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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON NUCLEAR WASTE

June 20, 2007

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1 UNITED STATES OF AMERICA

2 NUCLEAR REGULATORY COMMISSION

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4 ADVISORY COMMITTEE ON NUCLEAR WASTE

5 AND MATERIALS (ACNW&M)

6 180th MEETING

7 + + + + +

8 WEDNESDAY,

9 JUNE 20, 2007

10 + + + + +

11 VOLUME II

12 + + + + +

13 ROCKVILLE, MARYLAND

14 + + + + +

15

16 The Advisory Committee met at the Nuclear

17 Regulatory Commission, Two White Flint North,

18 Room T-2B3, 11545 Rockville Pike, Rockville, Maryland,

19 at 8:30 a.m., Michael T. Ryan, Chairman, presiding.

20 COMMITTEE MEMBERS PRESENT:

21 MICHAEL T. RYAN Chairman

22 ALLEN G. CROFF Vice Chairman

23 JAMES H. CLARKE Member

24 WILLIAM J. HINZE Member

25 RUTH F. WEINER Member

1 NRC STAFF PRESENT:

2 CHRISTOPHER BROWN

3 LATIF HAMDAN

4 JOHN FLACK

5 DAVE McINTYRE

6 BOB EISINGER

7 ANTONIO DIAS

8 DEREK WIDMAYER

9 NEIL M. COLEMAN

10 HAROLD SCOTT

11

12 ALSO PRESENT:

13 CHARLES FITZPATRICK, State of Nevada

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I-N-D-E-X

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

2 (8:32 a.m.)

3 CHAIRMAN RYAN: The meeting will come to

4 order.

5 This is the second day of the 180th

6 meeting of the Advisory Committee on Nuclear Waste and

7 Materials. During today's meeting, the Committee will

8 consider the following: the NRC Office of Public

9 Affairs' perspectives on radiation risk communication,

10 a basic primer on high-burnup spent nuclear fuel and

11 its cladding, ACNW staff attendance at recent

12 technical meetings and updates related to those

13 meetings, and discussion of ACNW letter reports.

14 This meeting is being conducted in

15 accordance with the provisions of the Federal Advisory

16 Committee Act. Chris Brown is the Designated Federal

17 Official for today's session.

18 We have received no written comments or

19 requests for time to make oral statements from members

20 of the public regarding today's sessions. Should

21 anyone wish to address the Committee, please make your

22 wishes known to one of the Committee staff. It is

23 requested that speakers use one of the microphones,

24 identify themselves, and speak with sufficient clarity

25 and volume, so they can be readily heard. It is also

1 requested that if you have cell phones or pagers you
2 kindly turn them off at this time.
3 Without further ado, it's my pleasure to
4 welcome David McIntyre, who is going to speak to us
5 today on NRC's outreach on radiation. David is with
6 the Office of Public Affairs, and, David, welcome and
7 thank you for being with us.
8 MR. McINTYRE: Thank you very much, Mr.
9 Chairman, members of the Committee. If I could start,
10 I'd like to take note of the new name of your
11 Committee. As a graduate of the College of William
12 and Mary, it's gratifying for me to see my alma mater,
13 W&M, incorporated into your acronym.
14 (Laughter.)
15 CHAIRMAN RYAN: Very good.
16 MR. McINTYRE: I haven't been able to see
17 that acronym without doing a doubletake yet, so it's
18 good to see some recognition for the old school.
19 CHAIRMAN RYAN: There you go.
20 MR. McINTYRE: But anyway, the reason your
21 staff so graciously invited me to address you this
22 morning is because the Commission has had on its radar
23 recently a need that they see for the agency to
24 improve its outreach to the public on the basic
25 biological effects of radiation, sort of the basic

1 information about radiation, what it is, why we --
2 where it comes from, why we should or should not be
3 concerned about various radiation sources, and I
4 wanted to brief you about what the agency's outreach
5 efforts are and what we've begun to do in terms of
6 first steps to meet the Commission's concerns on this.
7 And first of all, I mean, that would be --
8 sorry, I forgot to hit the button to go to the next
9 slide. One of the things I would like to stress is
10 that the Office of Public Affairs is obviously a
11 prominent part of the agency's outreach to the public,
12 but it is by no means all of it.
13 Every program office has independent
14 outreach efforts about their regulatory efforts, and
15 as I would say, as part of the key message, any NRC
16 outreach is about the health effects of low dose
17 radiation exposure, because it is the agency's mission
18 to protect people and the environment by keeping these
19 exposures as low as reasonably achievable. So
20 anything that relates to this subject, anything that
21 the agency does in its public outreach.
22 Now, I'd like to start off --
23 CHAIRMAN RYAN: If I may just interrupt
24 you for one second.
25 MR. McINTYRE: Sure.

1 CHAIRMAN RYAN: We have some participants
2 on our bridge line, which I'd like them to introduce
3 themselves, just to make sure all the connections are
4 working. Will the folks on the bridge line please log
5 in? Is there anybody on the line?
6 MR. McINTYRE: I put them to sleep
7 already.
8 (Laughter.)
9 CHAIRMAN RYAN: I guess they're not on the
10 line yet. If they sign in, we'll just take a minute
11 and let them --
12 MR. McINTYRE: Okay.
13 MR. FITZPATRICK: Charles Fitzpatrick,
14 State of Nevada, is on.
15 MR. McINTYRE: There he is.
16 CHAIRMAN RYAN: Hello, Charles. Good
17 morning.
18 MR. FITZPATRICK: How are you?
19 CHAIRMAN RYAN: Fine. Thanks for being
20 with us.
21 MR. FITZPATRICK: Thank you.
22 CHAIRMAN RYAN: Any other participants?
23 Dr. Malsch, I understood you might be there?
24 (No response.)
25 Guess not, so we'll proceed.

1 MR. McINTYRE: Okay.

2 CHAIRMAN RYAN: Thank you again for the

3 interruption.

4 MR. McINTYRE: I'd like to start just by

5 saying a little bit about OPA and where we fit in the

6 agency. We are part of the Commission Office staff.

7 We're not part of the EDO staff. And we report -- my

8 boss reports directly to the Chairman, and our task is

9 to assist him in his statutory function as the

10 principal spokesperson for the agency.

11 And we are, of course, the primary link

12 with the news media. We're available to staff any

13 time they get contacted directly by reporters that we

14 can help out and facilitate getting that information

15 to the news media. And we can sit in on interviews,

16 or, more often, we get the inquiries and we then reach

17 out to staff to get the information, if we don't have

18 it on hand.

19 But we also do take a lot of inquiries

20 from the public through e-mail and phone calls every

21 day in our office over in One White Flint North, and

22 at our regional offices, and these can range from

23 anything from, what do I do with my tritium exit

24 signs, to, you know, why are they dumping radioactive

25 waste in the landfill down the road from me? Anything

1 like that.

2 And we do have regional offices that do a
3 lot of the grunt work for Public Affairs. You'll see
4 them at the public meetings, and you'll see my
5 colleagues from the regions quoted a lot in the
6 newspapers, because they're the ones handling the
7 specific questions about the powerplants and various
8 issues in the localities.

9 And we all like to see our name, so I
10 thought I'd put that slide in. We have four here in
11 the -- four Public Affairs officers, plus Elliot
12 Brenner and Beth Hayden, our Director and Deputy here
13 in Headquarters, two in each of the regions except for
14 Region IV, where Victor Dricks handles things by
15 himself quite capably.

16 This slide is just a little bit about the
17 extent of OPA's efforts for the agency, and I've
18 highlighted in yellow public inquiries, web video
19 brochures and fact sheets and public meetings, because
20 those are the three areas that I felt were more --
21 most salient to our topic today.

22 Okay. Now, I would basically sort of
23 divide the agency's public outreach efforts on
24 radiation to three legs of a triad as it were, one of
25 which would be OPA. We do various fact sheets, which

1 I've given you in the briefing packets. These are
2 fact sheets such as biological effects of radiation,
3 radiation protection in the tooth fairy issue, or fact
4 sheets we put together when -- for the tritium spills
5 out in the Midwest, trying to put those issues into
6 context.
7 They are available as handouts at public
8 meetings. They are on the website. We also assist
9 the program offices with their web content for their
10 various pages. The way the agency handles the
11 internet site is each office is responsible for the
12 content of its area, so you don't have a unified real
13 -- there is no central voice or authority that's
14 really directing how the information is presented, so
15 there can be some unevenness, but that also allows the
16 staff to be directly involved in what information is
17 presented there.
18 OPA has a special web page for students
19 and teachers, which we'll show you later in my
20 presentation. We assist staff at public meetings. So
21 we're there when the staff is going out to meet with
22 the public, we have -- generally we'll have a Public
23 Affairs officer that can handle any media inquiries.
24 We take the public queries from the media
25 and the public, and we do advance work for speeches of

1 the Chairman or the other Commissioners, as they
2 request.
3 Now, a lot of the agency's outreach comes
4 through the program offices, and they really do have,
5 I feel, an impressive outreach effort in some of these
6 offices. For instance, NRR, Nuclear Reactor
7 Regulation, their Division of License Renewal has a
8 very extensive outreach effort for public meetings and
9 web content for information relating to license
10 renewal of the powerplant.
11 And as you may know, they are currently
12 busy with some very contentious license renewals.
13 They've got on their plate at the same time Oyster
14 Creek, Indian Point, Pilgrim, Vermont Yankee, and --
15 well, those are the main ones that are contentious,
16 all up in Region I.
17 NRR also does annual assessment meetings
18 that are rather sparsely attended by members of the
19 public for the most part, but this is a chance to tell
20 the public exactly how the licensees are performing,
21 the powerplants are performing, and the agency's
22 efforts to make sure that they are performing safely.
23 The Office of New Reactors is just
24 beginning an outreach effort. I believe the first big
25 meeting will be next week in South Texas, to explain

1 the Part 52 licensing process, so in areas where we
2 might -- where we are expecting to receive
3 applications for new powerplants.
4 And then, of course, there is the NMSS
5 High-Level Waste Repository Safety Division has an
6 outreach team headed by Janet Kotra that is very
7 active out in Nevada and California and the areas
8 around Yucca Mountain. They are out there this week
9 to have a meeting with affected units of local
10 government, just to explain how we're getting ready
11 for an application, should it come in next year as
12 we're told to expect.
13 And a lot of that, of course, is outreach
14 to the Native American tribal nations, and the
15 agency's outreach to those communities and those
16 stakeholders extends beyond high-level waste. The
17 Uranium Recovery Branch in FSME -- I'm not even going
18 to try to say that whole name -- deals with a lot of
19 Native American communities in the uranium recovery
20 areas, and, of course, as you know, that industry is
21 beginning to see a renaissance as well.
22 And even in the OEDO level, Marty
23 Virgilio's title has been expanded to include tribal
24 -- his position as the agency's main contact to the
25 tribal communities. And, of course, we have agency

1 outreach to other intergovernmental organizations in
2 dealing with radiation issues that's more of a high-
3 level area than we're really talking about today.
4 And I added "etcetera" to the slide,
5 because I'm sure I'm leaving something out, and I
6 didn't want to offend anybody.
7 And the third outreach effort that I would
8 point out is agency-wide communications effort that
9 has come up in the last four or five years. We've had
10 the branding initiative, which is the new agency logo,
11 which you see here on the screen, and our marketing or
12 branding tag line, "Protecting People and the
13 Environment."
14 And in OPA, of course, we kind of fancy
15 ourselves as the champions of plain English. When you
16 think about it, protecting people and the environment
17 has taken the agency's mission statement from 30 words
18 and put it pretty succinctly into five. So that's a
19 pretty effective, I think -- pretty effective way of
20 communicating our basic message.
21 Now, I'd like to talk about some recent
22 initiatives. We've -- I have at the end of my
23 presentation a little bit of a demo of the agency
24 website. But in response to Commissioner statements,
25 both in periodic meetings with senior management and

1 in public briefings that the agency needs to do more
2 to have information available to the public on basic
3 radiation, we've added radiation protection as a key
4 topic to the web page.
5 So that means when you go to www.nrc.gov,
6 there's a box there on the right of key topics, and
7 there is now a link to radiation protection, which
8 gathers all the information that we already had on the
9 website and puts it in one convenient page. So it's
10 basically taking the information we had, bringing it
11 together, and putting it closer to the surface. And,
12 hopefully, that will make it easier for somebody to
13 find if they -- if they come to our website looking
14 for information about radiation.
15 In addition, Public Affairs and FSME have
16 begun looking at this web content to see how we can
17 improve and especially simplify the presentation of
18 information on radiation protection. So that is an
19 effort that will probably be quite extensive, and
20 you'll hopefully see some improvements as time goes on
21 and we are able to make changes to the information
22 that's there on the web.
23 Now, what do we have already? On the web
24 we have the pamphlets and brochures. And most salient
25 to our discussion, we have this pamphlet, the glossy

1 pamphlet, "Radiation Protection and the NRC." I
2 believe there are copies here in the room that people
3 can have with lots of nifty graphics. We're actually
4 trying to get into the 20th century on the
5 presentation of our information.
6 And this is available on the web. We have
7 a fact sheet with -- on the biological effects of
8 radiation, which tries to put some of this in context,
9 that radiation is all around us. You get a few more
10 millirems if you live in the mountains in Colorado
11 than you do if you live down here in -- along the
12 coast. You get a few millirems if you take a cross-
13 country or trans-oceanic airline flight, things like
14 that.
15 We also have -- it's kind of hard to find,
16 and we need to make it a little more accessible -- a
17 personal dose calculator. It's a table that you can
18 fill out, "Oh, yes, I've taken five airplane trips, so
19 X number of millirems," and add that to the average
20 background, and just try to get an estimate of your
21 annual dose. And just to, you know, try to put things
22 in context that way.
23 Now, I'd like to talk about public
24 perceptions of radiation and what we're coming up
25 against when we try to explain this and put it in

1 context. The public's main perception of radiation is
2 danger. When you see the trefoil sign, or the new --
3 the red warning sign that got a lot of press before
4 anybody realized that most people are never going to
5 see it, it's basically, you see this, you're in
6 danger, get out of here.
7 Most people's idea of radiation is
8 probably going to the doctors and having an X-ray.
9 Well, the doctor puts a lead apron on you and then
10 runs out of the room to throw the switch. That's
11 emphasizing the risk there of radiation. So I think
12 that's what the public perception is.
13 So when we're trying to counter that, we
14 have the message -- and this quote is from this
15 pamphlet here -- that radiation can be either
16 beneficial or harmful, depending on its use and
17 control, the idea being that, yes, there is a risk,
18 but if it is managed, if it is well regulated,
19 radiation can be used safely for beneficial purposes.
20 And that is the message that we have in just about any
21 publication that the agency puts out about its
22 activities.
23 Now, that is a simplification of NRC's
24 official policy, which is the linear non-threshold
25 theory of radiation exposure, but there is no

1 radiation dose that does not carry some measure of
2 risk. That is not inconsistent with the previous
3 message, but that is -- the previous message is not
4 really what the public hears when you express the
5 linear non-threshold theory.
6 In plain English, that theory becomes
7 there is no such thing as a safe dose of radiation.
8 And in even plainer English, all radiation is harmful.
9 Now, I went to the website of the Nuclear
10 Information Resource Service, one of our frequent
11 interloculers on a variety of issues, and I found some
12 quotes on this subject that take that non-threshold
13 theory. One is there is no safe level of exposure,
14 and there is no dose of ionizing radiation so low that
15 the risk of a malignancy is zero, and that's
16 attributed to Dr. Karl Morgan, the Father of Health
17 Physics.
18 So here is the Father of Health Physics
19 waving a red flag about radiation. And I read that,
20 I don't want to go outside in the sun. But they also
21 have a fact sheet on radiation on their website at
22 NIRS that has this quote, "Ionizing radiation travels
23 through our living tissue with much more energy than
24 either natural, chemical, or biological functions.
25 This extra energy tears mercilessly at the very fabric

1 of what makes us recognizably human -- our genetic
2 material."
3 Ionizing radiation tears mercilessly at
4 the very fabric of what makes us human. This goes way
5 beyond the radioactive spider giving Peter Parker his
6 super powers. This is scary stuff. And I really
7 think that when we go out there, and we're trying to
8 say, "Okay, yes, there's a tritium spill at the plant
9 near you, but it's well within regulatory limits,"
10 what we're up against is this fear of radiation. So
11 that's what complicates our efforts to simply this
12 message and put this issue into context.
13 Okay. Now, if we could switch over to the
14 -- wow, you're good. Now, because of the setup, I'm
15 going to have to direct Michelle on where to click,
16 but we did rehearse this, so we can try it.
17 Over here on the right is the key topics
18 box with the radiation protection key topic that I
19 mentioned. And key topics is actually sort of prime
20 territory on our home page. There are three people in
21 the agency called the Web Access Group, or the WAG --
22 of course, have to have an acronym. One is a
23 representative of OPA, Beth Hayden. Another is the
24 Office of Information Service, and the other is the
25 OEDO Communications Center. And these three have to

1 agree on a change to key topics.

2 So this is not something that changes

3 easily or often. It really needs to be an issue of

4 prominence to be put there.

5 And, Michelle, if you could -- actually,

6 yes, click on that, please. This is the page we put

7 together within the last month after Commissioners

8 McGaffigan and Merrifield spoke out at the AARM

9 briefing in May about the need to have more

10 information on the website. Their goal is that they

11 would like the NRC's website to be the website of

12 choice for members of the public who are interested in

13 finding information about radiation.

14 And that could be a problem -- or

15 difficult, I should say. If you Google "radiation,"

16 the NRC first comes up at about 95 I think. If you

17 Google "nuclear," we're there on the front. But

18 anyway, so this page has information -- basic

19 information, what is radiation, what are its sources,

20 how does it affect the public, and if you scroll down

21 a little bit, Michelle, we have links to these fact

22 sheets and brochures that I was telling you about, and

23 other organizations, the EPA website, our students

24 page, and the IS -- what, yes, the Interagency

25 Steering Committee. Sorry, I lost it there for a

1 second.

2 And this is all easily linked to now. And

3 before, you kind of had to go searching for it. So in

4 order to respond to the Commissioner's wishes, we put

5 this up more prominently.

6 Now, Michelle, if you could go back to the

7 home page, please. The fact sheets are also available

8 under News and Information. If you could just hold

9 the cursor over that button there on the left, please,

10 Michelle. Do you see the drop-down menu, Fact Sheets

11 and Brochures right there? And that goes to all our

12 fact sheets and brochures, not just the ones that are

13 directly related to this subject.

14 And, sorry, I threw you a loop. Now, if

15 you could click on the Students and Teachers, this was

16 a page we set up in OPA a few years ago, basically to

17 try to give basic information and some suggested

18 course activities for teachers who are trying to teach

19 about nuclear issues. And if you click on the

20 radiation button up here -- we'll just skip to that --

21 this page has some basic information, and you can

22 scroll down, please, Michelle.

23 And most interesting it has a link to

24 EPA's Radtown, USA, which Commissioner McGaffigan has

25 mentioned a couple of times in public meetings. It's

1 a pretty nifty site. EPA has done a really good job
2 in putting information about the various isotopes and
3 where radiation comes up in our lives and industry and
4 medicine and in nature, and put it together on an
5 interactive site.
6 So I'll end by asking Michelle to click on
7 that and show you that. And can you enlarge that?
8 You can click on anything in this animation here, and
9 it will go to a fact sheet. Clicking on the train
10 gets you radioactive materials transported by freight
11 train. Yes, click wherever you want. It's fine.
12 (Laughter.)
13 You can get the cosmic radiation during
14 flights. Clicking on the factory over there, I think
15 it's you -- the factory with the wrecking ball,
16 discarded tritium exit signs. I get four or five
17 calls a month, "What do I do with my tritium exit
18 signs?" So I need to print out that page. But,
19 anyway, this is a pretty nifty site that they have.
20 That concludes my presentation.
21 Obviously, as I said, we're in the beginning stages of
22 trying to improve our presentation of this information
23 on the web and elsewhere. So I would be happy to try
24 to address any questions you have, and certainly any
25 suggestions you might have on how we can undertake

1 this task.

2 Thank you.

3 CHAIRMAN RYAN: Dave, that sounds like

4 some great steps you've taken over the short-term

5 history there. That's great.

6 One thing that strikes me -- that this

7 seems to be NRC's effort to reach people on an

8 individual basis, that might want to come to the

9 website or they're interacting on one particular topic

10 here or another.

11 Is there -- in that sense, it's proactive

12 in that, you know, you have an offering to the public.

13 It's maybe a little bit reactive when they're dealing

14 with a particular issue or calls that come in. Is

15 there a program to address, you know, education? Or,

16 you know, I know that Health Physics Society has a

17 teacher workshop program based on the South Texas

18 chapter. And they will for free go to any school,

19 provide information to the science teachers, packets

20 for training and class, and if you give teachers

21 curriculum materials that, you know, you are welcome,

22 come on in.

23 MR. McINTYRE: Right.

24 CHAIRMAN RYAN: So is there any effort to

25 have those either teacher outreach or other kinds of

1 outreach where the agency is seeking the opportunity
2 to provide this information?
3 MR. McINTYRE: At this point, I don't
4 believe there is any coordinated effort in that way.
5 A lot of staff members do make presentations at their
6 kids' schools, for instance --
7 CHAIRMAN RYAN: Sure.
8 MR. McINTYRE: -- and we have some
9 materials that they can use to -- you know, visual
10 aids that they can borrow. And we have, of course,
11 the student/teachers web page that I just showed you.
12 But as far as actually going out and engaging, I don't
13 think we have dedicated any specific resources to
14 that, at least in the few years I've been with the
15 agency.
16 CHAIRMAN RYAN: Well, there's quite a
17 large number of teachers that have gone through that
18 program with the Health Physics Society over the
19 years. I'd be curious -- I haven't asked them, but it
20 would be interesting to see what their view of that
21 effort has been.
22 I mean, do they see significant or
23 permanent changes in curricula for grammar school and
24 high school? You know, what's that doing? Because
25 that sort of multiplies your effort here of actually

1 getting people to deliver the materials after they've
2 been trained, what the information is.
3 MR. McINTYRE: Sure.
4 CHAIRMAN RYAN: The other question I had
5 about outreach -- how do you -- I noticed on the
6 website there's a lot of the Health Physics Society's
7 position papers, for one.
8 MR. McINTYRE: Yes.
9 CHAIRMAN RYAN: How do you interface with
10 licensees' programs? I mean, I know most utility
11 companies have very substantial public affairs and
12 outreach programs on educational issues, not just, you
13 know, what their company does. Do you interface or
14 interact or -- with any of that or --
15 MR. McINTYRE: Well, I think probably our
16 regional offices would do most of that outreach. For
17 instance, I know at Region I, when they have any
18 meetings on Indian Point, they make sure that they
19 have a health physicist along to explain any radiation
20 issues that come up or even on a conference call with
21 local government officials.
22 And Region III, of course, has done -- had
23 to do -- again, this is a bit reactive to -- with the
24 Braidwood tritium, had some very contentious public
25 meetings out there last year when -- trying to explain

1 the leaks that had been -- you know, not been
2 discovered for a while and putting them into context
3 with people who were quite upset about it,
4 understandably so.
5 As far as any sort of regular outreach or
6 contact with the licensees, with the power utilities,
7 I'm not aware of any at this point.
8 CHAIRMAN RYAN: It just strikes me as a
9 thought that that might not be a bad thing. At least
10 you can learn what questions they are being asked, and
11 what issues are important in their programs that, you
12 know, are coming to them. It's not that, you know,
13 you would rely on them to represent the agency.
14 Obviously, that wouldn't be correct.
15 But just communicating with them about,
16 you know, what are people asking you, and what are the
17 issues that you are hearing, might not be a bad thing
18 to survey. I mean, in the radioactive waste
19 management area, that has also been an issue over
20 time.
21 MR. McINTYRE: Sure.
22 CHAIRMAN RYAN: So, you know, and I know
23 that companies that are involved there do have fairly
24 substantial public outreach efforts.
25 MR. McINTYRE: Right. I know that my

1 regional colleagues deal quite regularly with their
2 counterparts at -- the Public Affairs spokespeople for
3 the utility. So I can certainly ask them if they have
4 any sort of contact like that.
5 CHAIRMAN RYAN: Yes. And, again, I think,
6 you know, if it's not routine and regular, that might
7 be an opportunity for, you know, information gathering
8 about what's of interest to the public, and then also
9 providing, you know, contacts and information from the
10 agency that could be used to go forward.
11 MR. McINTYRE: Okay. Thank you.
12 CHAIRMAN RYAN: Thank you.
13 Professor Hinze?
14 MEMBER HINZE: Well, I was curious. The
15 new security emphasis, has this in any way deterred
16 visitations to the nuclear powerplants or other
17 nuclear facilities by the public? Because it --
18 MR. McINTYRE: Dramatically.
19 MEMBER HINZE: It seems to me that that's
20 just a real excellent way, and I know that in
21 discussing this with friends that they've stopped at
22 Big Rock Point or whatever, and, you know, very much
23 enjoyed and understand a lot better as a result of
24 these visits. It's much better than --
25 MR. McINTYRE: Reading a pamphlet, yes.

1 MEMBER HINZE: Right. And it's something
2 you can take the children to. Does the NRC have any
3 impact upon -- on this? And what's being done to
4 maintain some semblance of public participation?
5 MR. McINTYRE: The security situation
6 after 9/11 -- basically, I think all the plants
7 canceled any public tours. And we have, when the
8 question comes in to OPA, "Can I take a tour of
9 Calvert Cliffs?" from a member of the public, we refer
10 them to the utility. It's really up to the utilities
11 at this point.
12 I don't have specific information. I
13 believe a few of them have at least made some talk of
14 reopening their visitors' centers. I know I visited
15 the one at North Anna a couple of years ago and was
16 very impressed with the information they had there,
17 and I had the room all to myself at the time. So it
18 would have been nice to have shared it with a class or
19 a crowd of people that were interested in it.
20 MEMBER HINZE: Well, are they building
21 facilities outside the secure area that would in
22 effect provide the opportunity to transmit this
23 information?
24 MR. McINTYRE: I don't know.
25 MEMBER HINZE: Thank you.

1 CHAIRMAN RYAN: Allen?

2 VICE CHAIRMAN CROFF: I've gone through a
3 couple of times this booklet "Effective Risk
4 Communication," which I think is very well done. How
5 is the NRC staff exposed to the -- to this booklet or
6 the contents of this? It seems to be a very useful
7 component of, I hope, other training. Are they
8 routinely exposed?

9 MR. McINTYRE: Well, I believe so. When
10 I went to Distribution last week and requested these
11 copies to give you, I got the last packet. And they
12 said, "Wow, there has been a rush on this booklet
13 recently."

14 (Laughter.)

15 So, and then, somebody told me that the
16 Commission actually mentioned that booklet in an SRM,
17 so every staff member went out and -- or every, you
18 know, office ended up distributing it again. So it is
19 there. People are periodically reminded about it, to
20 read it and use it in public meetings, and, of course,
21 it is on the website.

22 VICE CHAIRMAN CROFF: I guess I'm
23 unfamiliar with NRC training. When a new employee
24 comes in, is there some standard orientation they go
25 through for a day or so on everything from payroll to

1 maybe this kind of stuff, or --

2 MR. McINTYRE: I'm not sure. On the first

3 day, you get risk communication, but there is training

4 available for this, and I know there's media training

5 available and there -- we have a contractor who does

6 dry runs for public meetings, which I've sat in on a

7 few times and it's very helpful.

8 And she is really good about, you know,

9 just stopping somebody in the -- you know, halfway

10 through the first sentence of practicing a

11 presentation and saying, "You just scared me," and

12 making sure that the staff is alert to how the way we

13 talk resonates with the public.

14 VICE CHAIRMAN CROFF: But at this point,

15 the staff sort of has to know they need it, or seek it

16 out if you will.

17 MR. McINTYRE: As far as I know, yes.

18 VICE CHAIRMAN CROFF: Okay. Thanks.

19 CHAIRMAN RYAN: Or has a vision that tells

20 them they must do it, I guess. That could be

21 something the supervisors work out for their job

22 titles and --

23 MR. McINTYRE: Yes.

24 CHAIRMAN RYAN: -- all of that.

25 MR. McINTYRE: Yes, right.

1 VICE CHAIRMAN CROFF: Okay. No.

2 CHAIRMAN RYAN: One other question that

3 kicks in my mind, if I may -- go ahead, Ruth. I'll

4 wait.

5 MEMBER WEINER: No, that's fine. Go

6 ahead.

7 CHAIRMAN RYAN: No, no.

8 MEMBER WEINER: I'm burning to ask a few

9 questions.

10 CHAIRMAN RYAN: I could tell.

11 (Laughter.)

12 MEMBER WEINER: On page 3 of your booklet,

13 you have a -- of this booklet, and I have to say this

14 is a very thorough --

15 MR. McINTYRE: I can't claim credit for

16 this. This is, I believe, the Office of Research.

17 CHAIRMAN RYAN: It's NUREG-0308, for those

18 folks that don't know what "this booklet" refers to.

19 CHAIRMAN RYAN: I'm sorry. It's titled

20 "Effective Risk Communication." On page 3, there is

21 a little chart that -- of steps to implement

22 communication, and the last step is evaluate and

23 improve.

24 And I would like to know how your office

25 or anybody associated with public communication

1 evaluates what you consider success in public
2 communication, how do you evaluate it, and what do you
3 do -- and basically, other metrics. Any comment? And
4 they'd have to be qualitative metrics.
5 MR. McINTYRE: Well, in OPA, our most
6 immediate measure, of course, would be press coverage
7 of an issue, and whether it reflects well on the
8 agency or our perspective. And we can be proactive or
9 reactive, depending on the case, whether we know
10 something is about to happen or whether we're caught
11 by surprise on something.
12 As far as something in this context, I --
13 it is not necessarily OPA but the program offices,
14 when they go out and do public meetings, frequently
15 will do a lessons learned meeting afterwards and
16 discuss, okay, remember that point of the meeting
17 where it got a little difficult and we had trouble
18 explaining something. And that way we can, you know,
19 try to make sure that the presentations are better the
20 next time.
21 As far as success, there is a feedback
22 sheet that is routinely distributed at public
23 meetings, so people can give comments like -- good or
24 bad. And we look at those, or the program offices
25 look at those. And it can be anecdotal, whether

1 people come up to us -- I mean, we have some where --
2 sometimes where people come up to us and say, "You
3 know, I was really suspicious, but I -- thanks for
4 coming. I understand a little bit more now," and
5 other meetings where they just, you know, aren't going
6 to believe us one way or the other.
7 So I don't know if that particularly
8 addresses your question.
9 MEMBER WEINER: It does, and thank you.
10 It seems to me your evaluation program is basically
11 presentation by presentation. It is based on the
12 particular presentation or the particular audience or
13 the particular situation. And I wondered whether you
14 had any look, and apparently you don't, on your public
15 information program as a whole, as a national whole,
16 has -- over the years, has it -- have you evaluated
17 any major change in people's attitudes? Have you even
18 tried to do that?
19 MR. McINTYRE: Yes. There was -- I don't
20 have the information with me, but there was an effort
21 that stemmed from Commissioner Merrifield's
22 communications task force of a few years ago that --
23 I believe it stemmed from the task force, but there
24 was -- the EDO Communications Council did a -- some
25 focus groups around the country to get public views

1 about the agency, our regulatory activities, and about
2 the information that we present.
3 One of them was, "Can't find anything on
4 the website." But -- so we're responding to that and
5 trying to make things easier to find on the website.
6 But there has been an effort like that, and it's -- I
7 believe Mindy Landau is in charge of that in the EDO's
8 office, and she would have more information on that.
9 MEMBER WEINER: I would encourage you to
10 continue that effort and to look rather than at things
11 like "can't find anything on the website," to try to
12 get your focus groups to give you some idea of the --
13 any basic change in attitude that your public
14 information has produced. I'd just encourage you to
15 do that.
16 Second question is: do you -- does your
17 office or anybody associated with public information
18 keep up with the current sociological literature in
19 that area, and with the current health physics
20 literature, like the report by the French Academy of
21 Sciences, and use that to feed into your public
22 information.
23 MR. McINTYRE: Well, I believe the Office
24 of Research and the health physicists within the
25 agency do keep up with that literature. The second

1 part of your question is whether that filters down to
2 what we are presenting to the public is something that
3 -- it does at some points, but I wouldn't say that
4 there's necessarily a specific channel for that.
5 MEMBER WEINER: Well, again, I would
6 encourage you to do that, because there have been some
7 recent sociological studies -- and I'd be glad to
8 refer you to them -- that look nationally at public
9 attitudes toward nuclear power, toward things like
10 this, and there are some very interesting results.
11 Finally, I think your fact sheets are
12 really good. Let me just say that right off the bat.
13 MR. McINTYRE: Thank you.
14 MEMBER WEINER: A couple of questions I
15 have. I was looking at your response to the tooth
16 fairy issue. You don't address it directly. I mean,
17 you are saying, yes, you know, that you -- NRC does
18 this, and we get a little bit of effluent, and so on.
19 But you don't just plain say -- you don't give an
20 evaluation of the tooth fairy -- the whole tooth fairy
21 thing.
22 And I think you would be well advised to
23 do so. You're going to step on some toes, but the
24 public doesn't put two and two together as a rule.
25 You're talking -- all your public information stuff

1 indicates that the public will -- doesn't put two and
2 two together, and may not realize that this is an
3 argument against the tooth fairy project. They simply
4 may not realize it.
5 And I would encourage you to be more
6 direct, even if you think it's going to -- it is
7 certainly going to offend whoever that actor is who
8 started that whole tooth fairy project, but it -- if
9 you're going to communicate, you really need to be
10 very direct.
11 I also note that -- and this is very
12 common in public information -- strontium may be in
13 its pure elemental state, a silvery white alkaline
14 earth metal, but it's going to show up in the
15 environment as a compound strontium chloride or
16 something like that.
17 CHAIRMAN RYAN: And it's going to be
18 invisible, because it's so small.
19 MEMBER WEINER: And it's going to be
20 invisible.
21 CHAIRMAN RYAN: It won't be seen by the
22 naked eye.
23 MEMBER WEINER: That's right. And the
24 final -- my final point is there is a whole segment of
25 the population that reacts negatively to something

1 being manmade. Women make them, too. And I would
2 encourage you to use the word "anthropogenic," even if
3 it has a number of syllables, or to find an --
4 "people-made" is awkward.
5 MR. McINTYRE: Yes.
6 MEMBER WEINER: But "manmade" really --
7 let me tell you, there are people who find that --
8 it's off-putting.
9 MR. McINTYRE: Okay.
10 MEMBER WEINER: And I'd do that. That's
11 all. Thank you.
12 CHAIRMAN RYAN: Dr. Clarke?
13 MR. McINTYRE: You're welcome.
14 MEMBER CLARKE: Thank you. I want to
15 agree with Ruth and the others. I think you're
16 putting out some really nice stuff and some really
17 good information. On the subject of outreach, and
18 other -- what other people are doing that you probably
19 are aware of, but let me just throw out some things.
20 The National Library of Medicine publishes
21 the whole toxmat series of databases. They are
22 getting interested in radionuclides, and they are
23 starting to put out information on radionuclides.
24 They have an animation called Toxtown, which is very
25 similar to Radtown, which takes chemicals that one

1 encounters in different settings and then gives you
2 information about them. It's -- from what I can see
3 of Radtown, they are very similar, and both are very
4 well done.
5 But, you know, there may be merit to
6 checking some of these other groups that are putting
7 out information about health effects and seeing what
8 they're saying as well.
9 On the subject of, how do we know that
10 we're -- that we're being persuasive, that we're
11 informing people that they're getting the message, I
12 was wondering if you work with any outside firms that
13 work with marketing and advertising, with people
14 spending millions of dollars on commercials and
15 knowing right away when to pull them and when to keep
16 them running -- you know, whatever tools they use to
17 see if their message is being effective.
18 There may be some other things out there
19 that --
20 MR. McINTYRE: I am not aware that the
21 agency has devoted any resources to that, in recent
22 years at least.
23 MEMBER CLARKE: As I listened to the
24 things you were doing that I thought were very good,
25 it struck me that on a national level where people are

1 spending huge sums of money trying to persuade others
2 that their message is a good one, there may be some
3 other ways of getting that information.
4 Finally, on a chemical site back in a
5 former life in Massachusetts we were involved in a
6 large risk assessment and cleanup of a manufacturing
7 facility that got PCBs all over the place. And it was
8 a very brave corporation. One of the things they
9 decided to do was test all of the former employees, to
10 see what the blood levels of PCBs were.
11 Now, they're not a direct indication of
12 risk, but they do give you an indication of exposure.
13 But before they did that, they rounded up all of the
14 physicians in the area and they gave -- knowing that
15 when people heard about this they would go to their
16 family doctor, and gave them, you know, like a one-day
17 tutorial on what are PCBs, you know, what do they do,
18 brought in toxicologists, brought in other doctors,
19 brought in the EPA, things like that.
20 So I just kind of throw that out. If
21 you're on a site that's -- on a hot site, or getting
22 into a hot site, there may be some other kinds of
23 outreach that might be valuable. I wondered what your
24 connection with the health professionals is, if you
25 have an active connection with those groups or not.

1 MR. McINTYRE: I haven't personally, and
2 I don't know that Public Affairs has. There might be
3 some contact elsewhere in the agency, but that hasn't
4 reached Public Affairs at this point.
5 MEMBER CLARKE: Well, it's another group
6 that needs to get the right message.
7 MR. McINTYRE: Definitely.
8 MEMBER CLARKE: Thank you.
9 CHAIRMAN RYAN: There are lots of
10 resources. For example, on the physician question
11 there's REACTs in Oak Ridge. For decades they have
12 trained physicians in radiation emergency response,
13 for one, and basic, you know, radiological
14 contamination/control countermeasures in the hospital
15 setting, and all those kind of things.
16 As you well know, medical licensees have
17 health physicists, and they typically deal with that.
18 But the physicians are the folks that people go to
19 when they're sick and ask questions about radiation.
20 There have been some cases where a head cold, you
21 know, at a physician's office, "Well, where do you
22 work?" "Well, I work with radioactive material, blew
23 the whistle that there might be a problem with
24 radiation." Sometimes the answer is yes, sometimes
25 the answer is no.

1 So it's one segment of, what's the
2 outreach that the agency is thinking about or doing or
3 might do to reach various subgroups of the population
4 that might run into these questions, like physicians
5 or nurses or emergency room doctors, or things like
6 that? Not necessarily for anything other than they
7 are often the sources of this information.
8 You know, I mean, how many times have you
9 been in a dentist's office and you ask the X-ray
10 technician, "How much radiation exposure am I getting
11 from this X-ray?" and the answer is, "Oh, it's just
12 like a sunny day at the beach." I can't tell you how
13 many times that has happened, because I ask every
14 time.
15 (Laughter.)
16 And I get back information, so -- and, you
17 know, somewhere in their training I'm sure they were
18 told. But the proactive part of it is something to
19 think about. If you get good information out there
20 when it's not related to a potentially contentious
21 issue, that's information that might come back in a
22 good way later on when there is contention -- hitting
23 the schools and teachers and others, as well as just
24 general information on "here is what radiation is all
25 about" might be something to think about. That's sort

1 of one that kind of takes off from Dr. Clarke's
2 comment.
3 MEMBER CLARKE: If I could follow up on
4 that, Mike.
5 CHAIRMAN RYAN: Well, let me finish, if I
6 may.
7 MEMBER CLARKE: Okay.
8 CHAIRMAN RYAN: The second part is --
9 well, go ahead, Jim. I'm going to change topics, so
10 if you want to finish up on that.
11 MEMBER CLARKE: I was just going to say
12 that one of the things I had on my list and I forgot
13 to ask you about is I teach in a university, and so I
14 get students coming in and out of, you know, high
15 school, secondary schools. And they come in with
16 various ideas about radiation, and we do our best to
17 give them good information about radiation.
18 But is there an outreach program that
19 takes it down into the lower grades of education where
20 people start to form their ideas and their opinions?
21 MR. McINTYRE: Not that we have.
22 MEMBER CLARKE: Again, I think the way to
23 do it would be through the teachers, again, because
24 you're just trying to get them the best information.
25 And we found on the PCB project that when people are

1 concerned about their health they call up their
2 doctor.
3 So, you know, what does their doctor tell
4 them? You know, so that -- Mike has reinforced, I
5 think, that would be another group that you might want
6 to target, just to make sure they are getting good
7 information and they have good answers for these kinds
8 of questions. So I just wanted to ask about the
9 identification of cases --
10 CHAIRMAN RYAN: Again, just to emphasize,
11 back in a former life when I was a licensee, we sent
12 every physician in the area to REACTs. Every one. So
13 when they got questions, they knew what the answers
14 were. That's not training they get in routine medical
15 training.
16 MEMBER WEINER: May I make another
17 comment?
18 CHAIRMAN RYAN: Let me just finish my
19 other question, if I may.
20 MEMBER WEINER: Sure.
21 CHAIRMAN RYAN: In a different kind of
22 vein, how do you deal with emerging information? I'm
23 thinking currently of two things. One is, we had --
24 this Committee had the French Academy of Sciences
25 members come over and discuss their report. They very

1 clearly see a threshold in their analysis of
2 epidemiologic data.
3 The BIER Committee did not rule it out or
4 in. I can't quote it exactly, because it's a very
5 long, carefully constructed sentence that says it's
6 equivocal at this point. So the issue of threshold or
7 LNT is certainly one that's on the radar screen.
8 Now, I think you could think about, how do
9 you deal with these emerging issues? Because one
10 thing that troubles me often when I hear that
11 discussion is what Dr. LeGuen talked about in his
12 presentation of the French Academy report when he
13 said, "If you want to use LNT as an administrative
14 control decisionmaking tool, fabulous, go for it.
15 Now, let's put that aside and talk about basic science
16 data." Those are two different things.
17 You can use one as a tool, and very often
18 we are miscommunicating about the fact that we use an
19 administrative control tool, and we don't get that
20 second part across very often. It is taken as the
21 fact when, in fact, it's an assumption for the purpose
22 of conservatism and regulatory standard-setting.
23 MR. McINTYRE: Right.
24 CHAIRMAN RYAN: So that's the phrase that
25 gets lost. How do we start, or what efforts would you

1 suspect we could use to maybe combat some of that
2 misinformation?
3 MR. McINTYRE: Well, I think that message
4 is in one of the materials. I won't search for it
5 now, but --
6 CHAIRMAN RYAN: And I agree with that.
7 MR. McINTYRE: -- either the pamphlet or
8 the fact sheet that we -- explains the no threshold,
9 and says that there is some scientific debate about
10 it. But the NRC, in order to be conservative and
11 protective of the public, uses that as its benchmark.
12 Then, it becomes official policy and it gets
13 translated into plain English, as there is no such
14 thing as a safe dose.
15 CHAIRMAN RYAN: But that's where I think
16 the step goes wrong, because that's not a translation.
17 That's a mistranslation.
18 MR. McINTYRE: Well, that's how it
19 resonates outside. That's not what we say.
20 CHAIRMAN RYAN: Right.
21 MR. McINTYRE: That's not how we say it,
22 but that's how intervenors and --
23 CHAIRMAN RYAN: And I guess I'm just
24 thinking out loud with you, but how do you combat that
25 mistranslation problem? Because it's not only a

1 radiation question. A lot of things get mistranslated
2 MR. McINTYRE: Sure. Well, when we see
3 it, we try to correct it. If it's in a public meeting
4 with discourse, we would say, you know, actually
5 interrupt or at the first opportunity say, "Well, that
6 was a misrepresentation of our position or of the
7 facts," and try to correct it.
8 Now, if it's in the media, we try to --
9 we're very active in what we call pushback, in trying
10 to correct errors that get into the media, because
11 even if it's minor, reporters being human will draw on
12 their own stories for future reports or other stories
13 that they've seen in other media for future reports.
14 And if it's not corrected or even if it is
15 corrected, once it's out there, it can still be picked
16 up and the error repeated. But no, it -- my point in
17 the presentation was that that translation, as it
18 were, that there's no such thing as a safe dose, is
19 how it gets tossed back to us.
20 You know, but you say there's no such
21 thing as a safe dose, and we say, "Well, no. What we
22 say is linear non-threshold and there's an element of
23 risk," and it gets lost in there. But our efforts to
24 communicate that, we can communicate it as much as we
25 can and we do, to try to correct it.

1 CHAIRMAN RYAN: How about the idea that we
2 say something real simple like, "We believe our
3 standards are safe"?
4 MR. McINTYRE: As a Public Affairs
5 officer, I love that statement. I can't disagree with
6 you.
7 CHAIRMAN RYAN: That's my own personal
8 view, and one as a health physicist. I believe the
9 standards are safe, particularly when you look at
10 emerging information on medical exposure that, you
11 know -- and we have medical exposures now that are
12 higher than they've been and individual procedures
13 that are hundreds of thousands of times higher than
14 background that are routinely applied every day.
15 You know, simple examples like how many
16 CAT scanners operating for three months does it take
17 to equal the population dose from TMI? The answer is
18 one. So, I mean, that's -- I guess what I'm reaching
19 for is, how do you translate, you know, what can be --
20 what I refer often to as, you know, the Klingon of
21 radiation protection. It's just very confusing jargon
22 and it's hard for members of the public that aren't
23 technically trained to grasp all that as it flies by
24 and give some good examples that help communicate. We
25 do --

1 CHAIRMAN RYAN: That's a tough job, I
2 know.
3 MR. McINTYRE: It is, and we do make
4 efforts in these materials and in public presentations
5 to put radiation levels in some sort of context like
6 this. Well, this is equal to a chest X-ray or a
7 flight across the country. The danger there, of
8 course, is that if you're talking about something that
9 shows up in somebody's groundwater, they are more
10 angry about that than they are about going to the
11 doctor and getting a chest X-ray which they do
12 voluntarily for -- because of the benefit for it.
13 So there is -- you know, that's a warning
14 in using those, but that's depending on the situation,
15 of course.
16 CHAIRMAN RYAN: Sure. Yes, absolutely.
17 MR. McINTYRE: Using those analogies.
18 CHAIRMAN RYAN: I appreciate that.
19 Let's see. Do you have another question?
20 MEMBER WEINER: One more. And this is on
21 another topic. Like Dr. Clarke, I teach a class in
22 the Department of Nuclear Engineering at the
23 University of Michigan. And what I observe with my
24 students -- and they bring this to me -- is a gulf, a
25 growing gulf, between the students in engineering and

1 physical science and the students in other
2 disciplines, which has led to -- and, by the way, you
3 have hired several of my students in recent -- in the
4 last three years.
5 CHAIRMAN RYAN: So what's the question?
6 MEMBER WEINER: The question is: how can
7 we help these new employees to narrow and bridge this
8 gulf? Because what my students come away with, and
9 I'll quote one of them to you, is they say, "Most
10 people are stupid. If we really want to say -- want
11 to change people's minds, we have to get it on Oprah."
12 Well, we're not going to get it on Oprah, and most
13 people aren't stupid.
14 But this is part of that growing gulf, so
15 without -- it's a difficult question, but I would
16 encourage you with the new employees who come from
17 this area to take this into account, recognize that
18 it's not their fault, but it -- it creates a new breed
19 of brand-new scientists who are already sensitized to
20 the fact that people who are not scientists seem to
21 see things wrong.
22 CHAIRMAN RYAN: Okay. Latif, have you got
23 a question?
24 DR. HAMDAN: Yes. I think the reason we
25 have problems is that the emphasis is on the wrong

1 subject. Look at your slides 14 through 20. The
2 subject is radiation, public perception of radiation.
3 Radiation can be either beneficial or harmful.
4 The Linear-Non Threshold Theory of
5 Radiation Exposure translated -- there is no such
6 thing as safe -- a safe dose of radiation. In even
7 plainer English, all radiation is harmful.
8 NRC is in agreement. The emphasis should
9 be on how NRC regulates the use of nuclear material.
10 MR. McINTYRE: Well, that is our emphasis.
11 DR. HAMDAN: But it's not anywhere here.
12 What I'm saying is the framework, how will you frame
13 things? I'll tell you the non-threshold theory, if I
14 was emphasizing NRC regulation of nuclear theory, I
15 would have translated the LNT to say we mean business.
16 NRC regulations assume -- assume that
17 there will be no duration of even small radiation
18 levels. That is the message -- a more positive
19 message. This public -- in my opinion, this public
20 communication subject is a very, very, very important
21 subject. And I don't think -- I don't think it's done
22 to the detail when people start going to meetings and,
23 you know, bring speakers and all this, but the
24 concepts need to be rethought.
25 And instead of emphasizing radiation,

1 which is a large subject and it could confuse
2 everybody, the emphasis for regulating it, and DOE can
3 do that, and EPA can do that radiation, and they can
4 -- and there are books on that, and then, frankly, DOE
5 and EPA should be doing that.
6 For NRC, it has this unique rule of, okay,
7 we recognize radiation for what it is, and it is there
8 for --
9 CHAIRMAN RYAN: What's the question,
10 Latif?
11 DR. HAMDAN: The question is: why don't
12 you emphasize how NRC goes about regulating? And make
13 that not only 50 percent real message to public, make
14 it 80 percent. And in --
15 CHAIRMAN RYAN: Let me help you, Latif.
16 DR. HAMDAN: Yes.
17 CHAIRMAN RYAN: I think sometimes people
18 perceive the technical discussion as one where the
19 emphasis is on defining risk as opposed to more of a
20 message where -- describing how we assure safety. You
21 know, for example, pick a number. The drinking water
22 standard by the EPA for tritium allows 20,000
23 picocuries per liter of tritium in groundwater.
24 You could just say that and say 20,000?
25 That's a big number. Or you could say the EPA

1 drinking water standard is set to assure that drinking
2 water is safe. It's exactly the same message, but
3 it's said two different ways.
4 I think your point is that you are -- tell
5 me if I'm wrong, Latif, but I took away from your
6 comment that focusing on emphasizing safety as opposed
7 to defining risk might be the strategy of how to
8 communicate. No?
9 DR. HAMDAN: True. True. But I just want
10 to make it in simple terms. The simple terms are if
11 you look at --
12 CHAIRMAN RYAN: Drinking water is safe is
13 pretty simple.
14 DR. HAMDAN: You can talk -- you can spend
15 many lives talking about radiation and then arguing
16 about the -- whatever, which is fine, you need to
17 educate people. But in the case with NRC, this is
18 being done at the expense of not doing what NRC has
19 recommended it should be doing, and that is going out
20 and emphasizing, as a concept and more often than not,
21 okay, we recognize radiation is -- you know, is
22 potentially unsafe, but that's how we go about
23 regulating it, and that's how we report it to the
24 public.
25 And that should be the message. That

1 should be the subject, not radiation. The subject
2 should not be radiation. The subject should be how we
3 go --
4 CHAIRMAN RYAN: Well, to be --
5 DR. HAMDAN: -- about doing --
6 CHAIRMAN RYAN: To be fair to our speaker,
7 that's -- we asked him to talk about the radiation
8 piece today, not the whole program. So I think, just
9 to be fair, there are other elements of that website
10 that we didn't go into.
11 DR. HAMDAN: I'm trying to help.
12 CHAIRMAN RYAN: No, no, that's fine.
13 But --
14 DR. HAMDAN: This is not just one
15 presentation. This is -- you know, I've been through
16 this, you know, public communication for a long time,
17 and an advocate of it. But some big part of me thinks
18 that we don't pay attention to the strategy. We don't
19 pay enough attention to the entire strategy. And,
20 frankly --
21 CHAIRMAN RYAN: That's why we're here
22 today. We're thinking about it.
23 DR. HAMDAN: Okay. I think I've said
24 enough.
25 CHAIRMAN RYAN: Okay.

1 MR. FLACK: Mike?

2 CHAIRMAN RYAN: One last question.
3 They're over time.

4 MR. FLACK: Just one comment. This is
5 John Flack, ACNW staff. Generally, the agency
6 regulates with a margin. There is usually a margin to
7 some unsafe condition. In this case, the margin is --
8 if there is a threshold, the idea would be a
9 perception in putting across that the margin may have
10 been reduced, but there is still margin.

11 And I think that's the piece that does not
12 come across in an area where you're looking at a
13 graded -- that you're trying to understand how this
14 graded -- you know, getting lower and lower and it
15 provides greater and greater safety, rather than
16 using, as we do in reactor space, establishing margins
17 to safety, so that maybe the margin has been reduced
18 and that's the perspective, but it has not been
19 exceeded into an unsafe condition.

20 And that point I don't see come across
21 when -- you know, in this kind of approach where
22 you're looking at something in its holistic form in
23 various part -- you know, fluctuations within that
24 form. So I think that might be part of the problem
25 understanding this. I mean, you could say it's safe,

1 but then the question is, well, how close is it to
2 being unsafe?
3 And I think the point being made is is
4 there is still margin there that provides the
5 protection that the agency is trying to establish in
6 protecting the public health and safety. And I think
7 that's the message that really needs to be coming
8 across. I don't see that as often here. It's a
9 different perception.
10 CHAIRMAN RYAN: It's an interesting
11 conundrum. You know, on the other hand, in certain
12 arenas -- and I'll pick a medical one -- the doctor
13 says your appendix has to come out. You're in pain,
14 you're in the emergency room. You need to sign these
15 consent forms.
16 Now, there's seven pages of detailed
17 information on risks of anesthesia, risks of this,
18 risk of infection. You name it. Did anybody read it?
19 Sign here; we'll fix it. What are my chances, Doc?
20 Well, they're real good. This is one we do every day.
21 So there's an element of, you know, kind
22 of just factual, detailed, technical communication,
23 and then there's, you know, communicating either
24 confidence or a lack of it. And I think that's -- you
25 know, we're sort of all wrestling with that thought.

1 MR. McINTYRE: And we could expand that
2 into how we present all of the information, especially
3 on the website. And I could go on with my own
4 personal ideas on that, but some other time perhaps.
5 CHAIRMAN RYAN: Sure. No, and it's a good
6 dialogue, and, again, we're exploring it, because the
7 Commission has asked us to think about --
8 MR. McINTYRE: Sure.
9 CHAIRMAN RYAN: -- this question and its
10 direction to us in its non-interaction plan, and we --
11 Dave, you've really given us a real good launch-off
12 point here in what's on the website and what materials
13 are out there, so we can begin our thought process.
14 We really appreciate your coming down and being with
15 us today.
16 Thank you very much.
17 MR. McINTYRE: I appreciate all your
18 insights and advice, and I'll take them back.
19 CHAIRMAN RYAN: Okay, great. Any other
20 comments? Questions?
21 (No response.)
22 All right. Without further ado, we'll
23 move to our second briefing, and I think Mr.
24 Christopher Brown of the ACNW&M staff is going to
25 provide us with a basic primer on high-burnup spent

1 fuel and cladding. And this is a followup briefing on
2 some other issues we've had on burnup credit and other
3 issues for the past few meetings.
4 Chris, we appreciate your being here
5 and --
6 MR. BROWN: Thank you.
7 CHAIRMAN RYAN: -- helping us learn.
8 Thank you.
9 MR. BROWN: Good morning. The Committee
10 asked for some basic information on spent fuel, spent
11 fuel cladding, and assemblies. And Bob Eisinger's
12 name was mentioned at first, and Bob has served as my
13 mentor for a number of years on this issue. So what
14 we decided to do is that I would give the
15 presentation, and Bob may chime in on a few subjects
16 and would be available for questions.
17 And there's Bob right there, considered
18 probably one of the -- probably one of the experts in
19 this area in the U.S., probably worldwide also. And
20 so without any further ado, I'm going to go right into
21 the presentation.
22 I just also want to mention that each of
23 the slides that I have can be developed into four or
24 five additional slides. But I just wanted to tell you
25 some of the concerns that probably the staff will have

1 and that the ACNW may be faced with. We've already
2 looked at moderator exclusion, and Albert Macchio gave
3 us a presentation a few months ago, and he was going
4 to try to go into some more detail on work that has
5 been done on spent fuel cladding. I had curtailed his
6 presentation.
7 But definitely Part 71 and Part 72 have
8 information about maintaining criticality. Part 72
9 does call out no gross degradation of the fuel, but
10 also we want to prevent release of radioactive
11 material. Part 72 says that you should have
12 retrievability of the spent fuel assembly. Many
13 interpretations on what that means in Part 72.
14 But also, it's the starting -- when the
15 fuel comes out of the reactors, the starting point of
16 disposal. I was talking to one of my neighbors one
17 time, and I was -- I made a comment, and this slipped
18 out, that she had a small kitchen. And she said to
19 me, "Well, this is just what I'm dealt with, and I
20 have to deal with it." And this is what the staff has
21 to do.
22 You know, and basically when the fuel
23 comes out of the reactor, it goes to the pool, it's
24 the starting point of disposal. It comes out damaged,
25 it comes out with a lot of crud on it, it comes out

with oxidation, breaches, and this is what the staff has to deal with.

Also, transportation source term is a particular issue for high-burnup fuel. And this is -- I put this as a question, because I think this will come up in the Yucca Mountain license application, you know, whether the cladding is a barrier for isolation.

I just wanted to mention -- I put up all of these different reactors, because, you know, when we're talking about spent fuel, it's a big subject. I mean, we have a lot of different reactors out there, and there's a lot of different fuel assemblies. And so I'm going to try to narrow this down, and, of course, my primary focus will be on the PWR and BWR or LWR fuel assemblies.

Bob, do you want to say anything about that? Anything important about this slide? This is Bob.

MR. EISINGER: Just that it's there to point out spent fuel is not a homogeneous thing. People talk about spent fuel like it's a thing. It's more like a collection of things, a big collection.

CHAIRMAN RYAN: It's at least 12, we know that.

(Laughter.)

1 MR. EISINGER: Many subcategories.

2 CHAIRMAN RYAN: Many subcategories, I'm

3 sure.

4 MR. BROWN: This is a typical PWR fuel

5 assembly right here, and you can see it is imposed on

6 many parts. Of course, my presentation will focus on

7 the fuel tube or the cladding, which is normally

8 zirconium, and also the pellet, which is normally UO_2,

9 but there are different materials for the pellet.

10 When we look at the fuel assembly, it's

11 basically two parts. You have the rod and the

12 hardware. In terms of the rod, you have fuel. It can

13 be UO_2, MOX, metal. In terms of the cladding, you can

14 have zircalloy-2, zircalloy-4. We also talk about

15 zirconium alloys. In particular, we talk about the --

16 well, the ZIRLO is a cladding that falls in that

17 category. Also, M5.

18 I'll talk a little bit about the zirconium

19 alloys, because they're the newer claddings that were

20 designed for improved reactor performance. Also, you

21 have aluminum and stainless steel cladding. We find

22 the stainless steel claddings on older fuel types.

23 In terms of the hardware, they're listed

24 right there. If we go down to maybe like where you

25 see the wrappers, you'll see -- I will show you what

1 a wrapper is around a BWR fuel assembly. BWRs also
2 have debris filters, like -- plants like River Bend
3 have had some problems with crud, and so the fuel
4 vendors have developed these debris filters to catch
5 some of the particles. Also, it's mainly because of
6 the problems due to water chemistry.
7 When we talk about the PWR fuel
8 characteristics can be anywhere from 14 by 14 to 18 by
9 18 arrays, we're looking at anywhere from maybe about
10 -- maybe about 164 to about 200 rods inside of an
11 assembly. It could vary, maybe 179 to 264 fuel rods.
12 There are three manufacturers. I have a chance to
13 visit these manufacturers. You're talking about
14 Westinghouse, Global Nuclear Fuels, and one is
15 slipping me -- Areva. Okay.
16 There are different cladding types. As I
17 said, I'm going to talk a little bit about the
18 cladding types, in particular the zirc-4 versus the
19 ZIRLO, and the issues associated with that.
20 When we talk about rods, you have full and
21 partial length rods. Rods are pressurized. This
22 pressure can change inside of the rods, leading to
23 degradation mechanisms, which I'm going to talk about
24 such as creep. Cladding thickness and conditions can
25 vary due to the way in which they were fabricated,

1 such as annealed. You'll find cladding thickness on
2 the BWRs are different than the PWR claddings.
3 Fuel enrichments vary. You have burnable
4 poisons. For example, the ZIRLO rod manufactured by
5 Westinghouse, they have a particular assembly in which
6 their -- one of the fuel pellets are coated with
7 boron, and it serves as a burnable poison. But this
8 here can also be a problem, because the boron
9 interacts with the chemistry of the material and
10 increases the actual pressure in the cladding and can
11 cause very high hoop stresses.
12 I'll say a little bit more about that
13 later.
14 I couldn't get this here reversed
15 properly, but this is a BWR fuel assembly. And you
16 can see the -- the BWR is very interesting, because
17 they have these wrappers around it. And BWRs have
18 problems with -- you'll find that they have problems
19 with crud buildup. River Bend had reported some
20 problems with crud buildup.
21 They also have these control rods, and you
22 can see how they look below, and the blades.
23 When we're talking about the BWR fuel rod,
24 you have anywhere from 6 by 6 to 10 by 10 arrays. the
25 cladding thickness is different, because of the way

1 they are fabricated, and the rod arrangements are also
2 different. The BWRs also have these water channels in
3 them also.
4 Now, to talk a little bit about the
5 cladding, we are very familiar with zirc-2 and zirc-4,
6 but now we're starting -- you may start to hear about
7 ZIRLO and M5. What are they? What makes them
8 different?
9 Well, clearly, you can see that the ZIRLO
10 and M5 do not have any chromium or nickel, but they do
11 have approximately one percent niobium. And the
12 reason why they were developed by the industry is for
13 improved reactor performance. Zircalloy-4 has a
14 problem with oxidation.
15 The industry went to ZIRLO because their
16 notion was that this improved material -- and I'm sure
17 they've done a lot of the tests -- lead test
18 assemblies, in which they looked at the performance,
19 that it has a less oxidation pickup. But we're
20 finding that ZIRLO actually does not have a -- it
21 still have a very affinity for hydrogen pickup.
22 The M5 is working pretty well in the
23 reactors, and we don't have much of a problem with
24 that concerning hydrogen pickup. So, but the main
25 thing here is I wanted to show you, we talk about

1 these different cladding types, zirc-2, zirc-4, ZIRLO,
2 M5. And there are others, but these are the main
3 ones. But the main difference is that the ZIRLO and
4 M5 do not have any chromium or nickel.
5 And this is just to reemphasize a little
6 bit more about the ZIRLO, because this is what's in
7 the reactor now and what will be in storage. But
8 basically, you have an elimination of chromium. And
9 if you go to almost that last bullet, where I talk
10 about high-duty plants, you're seeing some corrosion
11 levels up to 100 microns for the ZIRLO. So it's not
12 as good as initially they thought it was going to be.
13 The physical properties of ZIRLO are very similar to
14 those of the zirc-4 clad.
15 One of the main limitations of zirconium
16 alloys: they like hydrogen. And because of the
17 interaction inside of the water in the reactor, it
18 causes a problem with oxides. So when you absorb the
19 hydrogen, you can have brittle zirconium hydrides in
20 the zirconium matrix. And this -- the notion is is
21 that you have a problem with stresses in the cladding,
22 which can then affect the structural integrity of the
23 cladding, possibly during transport or maybe there
24 could be a problem in the repository.
25 I kind of put this picture up here. I

1 call it limitations in zirconium alloys. I guess you
2 could call it also the origins of stresses in
3 zirconium alloys. You know, basically, the first
4 picture shows cladding prior to service. You just
5 have your zirconium metal, but once it's in service
6 you just develop this oxide. That's just going to
7 happen. Some claddings have more oxides than others.
8 If you go down to the one that's showing
9 the pellet, you can see that your -- you can see the
10 -- you can see that you can also develop some cracks
11 inside of the oxide, but also you can develop hydrides
12 inside of the cladding.
13 And this is going to be a subject I'm
14 going to talk a little bit about is the hydrides
15 inside of that metal cladding, how you can have a
16 phenomenon that's going to -- probably you're going to
17 hear a lot about is hydride reorientation. If we get
18 more involved with probably details looking a
19 moderator exclusion, and the industry has been
20 complaining about we need to resolve this issue of
21 transportation of high-burnup fuel -- and in terms of
22 the repositories, you know, whether or not hydride --
23 delayed hydride cracking is a problem.
24 Degradation modes of rods -- I've got
25 degradation twice there, excuse me. You can have

1 general and localized corrosion, you can have
2 spallation of the oxide in which you can have some of
3 it break off. You can have creep. You can have fuel
4 and cladding oxidation, and I'm going to show you how
5 you can actually have the fuel oxidation. I think
6 that's going to be of interest to some people.
7 You can have pellet cladding interaction
8 failure and hydride reorientation. By no means did I
9 name them all. But this here is sort of a pictorial
10 diagram that actually shows you some of the modes of
11 fuel degradation -- rod degradation where they are.
12 You can see creep rupture. That's basically a
13 function of stress, temperature, and time. Actually,
14 a constant stress.
15 You could have stress corrosion cracking,
16 external oxidation, hydride reorientation, fuel pellet
17 oxidation. So basically, to get that fuel pellet
18 oxidation, you've got to have some type of air getting
19 to the root, the cladding, to the actual fuel pellet.
20 And this is a problem, and we've had several issues
21 concerning this here. One was -- actually, it was two
22 issues.
23 I can only think of one right now where an
24 applicant was interested in loading a cask in which --
25 I'll give -- let Bob shed some light on -- briefly on

1 that situation of oxidation that can occur during the
2 blowdown of -- when you're removing water from the
3 cask.
4 MR. EISINGER: There was an applicant who
5 wanted to blow the water out of his cask prior to
6 welding it, using air, and we required him to control
7 the temperature, so that he wouldn't oxidize the fuel
8 if there had been any failed fuel in the cask.
9 MR. BROWN: This is just another pictorial
10 diagram here. I show how you can -- what's spalled
11 oxide, and also you can see some hydrides. Radial
12 cracks in the oxide can occur, and also I wanted to
13 show hydrides also, and my point when I wanted to show
14 the hydrides was that the hydrides tend to migrate to
15 the cooler regions of the cladding.
16 Oxidation of cladding of high-burnup fuel
17 -- what causes this? The water-side corrosion from
18 when it's inside of the reactor. There is a chemical
19 reactor that occurs, and you get zirconium hydrides
20 that are formed. That's just a fact. You're just
21 going to have hydrides that are formed. When the fuel
22 is inside the reactor and comes out of the reactor,
23 the PWRs tend to have the hydrides in a
24 circumferential direction.
25 The Bs are -- tended to be more randomly

1 oriented. Now, that's not the hydride reorientation.
2 That's when it comes out of the reactor. That's just
3 due to reactor operation. Hydriding increases with
4 increasing burnup.
5 Now, hydride precipitates are formed in
6 the reactor, generally circumferentially oriented in
7 the PWR cladding and randomly oriented in the BWR
8 cladding. That is what I just said earlier without
9 that slide.
10 But how are the radial hydrides formed?
11 Hydrides form as the fuel cools in the reactor pool.
12 Now, during the loading conditions we actually had the
13 canister inside of the pool, and went and -- when the
14 canister is removed from the pool, you actually have
15 to drain the water out. And this is probably when the
16 fuel probably sees its highest temperatures.
17 And so, basically, during the short-term
18 operation, you can have actually hydrogen that goes
19 into solution. So for high-burnup fuel, hydrogen can
20 go back into solution. Look at the last bullet. Upon
21 cooling, hydrides will precipitate into the radial
22 direction, but there are some caveats there. It has
23 to be under a particular stress in order for them to
24 reorient in a radial direction.
25 Now, we know that once we're done the

1 loading we put the lid on the canister, and the
2 canister goes out to the pad. So we actually have
3 temperatures that are decreasing, so that's what I'm
4 saying. When the temperatures decrease, it's a
5 possibility that the stresses would be high enough for
6 them to change directions.
7 Do you want to say anything more about
8 that?
9 MR. EISINGER: The stresses in most rods
10 is going to be too low to cause hydride reorientation.
11 But there is a segment of the population that either
12 because of the way it was -- fuel was operated and had
13 a high fission gas release, or because the way the
14 fuel was manufactured and has a burnable poison which
15 generates more gas, that you'll have a higher
16 pressure. So there will be some part of the
17 population that will fall in the spectrum where this
18 mechanism could be active.
19 MR. BROWN: And this would be a problem in
20 transportation. Could be.
21 MR. EISINGER: The industry likes to think
22 we say that there's going to be catastrophic results
23 from this. What we really say is we don't have enough
24 information to determine what the results will be.
25 MR. BROWN: As a side note, this afternoon

1 I will tell you what the industry is saying about
2 that, and how they want NRC to move.
3 Hydride reorientation is basically the
4 materials' phenomenon of hydride reorientation, and
5 zirconium-based alloys usually involves the
6 dissolution of circumferential hydrides and the
7 formation of zirconium hydrides oriented perpendicular
8 to a hoop stress.
9 And this is basically what the hydrides
10 look like. The first picture shows circumferential
11 hydrides and irradiated zircalloy cladding. As I
12 said, that's what it could be as it comes out of the
13 reactor. And then, this second one shows you have
14 mixed hydrides, and the final one shows radial
15 hydrides.
16 And this was actually your work here done
17 at Argonne.
18 MR. EISINGER: Battelle Columbus.
19 MR. BROWN: What's the problem with UO_2
20 exceeding 45 gigawatt days per MTU? Again, if I
21 didn't mention to you, we consider anything above
22 45 gigawatt days per MTU as high burnup. I was never
23 really sure how we actually determined that anything
24 about 45 was -- how that actually came about, and I
25 believe it probably was based on data, and maybe you

1 see a change in a curve.

2 MR. EISINGER: There is nothing holy about

3 45 gigawatt days per metric ton. Maybe it's 42, maybe

4 it's 48. But that's -- in that general burnup range

5 is where many of the properties of the fuel start

6 going from a linear low value to an exponential value.

7 There's a change in the shape of the curve where

8 things get a little dicier.

9 MR. BROWN: Okay. Thank you.

10 UO_2 fuel undergoes significant changes at

11 higher burnups. You can have changes in chemical

12 composition, and also formation of a rim structure.

13 In fact, you know, I have seen a rim structure, I

14 tried to get a picture of a rim structure, so you

15 could see that here. But I sent Bob an e-mail asking

16 him to really kind of define, what is the definition

17 of "rim structure" on the fuel? Want to share that?

18 MR. EISINGER: Well, there's a number of

19 definitions of rim structure, but basically, as you go

20 to higher burnup, due to the epithermal neutrons in

21 the outer region of the pellet, you generate more

22 plutonium, and so you have a buildup of plutonium,

23 which is about double what it is in the main part of

24 the pellet.

25 You also have a restructuring of the

1 pellet where normally you might have grains of 10 to
2 12 microns average diameter, now you have grains in
3 the order of 1 micron average diameter. Also, your
4 fission gas release in that region is very low. The
5 gas tends to remain in the bubbles that are formed
6 between the grains.
7 This region can extend maybe 150 microns
8 into the pellet from the outer surface.
9 MR. BROWN: Thank you.
10 Second bullet says these changes become
11 more prominent as the burnup increases. You can have
12 thermal gradients that could cause pellet cracking,
13 and as the pellet swells you can actually have a
14 pellet cladding gap -- starts to close. And this also
15 starts to develop stresses on the cladding.
16 Oxidation of spent fuel -- I know that
17 Neil has had a lot of questions concerning this here,
18 and I think he has some questions on this issue.
19 Irradiated uranium dioxide exposed to an oxidizing
20 atmosphere will eventually oxidize to U_3O_8. And
21 there's a chemical equation that shows that, and it's
22 an Ahrennius equation which is a function of time and
23 temperature. And you also have an increase in volume
24 due to the oxides that are formed, and it induces the
25 circumferential stresses in the cladding.

1 So this is also another area that we are
2 concerned about in terms of during the loading
3 operations and also some issues concerning the
4 repository.
5 In summary, what I just wanted to
6 highlight for you, what we do know with respect to the
7 issues concerning high-burnup fuel, in terms of the
8 fuel structure for -- and I have low burnup fuel and
9 high, I just called it low and high. In terms of the
10 rim structure, there is none for low-burnup fuel, but,
11 however, for high-burnup fuel what we know about --
12 that outer 8 to 10 percent of the fuel volume has a
13 rim structure with submicron grain size.
14 In terms of the fuel cladding gap for low-
15 burnup fuel, it's open. For high-burnup fuel it may
16 be open or closed, depending on the burnup and storage
17 temperature due to pellet swelling.
18 Do you want to say anything additional on
19 that?
20 Okay. In terms of the fuel structure, for
21 low-burnup fuel, when we talk about the grain boundary
22 bubbles, there are some bubbles in the structure on
23 grain boundaries. For high-burnup fuel, you have a
24 higher fission gas release, indicates more open grain
25 structure. In terms of the radionuclide distribution

1 and inventory, we know for low-burnup fuel it's open,
2 for high-burnup fuel there is excess actonides in the
3 rim region. Bob just said something about that.
4 And, finally, we know about the claddings
5 for low-burnup fuel. Most are zirc-4 and zirc-2.
6 I've highlighted that the problem with the zirc-4 and
7 2, they have problems with oxidation. They just have
8 an affinity for high hydrogen pickup.
9 Industry went to -- for higher burnup
10 fuels, they went to newer alloys such as the M5 and
11 ZIRLO, because -- the better reactor performance in
12 terms of absorbing hydrogen. So less hydrogen, less
13 oxidation.
14 Cladding defects that have been seen in
15 zirc-4 and zirc-2 in low-burnup fuels have been
16 pinholes and hairlines. But, however, in high-burnup
17 fuels we're getting fretting defects, which can occur
18 during -- where I showed you where spatial rates were.
19 Cladding composition -- less than 150 ppm
20 of hydrogen for the low-burnup fuels. But, however,
21 this is a very interesting range for the high-burnup
22 fuel -- 70 to 700. Well, the M5 is probably the
23 better performer in terms of the ZIRLO cladding, which
24 is starting to see very, very high hydrogen pickups.
25 And so that was kind of a brief intro.

1 The hope is that we would probably get some feedback
2 on what we would like to talk about more in detail,
3 because this is just an intro, and if we need to come
4 back and focus on another, you know, detailed topic we
5 can.
6 So we can take a few questions.
7 MEMBER CLARKE: Chris, a very basic
8 question, and it's kind of two parts I guess. This is
9 Spent Fuels, not even 101, maybe it's 100. But often
10 I hear term "damaged fuel." And if you could help me
11 understand, what do you mean by "damaged fuel"? And
12 I infer when I hear people talk about damaged fuel
13 that the fact that it's damaged means that there are
14 some things you can't do with it. Is that --
15 MR. BROWN: That's a very good question,
16 because the staff has written several guidance
17 documents on damaged fuel, and at one point they were
18 discussing -- the document discussed that sometimes
19 you may have missing grid spacers. There were a
20 number of things that classified damaged fuel, but I
21 think it would probably be best to tell you what the
22 current definition that the staff sees as damaged
23 fuel.
24 Now, I must emphasize -- I am going to ask
25 Bob to explain that. I think that high-level waste

1 may have a different definition or interpretation of
2 what they consider to be damaged, so I'll let you --
3 MR. EISINGER: Based on some recent IAEA
4 meetings, we've revised the definition of "damaged
5 fuel," basically saying now that damaged fuel was any
6 fuel that can't perform the functions that's required
7 of it, those functions being defined by regulations,
8 by operational necessity, by handling.
9 MR. BROWN: So, you know, even a more
10 general question: is a breach considered damage? You
11 know, when one thinks of damaged fuel, they think of
12 probably a pellet trying to get out or something like
13 that.
14 CHAIRMAN RYAN: But could it be something
15 as simple as the --
16 MR. BROWN: Crack.
17 CHAIRMAN RYAN: -- holding devices and the
18 insert devices are twisted, and it won't fit in the
19 position it's supposed to go into in the reactor.
20 That's damaged fuel.
21 MR. EISINGER: Damage can be either to the
22 rods or to the assembly.
23 CHAIRMAN RYAN: Right.
24 MR. EISINGER: Assemblies that have been
25 deformed to the extent that they can't fit into the

1 basket would be considered damaged fuel, the most
2 likely cause of that being excessive bow caused by the
3 in-reactor radiation. But that would be considered
4 damaged fuel.
5 As far as is a cladding breach a damaged
6 fuel? In the past, due to some events that happened
7 many years ago, there was regulations that were
8 written that said that things that -- with pinholes
9 and hairline cracks were not considered damaged fuel,
10 but things -- rods that had gross breaches in it were
11 considered damaged fuel -- no one ever defining what
12 "gross breach" meant.
13 Latest guidance does somewhat define what
14 "gross breach" means, but I have to say right now the
15 question of gross breach as even being considered
16 damaged is under reconsideration in the Spent Fuel
17 Storage and Transportation Division.
18 MEMBER CLARKE: And the damage occurs
19 while the fuel is in the reactor? While it's being
20 transferred?
21 MR. BROWN: It can.
22 MEMBER CLARKE: Both or --
23 MR. BROWN: Most of the damage to fuel
24 occurs while it's in the reactor. And just to put
25 things in perspective, the number of rods that

1 actually breach, where the cladding is not intact,
2 gaskets out of the cladding, is now less than .001
3 percent. So we're talking very few rods. Most of
4 those breaches are caused because of what's called
5 debris fretting. Somebody left some debris in the
6 reactor coolant when they were doing some maintenance
7 and it got up into the assembly.
8 But there are cases of damage occurring
9 when assemblies have been dropped, when they have been
10 handled in the pool and -- when they're transferred to
11 the pool. Whether any damage occurs during storage,
12 or during transportation, that's why we try to learn
13 as much about the behavior of fuel, so we can set the
14 conditions so that no further damage happens to
15 damaged rods during those phases, and no undamaged
16 rods become damaged during those phases.
17 MEMBER WEINER: Mike?
18 MEMBER CLARKE: That helps. Thank you.
19 CHAIRMAN RYAN: Chris, thanks for this
20 tutorial. I don't have any questions at this point,
21 but it sets us up for thinking.
22 PARTICIPANT: Could I make -- Chris, can
23 you go back to your slide of the --
24 MR. BROWN: I'm not sure if all the
25 members were done. I think --

1 MEMBER WEINER: Yes, if we could complete.
2 Allen?
3 VICE CHAIRMAN CROFF: Yes, I'm -- if Jim
4 was at 100, maybe I'm at 95. Something fairly basic
5 here. As I understand what's going on here in very
6 general terms, when we talk about the hydriding and
7 oxidation, it's water-dissociating at the outer
8 surface of cladding and forming an oxide layer on the
9 outside, and then the hydrogen migrates inside and
10 gets oriented one way or another. Is that --
11 MR. BROWN: Yes. And then, what happens
12 is that for some reason -- and diffusivity equations
13 can show this -- that the hydrogen tends to migrate to
14 the cooler regions of the cladding.
15 Do you want to say more about --
16 VICE CHAIRMAN CROFF: Outside.
17 MR. EISINGER: Most of the hydrogen that's
18 generated during the oxidative process of the cladding
19 doesn't go into the cladding. You only get about 20
20 percent. That migrates into the cladding, and
21 generally forms circumferential hydrides near the
22 outer surface of the cladding.
23 In some cases, this layer of hydrides can
24 be very dense and must really be considered just -- as
25 unmechanically unsupportive and -- but during heatup

1 those hydrides go back into solution up to a certain
2 extent, and then they can migrate, and they will
3 migrate, sort of even out within the cladding width.
4 VICE CHAIRMAN CROFF: Okay. Now, what
5 happens inside -- on the inside of the cladding with
6 the tritium? Does the tritium form a hydride layer?
7 Does it also migrate into the cladding? What goes on
8 there?
9 MR. EISINGER: We really haven't looked at
10 the tritium. Tritium is generated inside. I would
11 assume that it behaves similar to hydrogen, seeing as
12 that it's just an isotope. Physically, it should be
13 indistinguishable. We haven't looked to separate the
14 tritium and the hydrogen.
15 MR. DIAS: Okay. You said that only 20
16 percent of the hydrogen comes from actually the water,
17 so the remaining 80 percent are actually fission
18 product hydrogen?
19 MR. EISINGER: No, no, no, no, no. Eighty
20 percent of the hydrogen generated during the oxidative
21 process just goes off into the coolant water.
22 MR. DIAS: Oh, okay.
23 MR. EISINGER: Twenty percent that's
24 generated goes into the cladding.
25 MR. DIAS: But that's the one that's in

1 the cladding, okay. That --

2 VICE CHAIRMAN CROFF: So what I'm hearing

3 is we really don't understand much at all about the

4 tritium layer on the inside. That has not been

5 anything of interest.

6 MR. EISINGER: No.

7 VICE CHAIRMAN CROFF: Okay. Thanks.

8 MEMBER WEINER: Bill, one question. We're

9 all --

10 MEMBER HINZE: Let me say -- well, Chris,

11 I really appreciated this, but I find it also very

12 tantalizing, because I would like to learn more and

13 you indicated that you would be interested in some

14 direction on that. And one of the directions that

15 some of us are particularly interested in are

16 associated with the volcanic scenario, the eruptive

17 scenario, and the damage and fragmentation of the

18 spent nuclear fuel by explosive activity associated

19 with an eruption of a volcano. That could

20 hypothetically happen in the -- at Yucca Mountain.

21 I hear you talk about cracking. I hear

22 you talk about degradation. One of the concerns that

23 we do have, of course, is the grain size of the

24 erupted --

25 MR. BROWN: Right.

1 MEMBER HINZE: -- spent nuclear fuel, and
2 getting down into the range where it can be inhaled,
3 and thus be most detrimental to the RMEI. Can you in
4 a few words provide us with any information about the
5 strength characterization, the fragmentation, the
6 cracking, and incipient cracks that might lead to
7 grain sizes of the order that was mentioned here of
8 10 microns or less?
9 MR. BROWN: This information that you
10 shared here has been shared also to me by Neil, and I
11 passed it on to Bob. So there has been some
12 discussions on this briefly. And do you have any
13 information on this area?
14 MR. EISINGER: First off, a lot of the
15 data needs in this area will be discussed in a paper
16 that's coming out in Nuclear Technology in the month
17 of August by myself and Carl Beyer of PNNL dealing
18 with data needs for high-burnup fuel.
19 MEMBER HINZE: Excuse me. Is there any
20 chance that we could get a pre-publication copy of the
21 manuscript?
22 MR. EISINGER: I'll send something to
23 Ruth.
24 MEMBER WEINER: Yes, that would be very
25 helpful.

1 MR. EISINGER: As I mentioned before, the
2 fuel is -- has two regions, one with a sort of normal
3 grain size and has a -- and also a rim. There has
4 been work done on the fracture of normal grain type
5 structures, resulting in an equation that relates the
6 fraction of material in the respirable size range to
7 the impact energy on the grains. This is in a DOE
8 handbook. For all we can determine, the estimates in
9 that handbook are probably a factor of 10 higher than
10 they need to be to support the data.
11 We come to the grain -- to the rim, which
12 is a particular concern to us in transportation also,
13 because if there is an accident or something you have
14 already got material that's in the respirable grain
15 size range. I'm talking about .1 to 1 micron grains.
16 We don't have a lot of information on how
17 that particular material reacts to impact. You have
18 some work out of the Germans who have used some micro-
19 hardness probes, and say that the -- in fact, the
20 material in the rim region is more cohesive than in
21 the larger grains.
22 We find to have some issues with that,
23 because the probes are still large with respect to the
24 grain size, and, on the other hand, we have a lot of
25 anecdotal evidence that any time anybody has tried to

1 handle the fuel with the rim on it in order to make
2 metallographic/ceramographic samples or prepare
3 samples for any other type of analytic technique, the
4 material just crumbles away.
5 And so we've got two diverging schools on
6 that, and, of course, that is identified in this paper
7 as one of those areas that could make an impact on the
8 release fractions that you get from accidents.
9 MEMBER HINZE: Well, one of the things
10 that I noted in your discussion was -- in your first
11 statement is the heterogeneity of the spent nuclear
12 fuel. And it seems to me casting a blanket
13 description that it's strong or it's weak or we get
14 this type of range of sizes perhaps is unwarranted in
15 view of the lack of homogeneity.
16 And I'm also wondering if we're going to
17 be putting fuel into Yucca Mountain that's tens of
18 years old. How have the spent -- how have fuel rods
19 changed since the early days of commercial reactors?
20 MEMBER WEINER: I'm going to -- because
21 we're almost 20 minutes late, I'm going to really
22 interrupt this, because we will revisit this. So if
23 in a few sentences you could respond, Bob, and then I
24 think I will turn it back over to the chair.
25 MR. EISINGER: It is a very -- spent fuel

is very heterogeneous. We've cut down a lot of that heterogeneity by just looking at LWR fuel. The conclusions that we're drawing are based on the spectrum of evidence that we have, what generally appears to be the case. Can we put probabilistic states with 95 percent confidence? No, we cannot.

MEMBER HINZE: Well, Madam Chair, if I might as a matter of privilege here suggest, of course, faction to Chris, because you asked for further information. I would suggest that those of us that are interested in this topic receive a copy of this manuscript, review that, and then have the option of having further briefings for a group of the Committee or the entire Committee, whichever seems appropriate to the chair.

Thank you.

MEMBER WEINER: I think it would -- it is going to be important to revisit this topic, because I have some unanswered questions, and we simply have run out of time.

But thank you very much, Chris, for an excellent presentation.

CHAIRMAN RYAN: Before you leave, Chris, let's summarize. And, Bill, I agree with you. I think there's a couple of areas where we could expand.

1 One would be questions related to the igneous event.
2 Of course, you'd better factor in the fact that
3 there's a TAD and a disposal container as well, and
4 there's lots of things that could happen there.
5 Second is the area of transportation of
6 the materials. We certainly have, you know, risk
7 analyses that go in there, and some of these issues
8 might play into what happens during a transportation
9 accident of one sort or another. There's a wide range
10 of things there, so there's a second area there.
11 And then, the third could be, although we
12 did see some information that indicated at least so
13 far not much of what happens to spent fuel when it's
14 stored on a pad in a dry storage cask for a long
15 period of time, we did have one report on an
16 examination of a canister that was reopened at some
17 point down the line from initial loading and --
18 MR. EISINGER: I examined that.
19 CHAIRMAN RYAN: Huh?
20 MR. EISINGER: I examined that.
21 CHAIRMAN RYAN: You did. So, and the
22 question was -- or the answer seemed to be, from what
23 was reported to us, well, not a lot changed since the
24 day we closed it up. So there's a wide range of
25 questions there. I think with this initial tutorial

1 we have sharpened our thinking and maybe -- I agree
2 with you, I think there's more than one topic that we
3 could certainly look at in more detail.
4 MEMBER WEINER: Let me add a fourth topic,
5 and that is if there is a buildup of fissile material
6 around the rim, does that have an impact on the
7 probability of criticality during transportation?
8 CHAIRMAN RYAN: Boy, that would be a tough
9 one. I don't think so. This is just a little -- but,
10 yes, that's another question. Sure, there's lots of
11 interesting things to think about. So I think we're
12 all agreed that we will certainly work with Chris and
13 his colleagues to maybe bring the issues further up.
14 Sir, you had a point you wanted to raise,
15 and I didn't want to leave without at least giving you
16 the chance to --
17 MR. SCOTT: Thank you. I'm Harold Scott
18 from the staff. In the graph, Chris, slide 9 that
19 showed the composition, there is no tin in M5.
20 MR. BROWN: Okay.
21 CHAIRMAN RYAN: I'm sorry. That's
22 slide 9?
23 MR. BROWN: Thank you. I don't know how
24 that got in there.
25 CHAIRMAN RYAN: There's no tin in M5.

1 MR. SCOTT: Right.

2 CHAIRMAN RYAN: So that should be a zero.
3 Okay. That's the first column, tin. In M5 fuel,
4 there's no tin.

5 MR. SCOTT: And there is oxygen in ZIRLO,
6 in the last column.

7 CHAIRMAN RYAN: All right. Great. Thank
8 you.

9 MR. BROWN: All right. I took this from
10 another publication, so thank you for -- for
11 correcting that.

12 CHAIRMAN RYAN: Thank you.

13 With that, we will take our 15-minute
14 scheduled break.

15 We are going to close the formal part of
16 our record. We're going to have some informal
17 discussions among members and staff members. It's a
18 session that's open to the public. We will reconvene
19 at 25 of 11:00.

20 Thank you all.

21 (Whereupon, at 10:20 a.m., the
22 proceedings in the foregoing matter went
23 off the record.)

24

25

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Nuclear Waste 180th Meeting

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Charles Morrison
Official Reporter
Neal R. Gross & Co., Inc.

NRC's Outreach on Radiation

Dave McIntyre
Office of Public Affairs
June 20, 2007

Objective

- Discuss NRC's efforts to inform the public about the health effects of low-dose radiation exposure.
- Discuss public perceptions of radiation.

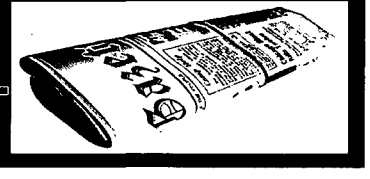
Key Message

In a real sense, *all* NRC outreach is about the health effects of low-dose radiation exposure, because it is the agency's mission to protect people and the environment by keeping any exposures as low as possible.

What is OPA's mission?

- Assist the Chairman in carrying out his responsibilities as principal spokesperson for the NRC.

Office of
Public Affairs

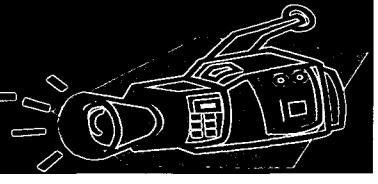


What is OPA's mission?

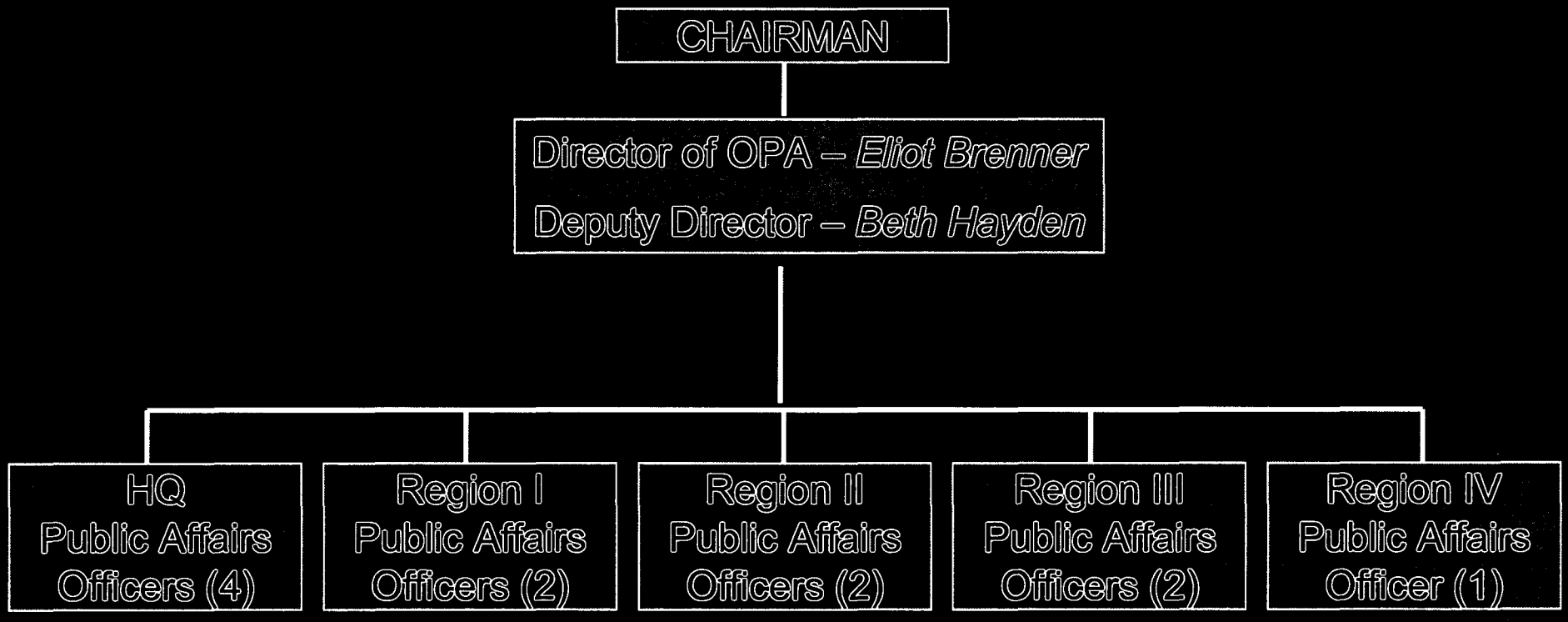
- Act as the agency's primary link to the **news media.**

- Ensure **openness** in our regulatory process by making clear, accurate information available in a timely manner to the news media and the public about the NRC's policies, decisions, programs and activities.

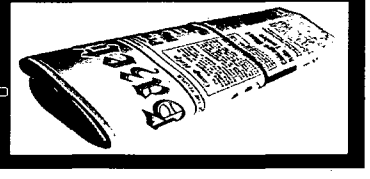
Office of
Public Affairs



Who are we?



Public Affairs Officers have strong backgrounds in journalism, English or communication and extensive experience in the news business.



Who are we?

Headquarters: Eliot Brenner, Beth Hayden, Scott Burnell, David McIntyre, Holly Harrington, Ivonne Couret

Region 1: Diane Screnci, Neil Sheehan
Region 2: Ken Clark, Roger Hannah
Region 3: Jan Strasma, Vika Mitlyng
Region 4: Victor Dricks

What do we do?

Press Releases and Communication Plans

Media and Public Inquiries

Interviews

Media monitoring and reporting

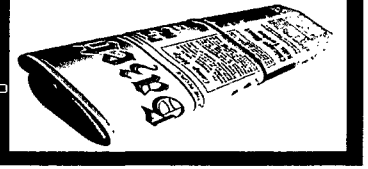
OPA

Web, Video, Brochures and Fact Sheets

Crisis Communication

Public Meetings

Training



NRC's Public Outreach Efforts (1)

- OPA
  - Fact sheets and brochures
  - Assist staff with Web content
  - Special Web page for Students and Teachers
  - Assist staff at public meetings
  - Answer queries from the public and media
  - "Advance work" for speeches by the Chairman or Commissioners

NRC's Public Outreach Efforts (2)

- Program Offices and the Regions
  - NRR – Division of License Renewal
  - NRR – Annual Assessment meetings
  - NRO – New outreach effort underway to explain the Part 52 licensing process for new reactors
  - Tribal Outreach – NMSS High-Level Waste Outreach, FSME Uranium Recovery, OEDO
  - Inter-governmental organizations (CRCPD, IAEA)
  - Etc.

NRC's Public Outreach Efforts (3)

- Agency-Wide Communications
  - Branding Initiative
  - Web site

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Protecting People and the Environment

Recent Initiatives

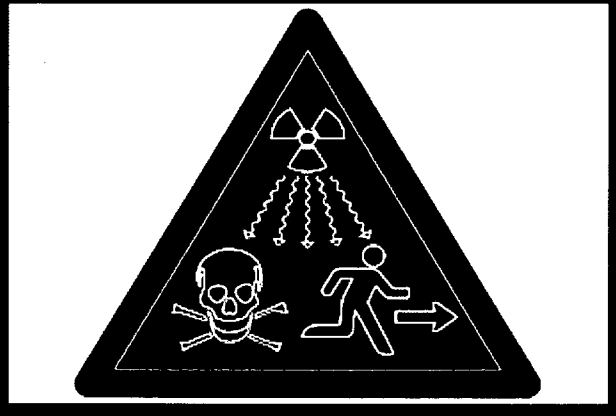
- "Radiation Protection" added as a "Key Topic" on the NRC Home Page at www.nrc.gov .
- OPA and FSME looking at Web content to improve – and especially simplify – the presentation of information on radiation protection.

What's on the NRC Web already?

- Pamphlets and Brochures, including "Radiation Protection and the NRC"
- Fact Sheets, including "Biological Effects of Radiation" and "Radiation Protection and the 'Tooth Fairy' Issue"
- Information about the sources of radiation and a "personal dose calculator"

Public Perceptions of Radiation

- The public's main perception of radiation = danger



NRC's Message

"Radiation can be either beneficial or harmful, depending on its use and control."

Radiation Protection and the NRC

NUREG/BR-0322

February 2006

NRC's Policy

- The "Linear Non-Threshold" theory of radiation exposure holds that there is no radiation dose that does not carry some measure of risk.
- That is not inconsistent with the previous message – the risk must be managed; BUT -
- Translated into "Plain English," that means ...

NRC's Policy, Translated?????

- "There is no such thing as a safe dose of radiation."

- In even plainer English, "All radiation is harmful."

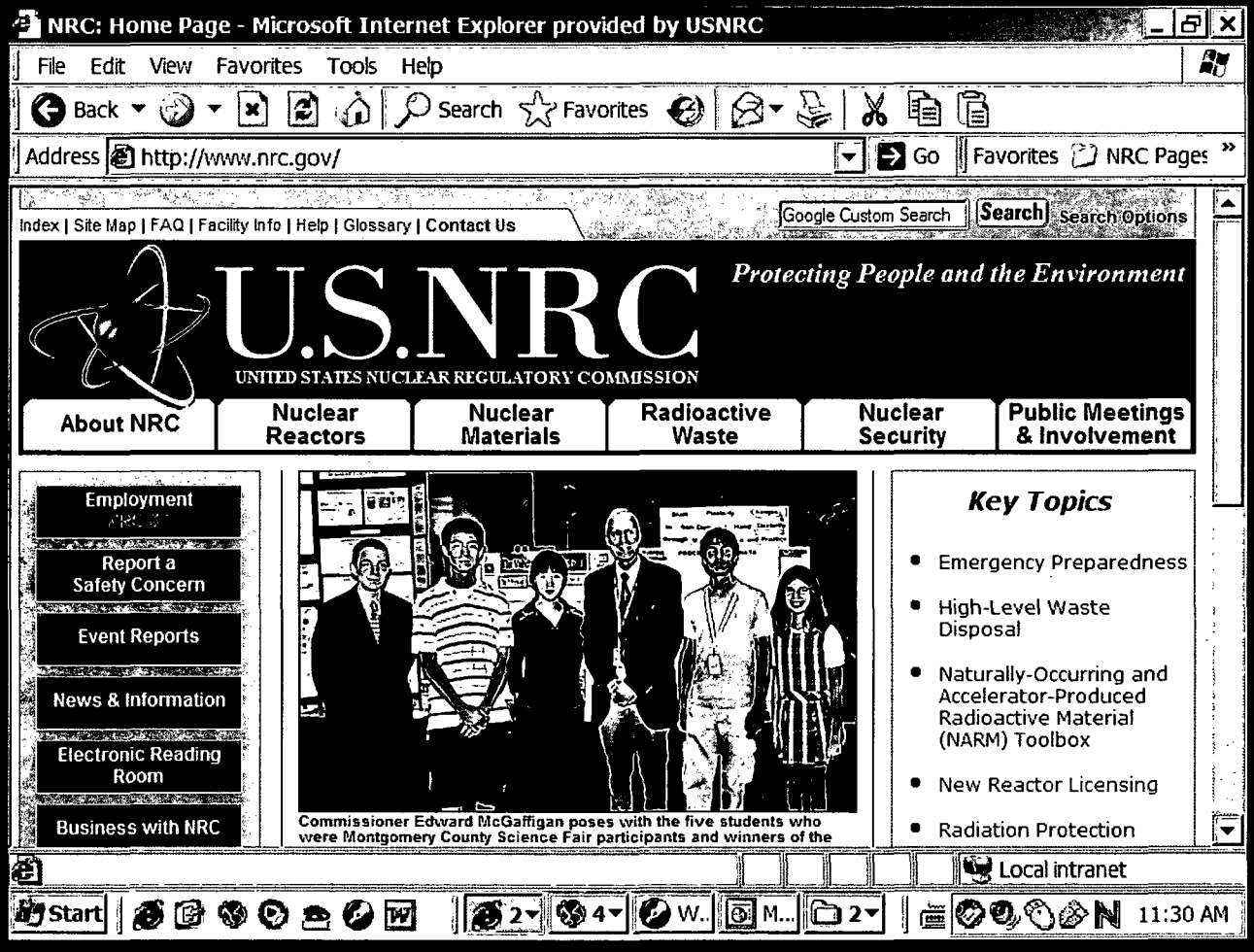
"There is no safe level of exposure and there is no dose of (ionizing) radiation so low that the risk of a malignancy is zero"--Dr. Karl Morgan, the father of Health Physics

- NIRS Web Site

"Ionizing radiation travels through our living tissue with much more energy than either natural chemical or biological functions. This extra energy tears mercilessly at the very fabric of what makes us recognizably human – our genetic material."

– NIRS fact sheet on "Radiation Basics"

Web Site Demo



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A Basic Primer on Fuel: Assembly, Cladding, and Pellet

C.L. Brown
Advisory Committee for Nuclear Waste and Materials
US Nuclear Regulatory Commission

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Why are we concerned about fuel behavior?

- Maintain criticality
- Prevent release of radioactive material
- Maintain Retrievability
- Starting Point of Disposal
- Transportation Source Terms
- A barrier for waste isolation?

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Examples of Types of reactors

- PWR
- BWR
- CANDU
- VVR
- TRIGA
- SGHWR
- HTGR
- LMFBR
- Pebble Bed
- ATR
- New Reactor Designs

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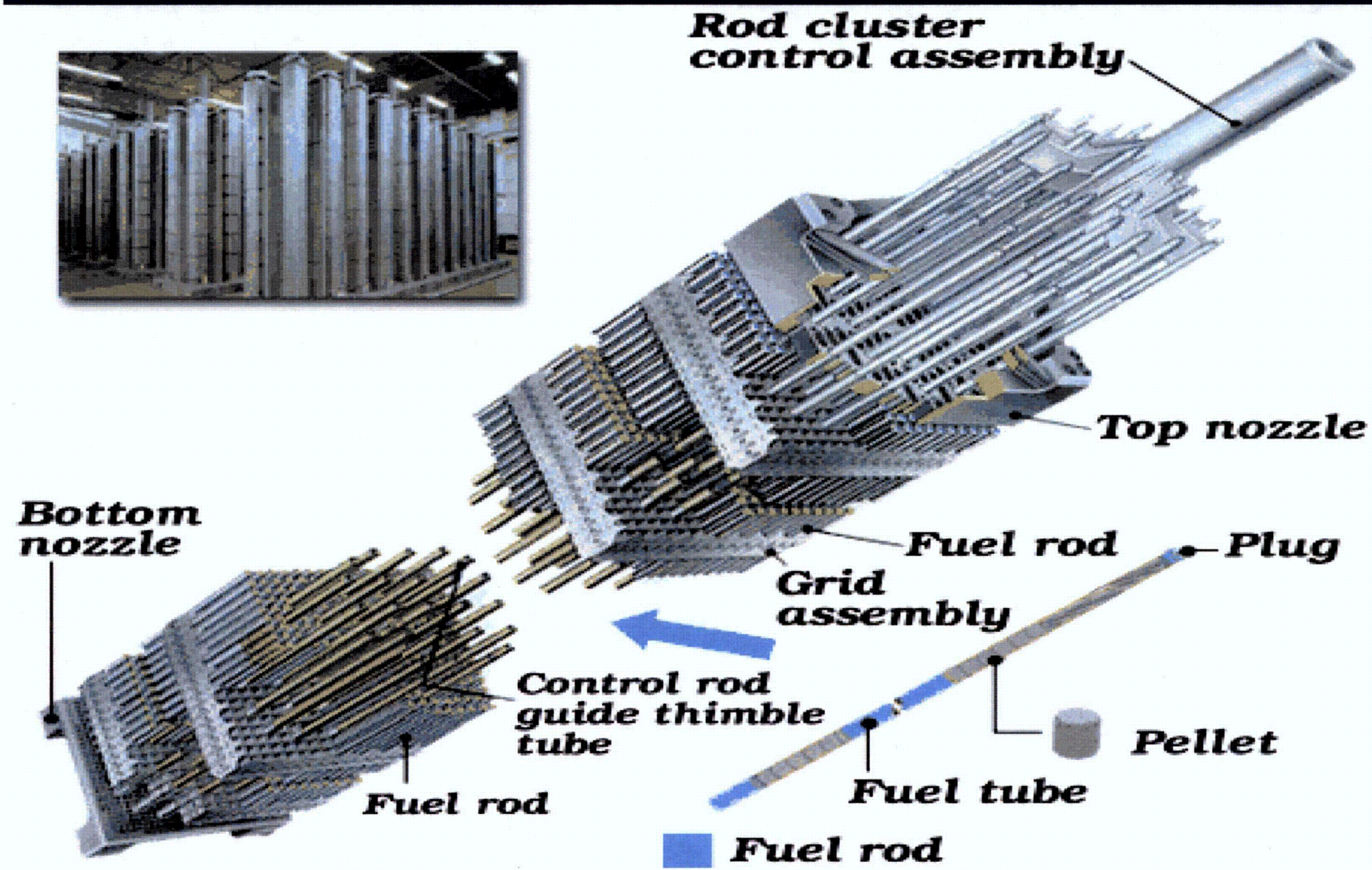

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Fuel Rods and Hardware

- Rods

Fuel	Cladding
UO_2	Zircaloy
MOX	Zr alloys
Metal	Aluminum
UZrHx	Stainless

- Hardware
  - Springs
  - Flow spacers
  - End bells
  - Water channels
  - Control rod tubes
  - Wrappers
  - Debris filters
  - Grid spacers
    - Zircaloy
    - Inconel

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PWR Fuel Characteristics

- 14 x 14 18 x 18
- 3 manufacturers
- cladding types
- full and partial length rods
- Internal pressure
- Cladding thickness and condition
- Fuel enrichment
- Burnable poison
- Reactor operating conditions

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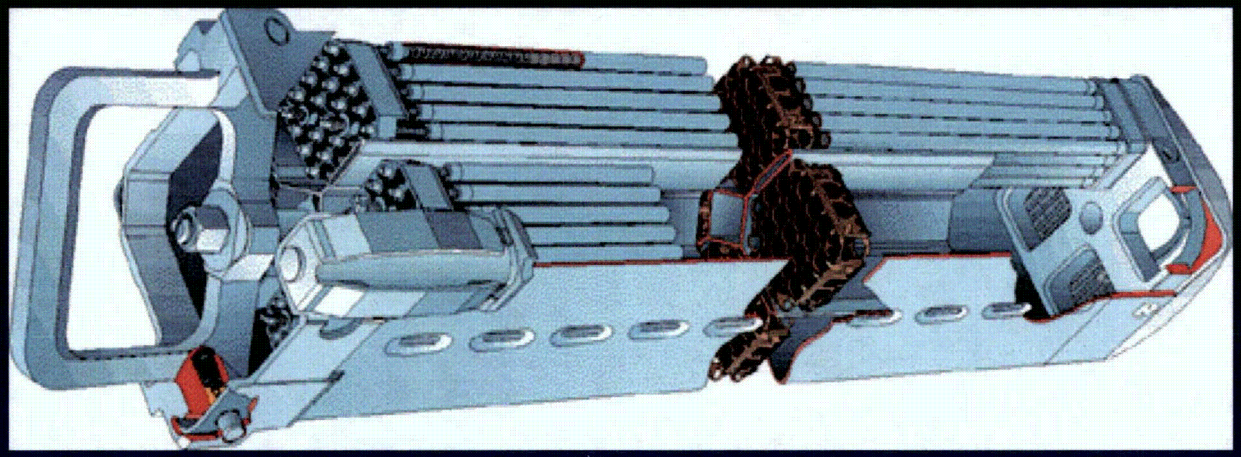
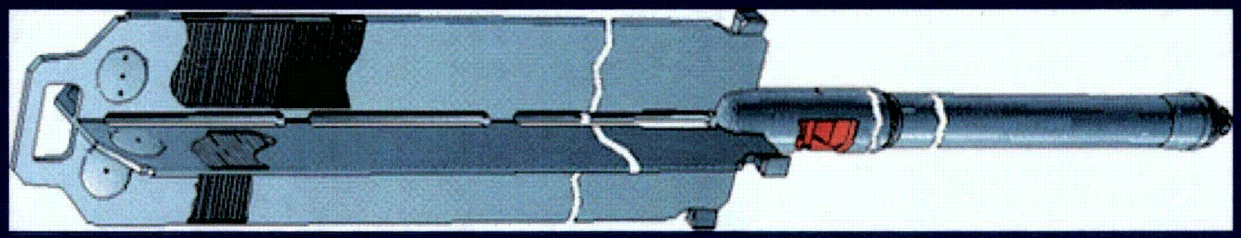
Reactor Vessel Assembly

ABB Fuel Assembly and Control Rod





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BWR Fuel Rod Variations

- 6 x 6 10 x 10
- Internal pressure
- Cladding thickness
- Enrichment
- Operating conditions
- Rod arrangement

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Chemical Composition of Zircaloy-2, Zircaloy-4, and Recent Zirconium Alloys in Weight Percent (Zirconium Balance)

Alloy	Tin	Iron	Chromium	Nickel	Niobium	Oxygen
Zircaloy-2	1.2–1.7	0.07–0.20	0.05–0.15	0.03–0.08	—	0.14 max
Zircaloy-4	1.2–1.7	0.18–0.24	0.07–0.13	0.007 max	—	0.14 max
ZIRLO*	0.9–1.2	0.09–0.12	—	—	0.9–1.3	
M5†	0.8–1.2	0.015–0.06	—	—	0.8–1.2	0.09–0.18

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ZIRLO

- Modification of Zr-4
- 1% Nb alloy
- Reduction in Sn and Fe
- Elimination of Cr
- 75% cold-worked and stress relieved
- More corrosion resistance than Zr-4
- High duty plants (corrosion levels up to 100 microns)
- physical properties of ZIRLO are very similar to those of standard Zircaloy-4 clad.

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Limitation of zirconium alloys

- The absorption of hydrogen
  - brittle zirconium hydrides in the zirconium matrix
  - Under certain conditions of stress, embrittlement of zirconium alloys can be promoted

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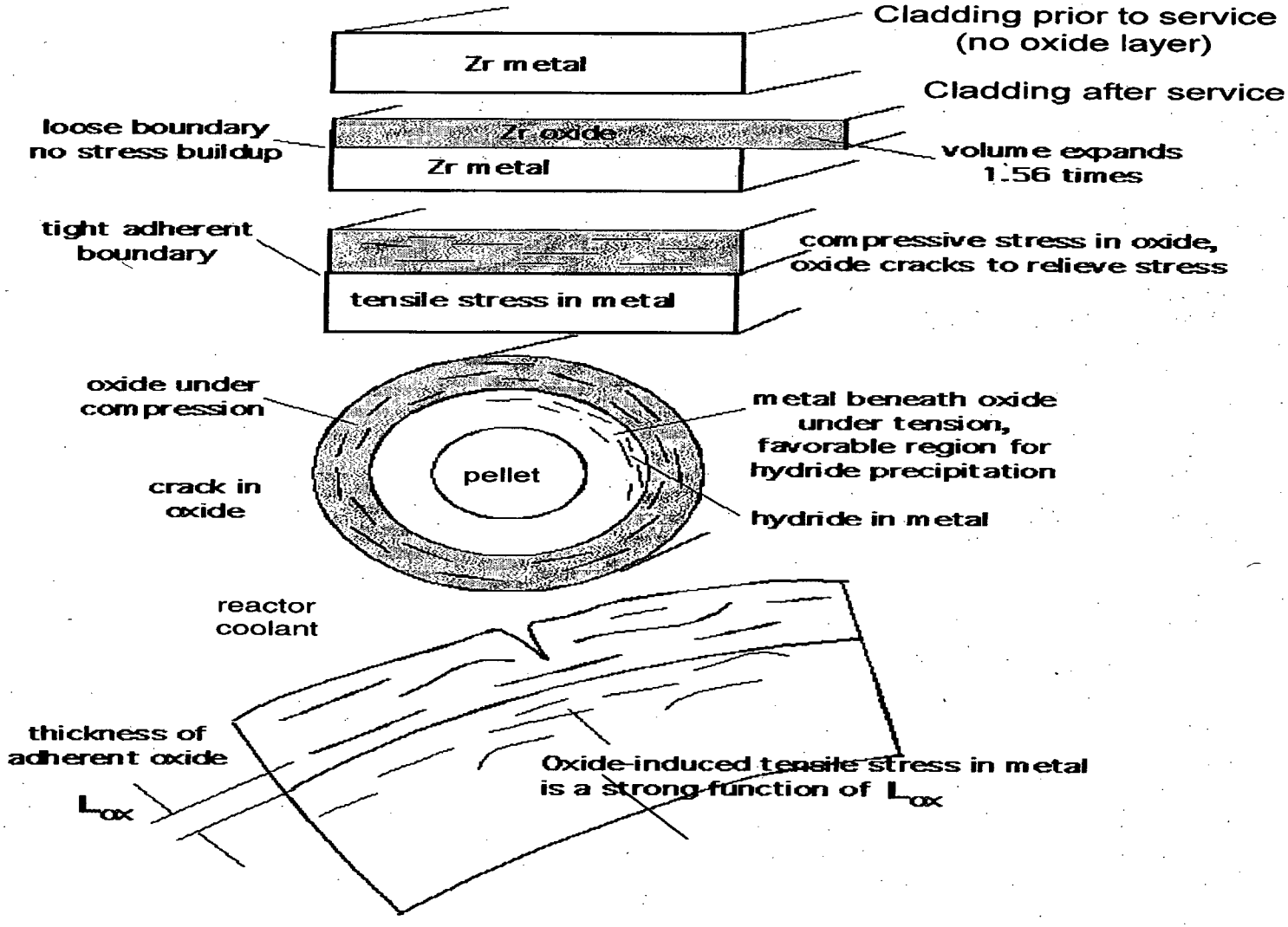
Limitation of zirconium alloys



NOTE: Oxide-induced residual stress in metal is a function of thickness of uncracked adherent oxide (L_{ox}) in contact with metal.

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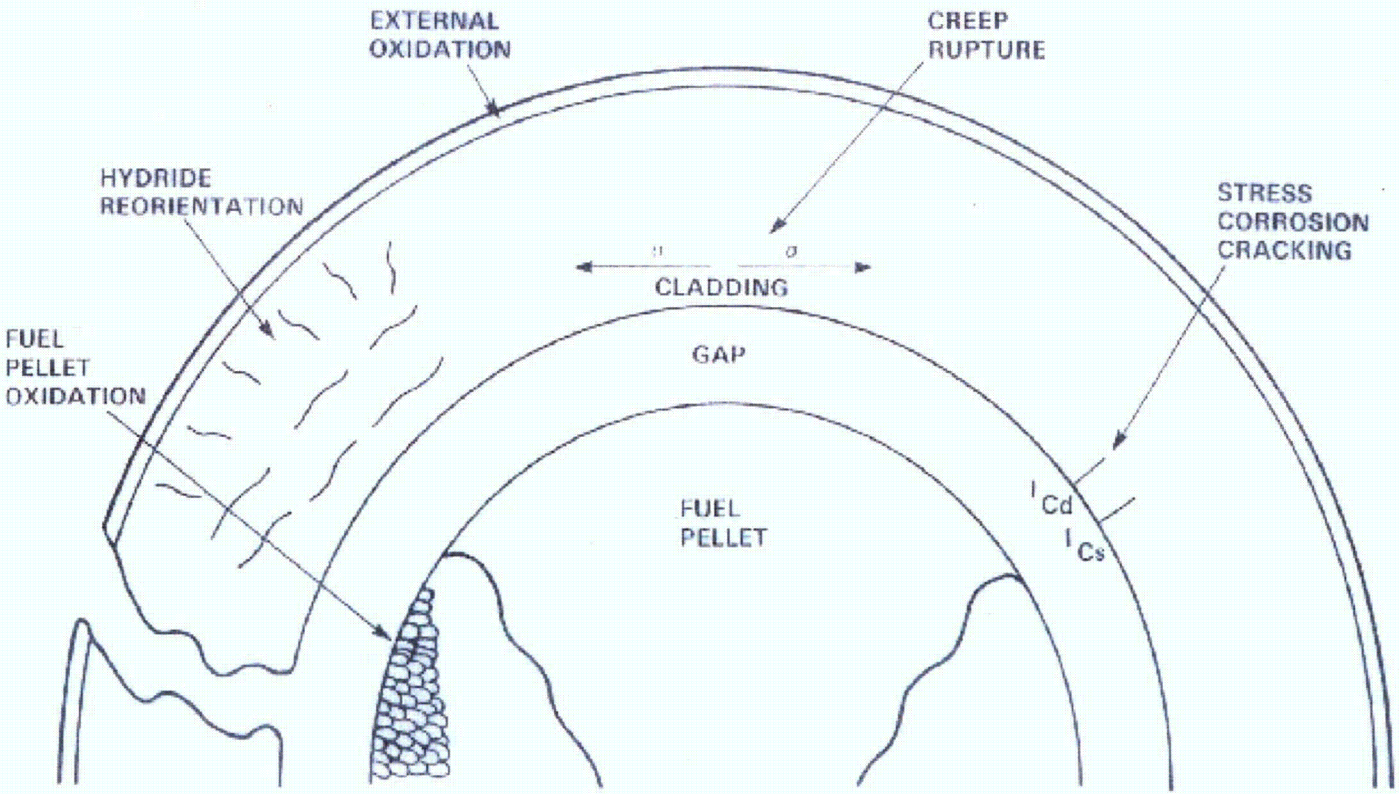
Degradation Modes of Rod Degradation

- General and localized corrosion,
- Spallation,
- Creep,
- Fuel and cladding oxidation,
- Pellet/cladding interaction failure,
- and Hydride Reorientation

MODES OF FUEL ROD DEGRADATION



HEDL 8209 036.2

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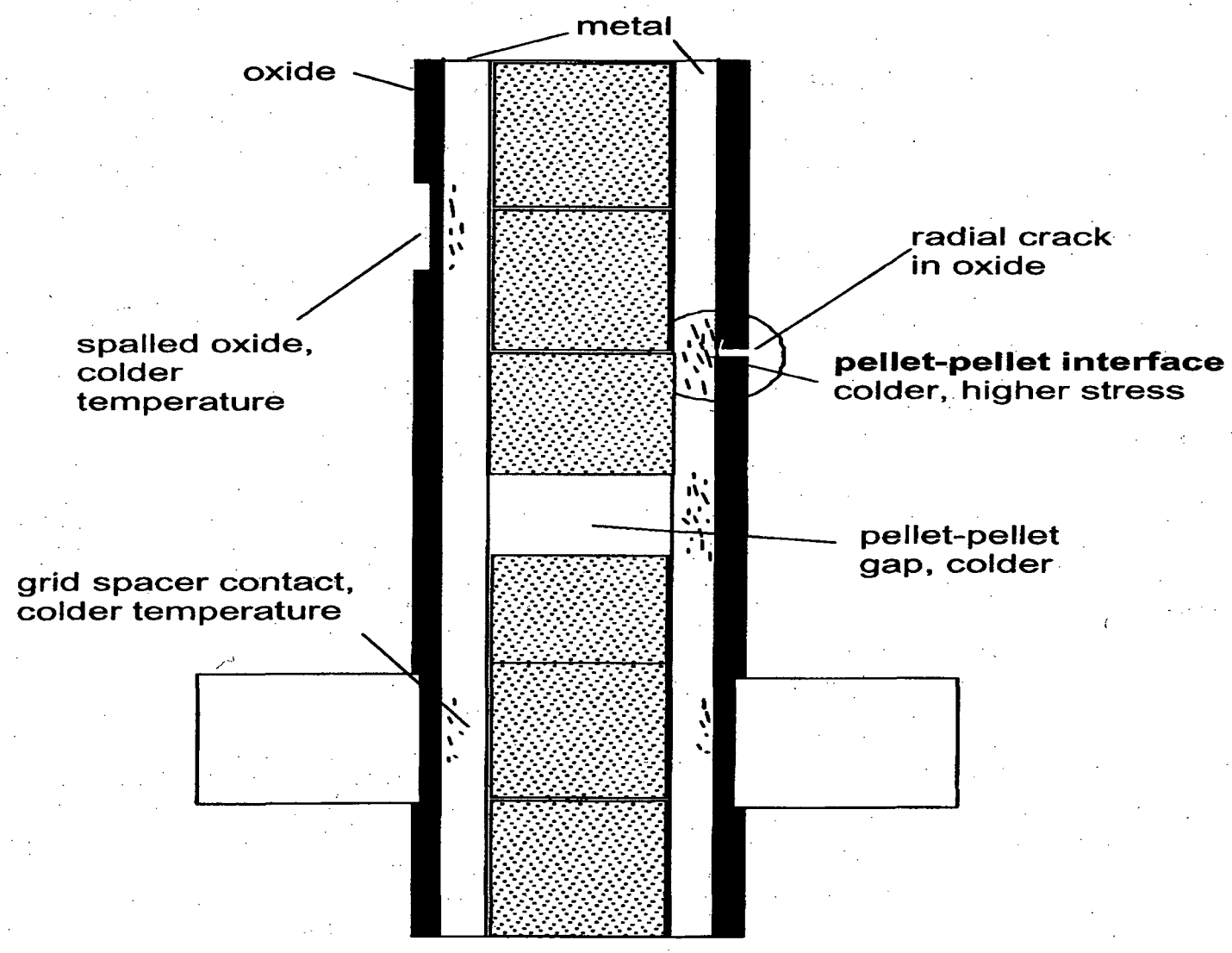

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Oxidation of Cladding/HBF

- Water-side corrosion
- Zirconium hydrides
- Hydriding increases with the increase in burnup

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Hydride precipitates are formed in the reactor

- Generally circumferentially oriented in PWR cladding
- Randomly oriented in BWR cladding

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How are radial hydrides formed

- Hydrides form as the fuel cools in the reactor pool.
- Fuel cladding temperature increases during short-term operations
- High-burnup fuel, hydrogen goes back into solution
- Upon cooling, the hydrides will precipitate in the radial direction

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Hydride Reorientation

- The materials phenomenon of hydride reorientation in zirconium-based alloys usually involves the dissolution of circumferential hydrides and the formation of zirconium-hydrides oriented perpendicular to the hoop stress (also referred to as radially oriented or radial hydrides)

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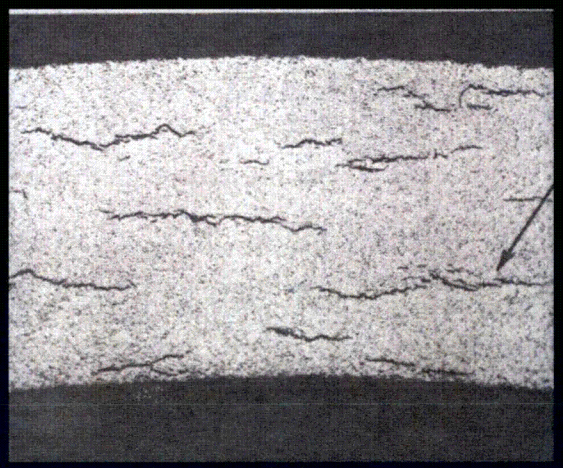
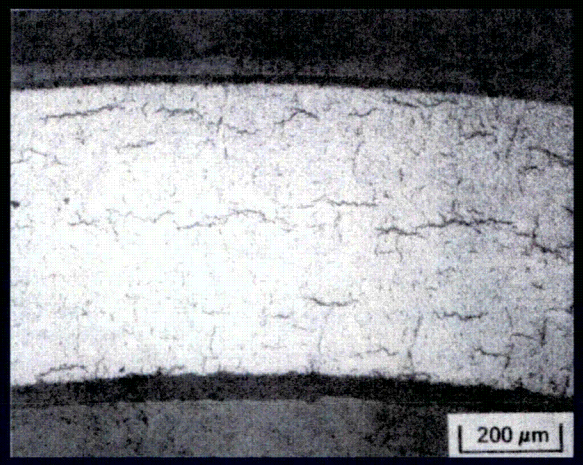
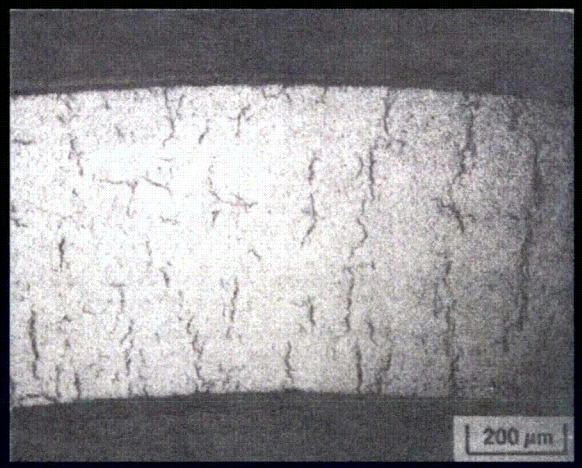
Hydride Reorientation



Circumferential Hydrides in Irradiated Zircaloy Cladding



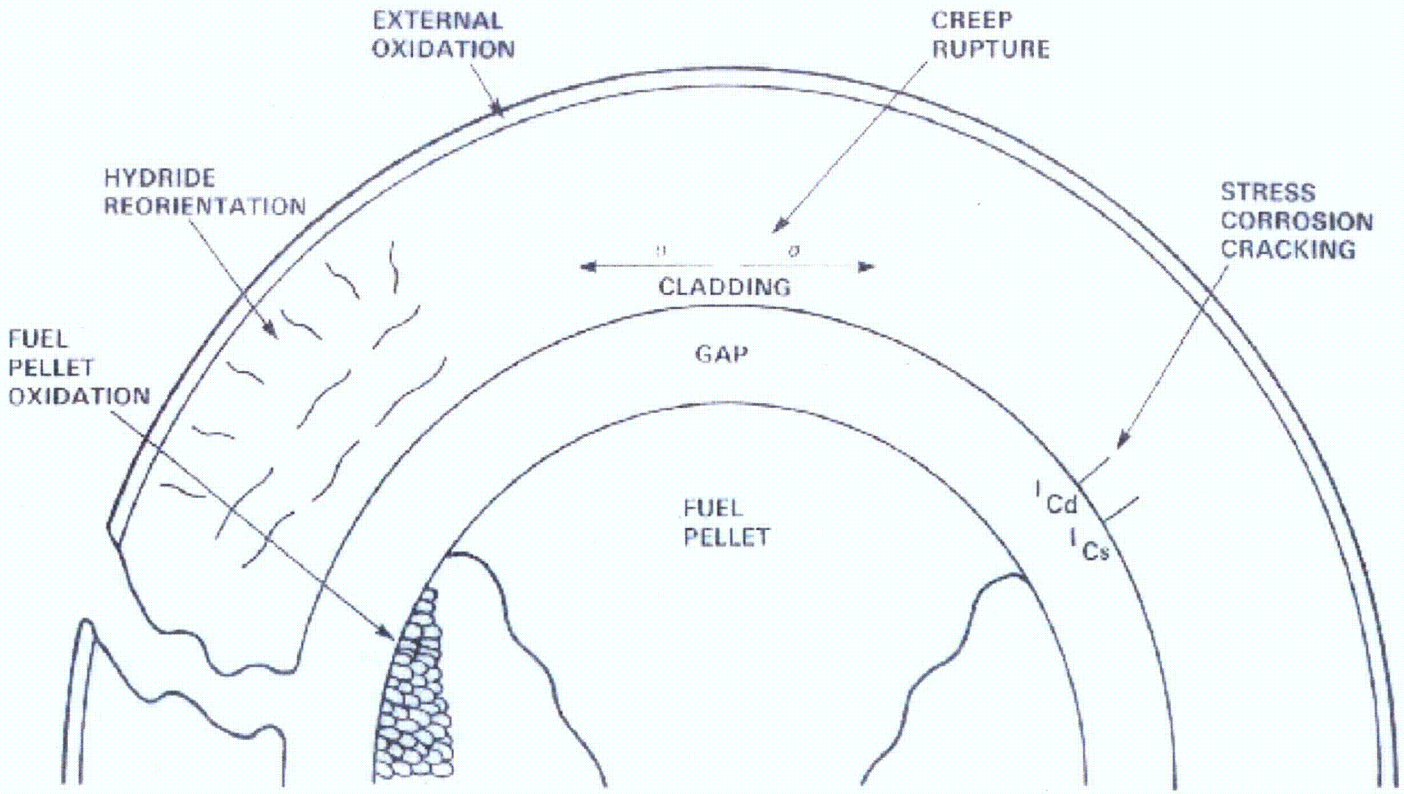
Mixed Hydrides In Irradiated Zircaloy Cladding



Radial Hydrides In Irradiated Zircaloy Cladding

Photographs from Nuclear Technology, v. 67 (Oct. 1982) p. 107.

MODES OF FUEL ROD DEGRADATION



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What is the problem with UO_2 exceeding 45 GWd/MTU

- UO_2 fuel undergoes significant changes
  - chemical composition
  - formation of rim structure.
- These changes become more prominent as the burnup increases
  - pellet cracking
  - pellet swells causing the pellet-cladding gap to close

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Oxidation of Spent Fuel

- Irradiated uranium dioxide exposed to an oxidizing atmosphere will eventually oxidize to U_3O_8
- UO_2 to U_4O_9 to U_3O_8
- Fct of Time and Temp
- Induces a circumferential stress in the cladding

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In summary, fuel characteristic changes as burnup increases

	Low	High
Fuel structure		
rim	None	Outer 8-10% of fuel volume has rim structure with submicron grain size
Fuel-cladding gap	Open	May be open or closed dependent on burnup and storage temperature, due to pellet swelling

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In summary, fuel characteristic changes as burnup increases

	Low	High
Fuel structure		
Grain boundary bubbles	Some bubble structure on grain boundaries	Higher fission gas release indicates more open grain structure
Radionuclide distribution	Open	Excess actinides in the rim region

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In summary, fuel characteristic changes as burnup increases

	Low	**High**
Cladding materials	Zircaloy-4, -2,	M5, ZIRLO, others
Cladding defects	Pinholes, hairlines	More large fretting defects
Cladding composition	<150 wppm hydride	50-700 wppm hydrides