that you
12 worry about for doing high burnup fuel is you get fuel
13 cooling and the whole degradation modeling was wrong.
14 They are all candling models. If you do foaming
15 instead, everything gets boxed up. We have not been
16 very aggressive in developing capabilities in the
17 degradation models. That's one of the biggest reasons
18 to want to do the high burnup fuel degradation is to
19 see if --

20 MR. KRESS: I see changes in the market.
21 I think you're right. I also think -- no, I guess
22 not. I was thinking M-5 may have a different --

23 MR. POWERS: I think I would investigate
24 M-5, especially with the MOX fuel just to see because
25 of lower propensity to oxidize on the inside if you've

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1 got a more aggressive attack.

2 MR. BOYACK: Anything else that falls in
3 the high priority area? What I've been doing is I've
4 been adding more code related --

5 MR. LEAVER: What have you got now on high
6 priority, just the two?

7 MR. BOYACK: So there's coordinated
8 relation experience with high burnup fuel and MOX and
9 acquire and analyze data. One was high burnup and the
10 other one is MOX. Then we have a minority of one.
11 One person that is basically staying here and I didn't
12 hear anybody else say anything. That was on an "if"
13 basis.

14 MR. KRESS: On the priority list this is
15 looking at the gap inventory. We have one down there
16 on assembly.

17 MR. BOYACK: What was the statement, Tom?

18 MR. KRESS: To do experiments to
19 reevaluate the gap inventory for high burnup and MOX
20 fuel. I don't know where we have that but it's in
21 there somewhere.

22 MR. BOYACK: Right here?

23 MR. KRESS: I put that it's a priority but
24 I but low on the priority list. We were just saying
25 what's a priority but we weren't giving relative

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1 priorities to it.

2 MR. BOYACK: You would have that in your
3 top five?

4 MR. KRESS: It would be one of the top
5 five.

6 MR. BOYACK: What I could do is send you
7 this PDF file and you could take a look through it.
8 When you write your letters you could pick up your top
9 five.

10 MR. KRESS: That's a good idea. My
11 comment about the core degradation including M-5 is a
12 bit wrapped up in that bottom bullet. I have a
13 feeling if it really is more ductile and you really
14 have higher things, the ductile may affect the
15 meltdown in core degradation behavior. It may create
16 blockages easier. It may not candle in the same way.

17 We have core degradation as a high
18 priority. I include that as a part of that core
19 degradation. In your red up there I would add within
20 five in the red part. The red part you can see there,
21 I would add in addition to high burnup and MOX I would
22 add within five clad on there. That takes care of my
23 --

24 MR. BOYACK: Dave, you suggested
25 priorities and then you were silent.

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1 MR. LEAVER: That's fine. I --

2 MR. BOYACK: These are all right, there
3 ones here?

4 MR. LEAVER: Well, I mean, if something is
5 a high priority and one person is trying it, it's hard
6 to think that we shouldn't reflect that. I was just
7 concerned that if we make everything a high priority,
8 then we lose the discrimination. If we make too many
9 things high priority, we lose discrimination.

10 I think some of the things that we've
11 indicated as high priority are not as high priority as
12 maybe one or two things that are really crucial. I
13 mean, getting the French data is absolutely crucial.
14 Somehow we need to communicate that in whatever it is
15 we do here.

16 MR. BOYACK: So, again, one of the ways of
17 doing that is for in your letter just break it up if
18 the three categories say high, medium, or low or
19 however you want.

20 MR. LEAVER: Each person can do that in
21 his letter but I was thinking more about this final
22 report that Moshen is going to write however that's
23 going to be put together.

24 MR. BOYACK: I think that's what we would
25 rely on heavily on the letters because that represents

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1 your written, thoughtful, well considered, mature.
2 How long do I need to go on? I'm running out of
3 words.

4 MR. KHATIB-RAHBAR: If you could please
5 send the letters in the final format so we can cut and
6 paste.

7 MR. BOYACK: The thought that occurred to
8 me, you get to choose to cut and paste whatever, but
9 you're talking about talking information out and
10 putting it in other courses of the report. Yes. What
11 I will do when I get back to work on Tuesday is I'll
12 go ahead and send you -- I guess I can send you PDF
13 files of everything we've generated.

14 Now, some of you like Word files, too?
15 I'll send both in two different e-mails. One will
16 have the PDF files attached and the same files
17 attached on a second e-mail in Word.

18 On this letter regarding research needs,
19 I would like to at least have an agreement with you on
20 timing. I'm willing to give up yesterday but I wonder
21 if we could keep it as close as possible out from
22 yesterday. What do you need to do this?

23 MR. POWERS: Next week.

24 MR. KRESS: Next week.

25 MR. CLEMENT: I need to go through

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1 discussion and then go through approval. I think it
2 is very fast. I have to discuss it with other people.

3 MR. BOYACK: Would two weeks be a
4 reasonable target? I understand it may take a little
5 longer to go through the bureaucracy. You might have
6 to deal with your colleagues.

7 MR. KRESS: Jim Gieseke will give you his
8 before he leaves.

9 MR. GIESEKE: The Bureaucracy is pretty
10 small. For you too, isn't it, Tom? Don't you have to
11 run it past your wife?

12 MR. KRESS: No.

13 MR. KHATIB-RAHBAR: That's the week of
14 March 3rd or 4th?

15 MR. BOYACK: 8th is the Friday. That's
16 March 8th, a Friday. I guess what I'll try to do,
17 Moshen, by the 6th I'll have you my chapter.

18 MR. KHATIB-RAHBAR: I'll be out of the
19 country by the 7th.

20 MR. POWERS: You're always out of the
21 country. What difference does it make?

22 MR. SCHAPEROW: From the NRC's perspective
23 we're hoping to spend some time on this in March.
24 We've got some internal deadlines for a draft report
25 by the end of March. It sounds like we'll be able to

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1 make it happen which is good from my perspective.

2 MR. KHATIB-RAHBAR: The letters are only
3 part of the deal.

4 MR. SCHAPEROW: Again, it's only a draft
5 report.

6 MR. BOYACK: I felt that the biggest hole
7 have been the chapters that I generate.

8 MR. LEAVER: Jason, what are you thinking
9 about the French MOX data and if we are able to
10 accelerate that process and get that data, say, in a
11 few months which my guess is if this group were to be
12 sitting here today, would that data -- we would have
13 numbers for the level of confidence more like what we
14 were talking about for high burnup as opposed to
15 rather low level of confidence.

16 I'm just trying to understand suppose that
17 data does come in a few months. What are you going to
18 do? I mean, would you ask this panel to come back
19 together and discuss that data or would you just use
20 it yourself?

21 MR. SCHAPEROW: I guess that's an option.

22 MR. LEAVER: You don't know? Okay. We
23 can talk about that.

24 MR. POWERS: The problem with data it
25 makes it much harder to prepare MOX.

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1 MR. LEAVER: To do what?

2 MR. KRESS: Without the data we can do
3 really good MOX. It's like more than two data points.

4 MR. POWERS: If I get more than two, I'm
5 in real trouble.

6 MR. KRESS: You can draw a straight line
7 with two data points.

8 MR. BOYACK: Let me return to the report.
9 I'll get my things to Moshen. The letters will be
10 there approximately the 8th. He has some processing
11 to do and then we need to get the report, the draft
12 report back to the panel. We'll have to turn it
13 around relatively rapidly. It may be a challenge.

14 MR. SCHAPEROW: I think it's not clear
15 that it has to be much more than a really rough draft
16 by the end of the month. That would probably satisfy
17 our needs.

18 MR. BOYACK: You can always hold up the
19 draft but the real key is the panel, I think, has to
20 be able to review the information. I'm agreed that
21 this is getting close to a final product before the
22 NRC maybe starts using for any other purpose.
23 Otherwise, that's the horse before the cart.

24 MR. SCHAPEROW: Also the further we get
25 away from the meetings people's memory fades as to

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1 what we discussed and some of the details. There are
2 a lot of advantages to doing it right away.

3 MR. BOYACK: I'll have mine in on the 6th.
4 Moshen will have everything else done on the 7th.
5 You'll need a week, right? The real question is if
6 you get it like the 15th or so, will you be able to
7 turn it around in a week?

8 MR. SCHAPEROW: I think so.

9 MR. KRESS: I'm very dubious about March
10 15th. It's my Roman background, I guess.

11 MR. POWERS: Now, do you see yourself as
12 Caesar or as Brutus?

13 MR. KRESS: Brutus.

14 MR. POWERS: So who are you going to stab?

15 MR. KRESS: I'm the stabbee. I mean the
16 stabber, not the stabbee.

17 MR. BOYACK: You made the same mistake in
18 the lunch line yesterday.

19 MR. KRESS: Oh, yeah. I did. I got my
20 things mixed up that I ordered. I do that pretty
21 often.

22 MR. POWERS: So the ides of March
23 shouldn't bother you at all if you're the stabber
24 instead of the stabbee. It's on the stabbee that
25 suffers.

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1 MR. KRESS: It puts a lot of pressure on
2 me to figure out who the stabbee is.

3 MR. BOYACK: What I'm hoping is if we can
4 get the draft report, it may have a few holes in it
5 but the draft report by the 15th. Then we can give
6 you like eight working days to review it.

7 MR. LEAVER: I thought the NRC was going
8 to put a draft report together by the end of March.
9 You're talking a draft of a draft?

10 MR. BOYACK: It should be a good draft.
11 If the panel has read it -- well, the draft they're
12 going to put together is what most of us get. That's
13 their draft. That's the NRC's draft. If we come back
14 and you come back with your comments by the 27th of
15 March, that gives us a little bit of time to try and
16 resolve the comments and make a draft that they can
17 say, "Well, we did it." Then it will come back out
18 again to the panel.

19 MR. LEAVER: Okay. Right.

20 MR. BOYACK: All of this will be written
21 down in an e-mail but I just wanted you to be aware of
22 it.

23 MR. LEAVER: One option I would hope that
24 the NRC would consider is capture this as best we can
25 in a draft but if it looks like we can get the French

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1 data in some reasonable period of time, that we wait
2 before we publish a final report to reflect that. I
3 offer that as something to consider.

4 MR. SCHAPEROW: Sounds optimistic to me.

5 MR. LEAVER: Well, maybe.

6 MR. SCHAPEROW: Given the history of this
7 issue.

8 MR. LEAVER: Well, you have a big hole
9 there.

10 MR. GIESEKE: It's not a whole. He has
11 numbers in it now. They'll use whatever numbers they
12 have.

13 MR. LEAVER: Those numbers, we really
14 didn't have a very good basis for those numbers. The
15 purpose of this exercise was to deal with burnup and
16 MOX and there's half the MOX problem that we really
17 couldn't deal with very well.

18 MR. GIESEKE: Dana gave them numbers.

19 MR. POWERS: They've got numbers that are
20 good to three decimal places.

21 MR. LEAVER: Three decimal points?

22 MR. POWERS: Oh, yes.

23 MR. LEAVER: Including the one to the left
24 of the decimal?

25 MR. POWERS: It's just the one to the left

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1 of the decimal.

2 MR. BOYACK: I haven't put dates on those
3 others. Okay. Will that do it? Any other comments,
4 questions, issues?

5 MR. SCHAPEROW: What is today? That gives
6 you about a week and half to get your stuff to ERI?

7 MR. BOYACK: Sure. Gotta do it.

8 MR. SCHAPEROW: It's going to take a while
9 actually. No need to get it done any sooner anyway.

10 MR. BOYACK: This is about all we can do.

11 MR. GIESEKE: What do you intend to do for
12 those tables that have the distribution of values?

13 MR. BOYACK: They will appear as
14 individual values entered but unnamed.

15 MR. SCHAPEROW: That's for A, B, C, and D.

16 MR. BOYACK: I don't have any plan to do
17 that. Just the individual values. Do you have any
18 other suggestions?

19 MR. POWERS: Especially on the MOX what
20 you want to do is wish 1, wish 2, expert 1, expert 2.

21 MR. NESBITT: Why won't you put the names
22 next to the radius?

23 MR. POWERS: Because that might motivate
24 people to discount some of it.

25 MR. BOYACK: This is just my view. If

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1 somebody else has a view and the panel wants their
2 names, I'll be glad to put their names.

3 MR. SCHAPEROW: That's what we've done.
4 We didn't write it down. It was never necessary.

5 MR. KRESS: How useful is it?

6 MR. GIESEKE: How useful is stuff where
7 there's three no entry plus one number? June take the
8 one number and use it, I suppose. That's what will be
9 done.

10 MR. BOYACK: That would be inappropriate.
11 What I will do in the text is I'll pick up comments.
12 There was a fairly long discussion in the morning
13 about these data and the lack of data. Dana when he
14 gave his, this could go in an entirely different way.
15 So I guess I shouldn't be making decisions on this.

16 I mean, the panel owns the opinions, not
17 me. What happened towards the end is each individual
18 elected based upon what they perceived, whatever set
19 of perceptions they had either to say, "I'm not
20 prepared to give a number," or, "I am with the
21 qualifications in the listing." Now, the use of the
22 stuff, of course, is not something we can control.

23 MR. LEAVER: Not something what?

24 MR. BOYACK: We can control.

25 MR. LEAVER: I think the NRC is the one to

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1 decide how it's to be used.

2 MR. BOYACK: Well, for their use.

3 MR. LEAVER: We can maybe make suggestions
4 how we think it should be used but ultimately that's
5 their decision.

6 MR. KRESS: If I were NRC I would pick the
7 highest number. Isn't that what they always do?

8 MR. LEAVER: They don't always do that.

9 MR. KRESS: They don't?

10 MR. LEAVER: No.

11 MR. KRESS: They could use the minimum
12 entropy average but don't ask me what that is. I have
13 no idea.

14 MR. BOYACK: Is there anything else before
15 we adjourn?

16 Charlie?

17 MR. TINKLER: No. I think the committee
18 probably got the kinds of deep facts that we were
19 seeking. We can't reach a conclusion on certain
20 things because of lack of data. That's
21 understandable.

22 I guess my initial reaction to this is
23 that the committee has done quite well considering the
24 available information. It has involved a fair amount
25 of integration. I would expect that we are a long

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1 ways from adopting regulatory values.

2 This thing goes out and is published in
3 draft and everybody in the world who has an interest
4 in source terms comments on it. That's a long
5 process.

6 I'm not adverse to the idea of reconvening
7 the group at some later time to present some
8 additional information. That's still possible. To
9 the extent the committee has provided recommendations
10 for high burnup, that's very useful information for
11 the NRC. There's still some more to be done. That's
12 the state of affairs. That's the way I view it.

13 My initial reaction is I can't imagine
14 that if there's a preponderance of committee members
15 that feel there's no basis for offering a number for
16 MOX we would say we feel bold enough to substitute a
17 value. Maybe but I have trouble imagining that one,
18 to tell you the truth.

19 MR. BOYACK: All right. Any other
20 comments from the panel members? Actually, it's been
21 fun working with you. I like working with a small
22 group. I've tried big groups and they are hard.
23 Small groups are fine where six experts are really
24 good and it seems to me you really tried to go ahead
25 and meet the objective state of the panel. You've

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1 done a good job so thank you very much and we stand
2 adjourned.

3 (Whereupon, at 2:01 p.m. the meeting was
4 adjourned.)

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