

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

+ + + + +

SUBCOMMITTEE ON MATERIALS, METALLURGY AND

REACTOR FUELS

+ + + + +

TUESDAY,

JULY 7, 2009

+ + + + +

ROCKVILLE, MD

+ + + + +

The Subcommittee convened in Room T2B3 in the Headquarters of the Nuclear Regulatory Commission, Two White Flint North, 11545 Rockville Pike, Rockville, Maryland, at 1:30 p.m., J. Sam Armijo, Chair, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

J. SAM ARMIJO, Chair

JOHN D. SIEBER

DANA A. POWERS

WILLIAM J. SHACK

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

NRC STAFF PRESENT:

CHRISTOPHER BROWN, Designated Federal Official

STU RICHARDS

ALADAR CSONTOS

TIMOTHY LUPOLD

ERIC FOCHT

WALLACE NORRIS

JAY COLLINS

CAROL MOYER

CHARLES HARRIS

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

TABLE OF CONTENTS

ITEM	PAGE
Opening by Chairman Armijo	4
Staff Introduction by Mr. Richards	5
Presentation by Mr. Csontos	13
Presentation by Mr. Lupold	80
Member discussion	142

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1
2
3 P-R-O-C-E-E-D-I-N-G-S

4 (1:29 p.m.)

5 CHAIR ARMIJO: Okay, the meeting will now
6 come to order. This is a meeting of the Materials
7 Metallurgy and Reactor Fuels Subcommittee. I'm Sam
8 Armijo, Chairman of the subcommittee. ACR members in
9 attendance are William Shack, Dana Powers, Said --
10 well, Said didn't make it, and Jack Sieber.

11 MEMBER SIEBER: Sieber.

12 CHAIR ARMIJO: Sieber.

13 Okay, Christopher Brown of the ACRS staff
14 is the designated federal official for this meeting.
15 The purpose of the meeting is to review the staff's
16 research activities relate to materials and
17 metallurgy. We will hear presentations from
18 representatives of the Nuclear Regulatory Research
19 Organization.

20 The subcommittee will gather information,
21 analyze relevant issues and facts, and formulate
22 proposed positions and actions as appropriate for
23 deliberation by the full committee.

24 The rules for participation in today's
25 meeting: we're announced as part of the notice of this

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

(202) 234-4433

www.nealgross.com

1 meeting, previously published in the Federal Register
2 on June 16th, 2009. We have not received any requests
3 for members of the public wishing to make oral
4 statements.

5 The transcript of this meeting is being
6 kept, and will be made available as stated in the
7 Federal Register Notice. Therefore, we request that
8 participants in the meeting use the microphones
9 located throughout the meeting room when addressing
10 the subcommittee. Participants should first identify
11 themselves and speak with sufficient clarity and
12 volume so that they can be readily heard.

13 Dr. Shack has an organizational conflict
14 of interest in ANL. ANL under contract with the
15 Nuclear Regulatory Commission has performed work on
16 projects selected for review by the subcommittee.
17 Since Dr. Shack was directly involved in some of this
18 work, he has a conflict of interest in this matter.
19 Of course, he will have no conflict of interest in
20 work performed by other organizations.

21 We will now proceed with the meeting. I
22 will now call on Michael Case or Stu Richards of RES
23 to introduce the presenters.

24 MR. RICHARDS: Thank you. I'm Stu
25 Richards. I'm the Deputy Division Director for the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 Division of Engineering and Research, and I'd like to
2 thank you for the opportunity to be here today, and
3 tell you a little bit about what we're doing in the
4 materials area.

5 We have a very strong staff in this area.
6 Tim Lupold and Al Csontos are the two branch chiefs,
7 and they've brought a number of their staff with them
8 today. So, I think we'll be able to answer hopefully
9 a lot of your questions. And without further ado, I'd
10 like to turn if over to Al and Tim.

11 CHAIR ARMIJO: Well, I just would like to
12 add one thing. This is such a large and complex
13 series of projects in materials and metallurgy, and we
14 are performing our biannual research report for the
15 Commission. So, it's really helpful to us to really
16 understand what you're doing and where you're headed,
17 and why you're doing what you're doing.

18 MR. CSONTOS: And if you don't see
19 anything here, we can always augment it later.

20 CHAIR ARMIJO: And we, deliberately in
21 order to make this doable, we selected certain topics.
22 And if there's things that have been left out, well,
23 we'll get written information so that we have a
24 complete report.

25 MR. CSONTOS: We have plenty other

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 presentations.

2 MR. RICHARDS: One thing I'd like to add,
3 just to follow up on your comments: I think that the
4 two branches in research in particular are very well
5 connected with their peers in NRR and NRO. There's a
6 lot of communication. There's frequent meetings. And
7 as a consequence, I think the work we have going on in
8 research is supporting what the program offices need,
9 and there are goals in mind, and I think they can
10 explain that.

11 CHAIR ARMIJO: Appreciate that.

12 MR. RICHARDS: So, hopefully we can answer
13 that question for you.

14 MEMBER POWERS: I will be interested in
15 what you do structurally. Can you get the line
16 organizations involved in your research programs?

17 MR. RICHARDS: By line, do you mean NRR
18 and NRO?

19 MEMBER POWERS: Exactly, or NMSS if there
20 are -- if it's pertinent to their needs.

21 MR. RICHARDS: Well, by and large the work
22 that we do is work that is asked to be performed by
23 either NRR or NRO. We have -- a lot of work is
24 defined under user needs. We have routine meetings.
25 I guess how often do we meet, quarterly, or semi-

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 annually to talk about user needs and to cover where
2 the research work is and where it's moving forward to?

3 Changes that need to be made.

4 And then, we've had a number of meetings
5 where the program offices in the staff and research
6 have gotten together to talk about specific progress
7 in given areas. Just recently, I guess we had a group
8 meeting on xLPR, where we had the different offices
9 come together and talk about what needs to be done,
10 and what the goal is, and how to get there.

11 MEMBER POWERS: One of the challenges that
12 I think we face in this user needs structure is the
13 user need gets sent over. It gets interpreted. It
14 gets executed, and a product is returned. That's kind
15 of fait accompli at that point. It may or may not
16 exactly fit what the -- what the organization thought
17 they wanted.

18 If they're caught in a bind of -- you
19 know, they're busy doing their line organization
20 thing, they're not experts. So, they don't always
21 formulate the question exactly along lines that are
22 compatible with the material scientists' thinking, and
23 things like that. And the product they get is not
24 always aligned perfectly with what the line
25 organization thinking is.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 And I mean what I'm asking is why do we
2 try to do structurally to try to bridge those
3 differences in both culture and language that exist
4 between research and line organization?

5 MR. RICHARDS: Well, again, I don't think
6 that fits our business model. They don't send over a
7 user need, and then two or three years later we send
8 them a product, and there's no communication in
9 between.

10 I think there's a lot of communication.
11 Typically, NRR or NRO, NMSS, they have a project
12 manager for that work, who is in close discussion with
13 the project manager on our side. We do have these
14 routine meetings at the division director level that
15 includes a staff, where there's joint presentations on
16 the progress made, how it's going.

17 I have to say under Brian Sheron as the
18 office director, him having come from NRR, he's very
19 focused on the research staff, making sure that the
20 work we're doing is supporting the program offices,
21 and we're not doing work that -- we're off doing
22 something on our own.

23 So, we're constantly being reminded that
24 our job is to work for the program offices, and that
25 comes from Brian Sheron.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. CSONTOS: The -- I guess from our
2 perspective, there is a user need, but we hold --
3 we're lucky in the sense that over at NRR and NRO,
4 they have materials folks who are just as
5 knowledgeable as we are, and they tell us what they
6 need, and we have a real good connection and
7 collaboration.

8 A lot of our folks intertwine in the same
9 areas. Don Naujock and Wally Norris are very close
10 with Ted Sullivan and myself, Dave Rudland, Ted. I
11 mean we're -- we hold meetings quarterly at a minimum.

12 Many times, it's almost weekly conversations back and
13 forth to get that to what it is.

14 The user need is a large type of
15 structural format, but it's really to the
16 communication that we have between these staff, as
17 well as the SL's between the two branches, and the
18 groups that we get this communication --

19 MEMBER POWERS: You're reacting a little
20 too defensively to my question. Historically,
21 materials and metallurgy has been the very best at
22 having a good communication line with the NRR
23 organization, better than any other of the research
24 organizations.

25 And so, what I'm really trying to find out

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 is what is it that you guys do that we can communicate
2 to the other parts of research to solve the problem
3 that you guys have already solved? Historically,
4 you've never had a problem. And a large part of it,
5 I think, is what Al said, is that over at NRO and NRR,
6 they have guys that speak metallurgy as a first
7 language, and consequently, there is good
8 communication in contrast to, say, PRA, where people
9 don't always speak PRA as a first language, and maybe
10 there's not such good communication.

11 That's probably not the most egregious
12 area, whether it's a miscommunication between research
13 and the line organizations. What I'm really
14 interested in is understanding what you've done, and I
15 agree with you --

16 CHAIR ARMIJO: I've heard you have
17 structurally scheduled quarterlies. In addition, you
18 have unstructured routine easy communication between
19 the user and -- and the researcher, and that's really
20 very valuable. That is the kind of stuff that keeps
21 everybody in tact.

22 MEMBER POWERS: I think this is something
23 that deserves a paragraph, and the research report is
24 commenting on what's done here. Because this is -- I
25 mean historically, Metals and Metallurgy has done

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 their job at this better than any other research
2 program. Just I mean not -- and there isn't even a
3 close second as far as being able to do that.

4 MR. LUPOLD: One of the things I think
5 really helps out in that area is that we have our
6 monthly status calls with the contractors that carry
7 out the research for us, and we encourage the users,
8 the end users for NRR, mainly NRR. We haven't had a
9 lot of interaction with NRO to day, but it's starting
10 to come around.

11 We encourage them to come to those
12 meetings on a monthly basis, and they help us out with
13 redirections of research if we don't get the findings
14 we thought we were going to get, or we get results
15 that we didn't think we were going to get.

16 A good example of that actually is that of
17 NMSS with FSS -- FSFT, where we were -- and I'll talk
18 about it a little bit later, but we got some results
19 that didn't really give them what they wanted. So, we
20 had discussions with them and redirected the research
21 plan, and took it down a little bit different path.
22 But yes, communications, the frequency of them, you
23 can't underestimate that. It's very important.

24 CHAIR ARMIJO: I agree with that. Well,
25 with that, let's just get started. I guess I forgot

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 to mention Argonne National Laboratory is on the
2 phone, either backing up staff or on their own. All
3 right, Al.

4 MR. CSONTOS: Well, I guess we already
5 approached that there are two branches that we're
6 talking about today that we're talking about today.
7 There's my branch, the Component Integrity Branch. We
8 deal with fracture mechanics, NDE, safety assessments.

9 And your branch, Tim's branch, which is the Corrosion
10 and Metallurgy Branch, and they deal with corrosion,
11 metallurgy and advanced reactors.

12 MR. LUPOLD: We aren't going to talk about
13 advanced reactors today.

14 MR. CSONTOS: And so, my staff, it's
15 actually interesting. When you talk about between
16 NRR, NRO and us, and research, but it's also within
17 our own branches; I have staff working with -- with
18 Tim's group on advanced reactors, and we have several
19 -- yes, so there's staff on PWSCC that work with us,
20 and we both intertwine, and that's why it's really --
21 there's a demarcation here, but it's really not that
22 strong of a demarcation when it comes down to actual
23 work product.

24 MR. LUPOLD: Pretty blurry.

25 MR. CSONTOS: Yes.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 CHAIR ARMIJO: Just order of magnitude.
2 What's the size of your branches?

3 MR. CSONTOS: I have about -- right now, I
4 have nine staff members. We're going up to 11, I
5 believe. What was it?

6 MR. LUPOLD: Something like that.

7 MR. CSONTOS: I can get you those numbers.
8 I had the numbers in there, but I took them out.

9 CHAIR ARMIJO: Ten is a good number to me.

10 MR. LUPOLD: And I've got about seven, and
11 I just brought in one additional co-op this summer.

12 MR. CSONTOS: And we actually are growing.
13 We have opportunities for young staff, if you know of
14 any. So, the work that we do --

15 MR. LUPOLD: From good universities, too.

16 MR. CSONTOS: Yes, from good universities.
17 The research that we do really has to be tied to
18 something, and to our clients. And our clients
19 usually do this through a User Need Request. We have
20 many user need requests from NRR. There are these
21 ACRS letters that you supported back at the end of
22 2007 after the Wolf Creek AFEA effort that you
23 supported the research that we did on residual stress.

24 I can talk about that later. That helped
25 support us to -- to continue our work in that area,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 even though it was tied to the NRR user needs.

2 There's also the staff requirements
3 memorandum from the Commission. But then there's also
4 a third one, which is a phone call for some of the
5 small stuff. I'm not going to talk about it here, but
6 there is a phone call that we got from NMSS about some
7 failures for storage of -- of sources out there for
8 medical devices.

9 We did a quick two-week thing to help them
10 out on that, but that didn't require a huge level of
11 effort, and we really would expect user need and such
12 -- such that.

13 MEMBER POWERS: How do we have a research
14 program in the areas of corrosion and NDE and even
15 fracture mechanics when the industry claims, and I
16 have no reason to doubt them, that they spend enormous
17 amounts of money on corrosion, NDE and certainly do a
18 lot of work in fracture mechanics? I mean why doesn't
19 NRC say, "Okay, we've got a question about corrosion.

20 Industry, go off and solve that for us." Why -- why
21 do we do that?

22 MR. RICHARDS: I think I can at least
23 start that off. The staff needs to be cognizant
24 enough in these areas so that we can provide that
25 judgement on whether the industry is doing the right

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 research on their own, or whether they're coming to
2 reasonable conclusions.

3 If we're not knowledgeable to the -- well,
4 close to the degree that they are, we're just not
5 going to have the capability to provide that
6 independent judgment that we're called on to do. So,
7 I think --

8 MEMBER POWERS: And corrasion, I think --
9 I mean if the thing breaks, the industry is the one
10 that suffers the penalties.

11 MR. RICHARDS: Well, you know there have
12 been instances where the industry has put forth
13 certain arguments, and the staff has disagreed. Then
14 over time it's played out that it is a problem, and
15 the staff has turned out right. So, in our -- if you
16 step back from just metallurgy as an agency, our job
17 is to provide that independent oversight of -- of work
18 and operation of the plants that the industry is
19 performing.

20 They are intelligent people, but they're
21 under a different set of pressures than we are, and
22 our ability to bring value to the table is to have
23 that independent oversight that doesn't share the same
24 pressures as industry.

25 I think it's important that we participate

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 maybe not taking the lead on some of this, but
2 certainly being prepared to be knowledgeable enough to
3 ask the right questions, to do some independent
4 research so that we can either disagree or agree.
5 Thanks.

6 MR. CSONTOS: For example, there's a lot
7 of efforts right now that the industry is putting
8 forth a large amount of funding on mitigations for
9 PWSCC. They're spending a lot of money on just PWSCC
10 research in the corrosion areas. We've spent -- I
11 don't believe we've spent as much as they did.

12 In fact, when I look at some of the
13 mitigation research, we don't get -- we don't spend
14 anywhere close to what they do, but the issue there is
15 really that we need to -- of we're going to be
16 providing the -- the response back to our clients with
17 significant technical basis, we need to be there, and
18 we need to be seen -- we need to see what it is they
19 are proposing, and be there at the regulatory
20 meetings, as well as doing our own independent
21 confirmatory research.

22 In fact, I'll get into it later, but some
23 of that residual stress work that we're doing is
24 really tied to NRR response to a short term regulatory
25 need on a research project where the industry wants to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 put an optimized weld overlay in two plants, and we
2 have nothing to support or deny those claims.

3 And so, NRR came to us and said, "We need
4 you to do the measurements because we're going to ask
5 you for these measurement results." And so, that's
6 where some of the research that they're spending much
7 more higher -- much more expensive than we are, but
8 yet we'll be getting out that information that will be
9 important in the regulatory arena.

10 So, it's -- it's sort of we're just
11 confirming or denying what they are proposing in a lot
12 of this research, these research areas.

13 CHAIR ARMIJO: Well, I hear it. You can't
14 believe everything you're told. You got to have some
15 independent basis for either accepting or rejecting
16 what people bring to you, and you -- and you certainly
17 can't match what industry can spend, and you don't
18 have to. You should be selective enough to --

19 MR. CSONTOS: Water chemistry is another
20 area where they're spending -- industry is spending a
21 lot of money in mitigation for using zinc and hydrogen
22 additions, while we're spending really at a minimum
23 right now just to check what they're doing. But our
24 staff is involved in those reviews, and looking at the
25 data that the industry is providing us because they're

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 hoping to fuse this.

2 We just don't right now agree with them on
3 several of the -- the contentions or the data that
4 they are trying to present to us.

5 CHAIR ARMIJO: Yes. As we go through it,
6 some of those things that come up where there are some
7 issues, if you just mention them as you go through
8 them.

9 MR. CSONTOS: Does that answer your
10 question?

11 MEMBER POWERS: What I'm actually looking
12 for: the way I can take the requirement that the
13 agency has set up in its plan that it's going to have
14 a good solid technical foundation for its regulatory
15 processes, and come down and say, "Yes, we should
16 research these areas."

17 And when you say, "Well, we need to do an
18 independent research program so we can understand what
19 the industry is telling us, yes, I say, "Well, that's
20 probably true. Why in this area, and not in this
21 other area?" I'm sure with a little effort I can find
22 something where all you do is read what the industry
23 tells you, and say, "Well, you know, I didn't violate
24 my intuition in this area," and you don't have an
25 independent research program, and some areas you do.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 I'm not seeing a roadmap that allows me to
2 come up and say, "Yes, these six areas that you laid
3 down here in your chart for your two organizations
4 randomly are the ones that should be there." That's -
5 - that's my challenge right now is -- I mean I don't
6 know that -- I mean nobody alerted you to come in and
7 be prepared to discuss that, but that's the issue that
8 I'm trying to understand is why these, and not others?

9 MR. RICHARDS: Well, just philosophically,
10 I think the agency should be putting the resources in
11 those areas that have the greatest -- the risk. And
12 when you come right down to it, for a lot of what
13 their branches are doing, they're dealing with primary
14 system pressure boundary material that is not
15 obviously. You can't turn the vessel on and see if it
16 runs.

17 I mean you can do that with pumps, and you
18 can cycle valves, and a lot of equipment is operating,
19 but we're looking at passive components that get ISI
20 occasionally, but you're trying to anticipate whether
21 these components are going to be able to maintain
22 their integrity without failing. And if they fail,
23 the consequences can be significant.

24 MR. CSONTOS: I think that's exactly it.
25 I think NRR has to come up with operability decisions

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 based on a lot of the cracking and degradation issues.

2 And so, they came to us for a technical basis to
3 support or deny those relief requests or whatever.
4 And so, that's where there's a direct link between our
5 groups to NRR for their operability of determinations,
6 and whether they're going to accept and deny -- or
7 deny relief requests.

8 So, there's a -- I think it's that
9 importance and the -- the safety significance of the
10 work we're doing, but it's also just how we are tied
11 in with NRR on the --

12 CHAIR ARMIJO: Yes. You've got to make
13 decisions, and you've got to be there to help them.

14 MR. CSONTOS: Right. I could help. I
15 understand -- but I understand what you're saying
16 about the --

17 MEMBER POWERS: I mean it's no secret that
18 there is a body of decision making people in this
19 country that thing NRC should not be doing research;
20 that all you guys have to do is read what the licensee
21 is submitting, and if it's not enough, ask them for
22 more, and if it is enough, stamp it, initial it, and
23 move on.

24 MR. RICHARDS: What basis would we have to
25 know if it's accurate, if it's adequate?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. LUPOLD: Right. It's very important
2 to know how some of the material properties change,
3 and what the sensitivity is to certain things, and
4 what the analyses that are done; what the sensitivity
5 is based on the assumptions. Because every analysis
6 that's done has assumptions that go into it, and you
7 need to know if those assumptions change a little bit,
8 what does it do to the results? I mean you guys have
9 done that significantly with some of the finite
10 element analyses and found that some small variables
11 can change the outcome considerably.

12 CHAIR ARMIJO: I think we better move on.
13 Let's get on with this.

14 MR. CSONTOS: Well, I'll be talking about
15 our branch's research programs. I wanted to -- I
16 didn't want to just go through a litany of all the --
17 the individual projects and just give you what the
18 individual projects were because when you look at it,
19 there's a short term -- long-term regulatory means
20 what we in CIB do, and we research. But there's also
21 a context to all the different programs, because they
22 all fit together into a puzzle, into a coherent
23 program.

24 And so, I want to go in, and I'll discuss
25 some of them in a little bit more detail and show how

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 we drill down, and how it gets to the actual programs
2 themselves. And so, I'm going to go with the next six
3 or seven slides and go over some graph to show you
4 what it is that we're doing, and then we'll try to
5 fill in where those different projects lie. Okay?

6 So, the topic areas that -- well, first of
7 all, we are evaluating the long-term and short-term of
8 the user needs, and expediting needs. That was Wolf
9 Creek. It was an expedited need.

10 The ready-to-serve, I know Sam, you had
11 brought up -- I think Chris, you had mentioned that
12 you didn't want to hear about ready-to-serve.

13 CHAIR ARMIJO: Well, I -- readiness to
14 serve, as I understand it, I don't see it as research.

15 MR. CSONTOS: Right.

16 CHAIR ARMIJO: I think you have to have
17 the people with a knowledge and a background to answer
18 those kinds of questions when they come up.

19 MR. CSONTOS: Right.

20 CHAIR ARMIJO: I wouldn't put that as part
21 of your research program. It's just a bias.

22 MR. CSONTOS: And -- well, no. I mean
23 when you look at some of the work we do for NRR, we've
24 been doing it for probably 15 or more years, flaw
25 evaluation and whatnot. But there are some things

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 that I would classify as ready-to-serve, but we still
2 do need research on them, especially when we're
3 starting to reduce conservatisms to understand what
4 role certain factors play, parameters play.

5 But there's also issues like, for example,
6 let's say an overlay on -- on pipes that we initially
7 said that we would have enough time to determine there
8 would be leakage from them to -- to shut the plant
9 down before we can repair that location.

10 Well, with an overlay, you do -- you're
11 changing it in such a way where you may not get as
12 much leakage as you initially thought without the
13 overlay when a pipe did have a crack through-wall.
14 So, there's research that needs to be added to what I
15 would call a -- would've called a ready-to-serve type
16 of program in the past with -- with our work with NRR.

17 So, there are some areas where we do have
18 to have some research tied to a ready-to-serve type of
19 program, like flaw evaluation for example.

20 CHAIR ARMIJO: Well, I would see those in
21 kind of like small, short-term, smaller projects.

22 MR. CSONTOS: Right.

23 CHAIR ARMIJO: Just terminology.

24 MR. CSONTOS: Yes. And I just wanted to
25 bring that up. That's all.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 CHAIR ARMIJO: Okay.

2 MR. CSONTOS: So, I'll be talking about
3 two major areas. One is component integrity
4 assessments, and we're going to be breaking that down
5 into the piping, CRDM and RPV areas. We have programs
6 in those three major areas. We have some other
7 smaller ones, but those are three major ones.

8 We're looking at probabilistic and
9 deterministic fracture mechanics. We're doing both at
10 this time, both for piping and for the RPV. You
11 talked about Mark, Mark is doing it for the PTS rule
12 on the RPV, and we're doing xLPR for the piping side,
13 and that's where we'll go into that in a little bit of
14 detail as well.

15 Mitigations and residual stress validation
16 for the -- for as long as I've known us here in NRC,
17 we've always -- we've done some validation on some
18 mitigation. Bill, I know you had done some for us on
19 the BWR side during IGSEC days. We, to my knowledge,
20 don't have a validation of residual stresses still to
21 this day on a lot of things that we've done for flaw
22 evaluation.

23 So, that was a critical part, and that's
24 where ACRS helped us out by -- by putting in for the
25 letter when you approve the -- or reviewed our work on

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 the Wolf Creek effort.

2 We also have high density polyethylene
3 piping research. That's fairly new in the last maybe
4 two years. We've had that where a couple of plants,
5 Duke Energy plants, have come in with relief requests
6 to replace some of their safety systems with plastic
7 piping. And so, that's interesting work, and we have
8 a couple staff members looking at NDE on that, as well
9 as the fracture or the failure of mechanisms related
10 to it.

11 That's where -- the other major area that
12 we'll be looking at is the non-destructive evaluation,
13 NDE area. We have that for both RPV's, piping, and
14 for high density polyethylene piping as well.

15 So, this is the next slide. I broke this
16 down. You had asked me for all these -- these
17 different project numbers. These two over here, this
18 one right here, is -- was not included. This is the
19 xLPR one, 6829. I didn't want to tie that in, other
20 than just to show you that these two -- this program
21 in particular is a lot of xLPR. This one over here
22 has some of it as xLPR. But I just wanted to add that
23 in there.

24 These revolve around all the dissimilar
25 metal weld issues that we're having, the PWSCC issues.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 That is something that is high on the NRR's radar
2 screen. So, we have a lot of programs in that area at
3 this time. So much so, that a few of them are
4 actually closing down: 6433 and 6360 are up to their
5 three-year level. And so, we're shutting those down
6 and building new ones up.

7 So, for 6433, we have 6687 replacing it.
8 For 6360, we have 6637 replacing it. So, we also have
9 high density polyethylene. We have a couple programs
10 there. What you'll see here is that some of the same
11 numbers are showing up for the -- for different
12 topics, or different technical areas.

13 That is because why you see the same
14 title, or very similar titles, component integrity
15 project, or reactive coolant pressure boundary
16 project. These are things because there are a lot of
17 different technical areas, but they all rely upon this
18 -- we would like to keep a more over-arching kind of a
19 scope so that we have a little bit more flexibility to
20 tackle the problems NRR finds.

21 The last one is the RPV, and we're looking
22 at some fracture mechanics there. Those are two
23 programs that you brought up that you wanted to talk
24 about, and I put those. Those are there.

25 CHAIR ARMIJO: The reason I raised that

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 one in particular is because I saw PTS and the rule-
2 making on PTS kind of the end of the line for reactor
3 pressure vessel fracture. And maybe I'm wrong. So, I
4 was wondering what -- what newer problem --

5 MR. CSONTOS: I'll show you in about -- I
6 think the next slide.

7 CHAIR ARMIJO: Okay.

8 MR. CSONTOS: And in NDE, we have three
9 programs there, and that's for both RPV, piping and
10 for the -- well, both the metallic piping, dissimilar
11 welds, and the high density polyethylene piping.

12 So, this is what you were talking about.
13 What I've broken down here is for component integrity
14 assessments in our branch. We have short-term
15 regulatory needs that NRR has asked for. Those are
16 PWSCC mitigations, looking at the -- the -- the --
17 basically the credit. What credit can we give to the
18 licensees for what different types of mitigations they
19 have proposing on the different dissimilar welds, plus
20 the CRDM as well.

21 So, what -- what is it that -- what can we
22 as the NRC say what kind of credit you get for that?

23 CHAIR ARMIJO: Now, I've heard they're
24 doing something with chemistry, zinc.

25 MR. CSONTOS: Yes.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 CHAIR ARMIJO: Some claim that may be of
2 any value. Is your research program addressing that?

3 MR. CSONTOS: We are -- in my branch --
4 I'm not the chemistry man.

5 MR. LUPOLD: That would fall under mine.

6 CHAIR ARMIJO: Okay.

7 MR. LUPOLD: To answer your specific
8 question, as of right now it's no. We're not looking
9 at zinc. We've looked at hydrogen and other
10 chemistries, but zinc is down the line.

11 CHAIR ARMIJO: Okay, okay.

12 MR. CSONTOS: There are many different
13 mitigations, and I'll show a slide as well in a little
14 bit that will show where that all breaks down as well.

15 But that's the short-term. And then some flaw
16 evaluations: every spring and fall we seem to get some
17 indications, and NRR asks us for our short-term,
18 rather than our long-term. That's right. That's
19 right.

20 And this high-density polyethylene, that's
21 becoming more and more of an important topic for NRR
22 in terms of NDE, and for failure mechanisms. We have
23 a lot of work in the code cases for code cases in this
24 area. So, this is tied -- a lot of this is tied to
25 current activities that they need right now, that they

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 need some of our technical assistance at this point.

2 So, it's really what I would call short-
3 term regulatory evaluations, or technical assistance
4 to NRR.

5 CHAIR ARMIJO: Now, just briefly, what
6 kind of systems or piping systems are people going to
7 use this high-density polyethylene? Is it service
8 water? Is it --

9 MR. LUPOLD: They are generally talking
10 about their class three systems of service, water
11 systems. Right now, it's being used on the
12 underground systems for service water. A lot of
13 utilities used it in non-safety related applications
14 already, and some of their --

15 CHAIR ARMIJO: How big is this stuff?

16 MR. LUPOLD: Oh, some of the applications
17 I've seen out there right now has been like six-eight
18 inches. But they're talking actually using it 30-40
19 inch diameters for some of these service water supply
20 lines.

21 MR. CSONTOS: Eric Focht is our resident
22 expert on the plastic piping. Is that --

23 MR. FOCHT: At Callaway, they're --

24 CHAIR ARMIJO: You need a microphone.

25 MR. FOCHT: For Catawba, they approved it

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 for 12 inches, and for Callaway, I believe it's for
2 two distinct thicknesses -- diameters. Sorry, not
3 thicknesses. Four-inch and 36-inch.

4 CHAIR ARMIJO: These are like your
5 sprinkler system, or something very --

6 MR. CSONTOS: Well, that's where we're
7 having the issues is that the joining issues -- there
8 are a lot of issues with joining and NDE. And NDE's
9 licensees industry actually told us that they're --
10 you want to talk about it, Wally, a little bit? Wally
11 is our NDE expert in the high-density polyethylene.
12 This goes to the -- to Dr. Powers question about why
13 we need this kind of research.

14 MR. BROWN: Can you give your full name
15 for the record?

16 MR. NORRIS: Yes, Wallace Norris. I think
17 this goes to the question that you asked in that when
18 the -- Duke first contacted us about this, their
19 technical basis indicated that there was no known NDE
20 method to examine this.

21 And so, they strictly wanted to have us
22 approve the relief based on a visual examination
23 program, and pressure testing. And so, that's one of
24 the things that was built into the user need is to
25 look to other industries to see what they were doing.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 And so, we quickly found just through literature
2 searches that the mining and gas industries have been,
3 in smaller diameter piping of course, but they have
4 been working on this NDE problem for years.

5 CHAIR ARMIJO: There are -- there are
6 methods of --

7 MEMBER POWERS: So, your function is being
8 a research librarian?

9 MR. CSONTOS: No. We have programs at
10 PNNL, which have supported through actual work, but as
11 part of it it was to look at various techniques that
12 are out there that other industries used.

13 So, the project was find what others are
14 using, see if it's applicable to our case, and our
15 case was then we have our -- our -- our -- Wally is
16 our program manager in this area for PNNL. PNNL is
17 our contractor in this area for NDE. And so, they're
18 the ones out there now looking into whether these
19 techniques are a viable piece to our inspection
20 toolbox.

21 MEMBER POWERS: Okay. I understand.

22 MR. RICHARDS: The other thing I just
23 might want to add is you mentioned it's like the pipe
24 you use in your garden for your sprinkler.

25 CHAIR ARMIJO: I was being felicitous.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. RICHARDS: Okay. Because Eric Focht
2 gave a presentation for our division on this, and it
3 is -- it is heavy-walled material.

4 MR. FOCHT: Right.

5 MR. RICHARDS: It is very -- you know, at
6 least from the pictures, it looks like it's very
7 robust.

8 CHAIR ARMIJO: Well, the other thing is
9 aging effects. The program would address things like
10 that.

11 MEMBER POWERS: It's one that -- I mean
12 it's a perfect example that someone might use when I
13 was talking about the NRC research program. Well,
14 they said, "Well, why are we doing that?" Duke Energy
15 proposed this. Why didn't you say Duke? We're not
16 going to approve a visual inspection on a leak test.
17 We need an NDE method. Go get an NDE method.

18 CHAIR ARMIJO: And we need aging data.

19 MEMBER POWERS: And we need aging data,
20 etcetera, etcetera.

21 CHAIR ARMIJO: Yes.

22 MEMBER POWERS: I mean it's almost a
23 perfect example, because it's not generic. It's a
24 licensee coming in with a novel proposal. If he wants
25 to do something different, then the onus lies on him.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 CHAIR ARMIJO: You could argue that, but
2 you know, if they're solving an existing problem that
3 is really a mess, you know, corroded cast iron pipe,
4 or plugged up cast iron pipe, there's a benefit in
5 them using a better material.

6 MR. CSONTOS: I don't disagree with Dr.
7 Powers. I mean this is something where we have to
8 take a look at what they're claiming to see if what
9 they're claiming, and what they're claiming was there
10 was no liable NDE technique out there.

11 MEMBER POWERS: And you feed that with
12 research or something like that.

13 MR. CSONTOS: Right. Well, I think it was
14 in journal searching, but yes. It was something
15 similar. But then of course we've had our folks look
16 into it to see whether or not it could work in our
17 type of thick walled or whatnot. But these are the
18 types of things that, yes, once we do this, then it --
19 I tend to agree that the onus is on the industry.
20 They're the ones having --

21 CHAIR ARMIJO: You don't have to develop
22 the technique.

23 MR. CSONTOS: We will not be -- we
24 shouldn't be doing industry's work for them. That's
25 the bottom line.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. RICHARDS: But on the other hand, I
2 think this is a good example where if you don't have
3 people on staff who have knowledge, then you're not in
4 a good position to ask those kinds of questions. I
5 mean if you -- let's just assume you eliminate the
6 people in research that were involved in this. That
7 license amendment request would come into NR. It
8 would go to a project manager. They would send it to
9 a technical branch, who may not have any knowledge at
10 all in this particular area, and what basis would they
11 have to ask those questions?

12 You could say, "Well, it's just an
13 engineering ought to be able to think of that." But
14 what basis do they have to say yes or no on whatever
15 comes back? The industry would probably come back and
16 say, "We looked around, and there is no reasonable
17 NEE." I mean you can't -- you have to put some kind
18 of caveat on there, but it's not reasonable, and it's
19 got a long history.

20 We hear these arguments, for instance, at
21 INC, and we're having a lot of discussions about
22 failure rates, and a lot of different issues. You
23 have to have some knowledge in order to have that
24 discussion.

25 MR. CSONTOS: We don't have any people who

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 worked with plastic piping. I got to be honest with
2 you. That's something fairly new to us.

3 Well, let me go on and talk about the
4 long-term programs that we have. We have programs in
5 the RPB, the piping and CRDM. Dr. Armijo, you just
6 mentioned what it is that you saw the PTS as winding
7 down. There are a couple other issues, and this is
8 where NRR has asked us for our support, which is of
9 course the PTS rule, and that's 10 CFR 50.61(a). But
10 we also have these two others, the Reg Guide 1.99
11 revision, as well as 10 CFR appendix GNH.

12 The staff here, we're actually working
13 with Oak Ridge National labs on N6438 on that program
14 where they are redoing some of our coding. The code
15 that we use for PTS, and the code that we're using has
16 to be updated to handle the -- the -- the startup and
17 shutdown, cool down, heat up effects, and that is, I
18 believe, in appendix G, and H as a surveillance
19 program.

20 So, these are the types of things that we
21 are doing in this -- in that one program on the RPB
22 side that we're hopefully going to get out in the next
23 -- within the next year or two.

24 MEMBER SHACK: Does this provide a
25 probabilistic basis for startup/shutdown curves,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 rather than the current deterministic one?

2 MR. CSONTOS: Eric Focht is again our
3 expert in that area. I'll let you --

4 MR. FOCHT: That's correct.

5 MR. CSONTOS: And so, we actually have the
6 favor code here at -- in Church Street, and we have a
7 little workstation. We call it research computer --

8 MEMBER POWERS: How can you resist? You'd
9 call it PARTY FAVOR.

10 MR. CSONTOS: We're trying to do a lot of
11 things in-house now, and that's -- and so, we have
12 this little computer station set up where we can do a
13 lot of our finite element work. FAVOR now can run on
14 that -- those workstations. And so, that's -- we're
15 hopefully doing this in-house with the next GLOBAL
16 ENTRY revision.

17 The piping work, long-term research uses
18 xLPR. The xLPR stands for extremely low probability
19 of rupture. The reason I have parenthesis and "LBB,"
20 there is that it's really replacing -- that work is
21 hopefully giving a probabilistic assessment took.
22 That's what xLPR is is to assess LBB with cracks, or
23 cracking or other degradation mechanisms, or
24 mitigations as well, to come up with what we're trying
25 to determine: if there is an extremely low probability

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 of rupture with existing plants for existing pipes
2 that have already been approved for LBB - all right,
3 they're already approved - that we can still meet the
4 GDC 4 requirement of extremely low probability of
5 rupture for these LBB approved lines.

6 CHAIR ARMIJO: And that requirement
7 numerically, what are we talking about?

8 MR. CSONTOS: Ten to the minus six annual
9 occurrence of -- annual probability of occurrence is
10 roughly what we -- what we have found in the
11 statements of consideration for GDC 4.

12 Okay, and the long-term program, PWSCC and
13 dissimilar metal welds: we have a lot of areas where
14 we're working corrosion. Our side is doing more flaw
15 evaluation work, and that really is tied to xLPR
16 development. And so, that's why they're hand in hand.

17 Then, of course the HDPE support: it'll be there I
18 imagine for quite a while.

19 MEMBER POWERS: I'm wrestling a little bit
20 here with what I would call cognitive dissonance.
21 Okay? Because this particular slide, I just loved it
22 because it said, "Okay, here's the name and the
23 general organization," and he has a long-term research
24 program, and a short-term research program, and under
25 short-term, I see a lot of specific activities.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 I mean I get the impression: high-density
2 polyethylene piping is a new wild idea that somebody
3 submitted. NRR asked you to take care of it, and you
4 guys did some stuff, and sent them away to deal with
5 the licensee.

6 Lots of little things in there. Then, I
7 come to the next line under, "Long-term research," and
8 that's there my cognitive dissonance comes out because
9 I see a lot of specific activities, some of which are,
10 I presume -- I don't know whether the PTS will ever
11 come to an end, but I presume that it will one of
12 these days.

13 By the way, I do consider PTS to be an
14 outstanding example of what NRC research can do, and
15 have said that many times to the Commission. So,
16 don't let me denigrate it.

17 What I'm missing here is what is your
18 organization trying to do? If I go one slide further
19 forward in your presentation, I actually find the
20 answer. You want the -- your long-term research
21 program is to have an expertise and probabilistic
22 fracture mechanics. That's what you really want.

23 MR. CSONTOS: That's right.

24 MEMBER POWERS: And to establish that
25 expertise, you have to carry out activities that pay

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 the bills, but that's what you really want. It's a
2 box that's missing there. Is there anything else in
3 that box besides probabilistic fracture?

4 MR. CSONTOS: It's really -- we're trying
5 to develop that on the problems of fracture mechanics,
6 but we're also trying to get to some of the fracture
7 issues that were -- we haven't really dealt with, and
8 that is the mitigations. So, we're trying to develop
9 a probabilistic mechanic's tool --

10 MEMBER POWERS: It seem to be mitigation
11 is where you really run afoul in doing the -- you have
12 the potential of running afoul in doing the industry's
13 work for it.

14 MR. CSONTOS: And that's why industry is
15 working with us on xLPR. I mean we're trying to
16 create a memorandum of understanding between us and
17 EPRI to help bring this program together. It's a --
18 what we're trying to do ultimately, and there is a box
19 missing here, and that is we're trying to create in
20 the long, long term -- maybe I should even have a
21 third box here, a long, long-term research program, to
22 look at creating a modular code, probabilistic
23 fracture mechanics code, that can deal with different
24 components.

25 Focusing right now, we have PTS for RPB's.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 For piping, we're looking at xLPR. Maybe at steam
2 generators one day, we can work on steam generator as
3 a component as well. But in the long, long-term, and
4 I'm talking maybe when I retire from here, we'll have
5 something like that. But in the interim, we're trying
6 to develop these individual component-specific modules
7 for probabilistic fracture mechanics evaluation.

8 The mitigation aspect of it that we
9 haven't taken a good count is there are a lot of
10 aspects, like for example like I said before, inlays,
11 onlays, overlays, MSIP, the different mitigations that
12 are out there. They change the -- the residual
13 stresses. They change the crack growth -- just the
14 way the cracks grow. The cracks grow from two
15 different materials. It goes from Alloy 82 182 to an
16 Alloy 690 material.

17 These are things that we haven't evaluated
18 deterministically, let along probabilistically. And
19 so, that's where we have some independent long-term
20 work to do, and then in the long-term, pull them into
21 the probabilistic arena.

22 So, yes, I guess you could say the long-
23 term program is probabilistic fracture mechanics. The
24 short-term would be --

25 MEMBER POWERS: I think I like your idea

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 better that your long-term goal is to create a pool so
2 that people in the line organizations can evaluate the
3 fracture probabilities of any of the major components
4 in the primary cooling system.

5 MR. CSONTOS: Right.

6 MEMBER POWERS: That's the long-term goal.

7 To carry that out, you have to have an expertise in
8 probabilistic fracture mechanics. There may be a
9 couple of other things, but that's the main one. And
10 then to develop that expertise, then you carry out
11 these -- these various activities.

12 MR. CSONTOS: Right.

13 MEMBER POWERS: I like that as a structure
14 much better than what I had in mind, and that sound to
15 me like -- I mean that sounds lovely to me as a -- I
16 mean it's consistent with which we wrote in the last
17 research report that the line organization should be
18 able to call up a routine device that would allow them
19 as a non-expert to do a fracture mechanics analysis on
20 any component of the reactor coolant system, or any of
21 the major components of the --

22 MR. CSONTOS: And that's exactly it. We
23 came up with that at Wolf Creek. We came up with that
24 every spring and fall. We -- we hear about these
25 cracks, and it takes us about three weeks to really

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 develop the model.

2 Well, it's already out there. There are
3 tools out there for aerospace --

4 MEMBER POWERS: Let me ask you this
5 question. And Stu, I may be asking you this. We have
6 in the past had people that very much wanted to see
7 each research activity tied closely back to a
8 regulatory need, a one-to-one correspondence.

9 But Al has just articulated a long-term
10 version that I labeled lovely, and he may or may not
11 be able to attach the things he needs to do to a
12 specific research activity. He may not be clever
13 enough to siphon off a little of the money from one of
14 these user needs to advance the science he needs to
15 do, and I'm thinking for instance the science he needs
16 to do to take into account that cracks really don't
17 have ellipsoidal shapes, as an off the cuff example.

18 And what do you think about this? I mean
19 should we try to convince those that make decisions to
20 buy into Al's vision for his long-term research
21 program, or should we limp along?

22 MR. RICHARDS: Well, I think there's a
23 middle ground there to be sought. I think the Office
24 of Research wants to ensure that we don't go off on
25 work that isn't going to be of some use or some value

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 down the road to the user offices.

2 A couple of times I think they mentioned
3 that we work for customers. So, we need to be focused
4 on providing products that user offices can put to
5 use, and they've asked us for. On the other hand, I
6 think that NRR and NRO, as they get more engaged with
7 us, they have in some cases and will continue to
8 recognize that in order for us to provide them that
9 service, we need to develop certain capabilities.

10 We need to have people that have knowledge
11 in these areas, and they need to have the tools to be
12 able to produce those parts.

13 MEMBER POWERS: There is nothing we need
14 to do here that will solve itself.

15 CHAIR ARMIJO: Well, we can endorse that
16 kind of a -- I see it's going to happen anyway.
17 Otherwise, you'd wind up with a whole series of ad hoc
18 solutions to short-term problems with nothing at the
19 end. You'll never get out of that mode of quick
20 responses.

21 MR. RICHARDS: Well, what Al was
22 describing here again is something that has been
23 discussed in detail with NRR. Correct me if I'm
24 wrong, Al, but it's not like we're off doing something
25 without the program offices knowing about it.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 This has been discussed at length, and
2 they are on board and support it. I mean if they
3 weren't supporting, then we should know that because
4 it's a collaborative effort. If NRR came back and
5 said, "Gee, I don't think you ought to be spending
6 your time there," we'd stand up and say, "Yes, well,
7 we need to get together and talk about that."

8 If we're not doing something of value for
9 you, maybe we need to redirect some of our resources.

10 MEMBER POWERS: The problem is that I
11 don't see in any of the sub-boxes the kinds of things
12 that I would think would be there if my objective is
13 as you've outlined. I can't imagine that everything
14 you need to do to get to this -- this expertise that
15 you need to have in this super system can be tied
16 exactly to a current need, and yet every one of your
17 boxes seems to be tied to a current need.

18 MR. CSONTOS: That's -- that's purposeful
19 here, I think the long-term, the long, long-term
20 program. We are trying to develop for xLPR a modular
21 -- that modular code that I was talking about, a long-
22 term research plan, and that's where it may take
23 another few more months to develop a draft of it, but
24 I have one of my staff actually doing that right now.
25 That's another mechanism for us is to create what we

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 call a long-term research plan, or just a research
2 plan where we outline exactly where we are hoping to
3 be in five years out.

4 Maybe that's beyond the -- the user need
5 time horizon because user need time horizons I would
6 say are at most three to five years, and we're looking
7 at maybe ten to 15 years out for something that is
8 modular that handles all the different major
9 components. All right?

10 MEMBER SHACK: Just a quick question.
11 Where does the embrittlement stuff come now? Is that
12 under your branch, or under Tim's branch?

13 MR. LUPOLD: Under my branch.

14 MEMBER SHACK: At least as far as material
15 properties and changes in embrittlement --

16 MR. LUPOLD: I think it's Reg Guide 1.99.
17 Yes.

18 MR. CSONTOS: Because we -- yes.

19 MEMBER SHACK: That seems strange, but
20 okay. Just on this question of independence, too, I
21 mean is FAVOR going to become the fracture code for
22 vessels? Is that what industry is going to come in to
23 convince you guys you can do a deterministic startup
24 curve, and then you're going to confirm it?

25 MR. CSONTOS: Good question. I'm not so

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 certain about that. It's something that we're
2 developing ourselves, but there's still -- it has to
3 be -- yes, there has to be some sort of independence
4 there, and I'm not sure. Do you have any ideas on
5 that, Eric?

6 MR. FOCHT: Specifically for appendix G
7 issues, the industry used FAVOR to develop their risk
8 informed curves, and we're also doing -- obviously
9 we're using FAVOR to develop our technical basis as
10 well.

11 MR. CSONTOS: I'll get back to you on that
12 one. Any other questions?

13 CHAIR ARMIJO: In this list, your chart,
14 you don't mention, let's say, AISCC and IGSCC and DWR
15 6. Is that your view that those problems are gone?
16 Not necessarily gone away, but really sunk to a lower
17 priority than PWSCC?

18 MR. CSONTOS: At this point, NRR -- I mean
19 you all --

20 MR. LUPOLD: See, he's talking about his
21 branch.

22 MR. CSONTOS: Right.

23 MR. LUPOLD: When you talk about my
24 branch, my branch takes care of research in the areas
25 of IGSCC, PWSCC, the mechanisms themselves.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 CHAIR ARMIJO: Okay.

2 MR. CSONTOS: I just handle the safety
3 issues related to it.

4 CHAIR ARMIJO: All right.

5 MR. LUPOLD: We break things, and he
6 analyzes things.

7 MEMBER SHACK: You crack them, and he
8 wonders if they're going to break.

9 MR. LUPOLD: That's true.

10 MR. CSONTOS: So, what I was doing here is
11 you saw that larger slide from the -- the graph, and I
12 want to drill down a little bit into one of them to
13 show you kind of how we do things in -- in research in
14 our branch. This is one of them, and this is a high-
15 priority program for us. It's a PWSCC piping
16 research.

17 This is the type of program where these
18 slides -- this exact slide here has probably been
19 vetted with NRR management staff at least half a dozen
20 times over the past year to get buy in. And so, this
21 is the kind of communication that we have.

22 What we're trying to do here is we're
23 looking and trying to access -- currently, the
24 regulations state that you're not allowed to classify
25 something or approve something as LBB approved piping

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 if it has an active degradation mechanism. PWSCC is
2 an active degradation mechanism, and we're trying to
3 assess it now to see if there needs to be any
4 appropriate -- what is the appropriate regulatory
5 requirements or actions needed to be taken?

6 Industry has taken the lead on this in
7 this area by doing a lot of mitigations on all the
8 different piping. They come in with a lot of efforts,
9 a lot of proposals, and some of them have been
10 resurrected from the IGSCC days, like the MSIP and
11 whole full structure weld overlays.

12 That is some of the objectives that we
13 have. All short-term objectives that we have are to
14 evaluate these industry mitigation activities to
15 assess what kind of credit we can -- what -- we can
16 say what kind of credit it provides.

17 Now, on the other hand, 20 years plus of
18 IGSCC, we haven't seen from what -- what I've been
19 told is that we haven't seen locations where there has
20 been an MSIP applied, a Mechanical Stress Improvement,
21 which is basically just squeezing the pipe, and the
22 structural weld overlays. We haven't seen cracks grow
23 in any of those lines.

24 And so, that's 20 years of operational
25 data. We're looking at several new techniques to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 optimize weld overlays: water chemistry changes,
2 inlays, onlays. And we have --

3 MEMBER SHACK: It's harder to squeeze your
4 pipes, too.

5 MR. CSONTOS: Yes, it's very different.
6 Yes. And so --

7 MEMBER SHACK: These are big mothers.

8 MR. CSONTOS: Well, that's probably
9 because Mike Mayfield came up to me one day in the
10 garage, and said, "Why are you guys doing this?" We
11 had done this back in '85, in '86, and that's a
12 different -- different line, different ROT rations,
13 different -- you know, it's just different. So, we
14 needed to do this.

15 MEMBER POWERS: You should've told him,
16 "Mike, if you'd done it right the first time, we
17 wouldn't need" -- yes, you cut Mayfield a break.

18 MR. CSONTOS: So, we have a lot of efforts
19 in that area. And some of these, like for example the
20 optimized weld overlay, NRR needs some answers fairly
21 quickly. And so, I'll go into that a little bit.

22 This is just for the short-term: in the
23 next year, probably within the next year, we need to
24 get a lot of these things done. We also have what we
25 call an initial probabilistic fracture mechanics pilot

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 study.

2 This goes into xLPR. This is the pilot
3 study to xLPR. We are trying to use some of the
4 knowledge that we used out of the Wolf Creek advanced
5 finite element analysis work that we did back in '07,
6 and pull that into more of a probabilistic framework.

7 Instead of doing hundreds of cases deterministically
8 by changing various parameters, we're trying to create
9 the probabilistic framework to assess cracks and
10 letting them grow to whatever shape they want, rather
11 than just keeping them elliptical, semi-elliptical.

12 Long-term, that pilot study will help us
13 determine the feasibility of creating this
14 probabilistic fracture mechanics tool xLPR for the
15 piping systems that are out there. There's a fairly
16 large difference between PTS and the xLPR and the --
17 in the eyes that there's many different piping
18 systems. Many are fabrication processes that were
19 done for the piping systems as a primary loop.

20 And so, they change the probabilities or
21 rupture quite differently between plant to plant, or
22 even fabricated or fabricator. So, CE versus
23 Westinghouse, and things along those lines.

24 Those are the types at issue, plus the
25 mitigation. There are determinants to fracture

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 mechanics, models that we -- K factors or K solutions
2 that we just really, really right now do not have a
3 good handle on because of the different mitigations,
4 for an inlay, for example, getting a crack to go
5 through 690 for three layers, and then going into 82.

6 How do -- how do we handle that? How do we do that
7 calculation?

8 So, that's the short-term or the long-term
9 for this piping research, and in -- in this
10 collaboration that we're doing, this is a safety
11 assessment. We're trying to create a tool that says,
12 "Well, maybe we need to dial down or dial up the
13 ISI's."

14 We have the NDE. We're trying to create
15 probability detection curves as well for different
16 mitigations. So, if you put an overlay on, what's
17 that probability detection of a crack with an overlay?

18 Without an overlay? You squeeze it.

19 We have a report that PNNL did for some
20 work that they did in Ignalina. I think it's the --
21 was it Ukraine? Is that Ukraine? I believe.

22 MR. LUPOLD: Lithuania.

23 MR. CSONTOS: Lithuania. And they
24 squeezed a crack that was 70 percent through-wall.
25 And in the US, you're not allowed to do that. You

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 have to repair that location, but over there, they
2 squeeze this pipe that has a 70 percent through-wall
3 crack. After they did the MSIP, it was undetectable.

4 And so, that's the kinds of issues that
5 we're dealing with here. How do we -- you know. So,
6 that's the kind of thing that we're trying to -- to
7 assess here. What is the proper detection for cracks?

8 Then how do we import them into this probabilistic
9 fracture mechanics tool that really is a probabilistic
10 fracture mechanics safety evaluation? And NDE is part
11 of that.

12 So, it may behoove us to have a separate
13 discussion at some other point, a presentation on xLPR
14 to show that framework that you were talking about
15 earlier, Bill, that showed all the different ins and
16 outs in the -- so, any way, this is a graph that I
17 just want to show up here to show this -- this -- I
18 guess you could say we just have -- we have to
19 integrate between three major groups.

20 We have to integrate first of all with CMB
21 branch, with all the crack growth folks, and that's
22 what this is here. They give the crack growth rates,
23 and that's where ANL helps us out doing some of that
24 work. PNNL helps us out on that effort.

25 Looking at dependencies, looking at water

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 chemistry as hydrogen content, different issues there,
2 different types of changes in the materials
3 themselves, the welds themselves, and then looking at
4 mitigations.

5 So, there's some work that's being done
6 now in Alloy 690. That gets fed into the safety
7 assessment. The probabilistic fracture mechanic and
8 the leak rate models, that's where my group spends a
9 lot of its time. We do a lot of work on loading
10 conditions, susceptible locations, residual stress
11 models, materials, mechanical properties, and also
12 these mitigations in doing deterministic assessments
13 on the mitigations.

14 Then, we also have in my group the
15 inspection folks, the NDE folks, and that's the third
16 leg of this effort. And so, all these efforts, as you
17 can see here that's where I put all the different
18 programs underneath there to show you where, and
19 you'll see multiple ones being hit on different areas
20 because we don't ask Battelle or our other contractor,
21 Engineering Mechanic Corporation of Columbus, to just
22 do one aspect of it. They really handle a large
23 aspect of -- number of these technical areas.

24 And so, that all gets fed together to
25 create the safety assessments. Now, this evaluation,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 or if you want to call it our safety assessment, is
2 what's going to be feeding into xLPR, and that's where
3 I put those two job codes underneath there. Those are
4 the two job codes that xLPR and that were -- at this
5 point, we're probably going to augment that in
6 probably 2010, 2011, with additional programs. But
7 that's where we're heading.

8 Okay, and now I'm drilling down even
9 further. This is the next slide. So, this is
10 drilling down this block right here, okay? This is
11 the mitigation effects. So, I'm drilling down even
12 further into now specific research programs, and how
13 they feed into xLPR.

14 This is our mitigation program. We have
15 this broken down into code support, and that's direct
16 tied. We work with NRR on reviewing code cases that
17 the industry or the ASME is provided. Right now,
18 we're talking about conditioning code -- we're talking
19 about whether we should approve it, and we have some -
20 - some discussions with NRR. They're the leads on
21 that area.

22 We then have the stress analysis and
23 validation portion of it here, and I really can't
24 tell. This is red and this is purple, but then we
25 have the NDE side over here. So, for the mitigations,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 you can see that we have a lot of issues here that
2 revolved around stresses, and how the stresses get
3 reversed.

4 And so, this is why we have this residual
5 stress validation program down here because really we
6 haven't had a chance yet to see whether or not our
7 models are validating. We've had a lot of models that
8 we test to known residual stress measurements, but not
9 blindly, and that's where the letter that you sent to
10 support, our work, this is where it's going towards.
11 And I'll go into drilling into this one next. Okay?

12 So, we have the different techniques, and
13 we're creating reports for those different techniques.

14 So, for a mechanical stress improvement, that report
15 now is with NRR. A full structure weld overlay, that
16 report is done. We're waiting on an optimized weld
17 overlay design from the industry.

18 The industry comes forward, and they
19 provide us the design that they are planning to use.
20 One of the programs, a phase IV program for this
21 international residual stress validation program is an
22 optimized weld overlay that AREVA is making, and we
23 are doing the measurements, and we're validating our
24 weld residual stress modelers work to those
25 measurements.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 Then, we'll let the modelers tweak it
2 afterwards. Initially, I want to see what that
3 variability is before they get the results.

4 Then of course we have the corollary,
5 which is the NDE side of this. What is the change and
6 probably detection for a crack, or for an indication,
7 or whatever you want to call it, a flaw, before and
8 after the different mitigations that are out there?

9 And so, that's why we have -- we have some
10 corollaries that are joint. The pink program, or the
11 pink tube program, I know you had asked -- Chris, you
12 had asked me to provide that. That's part of this NDE
13 portion looking into not just mitigation, but also
14 just PWSCC issues with mock-ups.

15 Now, here is where -- this is basically my
16 branch. There is some support coming from Tim's
17 branch in this area. This is where Tim's group does
18 all this work right here in the green or the yellow.
19 So, you should probably see it.

20 So, we're tracking the products. We're
21 not actually doing the research other than hydrogen.
22 We're not doing the zinc work. But the -- the user
23 need that came over from NRR said, "Track and
24 evaluate." Not to do the research, but just track and
25 evaluate, and that's what we're doing right now.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. LUPOLD: Right.

2 MR. CSONTOS: We have an annual
3 responsibility to provide result -- provide results
4 and some of our evaluations to NRR, and we're having
5 that as a public meeting August 4th and 5th, I believe.

6 It'll probably be over here at the Legacy Hotel.
7 It's a mitigation meeting with the industry where they
8 have an opportunity to review -- have a chance to look
9 over what we have done.

10 So, our results from these programs will
11 be provided in a presentation. Industry can respond
12 back. We can take those comments and see whether or
13 not they're worthwhile to address or not before we
14 write the full report.

15 Okay, so now I'm drilling down into the
16 weld residual stress program. So, what I've been
17 trying to do here is just trying to show you how we
18 get into the nitty gritty of individual programs, and
19 here what we're doing here -- I think you say -- Sam -
20 - I think I heard Chris and Sam when you came to talk
21 about all the different programs, one of the times
22 when Chris said, "We have so many similar sounding
23 names for the programs." And -- and why is that?

24 And so, what I wanted to do was show you
25 that we have programs that have titles that are --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 like for 6547, it's residual stress validation. We
2 have programs with Battelle and the EMC² on component
3 integrity, and they're very similar. 6433 is ending;
4 6637 is starting; 6360 is ending. In fact, they're
5 ending in the next probably month. Then 6687 is
6 taking over for them.

7 Titles are very similar. I believe one is
8 pressure boundary -- "Primary coolant pressure
9 boundary assessment," or something, and the next one
10 is "Reactor coolant pressure boundary assessment."
11 Okay, it's very similar.

12 CHAIR ARMIJO: Didn't I buy that before?

13 MR. CSONTOS: So, what it is is it creates
14 a kind of a over-arching title and scope that allows
15 us to handle all the different issues related to the
16 pressure boundary issues that we deal with. Rather
17 than being specific to, let's say, dissimilar welds,
18 then we would have to create a new program to work on
19 piping, plastic piping for example. Okay?

20 We don't want to do that because it takes
21 us a long time to get programs started because of the
22 procurement laws and rules. And so, because of that,
23 we want to be able to have a little bit more
24 flexibility in where we can pass people for the
25 emergent issues that we deal with.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 So, we have more over-arching kinds of
2 titles that way, but in -- let's say for example
3 there's residual stress programs. We have programs.
4 We have three programs: 6547, 6774 and 6864 that have
5 I would say fairly similar titles, okay?

6 The difference is that they are all
7 specific to different tasks. For example, 6547 is in
8 charge of making two mock-ups for us. They
9 pressurizer surge coming right over Wolf Creek type of
10 analysis. We were able to procure two ferritic ends
11 from a cancelled CE plant. We welded them up, and
12 created mock-ups out of them to do our residual stress
13 testing and maybe in the future some NDE testing.

14 That then is for this program, okay? Even
15 though that title is similar. Over here, the title is
16 similar, and it's measurements. We're going to get
17 measurements done from Oak Ridge National Labs because
18 they're experts at neutron defraction measurements,
19 and we have other techniques. They do X-ray
20 defraction and incremental hole drilling that's
21 ferritic as well, and they're experts in that area.

22 The vector folks, so we have another one,
23 6864 that wasn't on your list because it's fairly new,
24 but that's for deep-hole drilling. It's a proprietary
25 technique. There's a measurement technique that is

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 really needed, and that's the one that is a through-
2 wall residual stress measurement that just is
3 basically a hole, a small little hole about three
4 millimeters in diameter.

5 You can get the entire through thickness
6 residual stresses for a weld.

7 CHAIR ARMIJO: Did you mention what kind
8 of changes --

9 MR. CSONTOS: You can get all three
10 components: axial, hoop and radial stresses from that,
11 the residual stress. And then it seems to work and
12 there's a lot of folks out there who have used it.
13 The Japanese have used it in their nuclear industry.
14 The Brits have used it a lot. In fact the French,
15 they're doing basically a similar thing that we did
16 with Wolf Creek, and the regulator has stipulated they
17 need to use this deep hole drilling technique to
18 validate that their overlays are going to provide a
19 compressor residual stress for these dissimilar weld
20 joints.

21 And over there, it's a little more serious
22 because they don't have what we'd call a safe weld, a
23 stainless steel safe end weld, whereas in Wolf Creek
24 we got a lot of credit for that because that really
25 did a good job in reducing residual stressors on a

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 dissimilar weld.

2 So, they're a little worried about this.
3 So, that's why we have -- and so, this is one of the
4 reason why I think one of the questions was, "Why do
5 we have so many similar sounding names for programs?"

6 I think that -- I hope that answers it. Okay?

7 MEMBER SHACK: But just on this -- this
8 vector thing. Is this one of these things where I
9 make one measurement, and then I go off and I do a
10 finite element analysis that actually tells me the
11 answer?

12 MR. CSONTOS: No. That's the one that I
13 was worried about. I knew that one -- in fact, that's
14 a guy in -- Mike Prime from Los Alamos, I believe, has
15 created another technique, and it does that where you
16 slice, and then you do a measurement, and then you
17 recombine it, or combine it up in the FEA analysis,
18 and then come back a residual stress state.

19 I basically told him that I can't really
20 validate FEA to something that is an FEA. So, I'm
21 just a little nervous about doing that. So, this is -
22 -

23 MEMBER SHACK: One is elastic plastic, the
24 other is just elastic.

25 MR. CSONTOS: That's true. And so, that's

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 actually one of the problems that we have. That was -
2 - for a long time, we were really not certain if
3 wanted to go to vector for this because of their
4 plasticity issues, and they fixed that through what we
5 call an incremental deep-hole drilling process.

6 And we have gotten some results back from
7 that, and the difference between the incremental and
8 regular deep-hole drilling is not that much different,
9 but it is only in locations where we anticipate having
10 high residual stresses, ID repair locations, certain
11 ID locations where you have a back chip repair, for
12 example. Westinghouse typically do.

13 Those locations will be high yield
14 stressors even at the point of yielding basically, and
15 so we have to be very careful there with these types
16 of techniques that we make it plasticity and that it
17 could screw our results up pretty badly.

18 So, then -- so anyway, I hope that helps
19 out with understanding why there's the similar
20 sounding names.

21 MEMBER SHACK: So -- and since these guys
22 are going to get to do blind comparisons to the
23 measurements, too, right?

24 MR. CSONTOS: Oh, yes. Yes, yes. We --
25 this is -- let me talk about it here. This is where I

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 wanted to drill a little bit more in to show you
2 exactly what we're doing. That was an overview of the
3 different programs. This is exactly what we're doing.

4 That's the letter that you helped to support. That
5 was the date of that letter, supported our research.

6 The purpose was from the FEA days we found
7 that was the critical parameter for whether or not we
8 had rupture or leakage, sufficient leakage. And so,
9 what we did is we created a program. Right now it's
10 what we call Phase I through IV. We are developing an
11 MOU with EPRI to support this work.

12 In fact one of my -- one of my staff is
13 not here right now because he's out there at EPRI Palo
14 Alto working on finalizing that MOU. What it is is
15 that we are developing a sequential program that goes
16 into just really simple fabricated geometry to then
17 actual components. And we just had a presentation, a
18 webinar, with international folks on this.

19 They're very impressed with how we are now
20 taking this and going from beginning to end with this
21 program. They're only going to be available to take
22 into a part with one of the parts, Phase II of this
23 program, because the rest of it is EPRI, and -- and a
24 lot of it is proprietary. So, we have to be careful
25 with that.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 But the whole point is, the purpose of
2 this work, is the second bullet. We just want to get
3 reasonable assurance that our FEA models are
4 defensible. That's really what we're getting to.

5 It's one of those things where I've been
6 noticing that some of the work that we did for CRDMs -
7 - the residual stresses didn't seem to -- from what I
8 read and what I saw, didn't seem -- the models were
9 accurately predicting what I thought we saw from North
10 Anna, and some of the other locations.

11 Bill Cullen, when he was here, we used to
12 have good discussions about FEA modeling. And so,
13 that's really what this is all about because we're
14 basing a lot of our flaw evaluation work on this
15 residual stress.

16 Again, it's just blind validation. Oh,
17 and this program and these outcomes down here, after
18 all this is done, we are developing a sequential
19 format to asking the international body, the round
20 robin participants, to provide us the results back in
21 a blind way so that we can get an understanding of
22 what the uncertainty is in 20 different residual
23 stress models that are out there.

24 And that goes into xLPR to understand what
25 the variability is of that -- of that critical

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 parameter. And so, that's why this program is really
2 Phase II. We have about 15 to 20 international
3 participants who have agreed to, as soon as we provide
4 them the data, they'll provide us their results within
5 three months. And so, that's a -- it's a useful tool,
6 and we get a lot of effort out of that.

7 This is the program: Phase I through IV.
8 And so, we've now drilled down from long-term research
9 programs into now looking into these -- all these
10 residual stress programs that then feed into the flaw
11 evaluation work.

12 This is a sequential form here where we go
13 from Phase I, which are simple cylinders, and EPRI is
14 the lead. They created these plates and simple
15 cylinders. Some of them have dissimilar metal welds.

16 Some of them are just similar metal welds. Get an
17 understanding of how we're doing our modeling; if
18 we're getting something reasonable or not; what are
19 the little different parameters that we need to
20 change?

21 Then we go into Phase II, which is our NRC
22 pressurizer mock-up. That has two mock-ups in it.
23 That's the mock-ups that PNNL were making. It's
24 called the international weld residual stress round
25 robin mock-up, and a full structure weld overlay mock-

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 up.

2 Those are pressurizer sized. They are
3 Westinghouse type fabricated geometry. We have all
4 the different techniques. So, we're not only
5 validating the models to measurements, but we're also
6 validating measurement techniques to measurement
7 techniques.

8 And in that vain, when we work with the
9 experts outside of the US, one of the comments they
10 said is, "Do you want a neutron defraction?" -- or,
11 "Do you want it defraction based, and do you want it
12 stress relief based?" And we have two of each.

13 And so, that's where we are, and we're
14 going to have some of that data done by April of next
15 year. We'll hopefully have something in a written
16 form or a report form sometime in May-June. So, maybe
17 about a year from now, we'll be able to present that
18 work.

19 Phase III is a safety and relief nozzle
20 that EPRI has procured from WNP III. There are four
21 nozzles. I think two safety, one spray, and one
22 relief. They don't have a surge.

23 From that, we're going to do a simple
24 cylinder. Then we have a fabricated component where
25 we know the fabrication very well, and we can validate

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 two known fabrication steps to then a completely
2 unknown, something from a plant. And then this final
3 fourth phase is also something that came right out of
4 a plant.

5 I don't have the figure here, but Phase IV
6 is what NRR has the highest priority for us on, and
7 that is the optimized weld overlay mock-up. It's a
8 cold leg that came out of WNP III that EPRI procured,
9 and it was going to cost of probably \$500,000 to \$1
10 million to make that mock-up if we had to do it from
11 scratch.

12 And so, what we did is we're -- they have
13 it. They're doing all the welding. They're doing all
14 the overlay welding. They're doing a lot of the
15 metallography, all the measuring, strain gauging, all
16 that type of work. And actually what Jay over there
17 at NRR asked us to do was to do the measurements
18 because they just wanted us to do it as a -- and EPRI
19 will do some measurements, but we just want to do it
20 to make sure that we are -- that the measurements were
21 done in a -- in a systematic and controlled way, and
22 that we have the measurements; we're not relying upon
23 the industry measurements.

24 CHAIR ARMIJO: You're going to do both the
25 -- this deep-hold drill --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. CSONTOS: We're doing all four. We're
2 doing X-ray defraction, incremental hole-drilling, and
3 deep-hole drilling. Oh, and we're not going neutron.
4 IT's too thick for neutron.

5 CHAIR ARMIJO: Right.

6 MR. CSONTOS: It's too thick for neutrons.
7 And I can go through the reasons why X-ray just
8 surfaced.

9 MEMBER SHACK: Too big for neutrons, but
10 you're going to do X-rays.

11 MR. CSONTOS: That's right. So, it just
12 surfaced. Incremental hole gives us two millimeters.
13 Deep-hole drilling gets up between the two
14 millimeters on each side.

15 CHAIR ARMIJO: Yes.

16 MR. CSONTOS: And so, that's the whole
17 purpose of it. So, that is -- that's where I just
18 kind of wanted to show you how we drill down into --
19 from large programs into small programs. This is
20 where I just want to say if you had any questions
21 specifically about a program, I can go into it, but
22 something that -- I just wanted to leave it up to you.

23 MEMBER SHACK: What's the neutron source?
24 SNS or?

25 MR. CSONTOS: At -- at Oak Ridge, yes.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 It's the older source.

2 MEMBER SHACK: It's the older source?

3 MR. CSONTOS: Yes, not the spallation
4 source.

5 MEMBER SHACK: Okay.

6 MR. CSONTOS: Right. The Vulcan is a new
7 one, and a two year wait in line for that one. So, if
8 we can --

9 MEMBER SHACK: Enough neutrons out of the
10 other one to get --

11 MR. CSONTOS: That's true. Well, they
12 have the new Vulcan spallation source. That's --
13 that's just incredible. It's -- they're trying to do
14 some --

15 MEMBER SHACK: But which one are you going
16 to get to use?

17 MR. CSONTOS: Not the new one. We're
18 going to get to use the old one. It's still the
19 highest flux in the US, so that's -- that's --

20 MEMBER SHACK: Yes, but that's not
21 important.

22 MR. CSONTOS: I know. I know.

23 MEMBER POWERS: What type of -- was
24 neutron imaging tanks --

25 MR. CSONTOS: Well, we had some work at --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 one of the things we came across is we also have a --
2 I haven't talked about it here, but there may be a
3 Phase IV in that program, a Phase V, which is we have
4 some Saint Lucie nozzle material that we had from last
5 year, and that may be something to see cancel
6 components to actual retired components. What's the
7 difference in the residual stresses?

8 We're getting those cleaned up right now.
9 They're in decon, and the -- one of the things that --

10 MEMBER SHACK: Those are the famous PANIC
11 components.

12 MR. CSONTOS: That's right, the PANIC
13 mock. That's all right, the PANIC surge nozzle and
14 cylinders. But the -- the big thing is that one of
15 the guys from Los Alamos is interested in doing proton
16 radiography to see if they can do it, and they'll do
17 it for us for free, plus they'll give us the neutron
18 work for free. So, we're trying to see --

19 MEMBER SHACK: If the source ever works.

20 MR. CSONTOS: Yes, that's right. And so,
21 that's one of the things I've asked one of my staff to
22 look into because I don't want to give them just -- I
23 don't want to give them something that's very valuable
24 to us just to test with. I want to get a good plan
25 together. And so, kind of something like this where

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 we have a specific plan of how they're going to attack
2 that mock-up to see -- or that actual component to see
3 what the residual stresses are, and give us time
4 lines, things like that. Just for free doesn't really
5 matter to me. I really want to get something out of
6 it.

7 Any questions on specific programs? I can
8 answer them now. I was going to go -- I wasn't going
9 to go through them individually unless you wanted me
10 to.

11 CHAIR ARMIJO: I'm not sure. I'm not
12 sure. I -- we understand your approach.

13 MR. CSONTOS: Yes.

14 CHAIR ARMIJO: And -- and --

15 MR. CSONTOS: I think that was more -- I
16 just wanted to do that because I can go into the
17 individual programs, but really until you get an
18 understanding of how the individual programs fit into
19 a puzzle, that's how we -- how we -- you know, as a
20 final goal, and really the method that we use is these
21 contracts. And the contracts, from our point of view,
22 as long as we meet our budgetary milestones, as long
23 as we get the job done, that's what's important.

24 CHAIR ARMIJO: We just have some of these

25 --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. CSONTOS: Sure.

2 CHAIR ARMIJO: In the NDE, now, you're --
3 industry is trying the conventional NDE techniques,
4 using them, and they're also exploring more advanced
5 techniques and --

6 MR. CSONTOS: Phased array.

7 CHAIR ARMIJO: -- phased array. You --
8 you guys have been doing some of that.

9 MR. CSONTOS: Oh, yes. We have a lot of
10 efforts.

11 CHAIR ARMIJO: Yes.

12 MR. CSONTOS: Wally Norris is the PM who
13 has a lot of work at PNNL. We have a very large
14 program over there right now, and in fact, that's on -
15 - what's one of the last slides in my package. I
16 think it's 6398. Is that right?

17 CHAIR ARMIJO: Yes, that's what I'm
18 looking at. There's also 6593, "Emerging into E for"
19 --

20 MR. CSONTOS: That's right. That's pink
21 two. There's pink one and pink two. The pink
22 programs are international programs where we have
23 international round robins of mock-ups. Some are
24 dissimilar weld metal mock-ups. Some other types of
25 Alloy 600 mock-ups. They get sent around the world,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 and some of the locations I -- I think Korea and Japan
2 have some universities. I think Tokyo University is a
3 part of that. Is that correct? I think -- right.
4 And they've used some very interesting techniques that
5 I don't think we ever even -- well, we wouldn't use
6 right now.

7 MEMBER POWERS: I mean, you bring up one
8 of the issues that I've never really quite understood.

9 I guess there are two things I don't understand. I
10 don't understand -- only two, Bill. Just two in the
11 entire world. I only have two things that I don't
12 understand. One is the relationship between your
13 program and, say, the western European country
14 programs and the Japanese programs. I assume they're
15 confronting. I mean certainly CRDM has to have some
16 trans-national character to it.

17 I don't understand the relationship
18 between your program and the industry programs, which
19 to me are -- are completely opaque. I mean they claim
20 -- they swear and be damned to me that they're
21 spending huge amounts of money, and I never see it.
22 So --

23 MR. CSONTOS: They are spending quite a
24 bit of money on it. That's the reason why I went to
25 PNNL for our mock-ups was because they make mock-ups,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 and the know the people who make mock-ups for the
2 industry for their PDI qualification.

3 We have, and Wally, you can talk to us if
4 you want, we -- we're actually developing MOU with the
5 french, right? IR Sound?

6 MR. NORRIS: Have.

7 MR. CSONTOS: Have, okay. You want to
8 talk about that a little bit, how we interface with
9 the western Europeans in the NDE arena, and also the
10 Japanese? But we just had a kick-off meeting, and we
11 had this tag meeting. That was in Seattle, right? It
12 was a little -- there was a group of -- why don't you
13 go ahead and just -- I've done the job for about a
14 month-and-a-half, I think. So, this is an area that I
15 need to get a little bit more schooled in.

16 MEMBER POWERS: You don't understand it
17 either, huh?

18 MR. NORRIS: Well, I think that two
19 different sorts of issues, and one of the things we've
20 learned now in interfacing a little better with EPRI
21 is that many times they are reluctant to investigate
22 state of the art, say, in phased array, because they
23 don't want to get ahead of their vendors, and the
24 vendors are, while they're using phased array, they're
25 still in some areas stuck in conventional because it

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 meets the regulatory requirements.

2 It generally works, and it would cost them
3 a good deal of money to get into the better
4 techniques. But by not getting into the better
5 techniques, they're having problems in, like,
6 dissimilar metal welds.

7 The cast austenitic stainless steel issue
8 is what Al was referring to. There was just an
9 industry workshop in Seattle a few weeks ago, and the
10 -- I mean this is one area, I think, where the
11 Europeans are ahead of us. But when you talk about
12 something like CRDMs, we, in the game, got into
13 replacing heads.

14 The French, rather than getting into
15 repairs and trying to get into the NDE just started
16 replacing their heads as soon as they found the
17 cracking.

18 So, I think relative to exchange of NDE,
19 there's not as much of some of the research areas,
20 like we -- the MOU with the French, and looking into
21 cast. They very much want to get into state of the
22 art phased array. So, I think in that regard, they're
23 ahead of EPRI on that issue.

24 MR. CSONTOS: Did that answer your
25 question?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MEMBER POWERS: Well, maybe. It sounds as
2 though you observed thinker, and you go off and do
3 your own thing.

4 MR. NORRIS: I think it goes back somewhat
5 to the issue that you raised in that the industry
6 sometimes, I think, lets the ball drop on some of
7 these issues; that they'll claim that they can do
8 certain things, but when we push to try and get them
9 to either provide that data, or when it seems like
10 it's an issue that they should be taking a lead on,
11 there are certain times they do not.

12 MR. CSONTOS: And -- and in the industry's
13 defense, they have a small, small group that EPRI, for
14 example, has a few folks who are just inundated with
15 requests after requests. It just would be nice -- for
16 myself here, I would like to get another NDE expert as
17 well in -- in our branch.

18 Wally is overworked at times as well
19 because he's our resident expert in this area. It's
20 just hard to get the good NDE folks. And I think that
21 one of the areas that we've been having issues with in
22 the NDE side is that we've been asking for, gosh, six
23 years now for information on probability detection,
24 trying to collect some data from the PDI database, and
25 to see what it is that -- what is the probability of

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 detection.

2 We're slowly getting this. We have some
3 of our staff right now, through PNNL, down at EPRI
4 Charlotte to try to pull some of that data and create
5 some of the probability detection curves that, for
6 example, French -- when we met with the French, he
7 said that he's had it for years, and their regulator
8 side has asked and demanded it from their -- from
9 their folks.

10 And so, from our point of view, we're
11 getting that now. So, it's -- it just is somewhat
12 slow in coming. And -- and really the worry there
13 from the industry side is Saint Lucie. You have us
14 act before we really had a chance to see whether or
15 not that indication was really there or not, or was it
16 a 90 percent through-wall indication?

17 So, they're worried about that, and that's
18 reasonable, I think, to be worried about that, and how
19 we would take that result. But on the other hand,
20 this is something that is really important to us in a
21 probabilistic safety assessment or fracture mechanics
22 space because the probability of detection is really
23 critical to really understanding what it is, and if
24 that flaw is there or not there, and whether or not
25 that probability detection as it gets larger, and the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 probability detection usually goes up, will we be able
2 to catch a crack in ISI space between the different
3 ISIs?

4 And so, that's why it's fairly important
5 for us, and they saw that as we spoke with them about
6 the xLPR program, and that's where they're starting to
7 release some of that data. Like I said, we have some
8 -- Pat Hessler from PNNL heading down there to collect
9 some of this data for us, for use in xLPR.

10 MR. NORRIS: I think you brought up an
11 interesting point about PDI and POD. It seems to have
12 very much in the past few years that EPRI gets funding
13 only to do certain tasks, and they're some of these
14 areas where they have no budget to look into. And so,
15 we don't get that information. They don't have it,
16 and they have a limited staff to -- to work on some of
17 these questions.

18 MR. CSONTOS: And that's why we're trying
19 to interface with EPRI. I remember for the last few
20 years, we've been going to Palo Alto in the September-
21 October time frame to see about their what they call
22 IMT's. What does it stand for? Matrix -- Industry
23 Management Table -- Issue Management Table, that's
24 right.

25 It's where their issues are prioritized to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 safety significance, and then what research is going
2 towards them. And we're trying to inform them about
3 where some of our concerns are, where our drivers are
4 going. They provide their risk side of the house, and
5 we come to some sort of evaluation at that point.

6 It's a public meeting, and -- and we sit
7 there and we talk about what it is in research space
8 that is critical to both our sides. Is it industry
9 sides, and our sides? PWSCC stuff was top of the list
10 for -- eight of the top ten, or seven of the top ten
11 at the time. So, that's why you see a lot of our
12 programs the same thing.

13 Again, those are starting to -- like you
14 said, PTS is declining, and well, PWSCC is trying with
15 the mitigations. It's apexed, and it's starting to
16 come down as well, so.

17 CHAIR ARMIJO: Okay, any other questions?
18 We're right at 3:00. I think we're on schedule. I
19 think we can take a break.

20 MEMBER SHACK: Thanks, Sam.

21 CHAIR ARMIJO: I think we should take a
22 break, and reconvene, let's say, 3:15. Well, maybe
23 3:20, five minutes later.

24 (Whereupon, the above-entitled matter went
25 off the record at 3:02 p.m., and resumed at 3:19 p.m.)

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 CHAIR ARMIJO: Okay, Tim.

2 MR. LUPOLD: Okay, thank you very much.

3 I'm Tim Lupold, and I'm the -- I have the Corrosion
4 Metallurgy Branch. Okay, I have a few things in here.

5 Some of the things we do: we respond basically to
6 User Need Requests. We don't have near as much ready-
7 to-serve efforts such as Al does.

8 I mean we get requests in that they need
9 this information, and it takes a while to generate
10 that information. So, it's hard to classify it as
11 ready-to-serve. They all ask us --

12 MEMBER POWERS: So, you're saying you are
13 slow is what you're saying?

14 MR. LUPOLD: You could say that, yes.
15 Matter of that, there are some changes in -- all
16 right. But really, in my branch, there's like three -
17 - three particular areas I'm going to go into. I'm
18 going to talk about proactive management and material
19 degradation. And I'm going to talk about the
20 corrosion metallurgy related specific items, which
21 encompass environmentally assisted corrosion, primary
22 water stress corrosion cracking, which is technically
23 an environmentally assisted corrosion.

24 I'll also talk a little bit, if you want
25 to hear about it, about some of the research we're

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 doing on some spent fuel canisters, the stainless
2 steel cracking that are in marine environments. Okay,
3 and also, another program --

4 MEMBER SHACK: What's that connected with?

5 MR. LUPOLD: That was a request from SFST,
6 and some research that was done in Japan where they
7 dripped chloride solution on stainless steel to see if
8 it would crack. Japan has sea water everywhere, all
9 around them, so they were concerned about the cracking
10 in a marine environment.

11 MEMBER SIEBER: They did, right?

12 MR. LUPOLD: Definitely they got it to
13 crack, absolutely. I mean it's pretty well known that
14 chlorides and stainless steel are going to cause --
15 and elevated temperatures are going to cause stress
16 corrosion cracking.

17 So, SFST personnel questioned it, and
18 said, "Well, we think your tests flawed because you
19 are actually dripping liquid chloride solution on the
20 stainless steel." But then they got to thinking, and
21 said, "You know, we could have salt played out in
22 these things, humidity changes. There could be a
23 potential for corrosion there." So, they asked us to
24 investigate this issue.

25 MEMBER POWERS: Okay. Ask anybody that

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 lived next to the ocean what happened to their
2 stainless steel flatware.

3 MR. LUPOLD: All right, I'm going to talk
4 a little bit about proactive management and material
5 degradation. Project manager on that right now in
6 Gene Carpenter. It used to be Dr. Amy Hall that --
7 Dr. Hall has been requested to work on some other
8 things, like the generic aging lessons learned update.

9 So, we kind of shifted resources around, and Gene is
10 taking over this project.

11 It's a really good fit with the other work
12 that Gene had on his plate. Gene had been working
13 with Life Beyond 60, light water reactor
14 sustainability, and really those two programs fit
15 very well together.

16 All right, I've set these slides up such
17 that there's -- for -- we have a contract out for
18 research. The first slide is going to tell you what
19 the scope of that is, and then the next slide will
20 tell you about the basis. Why are we doing this type
21 thing? And then the third slide will be the approach,
22 all right?

23 I don't intend to go through and read
24 this. If you want to take a look at it on your own,
25 you can read it and get the detailed information. But

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 I'll just talk a little bit about the program, and how
2 I perceive the program.

3 The PMMD program I really see as an over-
4 arching program. It's really looking at what are the
5 material degradation problems that you could run into
6 out on these plants. And we're trying to find what
7 the material behaviors are, and what some of the
8 repair strategies would be on these -- on these
9 materials.

10 MEMBER SHACK: Is this a user request, or
11 is this an SRM that drives this work?

12 MR. LUPOLD: This was -- this started out
13 as a user request, but we think we've accomplished a
14 lot of the needs from the user request. What's really
15 driving right now is an SRM in that the Commission
16 likes the fact that we're doing proactive management
17 or materials degradation work. They really --

18 MEMBER SHACK: Because this is the real
19 opposite of ready-to-serve.

20 CHAIR ARMIJO: Yes.

21 MR. LUPOLD: Yes.

22 MEMBER SHACK: It hasn't happened yet.

23 MEMBER POWERS: The problem I have is that
24 this program has started what, five years ago or
25 something like that? It was going to be the answer to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 a maiden's prayer. It was going to charge out, and it
2 has seceded in disappearing below my radar or horizon.

3 I've never seen anything come out about
4 it. How many viewgraphs have I see that says,
5 "Develop a plan for this program?" I bet I've seen 20
6 of them that said, "Develop a plan." And I never see
7 the plan. Maybe because I don't look, but I've never
8 seen the plan.

9 MR. LUPOLD: The plan isn't fully
10 completed right now. I'll tell you that right up
11 front. But obviously I flipped to this next page
12 here, the basis. This is why we're -- the Commission
13 and everyone in the NRC don't want to see another
14 example such as Davis Besse. We also don't want to
15 see another situation such as V.C. Summer, all right,
16 in which you actually had degradation through the
17 primary pressure boundary. And how did we identify
18 those things?

19 MEMBER POWERS: I want peace and
20 tranquility throughout the world, too. They're going
21 to have another Davis Besse. They're going to have
22 another V.C. Summer. So, the fact that I don't want
23 to is a pipe dream.

24 MR. LUPOLD: That's true, but we can
25 reduce the probability of having such an event like

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 that if we do the right research, and we specify the
2 right inspections.

3 MEMBER POWERS: Right.

4 MR. LUPOLD: Okay, all right. This is --
5 yes, this system doesn't have all the things I wanted
6 to talk about. The real objective as to what we're
7 trying to do here is to identify degradation
8 mechanisms before they find us, all right?

9 We want to be able to look and determine
10 ways of detecting degradation, and then take
11 mitigating actions for it, and before it becomes a
12 real problem. Ultimately what this will do is extend
13 the life of some of the programs.

14 Yes, you do have the slide that shows the
15 pictorial of this. It starts out and says, "The
16 solution of proactive management materials
17 degradation," PMMD.

18 CHAIR ARMIJO: Which number?

19 MR. LUPOLD: Yes, my sent doesn't have it.

20 CHAIR ARMIJO: We don't have any graph or
21 any --

22 MR. LUPOLD: I added these things in here,
23 just these talking points, and some of my notes. So,
24 I guess you don't have this.

25 CHAIR ARMIJO: We don't have this.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. LUPOLD: Sorry about that. But the
2 whole idea is to look at the degradation, to try and
3 detect the degradation mechanism before it becomes
4 catastrophic, all right? And then you can develop
5 mitigation techniques so it extends the life of your
6 components.

7 Ultimately, what you want to do is extend
8 it out so that you'll end and retire your plant before
9 you have failures of the components, or you'll come up
10 with another alternative such as replacing the
11 component before it fails.

12 CHAIR ARMIJO: Now, a year or so ago --
13 well, about two years ago, you issued a report, a big
14 report, a matrix of where you thought there might be
15 problems and what systems, and the importance of those
16 systems. And what I'm looking for is from that
17 report, did it trigger anything? Either like an
18 augmented inspection, or a special inspection to look
19 for evidence that in fact these predictions meant
20 anything.

21 MR. LUPOLD: Well, that report you're
22 referring to was New Reg 6923.

23 CHAIR ARMIJO: Yes.

24 MR. LUPOLD: All right, and it identified
25 a lot of areas that had degradation mechanisms, and it

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 rated whether it was highly susceptible, low
2 susceptibility, and intermediate susceptibility, and
3 how much we knew about the phenomenon.

4 CHAIR ARMIJO: Exactly.

5 MR. LUPOLD: Okay.

6 CHAIR ARMIJO: That's what I remember.

7 MR. LUPOLD: Currently, what is happening
8 right now in the license renewal area is we're looking
9 at that report, and we're updating GALL, and we're
10 using that report as a basis to update the GALL
11 report.

12 So, if they're -- the hope is that the
13 people are doing that. Well, if there's degradation
14 mechanisms in there, in New Reg 6923, that don't exist
15 in GALL, they'll put them in GALL against those
16 components, and then they'll evaluate whether or not
17 the aging management programs adequately address those
18 new degradation mechanisms.

19 CHAIR ARMIJO: So, it's got to go through
20 the GALL update, and through the --

21 MR. LUPOLD: Yes.

22 CHAIR ARMIJO: -- license renewal. But
23 what about plants that aren't going to be license
24 renewal? They still have materials degradation going
25 on.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. LUPOLD: They do. Now, what we're
2 going to use the New Reg for there is those -- those
3 components that have a high susceptibility and we have
4 very knowledge of the program, that's the area where
5 we're going to target some additional research in so
6 we can understand the degradation mechanism more, and
7 see if it is really legitimate, and see if we have
8 concerns in these areas.

9 This program -- you heard me call the PMMD
10 more as an over-arching program. This program is
11 providing input into where we're going to do research
12 in PWSCC, where we're going to do research in ISCC,
13 and those areas.

14 CHAIR ARMIJO: EPRI had something similar,
15 but maybe it's a different kind of issue.

16 MR. LUPOLD: Issue management.

17 CHAIR ARMIJO: Yes, right.

18 MR. CSONTOS: And that's where we've been
19 having discussions. I think the last one we had was
20 October of last year, where we meet with them, go over
21 some of the PMMD results, go over the IMT's. Then
22 that all helps us with some of the direction for the
23 research program.

24 CHAIR ARMIJO: Yes, well, I didn't fully
25 understand the EPRI program, nor the NRC program.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 But, I would -- the way I interpreted it was based on
2 that expert knowledge and assessments that somewhere
3 out of this, between EPRI and NRC, there would be
4 something that said, "Okay, if there is one problem
5 that's likely to hit us that hasn't hit us yet, it's
6 this, and we'll go inspect a plant, or confirm it in
7 some sort of an accelerated laboratory test." But
8 nothing is happening.

9 I was just waiting for the other shoe to
10 fall. What are we going to look at first to show that
11 we can use -- we don't have to be caught flat-footed.

12 MR. LUPOLD: Right. We have not
13 concentrated in that area yet, but we will be turning
14 our attention to that, to identify those areas where
15 additional research is needed, and so we can identify
16 those areas.

17 What we've been trying to do right now is
18 establish collaborative relationships with
19 international partners who are actually dedicating a
20 lot more money into this program than what we are
21 right now.

22 We're trying to leverage our working
23 relationship with them to be able to get as much
24 information as possible, and that is being done with
25 the Koreans. That's being done with the Japanese

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 right now. So, we're working with them to leverage
2 our research dollars, and to be able to find out what
3 they have learned in these research areas.

4 MEMBER SHACK: Well, I like using this
5 thing to inform GALL. I mean that seems to me an
6 effective and efficient use of resources. You take a
7 look at this; you see what the aging management
8 programs that you have in place are going to do, and
9 that would help you focus on where you're going to
10 need the additional research. So, that really strikes
11 me --

12 CHAIR ARMIJO: I don't have an objection
13 with doing that with GALL. I'm just saying there's --
14 some plants may never go for that life extension.
15 They're going to need --

16 MEMBER SHACK: There's not going to be
17 many of those.

18 CHAIR ARMIJO: I would hope not.

19 MEMBER SHACK: There will be some.

20 MR. LUPOLD: All right. And I agree. I
21 mean that is on our scope. That is on our plate as an
22 activity we'll need to do under this program. We
23 recognize that.

24 One of the things we're doing right now is
25 creating an information tool, and concentrating right

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 now on an electronic search capability of this New Reg
2 6923. It's 4,000 pages long; so it's very difficult
3 to be able to go through and flip through, and find
4 information in it.

5 So, right now, one of the biggest
6 activities I can point to under this task is PNNL to
7 develop that information tool to be able to search
8 this. In addition to the -- in addition to just the
9 search capabilities, this information tool draws in
10 experience from many other databases.

11 So, this can be used for -- to identify
12 what the degradation mechanisms are, what the failures
13 that have occurred in industry, and how we can learn
14 from that and apply it to the reactors. Okay?

15 There's a lot more work to do in this
16 area, and I admit -- I mean we have not made a real
17 good start from the gate on this one. There is more
18 work to do.

19 Okay, I'm going to go into the
20 environmentally assisted cracking. Right now, we have
21 a couple programs, and I call them programs; they're
22 really projects. We have our project N6782. This is
23 the project that we have in place with PNNL to conduct
24 cracking -- crack growth rate testing of our Alloy 600
25 and 690 materials.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 Right now, our attention is turning now to
2 the Alloy 690 materials, and their weld filler
3 materials, such as Alloy 52 and 152, 52M. Fifty-two M
4 is one of the most common ones that is used in the
5 industry right now.

6 This task, this project, took on extended
7 arm from a previous project we had with PNNL, and 6007
8 was the previous project. We're just continuing on
9 now with more testing, more materials.

10 One thing I will say here in this project
11 is that we're working with industry and actually
12 collaborating with industry in order to identify those
13 areas where we don't know a lot right now, whether
14 there's information gaps in some of these materials
15 that are being used by industry in the mitigation
16 efforts.

17 Some of the things we question: what
18 happens in the dilution area of a weld? All right,
19 when you are welding these alloys to low alloy steel,
20 and you really dilute the chromium content, what's the
21 crack growth rate going to do when it -- when it
22 reaches those zones? How big are those zones? Are
23 they significant?

24 So, we were doing some research to
25 determine what the chromium content was in those

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 dilution zones, and we're trying to measure crack
2 growth rates in those zones, and into the new
3 materials.

4 CHAIR ARMIJO: Now, these experimental
5 facilities look exactly like the Argonne the way
6 they're described, the Argonne facilities.

7 MR. LUPOLD: Yes, they are.

8 CHAIR ARMIJO: Is there a particular
9 reason why PNNL and Argonne are set up to do the same
10 thing? Or, that they're not? I expect they're not
11 doing the same thing, but they're set up.

12 MR. LUPOLD: Well, they're not doing the
13 exact same thing. They have the same test equipment,
14 and we're doing the same type of tests. Argonne will
15 do certain materials. PNNL will do certain materials.

16 We're finding out, especially now that
17 we're getting into the 690 with the crack -- how long
18 it takes to do crack growth rate tests. That the more
19 -- the more testing cells we have, the better. And
20 we're actually trying to increase the number of test
21 cells.

22 CHAIR ARMIJO: This is the production
23 rate, then?

24 MR. LUPOLD: Yes, right, right.

25 CHAIR ARMIJO: The production.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. LUPOLD: Our customers have told us on
2 several occasions that we need more data, "We need
3 more data." And we're trying to fill that void by
4 generating data as quickly as we can, pertinent data.

5 MR. CSONTOS: And the two experts, too.
6 We have two experts; one is at PNNL, and one is at
7 ANL. And so, both of them are excellent members. So,
8 that's why we also split it up because we have two
9 folks who can be supported in this.

10 MR. LUPOLD: Yes. And the basis is -- is
11 the cracking that we've had in the industry. We've
12 seen it internationally. We've seen it here in the
13 United States. We know that the PWSCC will crack.
14 The approach goes through how we actually fabricate
15 the test specimens and put them in the cells, and what
16 the environments are that we subject them to,
17 etcetera.

18 As we pointed out earlier today, we've
19 looked at different hydrogen concentrations, all
20 right? But we haven't gotten in any zinc research
21 yet. We're monitoring what industry is doing on that,
22 and eventually I believe we'll probably get into some
23 testing with zinc.

24 Now, I'm not sure what benefit that's
25 going to be. A lot of the research that's been done

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 recently that I'm aware of says that zinc will aid you
2 in delaying initiation, but once initiation has
3 occurred, it really doesn't affect the growth rate at
4 the cracked tip. So, really, the cracked growth rates
5 go --

6 CHAIR ARMIJO: As opposed to hydrogen in
7 BWR water?

8 MR. LUPOLD: Right.

9 MR. CSONTOS: Hydrogen and notable metal
10 chemistry and BWR has a very good technical basis.

11 CHAIR ARMIJO: Right.

12 MR. CSONTOS: Hydrogen in the PWS has a
13 good technical basis. The zinc has a questionable
14 technical basis because for initiation it looks okay,
15 but when you -- you cannot prove, I think, that you'll
16 get the zinc to the crack tip because the zinc has to
17 migrate, and it's great; it gets into the oxide film
18 very nice, but the problem is that you just don't know
19 if you have a crack, already existing crack, in a
20 location. I mean heck, which plant had the online
21 zinc, and had --

22 MR. LUPOLD: Farley.

23 MR. CSONTOS: Farley had the downline
24 zinc, and they had a crack.

25 MR. LUPOLD: In their pressurizer surge

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 nozzle.

2 MR. CSONTOS: So, it's one of those things
3 where it's questionable. We're going to be waiting.
4 I think -- I used to work in this area a lot when I
5 was a PM, and this area, we're waiting on industry to
6 provide the EPRI guidelines, water chemistry
7 guidelines.

8 There's an update that was supposed to
9 come out, and it was supposed to come out this March,
10 but there were a lot of I guess questions from the
11 industry side, and Dominion Engineering is the one who
12 is in charge of it, Chuck Marx at Dominion
13 Engineering.

14 That was supposed to come out in March as
15 a draft, and we were supposed to look at it and take a
16 gander through it to see how it might affect our
17 research, or Tim's group's research. Has not come out
18 yet. So, we're waiting on this still. We'll get an
19 update on that in maybe the August meeting, and that
20 may impact our research.

21 MR. LUPOLD: Okay, another project that we
22 have -- I've kind of organized these things to talk
23 about primary water stress corrosion cracking first,
24 and then I'll get into some of the IGSEC, and move
25 into other programs after that.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 The properties of CRDM welds in 6783: this
2 is a project where we want to take nozzles that come
3 out of plants. We have North Anna nozzle we would
4 like to test, and so we've just gotten to the point
5 where we're initiating this contract. This contract
6 right now has been delivered to Argonne National Lab,
7 and we're in the process of negotiating scope and
8 schedule on this project. That is all the further it
9 has gotten to date.

10 The nozzles are actually out at PNNL in a
11 box, and our vision is that we'll be shipping them to
12 Argonne National Lab so that they can -- so NDE can be
13 run on them. This nozzle 63 that was taken from
14 North Anna actually had in indication of a leak path
15 on it when it was tested in the field, and we would
16 like to do leak path or NDE to verify that currently
17 before we dissect it, and then we would like to
18 compare the results of that NDE to the actual
19 condition once we remove the nozzle from the low alloy
20 steel to see if there really was a leak path there,
21 and to see how significant it is.

22 Kind of get a benchmark on how good our
23 NDE really is for doing leak path. And then we want
24 to see --

25 MEMBER SHACK: Is this one of these things

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 where you'd invite teams in to look at it, and you'd
2 get -- you'd have hopefully a collection of results?

3 MR. LUPOLD: I don't know if we're going
4 to do a round robin on it or not. That's some of the
5 things we're talking about, but I have talked with
6 Argonne about this, about the possibility of bringing
7 EPRI in, possibly bringing Areva in in order to do the
8 examination on the nozzle.

9 CHAIR ARMIJO: But there's no doubt that
10 there is a significant defect or crack?

11 MR. LUPOLD: We believe there was a crack
12 on this one because it was overlaid. It was overlaid
13 with 52 materials. This is one of the few samples
14 that we have of Alloy 52, which is applied to a
15 nozzle, and has been in service. So, we think there's
16 some insignificant information that we can extract
17 from this particular nozzle. And we think that --

18 MEMBER SHACK: Do you think that the 52 is
19 on there for cause, rather than --

20 MR. LUPOLD: Yes. We think there is an
21 indication. The utility -- my understanding, and what
22 I've been told is that this nozzle had an indication
23 on it in the 82 weld, and it was overlaid because of
24 that. Jay, you might know some additional information
25 on this weld.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. COLLINS: Jay Collins, NRR, DCI
2 Divisional Component Integrity. The first inspection
3 was a visual inspection and identified this as a
4 leaking nozzle, and this was what North Anna had.
5 This was back in 2001 when they were just developing
6 the NDE techniques. So, they went in and they looked
7 at this nozzle, and they couldn't identify exactly
8 where the problem was that was causing the through-
9 wall leak.

10 So, they assumed in the welds, so they did
11 the weld overlay on the -- on the wetted surface of
12 the weld, and then down part of the nozzle.

13 What they found at the next outage is a
14 possible indication of leakage from this weld, and a
15 definite indication of leakage from another weld,
16 which they had overlaid previously. And what this was
17 was they had not performed the 52 overlay far enough
18 along on the J-groove weld to include the butter.

19 So, they identified that as a problem.
20 And this weld we have the ability to identify those
21 two things, plus the leak path was identified through
22 NDE only, but identified by NDE and clearly drawn on
23 the NDE specs, which we still have access to. So, we
24 think this is a very good item to go through that.

25 CHAIR ARMIJO: Forensic science.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. LUPOLD: This is also a nozzle. Since
2 it is 52 material, we can look at the 52 material to
3 see what kind of flaws occur in these welds when
4 they're made. There's been a lot of talk about
5 ductility dip cracking, and other cracking in the
6 welding processes. We'll get an opportunity to
7 examine this material for such defects.

8 Okay, all right. Talked a lot about that.

9 I'm going to the project on environmentally assisted
10 cracking, and 6519. This particular contract covers
11 both ISEC and PWSCC. Okay, the PWSCC work is very,
12 very similar to the contract that we have with PNNL.
13 We did find the opportunity, though, this year, to
14 start to buy some additional materials so that we can
15 build two additional test cells for the research that
16 we have in this area.

17 And as I think I mentioned, 690 material
18 and its related weld materials, 52 and 152, they do
19 appear to have a slower crack growth rate than what
20 682 and 182 have. And conversely, when you have a
21 slower crack growth rate, that means your tests take
22 longer.

23 So, the more test cells we can put into
24 operation, the faster our customer will get the
25 information.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 CHAIR ARMIJO: Can you accelerate that by
2 just stressing it more? Or, is that kind of as high
3 as -- without plastic --

4 MR. LUPOLD: Well, there's a -- we
5 actually don't want to stress it too much because then
6 we're going to get criticized for subjecting these
7 components to stresses that are completely impossible
8 to be seen in service. All right, so we want to make
9 sure that we're somewhat consistent in a range we
10 think could occur in industry, and then get what --
11 get that particular crack growth rate from that.

12 MR. CSONTOS: There is an issue here with
13 testing period, accelerated testing. When you do
14 accelerated testing of these high chromium nickle
15 alloys, it's -- it's these issues, and I had this at
16 Yucca Mountain when I was there, and I have it here
17 when I work on the reactor side. To initiate, there's
18 a technique to fatigue pre-crack it, and then that
19 provides I guess enough deformation and plasticity to
20 then generate the crack, initiate a PWSCC crack, and
21 then grow it.

22 What happens is that it tends to stop, and
23 you have to fatigue it again just to kick it to start
24 it. And then, it'll die off again. So, one of these
25 tests, one CT specimen -- well, actually, there's

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 multiple CT -- there's now two to three CT specimens
2 in each test rig, and it could take six months just to
3 get data from those three.

4 That's the kind of difficulty we have in
5 terms of we're already accelerating it, and we're at
6 the point already of saying, "Well, is this really
7 realistic to a plant environment where we have to pre-
8 fatigue this thing to a point where we can generate
9 the crack." Is that real?

10 And so, there's an issue there as well
11 with accelerated testing, in addition to just
12 stressing it more, or whatnot. But, this technique
13 just to start a crack is --

14 MEMBER SHACK: But of course, I mean that
15 -- the first one is fair because you're trying to go
16 trans-granular and inter-granular.

17 MR. CSONTOS: Yes.

18 MEMBER SHACK: And until you get it inter-
19 granular, you're not measuring anything. Now, when
20 you're inter-granular crack stops, whether you should
21 then kick it I think is a -- is another question with
22 the --

23 MR. CSONTOS: Right.

24 MEMBER SHACK: You've got to get the
25 sucker inter-granular first --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. CSONTOS: Before you can -- right,
2 right. I agree.

3 MEMBER SHACK: But are you going to do
4 temperature acceleration?

5 MR. LUPOLD: We have not been doing
6 temperature acceleration. We have been doing
7 temperatures at the environments that they would see
8 in field application. We don't have any current plans
9 to change that right now.

10 CHAIR ARMIJO: How about any kind of
11 chemical acceleration? Let's say, much lower hydrogen
12 than you normally would expect? You know, in the
13 BWR's you could crank up the oxygen a little bit, and
14 that would nucleate beautifully.

15 MR. LUPOLD: We have used sulfate in some
16 areas in order to initiate the cracks and get them
17 started, and get them growing, and accelerate them
18 that way. We have not used hydrogen -- we have looked
19 at different hydrogen concentration levels to see what
20 the effect is on crack growth rates. We've run them
21 down low around -- well, some was zero cc's per kg.
22 Others were around 20, and then up around 29. I think
23 some of them have run up as far as 50 cc's per kg on
24 hydrogen. So, we can see what the effects are on
25 that, and see how it changes the crack growth rate.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. CSONTOS: We run into problems with
2 the industry reps and experts saying, "Is this
3 representative?" And so, for us, we've tried to
4 multiply the number of CT specimens from one to three
5 per chamber, and now we're looking at multiplying the
6 number of chambers, and that's where Tim has bought a
7 couple more chambers.

8 And so, that's the way we're trying to get
9 to this, and it's -- it's a slow, tedious process, and
10 we really need to note some of the properties, 692
11 properties, 52 properties, fairly soon because we have
12 a lot of flaw evaluation to work that I'm doing in my
13 branch for NRR: overlays, inlays, all these things.

14 In fact, inlays is a real big one for us.
15 We're looking at three layers of 690 to prevent
16 cracking in these joints. And so, we have an inlay
17 analysis that we presented at the ASME code, and we
18 used three different crack growth rates. Because what
19 Tim's group has provided us is basically three lays --
20 three steps of crack growth rates, and then we have to
21 evaluate it to those three, and come up with a --

22 MR. LUPOLD: Any time you generate crack
23 growth rates, you're going to get a curve, a
24 distribution of crack growth rates. And what Al is
25 talking about is when you take a 75th percentile

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 through that data, or you take a 90th percentile, or
2 you take a 50th percentile, and then he evaluates them
3 and this is -- this is kind of like the sensitivity
4 analysis that's done.

5 How much does that crack growth rate
6 really affect the final results? And in some cases,
7 very much so. In other cases in certain designs, the
8 crack growth rate may not affect it a great deal
9 because the stresses are at certain levels that no
10 matter -- they're just not going to grow.

11 MR. CSONTOS: And so from our -- bottom
12 line for us was you put an ID repair basically is what
13 it is. You put high tensile stresses on the ID.
14 You're saying that your crack growth is very low,
15 okay? Well, does that -- how does the ISI, current
16 ISI schedule, okay? How does that fit into this type
17 of inlay interval? How does that inlay change and
18 effect that ISI interval? And that's where Argonne
19 has gone in and used what Tim has developed. And
20 that's why I'm saying we worked really well together,
21 and then we provide it over to Jay, and Jay may have
22 some questions about how well we worked together, but
23 -- but I think we work well together.

24 MEMBER SHACK: You're right. I mean I
25 keep thinking that it's never going to grow through a

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 whole 690 weld, but if you're talking about three
2 layers, boy, that's not a whole lot of material.

3 MR. CSONTOS: And then you put a high,
4 high tensile stress in there, and I just don't know
5 what -- that's where that -- you have the one layer,
6 and then you have two layers. That's where we have
7 problems right now with our fracture mechanics is that
8 we really haven't done that yet. This is the first
9 time we've done it, and we've spent probably the last
10 six months trying to develop the technique first of
11 all, and then give the analysis.

12 MR. LUPOLD: And then you throw in the
13 potential cracks that you can have in your as-welded
14 condition.

15 MR. CSONTOS: We have this issue now.

16 MR. LUPOLD: And hot cracking.

17 MR. CSONTOS: We have --

18 MR. LUPOLD: You're already starting with
19 some flaws that could potentially nucleate in that
20 place.

21 MR. CSONTOS: There are some issues with
22 these 690 or 52 welding, and there are some hot
23 cracking issues. We had several overlays had to be
24 ground down or stopped because of it, because we've
25 had a lot of these cracking issues related to it.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 Some people -- in fact, we had one that
2 recently was done for -- I can't remember what plant
3 it was. It was a Duke Energy plant, I believe. It
4 was on a cold or hot leg, and they stopped mid
5 overlay. Luckily, it didn't go over the end weld, so
6 they just stopped it. They didn't grind it off. They
7 just left it there. And we're trying to figure out
8 what's going on.

9 So, we're looking into a new program this
10 coming fiscal year to look at some of those issues,
11 and seeing whether or not we need to really worry
12 about this. And this is where it's more of an issue
13 for inlays because do you really get three layers?
14 How big are these cracks? What's the distribution?

15 We did a cursory examination with some
16 overlay materials through PNNL. So, one of your
17 contractors, Steve Bremer, Dr. Steve Bremer up there,
18 and he's looked at some densities of hot cracks from
19 overlaid materials, and some of the crack growth
20 testing material that he had.

21 He did a corollary study for us to look at
22 how many hot cracks there were, and what the size of
23 distribution was. So, that fed into some of the ideas
24 for our initial crack sizes for the inlay work.

25 CHAIR ARMIJO: Doesn't sound very

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 encouraging. You don't need another problem with hot
2 cracks.

3 MR. LUPOLD: Okay, I'll talk a little bit
4 more about some of the ISEC right now. There have
5 been several new regs issues in the previous programs
6 that we've run for ISEC. These other programs were
7 Y6388. This program right now, 6519, is really a
8 carry on from some of that preliminary work, which was
9 done on those -- on those previous programs.

10 What we're really doing right now is
11 wrapping up the work on the BWR environment, and the
12 materials for the BWR internals. And we'll be issuing
13 the new reg summarizing that work under this project
14 6519.

15 Soon, hopefully we'll have a draft by the
16 end of this year on that. And now, we're turning our
17 attention on the environmentally -- on the ISEC to PWR
18 materials and environments. Materials are pretty much
19 the same, stainless steel materials.

20 CHAIR ARMIJO: Does that mean your concern
21 about ISEC and BWR is with modern water chemistry and
22 whatever materials are there, that you -- it's reached
23 some sort of a low level of concern?

24 MR. LUPOLD: I think that we could say
25 that it has reached a low level of concern because

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 we've done the research on it. We know what the
2 fluence levels are in the BWRs, and we feel that we've
3 conducted enough tests to statically characterize
4 those materials and those environments, and don't have
5 major concerns in those areas.

6 All right, now, PWR's, pressurized water
7 reactors, have higher fluences. So, we're concerned
8 with the internals there. Because not only do you
9 have ISEC, you can avoid swelling and embrittlement of
10 materials, and we need to -- we need to look at that
11 and some of the synergistic effects that occur, and
12 evaluate whether that's a concern or not.

13 Okay, and the approach is really we
14 general the fracture toughness, J-R curves and measure
15 crack growth rates on the materials that we have.
16 We've set a number of materials out and had them
17 irradiated. We've used the Halden reactor to
18 irradiate some of the materials. We've used the BOR-
19 60 reactor in order to irradiate some of the
20 materials, and then we get these materials back, and
21 then we subject to these tests.

22 Okay, I'll talk about N6818. This program
23 is, again, in its infancy. We've initiated the
24 contract with Argonne National Lab on this. It's set
25 up really to look at all the research that we've done

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 in the past, look at what the industry research has,
2 and identify where there are gaps in that information,
3 and where it would be important for us to do some type
4 of research or confirmatory research in those areas,
5 all right?

6 Omesh is the expert in the area, and we're
7 looking to get him to help us review the data and help
8 us generate our research plan going forward, okay?

9 We also set this contract up so that we
10 could use Argonne National Labs if we need additional
11 resources to help review some of the aging management
12 programs that the existing licensees are proposing for
13 --

14 MEMBER SHACK: Now, does 227 have a lot of
15 technical content, or that's really more a
16 programmatic thing?

17 MR. LUPOLD: 227 is the inspection and
18 evaluation guidelines for the internals. It doesn't
19 have a lot of technical content in it because it
20 refers to other documents, which contain that
21 technical information, and they draw from that in
22 order to make conclusions that these are the
23 inspections that should be done, etcetera.

24 There's a lot of technical basis. Not in
25 2007; they're in the other documents. Okay? That was

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 one of the problems that we had right now with
2 reviewing 227. Our first go-round of RAI's on that
3 was, "Can you give us all these other documents that
4 you refer to in this so that we can really do a proper
5 evaluation?"

6 Okay, let me talk about 6270. This is our
7 Halden environmentally assisted cracking program.
8 Now, we set these thing up. Y6279, what this really
9 is is a line item in our budget that we use in order
10 to fund the ongoing Halden reactor project, which has
11 been going on for many, many years, all right?

12 We participate along with many other
13 countries. The NRC is actually an original member in
14 this research program. We pay X dollars a year in
15 order to maintain membership with the reactor project.

16 The whole does much more than just materials, but the
17 area I'm interested in are the materials.

18 CHAIR ARMIJO: You provide part of the
19 funding, and then, let's say, fuels provides -- fuels
20 research provides part of the funding. Then there's
21 this man materials interface.

22 MR. LUPOLD: Digital, our INC groups.
23 There's pre-funding for that.

24 CHAIR ARMIJO: Pots of money go into the -
25 -

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LUPOLD: Right. So, in effect we
2 basically pay about \$1.3-1.4 million a year in order
3 to participate in all these different programs from
4 the Halden Research Project. We've gotten materials
5 from them to evaluate, and we've gotten information
6 from their programs, and we use that in our reports
7 and our evaluations.

8 MEMBER SHACK: Have you looked at ATR
9 these days? I've been told it's a much more
10 reasonable effort to deal with them now.

11 MR. LUPOLD: We've actually been talking
12 with them about the potential for irradiating some of
13 the materials. Matter of fact, the last batch of
14 materials that we sent over to Halden we considered
15 sending out to ATR for radiation. The problem was
16 there was a backlog with the ATR. They've got a lot
17 of people in line for radiations. So, the earliest we
18 would've been able to get the samples in there
19 would've been about 2010.

20 Okay, now, the ATR, the advantage with
21 them is they had such a high flux. They irradiate
22 materials much quicker than Halden. But if I can't
23 get in line to get them irradiated for a year-and-a-
24 half to two years, it kind of defeats the purpose.

25 Okay, now, the Zorita Internals Research

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 Project. If you look on your spreadsheets, this
2 number K6202 will probably say something like CIR2
3 extension. Again, CIR2 extension was a line item in
4 the budget, which we allocated money to. But what
5 we're spending it on is -- that's for Zorita.

6 All right, now Zorita is the name of a
7 reactor in Spain. It's the region in Spain, actually.

8 The actual reactor is the Jose Cabrera Nuclear Power
9 Plant. It shut down in 2006. They offered the
10 materials to CSNI, and there was an initiative started
11 through the -- was it the IEC? International ISEC
12 Cooperative Program. I can't remember what the
13 actually initials stand for off the top of my head.

14 The plan originally was that there would
15 be an industry group, and there would be a regulatory
16 group under this project. Each would pay half the
17 costs, and they would get materials that they could
18 test.

19 We tried to work with Spain. Spain and us,
20 we are the ones that are interested from the
21 regulatory side, and we're the only ones in the world
22 from the regulatory side that were willing to actually
23 put forth money on this effort in order to obtain
24 materials from Zorita.

25 Now, the industry is banking most of this

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 now. They have to to carry it through. They'll have
2 to pay a majority of the costs. We approached the IEC
3 recently, and proposed Spain and ourselves joining in
4 with the industry members, and becoming a member
5 ourselves.

6 We were willing to pay maybe 1.5 times
7 what every other member was. And so, it was both
8 Spain and ourselves. And they basically agreed to
9 that to allow us to join this program as basically a
10 partner with industry, and industry consists of
11 Westinghouse, EPRI, Mitsubishi Heavy Industries, and
12 there may be a few other ones there, but those three
13 are the real heavy hitters in the program.

14 And what we want to do is get materials.
15 The reason these materials are so much of interred to
16 us is they have a very, very high dose rate on them,
17 some of them, up to about 55 and 58 dpa on the baffle
18 wall.

19 So, we think that this information could
20 be very valuable in evaluation plants not only for
21 their current licensing, but in their extended
22 license, and possible even in the 60 to 80 year
23 license extensions also.

24 CHAIR ARMIJO: What kind of tests are
25 going to be performed on these things? Stress

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 corrosion tests, or what?

2 MR. LUPOLD: Well, there's a lot of --
3 most of them -- see, this is -- this is an interesting
4 area. This is another reason why we think we have to
5 be involved in this. Most of the tests that were
6 proposed by the industry were material property
7 changes. They were going to look for material
8 property changes and see how they changed; see how the
9 fracture toughness changed, things like that.

10 In the industry matrix, there was
11 absolutely no crack growth rate testing of any of
12 these materials, and we thought that was important
13 that you had that information such that if you ever do
14 develop a crack, then you can evaluate what the
15 effects of that crack are on some of these components.

16 All right, so we included that into our
17 matrix, and it was our intent to do that type testing.

18 And the industry said -- that was one of the I guess
19 conditions that industry placed on us to join this
20 that you can join in and become a member, but we want
21 you to pay for the crack growth rate testing since
22 you're the ones that want it.

23 So, again, this is -- this is an area
24 where I think it's important that we do research like
25 this because the industry really did not want to do

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 the crack growth rate tests which we really thought
2 were important.

3 MR. CSONTOS: And for my group, we're
4 looking at the reactor vessel deterrent to see about
5 late-blooming phase that may have irradiated more
6 afterward, and then do some more metallography and
7 fracture and mechanical property testing. And that's
8 something that -- we're working that new.

9 MR. LUPOLD: It's kind of like a side
10 thing with this project. We want to be able to get a
11 full thickness part of the vessel, see if we can do
12 it. I don't know if we're going to be able to do it,
13 but we keep planting that seed in the members' ears
14 that we want to do this.

15 MR. CSONTOS: There's I guess a larger
16 issue here, and that is it would be nice to start to
17 look at I think more -- you know, like the Saint Lucie
18 nozzles, and getting some more -- maybe with these
19 retired components, the components or even plants, as
20 to try to capture some more of these materials before
21 they get thrown away or disposed of in some way, and
22 do some more testing on them to fill in more data for
23 aging issues.

24 So, that's something that we're really --
25 other than the Saint Lucie and this project -- I'm not

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 really too familiar with -- and North Anna. I guess
2 North Anna was one of them. But again, for the
3 domestic stuff, we had a real issue with North Anna
4 because we really can't take ownership of it. And so,
5 there's still issues with that.

6 But anyway, the bottom line is I think
7 these are some of the areas that we'd probably like to
8 get a little bit more effort in to start capturing
9 some of these retired components, doing more testing
10 in it. I think you're starting to see a little bit of
11 that Zorita with the Saint Lucie/North Anna, and I
12 think that's something useful that you may want to --

13 CHAIR ARMIJO: That's a trend, do you
14 think?

15 MR. CSONTOS: I hope. I hope. I don't
16 know.

17 CHAIR ARMIJO: But you want it to?

18 MR. CSONTOS: That's what we're hoping,
19 yes.

20 MR. LUPOLD: Yes.

21 MR. CSONTOS: And that may be helpful if
22 the report --

23 CHAIR ARMIJO: Mentions that?

24 MR. LUPOLD: Again, when we send materials
25 out and we have them irradiated, some of the questions

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 that come up are, "Well, what is the spectrum of the
2 flux that was used to irradiate these things? And is
3 this representative of the spectrums that you're going
4 to see in an actual core?" And some of the test
5 reactors are much higher, higher energy neutrons, than
6 what you are going to see in the core, and I don't
7 think we can defensibly say --

8 MEMBER SHACK: I mean it would be nice if
9 in Zorita you could get low-fluence specimens of the
10 same materials that you could then take to a test
11 reactor because you're never going to get enough of
12 these retired -- I mean getting these materials and
13 making specimens out of them is a budget buster.

14 MR. CSONTOS: And that's what, actually
15 for my budget for this year, I think it's -- no, no,
16 for next year I got an extra \$1 million for the Saint
17 Lucie work, and that was -- I think that was above us
18 somehow provided that because of the Saint Lucie work
19 and seeing what effect that had for that quick, short-
20 term issue that we had, that someone saw that it was a
21 big deal.

22 So, that's the kind of funding that
23 hopefully we can take and use to get more materials
24 and do some of these testings. Anyway, like you said,
25 comparing real materials to --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MEMBER SHACK: We'd really like to be able
2 to know just how much you can rely on test reactor
3 radiations.

4 MR. CSONTOS: Exactly.

5 MEMBER SHACK: Because there sure are a
6 whole lot more --

7 MR. CSONTOS: Correlation work, right.

8 MEMBER SHACK: -- convenient.

9 MR. LUPOLD: They're easier to control.
10 You can irradiate your specimens to set levels, and
11 have much more knowledge.

12 MEMBER SHACK: You just have to be able to
13 believe the results. You need to know if they're
14 applicable to the actual power plants.

15 CHAIR ARMIJO: Speaking of test reactor,
16 if you go to back to the Halden thing.

17 MR. LUPOLD: Yes.

18 CHAIR ARMIJO: From the materials for EAC
19 work, what do you expect to be able to get out of the
20 Halden program that you aren't getting from Argonne,
21 or PNNL, or elsewhere? Is there some unique
22 experiment going on?

23 MR. LUPOLD: Well, I wrote some notes down
24 here. I'm not overly familiar with this program. I'm
25 not the expert in it. But let's see now. We have

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 some --

2 MR. CSONTOS: Carol could probably answer
3 some of that.

4 MR. LUPOLD: Yes.

5 CHAIR ARMIJO: They gave a presentation at
6 the RIC conference this year, and I sat in on it. I
7 was pretty impressed at the time, but I've since
8 forgotten.

9 MS. MOYER: I'm Carol Moyer, also in the
10 Corrosion Metallurgy Branch. I had some involvement in
11 this program a couple of years ago, and I do know that
12 Halden did some tests on material that was from a BOR-
13 60 reactor, and they did some work on other remove
14 from service materials.

15 MEMBER SHACK: French reactors, yes.

16 MS. MOYER: They did look at baffle bolts
17 and some pre-irradiated specimens, and then they --

18 CHAIR ARMIJO: But do they have the
19 capability to do in-reactor stress corrosion cracking.

20 MS. MOYER: They do. That's what's neat
21 about them is they have the ability to load specimens.

22 They have tiny little compact tension specimens that
23 are placed under load, and in environment, and under a
24 radiation all at the same time, which is something
25 that we cannot do at Argonne, and in PNNL facilities.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 CHAIR ARMIJO: Well, they could do crack
2 growth or crack nucleation work, stuff like that.

3 MS. MOYER: Nucleation, yes. Crack growth
4 rate: the specimens are small and the monitoring of
5 them is not as continuous as we get in the Argonne
6 lab.

7 MR. CSONTOS: Also, I don't think the
8 constraint is there as well.

9 CHAIR ARMIJO: Yes, yes.

10 MR. CSONTOS: So, it wouldn't be
11 applicable.

12 CHAIR ARMIJO: It's like a fracture
13 mechanic.

14 MR. LUPOLD: One of the big areas I think
15 we can get out of there I think is relaxation. That's
16 one of the areas we expect to get some information is
17 on the relaxation, like bolt relaxation. How much
18 relaxation do you get from different dose levels on
19 the materials?

20 CHAIR ARMIJO: So, if you were interested
21 let's say in the water from the water chemistry, zinc
22 effects on nucleation, you might do some tests at
23 Halden in reactor.

24 MR. LUPOLD: I don't know if we could
25 actually have zinc in the chemistry in the sample. We

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 might be able to irradiate it and then subject it to
2 tasks with the zinc chemistry.

3 CHAIR ARMIJO: They have these loops for -
4 -

5 MR. LUPOLD: You might not want to crap up
6 their loops. I'm not sure if they would let us do
7 that or not.

8 MR. CSONTOS: The reason -- the reason why
9 we don't do it right now in our autoclaves is because
10 the zinc will crap up the autoclave. I hate to use
11 that word, but it really will mess it up, yes. It
12 will -- it will play out into the autoclave material,
13 and cause some real problems in the future with water
14 chemistry control. So, if we have --

15 MEMBER SHACK: You'll forever have to live
16 with it.

17 MR. CSONTOS: Exactly. You'll forever
18 have to live with it. That's exactly it. And so, for
19 our guys, what they're saying is, "Well, if we're
20 going to do it, we're going to do it at the end of our
21 test matrix because we don't want to have our
22 autoclaves screwed up for the rest of eternity for the
23 rest of testing." Because autoclaves are expensive.

24 MR. LUPOLD: Or we will just designate one
25 autoclave, and then do all the testing on that one

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 autoclave.

2 MR. CSONTOS: Right, right.

3 CHAIR ARMIJO: Okay, do you have a write
4 up of the scope of the Halden experimental program for
5 materials?

6 MR. LUPOLD: I can get you one.

7 CHAIR ARMIJO: Yes, if you'd get me one.

8 MR. BROWN: You can send it to me.

9 MR. LUPOLD: Yes. And now I'll talk a
10 little about steam generator program. This again is a
11 long-term program. It's a five-year program. Charlie
12 Harris is the project manager on this particular
13 project.

14 This is a project conducted at Argonne
15 National Lab, and this is in response to User Need
16 Requests that we've received from our customers, and
17 it involves various things like wrapping up of some of
18 the severe accident work that has been done concerning
19 what happens to cracks in tube sheet region under
20 severe accident conditions.

21 We've seen some interesting facts from
22 severe accidents on that, how leak rates through the
23 tubes can change on that due to creep of some of these
24 tubes. We're looking at a number of things. We're
25 assessing the inspection techniques and reliability of

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 those techniques, the eddy current exams that were
2 done.

3 We're looking at the tube integrity, and
4 the predictions. Models have been developed in the
5 past for the Alloy 600 tubes, and it's our intent
6 under this project to update those to the new
7 materials that are being used for tubes in replacement
8 steam generators. We're also looking at the different
9 degradation modes in these.

10 Some of the things we're looking at here
11 are what kind of defects are actually occurring in the
12 tubes. A lot of the problems that you have with new
13 steam generators are associated with wear from foreign
14 materials. And some of the questions you have are,
15 "What happens if you have wear, and you have actually
16 a crack that occurs in that area?"

17 First off, you're going to ask yourself,
18 "Well, can I even see it if it occurs?" All right?
19 Because typically licensees will use bobbin probes.
20 They'll identify that they have a wear there, or some
21 indication there, and then they'll characterize it
22 greater with a rotating coil.

23 If they have a flat spot, are they going
24 to miss a potential flaw that might be created there
25 between when you first identified the wear spot in

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 future exams? You don't want a flaw to start to
2 develop, and then miss it every time you examine tube
3 from there on out.

4 We're also looking at some of the U-bends
5 now; our capabilities for finding flaws in those U-
6 bend areas, basically looking in different regions.
7 Ultimately, we're also going to start -- well, one of
8 the big -- one of the big activities I really need to
9 mention is our structural evaluations that we're
10 currently doing through steam generators.

11 There is a concern that if you have
12 circumferential flaws in the ones through steam
13 generators, and then you have an event that
14 effectively cools down the steam generator, these
15 flaws could potentially cause the tube to rupture.
16 That's the big area where we're doing research on
17 right now, concentrating our efforts.

18 Charlie, anything you want to say on the
19 scope? Any additional research that we're working on?

20 I guess one thing it is worthwhile saying is that
21 these data systems that the vendors use for any
22 current testing are changing. There's constantly new
23 versions coming out, and utilities are using --
24 licensees are using these automatic -- automated
25 evaluations systems more and more because it becomes -

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 - they're trying to cut down on the time it takes in
2 order to do these examinations.

3 And so, a lot of our effort goes into that
4 and into evaluating these new systems that come out.

5 MR. HARRIS: Charles Harris in the
6 Corrosion and Metallurgy Branch. As Tim was just
7 saying, the -- the NDE side in combination with some
8 of the defect areas he mentioned. The program is
9 looking at, for instance, any current signals in
10 combination at the tube sheet, and then maybe with a
11 foreign object present, what kind of signals can you
12 get there?

13 The automated systems currently in use,
14 NRC, we don't have a lot of information on how they
15 work. Computerized data screening has been in use for
16 a while, and now there's a new generation being
17 introduced, for example, by Z-tech. They have a new
18 product they all a RevoSPECT, which is an acronym for
19 revolutionary, I believe. Revolutionary Specialized
20 Eddy Current Testing.

21 This steam generator project, we've chosen
22 that as one of the automated analysis screening
23 systems that we want to evaluate independently of the
24 industry. And actually, we've recently seen some
25 questionable conflicting results from what industry

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 has told us.

2 CHAIR ARMIJO: These are in independent
3 tests that you've performed?

4 MR. HARRIS: At Argonne, yes.

5 MR. LUPOLD: Independent evaluations of
6 the software systems.

7 CHAIR ARMIJO: Using your own standards,
8 or defected tubes, or?

9 MR. HARRIS: We have samples, and we've
10 also obtained eddy current data from EPRI. So, we can
11 run all the -- for example, from -- EPRI will give us
12 complete set of eddy current data from a tube that has
13 come from a plant, and Argonne can screen that data
14 looking for indications automatically with the new
15 software.

16 CHAIR ARMIJO: So, it's software?

17 MR. LUPOLD: So, some of it -- some of it
18 is just an independent evaluation of the software, the
19 results that you get from the NDE. But there are
20 other instances where they will -- we'll take the
21 probes and collect the data from tubes with known
22 flaws in it, and run it through the software, and then
23 evaluate it versus the reality that we know in that
24 tube.

25 CHAIR ARMIJO: This software turns an eddy

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 current electrical signal into a defect size, shape,
2 or something like that?

3 MR. LUPOLD: Right, right. And like I
4 said, Charlie mentioned to me just the other day that
5 they were starting to find some problems where some of
6 the software may actually miss some defects somewhere.
7 Or, not evaluate them properly.

8 MR. HARRIS: We could say it's
9 revolutionary in the sense that this new software
10 screens through all the eddy current signals in the
11 whole entire length of the tube, eliminating the need
12 for an operator to screen through, supposedly to
13 alleviate fatigue. You're looking at signal for hours
14 on end.

15 MR. LUPOLD: Tedious tasks trying to
16 automate it.

17 MR. HARRIS: The question is --

18 CHAIR ARMIJO: Does it do it right?

19 MR. HARRIS: -- are you doing it right.
20 Exactly. Are you doing it right? Are you setting
21 your thresholds properly?

22 CHAIR ARMIJO: I imagine all of this is
23 very dependent on the quality of your -- your
24 standards, various defects for wear standards and
25 cracking standards?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. LUPOLD: Absolutely. Eddy current is
2 extremely dependent on having good standards in order
3 to calibrate your equipment with.

4 CHAIR ARMIJO: Yes.

5 MR. LUPOLD: If you don't have that, you
6 can do an eddy current examination, and you have no
7 idea exactly what conditions you have. I learned that
8 painfully one time. We were trying to examine a
9 component pulling heat exchanger tubes.

10 All right, well, the last thing I mention
11 there is other things we're doing in the U-bend region
12 is we're looking at leak rate and burst pressure
13 modeling of flaws in a U-bend area. That's a section
14 of the tube that we haven't looked at that in the
15 past. So, new areas.

16 All right, do you want to continue on?
17 The last one I have is really on the spent fuel
18 storage casks. We talked about that --

19 CHAIR ARMIJO: Might as well. You put it
20 together.

21 MR. LUPOLD: Okay. This is our project,
22 N6195. This is a project with Southwest Research
23 Institute, and again, it was initiated because of some
24 testing that the Japanese did, and we questioned
25 whether their testing approach was too harsh; whether

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 it caused what some people call a false positive test
2 here.

3 So, we initiate -- initially made some
4 samples, some U-bend samples, from a couple of
5 different types of stainless steel. We use 304, 304L,
6 316L, and we put them in a test chamber. The
7 specimens were heated, and we used the spray on these.

8 They get sprayed for a short period of time. Then
9 they would just heat back up.

10 The heaters were always on, maintaining
11 them at set temperatures. The temperatures we used on
12 these things were like 77 degrees Centigrade. We had
13 higher ones up to 200. Well, 77 degrees Fahrenheit,
14 I'm sorry. Two hundred degrees Fahrenheit, and 350
15 degrees Fahrenheit. Because some of these chambers
16 are canisters. They're designed to maintain skin
17 temperatures below 400 degrees.

18 MR. CSONTOS: With the aging of the fuel,
19 you don't know which -- each one could be different
20 temperatures.

21 CHAIR ARMIJO: Do you know if these casks
22 can get up to -- the cladding is limited to 400
23 Centigrade.

24 MR. CSONTOS: Right.

25 MR. LUPOLD: Centigrade, Centigrade.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 CHAIR ARMIJO: But on the surface of these
2 casks, you --

3 MR. LUPOLD: They could get -- they could
4 get as high as 400 degrees under designed conditions,
5 okay? That's why we selected a value close to that.

6 MR. CSONTOS: When I was in NMSS, you can
7 look at the surface of some of these, and the wells on
8 the top were -- you can see some distortion because of
9 that. I don't think they were heat treated
10 afterwards. I'm pretty sure they weren't heat treated
11 afterward.

12 All the design basis evaluations that NRC
13 did weren't around corrosion or cracking. It was all
14 based on drop tests, mechanical tests. I was at
15 Sandia watching drop tests for these types of
16 canisters to see if they could withstand the 30 feet
17 drop, and all these different drop tests. But in
18 terms of corrosion, this is where this is coming in is
19 now that we may be out there for a longer period of
20 time, aging these -- these cask storage units out
21 there aging the fuel and the waste, how long can we --
22 stainless steel corrosion or chlorides, stainless
23 steel, everybody -- we all knew -- when we first
24 started this program we went, "Okay."

25 We're going to tell you right now it's

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 most likely going to crack, but the issue there was,
2 "Okay, if we have salt forming on the surface; if we
3 have deliquescent brines form because that's where --
4 that's kind of the mechanism that we see. Not this
5 dripping of the -- of the salt solution. But if you
6 have a deliquescent brine from the surface, what level
7 of deliquescent brine?

8 What kind of combinations of brine? Is it
9 just potassium chloride? Is it sodium chloride? What
10 kind of brines could form there, and what would
11 happen? And so there's a whole aspect --

12 CHAIR ARMIJO: I wish Dana was here
13 because I would say that's a responsibility of the
14 cask manufacturer to qualify the component for salt
15 water or coastal --

16 MR. CSONTOS: If it's not part of Part 72
17 or 3. I can't remember which one it is, but that's
18 not part of the design requirements NRC has developed
19 yet.

20 MR. LUPOLD: See, this may lead into --
21 into future discussions with the industry when we
22 present our research results, and say, "Hey, we
23 subjected them to this. We've got cracking. We
24 changed the model, and we subjected them to this, and
25 we got cracking." Then we start to say, "We think we

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 have an issue here, and we think you need to do some
2 additional work here to prove why there is not a
3 problem."

4 CHAIR ARMIJO: I think you're doing a good
5 thing, but I would -- I'm surprised at the utilities
6 that are buying these things from some cask
7 manufacturer. Simply say, "Guys, qualify it."

8 MR. CSONTOS: Remember originally they
9 weren't going to be at the site for decades.

10 MR. LUPOLD: Right.

11 MR. CSONTOS: They were only going to be
12 onsite until Yucca Mountain could take them.

13 MR. LUPOLD: Exactly. And now, these
14 things are starting to get license extensions on them.
15 Originally, they were only licensed for 20 years.
16 Then they were getting 40-year license extensions, and
17 now people are talking about some of these canisters
18 being onsite for 100 years or something like that.
19 That's why we really need to look into this.

20 Now, one of the key arguments that the
21 licensees are going to say is that we have our casks
22 in -- called a mausoleum. Now, they're encased in a
23 concrete cover. We don't get direct chloride on top
24 of these, all right, and things like that.

25 So, that's probably our next evolution on

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 this is to try and see what the effect of having a
2 sheltered canister is versus a non-sheltered
3 cannister, and how much more does salt develop played
4 out on the surfaces for a sheltered canister, versus
5 one that's not sheltered.

6 CHAIR ARMIJO: It depends on the kind of
7 the shelter.

8 MR. LUPOLD: Right. And that may make a
9 huge amount of difference. Now, obviously all these -
10 - all these bunkers that they're installed in, there's
11 no direct line of site from the vents down to see
12 these canisters, and that's there because of a
13 radiation shielding hazard. All right, so the
14 question is really do you get a lot of salt buildup on
15 some of these canisters?

16 We know that we have salt buildup, and
17 then we have certain extremely high levels of humidity
18 in the air, absolute humidity, that it can lead to
19 some cracking. The latest results were you had to
20 have like 60 grams per cubic meter of humidity of
21 absolute humidity, moisture in the air.

22 If you look at the environmental data for
23 all the sites in the marine environments, they're not
24 going to get 60 grams per cubic meter. They're
25 probably going to be more in the area of 30 grams per

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 meter.

2 So, the question is in our -- in the
3 testing we just did, did we still make the conditions
4 in our attempt to accelerate it too hazardous or too
5 conservative, and made it unrealistic for the
6 conditions.

7 MR. CSONTOS: We were looking at types of
8 salt that could form early on. What's the relative
9 humidity that they would start to deliquesce at? And
10 then look at what the consequence would be. We came
11 out at the consequence was, well, they crack. But
12 then, they looked at it and said, "Let's see what the
13 realistic conditions would be at these locations."
14 And we think we may have been a little too
15 conservative.

16 This is where dropping water, salt water,
17 on stainless steel, chloride water, you're going to
18 get cracking. It's -- so we're going -- we're trying
19 to reduce that conservatism to somebody more
20 realistic, and that's what I think you're talking
21 about you're moving towards.

22 MR. LUPOLD: Right, exactly. So, really,
23 our next approach is, yes, we're just trying to become
24 -- we want to get a realistic test. We want it to be
25 accelerated tests. We're struggling with how do you

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 make it accelerated --

2 CHAIR ARMIJO: You don't want a 100 year
3 test.

4 MR. LUPOLD: -- without -- exactly. We
5 don't want a 100-year test. We want to accelerate it,
6 but we don't want to create the conditions such that
7 it's not realistic than in the environment --

8 CHAIR ARMIJO: Did any of these guys do
9 any of the techniques that were developed long ago?
10 Shot peening with compressive stresses on it so it
11 doesn't crack or anything like that?

12 MR. CSONTOS: This is something -- this is
13 something that we dealt with in Yucca Mountain quite a
14 bit. Deliquescing brines for localized corrosion, and
15 also the initiation of stress corrosion and cracks.
16 Okay, so you had pitting localized corrosion and
17 stress corrosion cracks. That's where the SFST guys
18 and the Yucca Mountain folks were closely related at
19 some points.

20 And so, we were talking about this, and
21 one of the things that I brought up was that there
22 were a lot of techniques that were identified during
23 the Yucca Mountain days to try to get away from this
24 one location where you could not relieve some of the
25 stresses globally was that end-cap weld. And this is

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 where the end-cap weld, for some of these canisters,
2 like I said, they're highly distorted.

3 So, there's all sorts of induction, shot-
4 peening, laser-peening that were identified as
5 potential techniques to try to relieve those -- those
6 tensile stresses on the OD of -- of the canister. To
7 my knowledge, we haven't heard anything yet from the
8 SFST guys because really, it's because the design
9 review never had corrosion at all. It was --
10 corrosion was never part of it. And so, now we're
11 looking at it.

12 MR. LUPOLD: So, that was the last real
13 major program that I had in my area. So, really, I
14 turn it back over to you for additional questions and
15 comments.

16 CHAIR ARMIJO: Bill, Jack, comments,
17 questions? I just had one question that's always
18 bothered me. In coming from the BWR side, because I
19 think the IGSCC problems clearly is the beginning of
20 all these things, then IASCC and all of that. And the
21 solution seemed to have been developed with better
22 materials when you're replacing with 316 nuclear
23 grade, and the water chemistry, which really I think
24 is -- takes a heart out of the IASCC problem. But do
25 we know that this problem is solved? And is -- the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 NRC's positions says, "Well, it's solved well enough
2 for now." And how would you -- could you do anymore
3 to say, "Hey, we really did solve this problem, and we
4 don't want anybody to run a BWR without hydrogen water
5 chemistry? We sure don't want anybody building a BWR
6 with 304 stainless steel."

7 As far as the NRC's concern is is the
8 IGSCC and IASCC and BWR's pretty much put to bed? I'm
9 a research guy. So, I'm not much of a regulator
10 because they probably won't --

11 MR. LUPOLD: I don't think it's completely
12 put to bed. It's something we're going to have to
13 look at under the PMMD program, and determine if
14 there's anything that needs to be done, particularly
15 when you start licensing these plants from 60 to 80
16 years. There could be some things that -- the thing
17 I run into that we have absolutely no idea on right at
18 this moment.

19 CHAIR ARMIJO: The reason I asked this is
20 a couple of years ago I wrote up something on the
21 research program, and in doing that, I came across a
22 couple of references of cracking of shrouds in Japan.

23 316 nuclear grade. I don't think they used hydrogen
24 water chemistry, but 316 nuclear grade was not
25 supposed to --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. CSONTOS: That is an issue, and EPRI
2 is looking into the core shroud issue quite heavily.
3 To my knowledge, we haven't really been approached by
4 NRR to look at this issue. That issue is such a big
5 deal in Japan that the deep-hole drilling technique
6 for residual stresses that Mitsubishi built an entire
7 core shroud from scratch to look at the welds, and to
8 see what the -- it's really the H5, and I think it's
9 the H4 welds on the core shroud. Those are cracking
10 quite a bit, and they're a little concerned -- they're
11 really concerned about it.

12 And so, we haven't really seen that from
13 NRR's side. I mean to my group. I've been seeing it
14 during -- when I go to conferences, and I see about it
15 and I talk to various regulators internationally, and
16 the core shroud issue is a big deal, especially in
17 Japan and in Korea. Mostly Japan.

18 But it is an issue, and I think they're
19 looking at different types of -- EPRI is looking at
20 this as well. That's why I put a little caveat on my
21 presentation about mitigation. I had surface
22 treatments. One of the things that they're talking
23 about are doing surface treatments on some of those
24 welds to reduce the cracking.

25 CHAIR ARMIJO: I think they did a bad

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 surface treatment. They ground the hell out of them,
2 and created nucleation sites. I mean the other
3 problem I saw was a 316. I think it was a piping in
4 Sweden. It was restrain weld or something that
5 failed, and maybe it was -- you know, but it was in
6 the piping system. It wasn't in the core. The shroud
7 was in the core, and it cracked, and maybe bad
8 fabrication, but I was surprised about the piping weld
9 in the Swedish reactor.

10 And so, I'm just saying is 316 nuclear
11 grade really all that we hoped it would be? Or, is it
12 just going to take a little bit longer?

13 MR. CSONTOS: It could just be that. We
14 just -- right now, it's not that we're -- in terms of
15 research, we haven't closed it off, but we also
16 haven't been asked to really -- it hasn't been a
17 regulatory issue that has come up yet for that to the
18 point where we are that engaged to spend dollars --

19 MEMBER SHACK: What is in the proactive
20 thing is the principal degradation.

21 MR. CSONTOS: Yes.

22 CHAIR ARMIJO: Through that, if in fact
23 it's actually happening, maybe not in US plants, maybe
24 not fabricated or operated the way we do, but it's out
25 there, and should be kind of do something to make sure

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 that we aren't going to be susceptible? I don't know.

2 MR. LUPOLD: We'll definitely need to
3 consider it.

4 CHAIR ARMIJO: Okay, we're wrapping up.
5 Dr. Powers came back. Do you have any comments? Do
6 you? Comments questions?

7 MEMBER POWERS: Well, I had started a
8 draft set of conclusion, and I have to admit I've only
9 gotten the first -- I've gotten more than two programs
10 here digested. And so, I will -- maybe I should work
11 further on this. Again, to my mind, the materials
12 metallurgy kind of research program is central to the
13 agency's mission in the coming years because it seems
14 like everything is cracking, corroding and degrading
15 in these plants as they get older.

16 I have always thought that the Materials
17 and Metallurgy Research Program had the best
18 coordination with the User Needs, and I've used it as
19 an example. I worry that you resting too much on your
20 laurels there, and encourage you to maintain that
21 leadership in that area with diligence.

22 I have just met with the research
23 director, and he assures me on no uncertain terms that
24 he's going to insist that you maintain your diligence
25 in that area. But I think you guys are in very good

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 shape on that.

2 If I were to point to a weakness in the
3 grand scheme of things, I think I would point in two
4 directions. One is it's not clear to me that you are
5 aggressively pursuing the opportunities to leverage
6 your programs by collaborations internationally. I
7 know that you certainly participated in international
8 meetings, and I know that in your programs you have
9 data exchanges and things.

10 I think that you can do more in leveraging
11 limited resources in those areas, and so it's worth
12 looking at because I think everybody is facing the
13 same problems you are. They may be lagging behind by
14 five years, but it's not ten they're lagging behind.

15 I think I do continue to worry that the
16 Proactive Materials Degradation Program has dropped
17 below my horizon, and I don't think it's living up to
18 its advertising in the past. And so, I worry a little
19 bit about that in the grand strategies of things.

20 Tim, I apologize that I didn't get to
21 understand your grand strategies of things. Al, I saw
22 more in yours, and I like your objective. I think
23 it's unfortunate that it's hidden; that I had to draw
24 it out of you to find out where it's going. I don't
25 know why that is, but I think you got the right grand

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 strategy.

2 It is -- it aligns with my word view, an I
3 am only one member of the ACRS. My world view and
4 \$2.50 will get you a cup of coffee at a cheap diner
5 now days, but I think yes, you want to be able to
6 establish an expertise in fracture mechanics in that
7 you can produce this tool that can routinely be used
8 by a non-specialist who evaluates systems for which
9 he's responsible.

10 I mean it just seems beautiful to me, and
11 what you have to do then I -- I think you need a
12 structure to make sure you're driving to that end some
13 metrics to see that you're driving that. Again, Tim,
14 I apologize I didn't get to go through yours, but it
15 may be that similarly when I go through the viewgraphs
16 I can understand better what's going on there.

17 But those are the things that have come to
18 my mind in listening to what is a crucial research
19 program for the NRC. I think it's natural for a
20 research programs review, but for your own benefit you
21 need to be a lot more capable of saying why we do
22 research in these areas, and why we cannot let the --
23 just wait for the industry to deliver things.

24 Yes, I would work on that language because
25 that question is being asked of me whenever I talk to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 the Commissioners about research in general. That
2 question, if it's not explicitly asked, is implicitly
3 asked. Now, some of those people who are the most
4 aggressive in asking that question are no longer a
5 part of the Commission, but you don't know what's
6 going to come to the Commission in five years from
7 now, and unfortunately your research program is such
8 that it's -- it is measures in decade scales and not
9 particular Commission scales.

10 At any rate, I toss those things out. As
11 far as the specific programs, I think we understand
12 what each one is trying to do. I don't think I need
13 to make specific comments on them.

14 CHAIR ARMIJO: One more time: Jack, you're
15 okay?

16 MEMBER SIEBER: Yes. It would've helped
17 me if I would've had an overall discussion of the
18 direction of things. "Here through the objectives
19 that we're trying to achieve, these are the groups or
20 programs that will get us there." That would've
21 helped me deal with the details. You know, the
22 hundreds of projects.

23 MEMBER POWERS: I think our research --

24 CHAIR ARMIJO: That's been the problem in
25 reviewing the materials because there's so many things

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 and so many fingers --

2 MEMBER POWERS: Little pieces.

3 CHAIR ARMIJO: -- all inter-woven.

4 MEMBER POWERS: Right.

5 CHAIR ARMIJO: Read one task, and then it
6 starts sounding much like another task that you just
7 read. And I understand why it's gotten that, but you
8 may --

9 MEMBER SIEBER: That's the way you
10 organize and assign the work, but it doesn't help the
11 --

12 CHAIR ARMIJO: Presentation understanding?

13 MEMBER SIEBER: -- casual reader
14 understand the overall direction of the various phases
15 of the program. If somebody can do that --

16 CHAIR ARMIJO: Well, we in fact -- Hossein
17 has made a first cut. Not just for materials, but for
18 all of the programs to try and put in an overall
19 structure. When it looks like we've got something,
20 we'll be bouncing that off of you guys to be sure it's
21 --

22 MEMBER SIEBER: The structure should
23 belong to them.

24 CHAIR ARMIJO: Well, maybe we would prefer
25 that you put it together.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MEMBER POWERS: I think it's also fair to
2 say that we're preparing this biennial report to the
3 Commission, but I mean what we want to do is
4 communicate accurately to the Commission about the
5 research program. And so, we're going to ask that you
6 help us in producing this thing.

7 MR. CSONTOS: Certainly.

8 MEMBER POWERS: And this is -- this is not
9 a grading exercise. This is a communication exercise,
10 and you will notice that on the web when that research
11 program -- when that research report comes out. And
12 so, you want to help us put the best foot forward --

13 MR. CSONTOS: Sure.

14 MEMBER POWERS: -- that we can on that.

15 CHAIR ARMIJO: Okay, Bill?

16 MEMBER SHACK: It's all music to my ears.
17 I like this stuff.

18 CHAIR ARMIJO: Okay, well, with that, I
19 want to thank everyone for this afternoon. It's been
20 very informative. A lot of material. Appreciate it.
21 And we will adjourn ten minutes ahead of schedule.

22 (Whereupon, the above-entitled matter went
23 off the record at 4:47 p.m.)
24
25

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

Materials Research Projects Presentation to the Advisory Committee on Reactor Safeguards

Aladar Csontos
Timothy Lupold
July 7, 2009

Overview

- Materials research conducted by two branches:
 - RES/DE/CIB: Component Integrity Branch
 - Fracture Mechanics, NDE, and Safety Assessments
 - RES/DE/CMB: Corrosion & Metallurgy Branch
 - Corrosion, Metallurgy, and Advanced Reactors
- Research related to needs of other NRC offices
 - Generally, through a User Need Request (UNR)
 - ACRS letter for residual stress research program
 - Staff Requirements Memorandum from Commission

RES/DE/CIB Research Programs



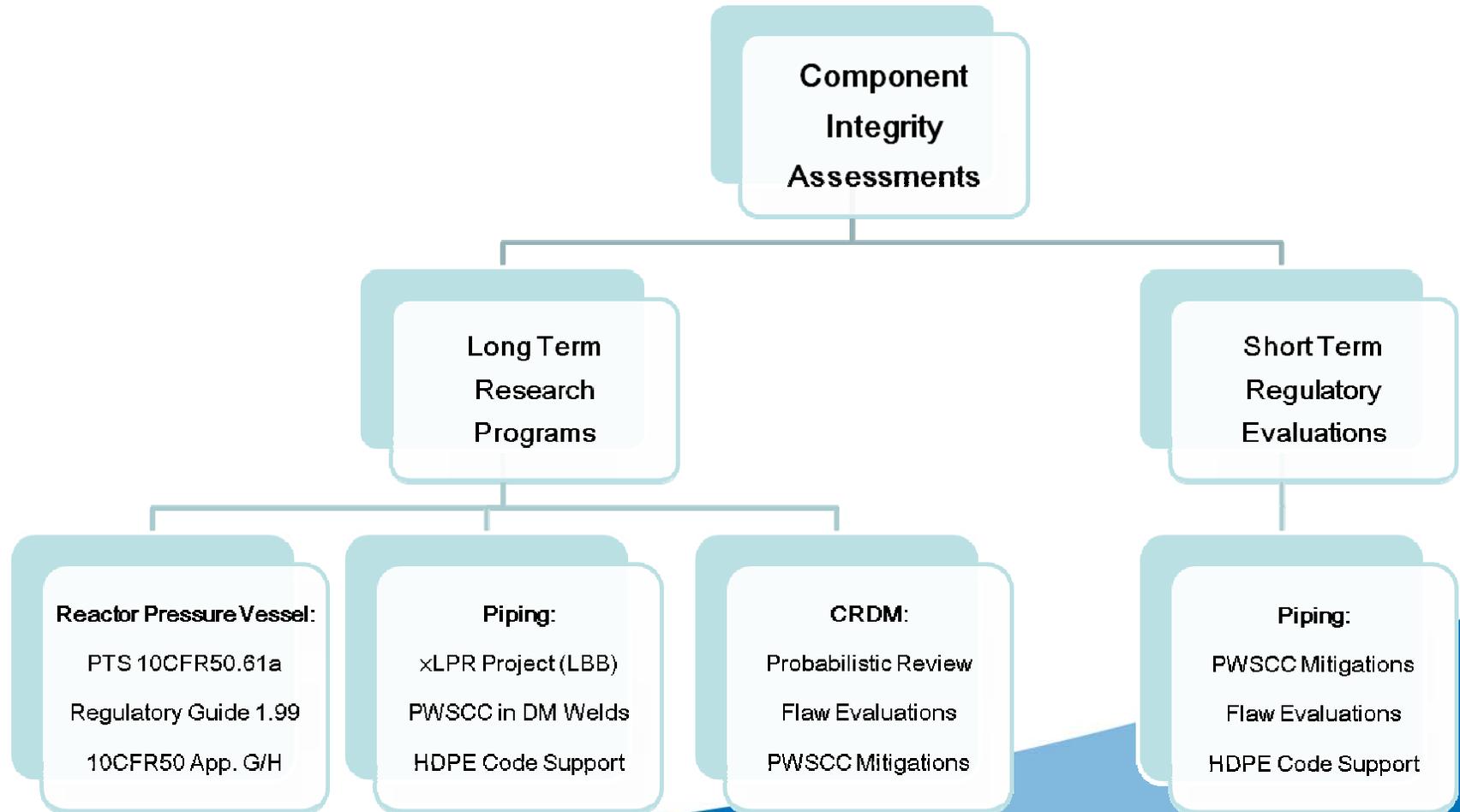
RES/DE/CIB: Overview

- Materials research supporting NRR:
 - Evaluating short/long term regulatory issues:
 - UNRs and expedited needs
 - ‘Ready to serve’ efforts include research
- Topical areas:
 - Component integrity assessments:
 - Piping/CRDM/Reactor pressure vessel
 - Probabilistic/deterministic fracture mechanics
 - PWSCC mitigation and residual stress validation
 - High Density Polyethylene (HDPE) piping research
 - Non-Destructive Evaluation (NDE):
 - Dissimilar metal welds and advanced techniques
 - HDPE piping

Topical Areas: Projects

- Component integrity assessments:
 - Dissimilar metal welds (piping and CRDM)
 - PWSCC mitigations, residual stresses, & xLPR
 - N6319/6433/6637/6547/6774/6360/6687/6829/6438
 - HDPE piping: failure mechanisms
 - N6637/6433
 - Reactor pressure vessel: fracture mechanics
 - N6578/6438
- NDE: Metallic and HDPE piping
 - N6398/6319/6593

Component Integrity Assessment Programs

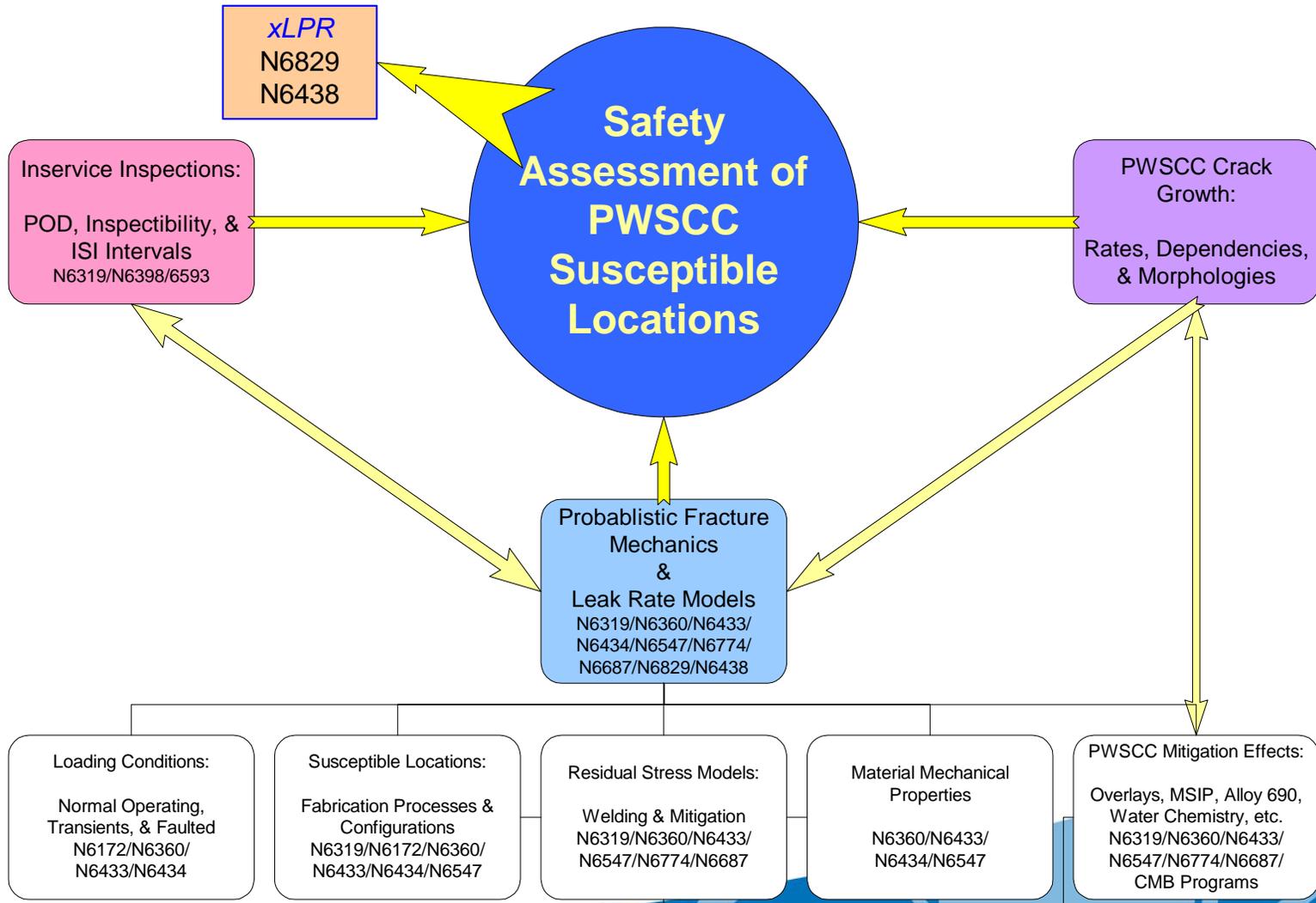


PWSCC Piping Research

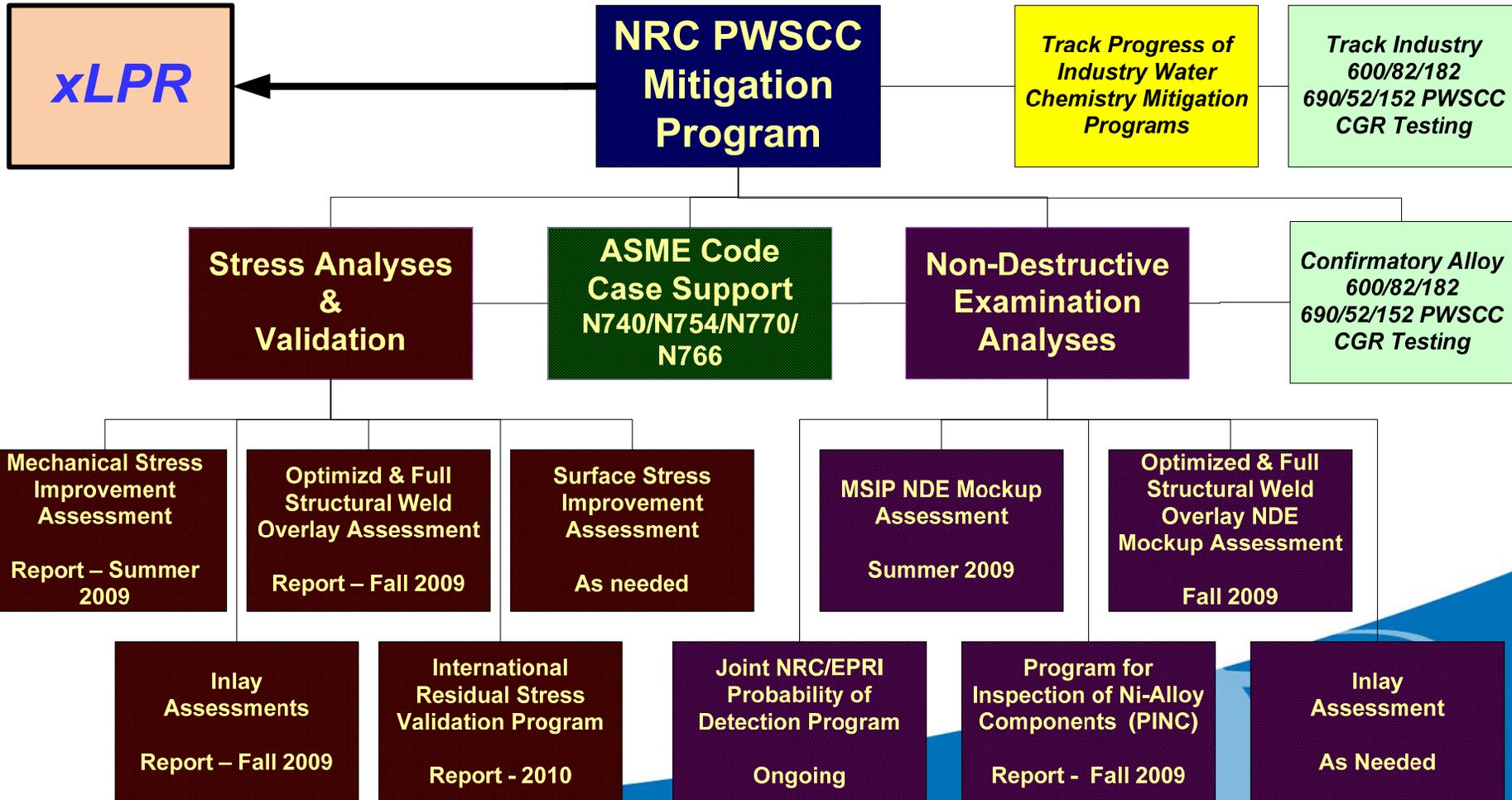


- Purpose:
 - Support NRR/NRO in considering appropriate regulatory requirements to address PWSCC in xLPR piping systems.
- Objectives:
 - Short Term (1-2 years):
 - Evaluate the near-term adequacy of industry's mitigation activities
 - Initial probabilistic fracture mechanics (PFM) pilot study
 - Long Term (3-5 years):
 - Complete and validate a regulatory PFM tool to assess xLPR in piping systems susceptible to active degradation mechanisms (PWSCC)
- Collaborations across key technical groups critical to developing the probabilistic xLPR tool
 - NDE, corrosion, fracture mechanics, fluid mechanics, metallurgy

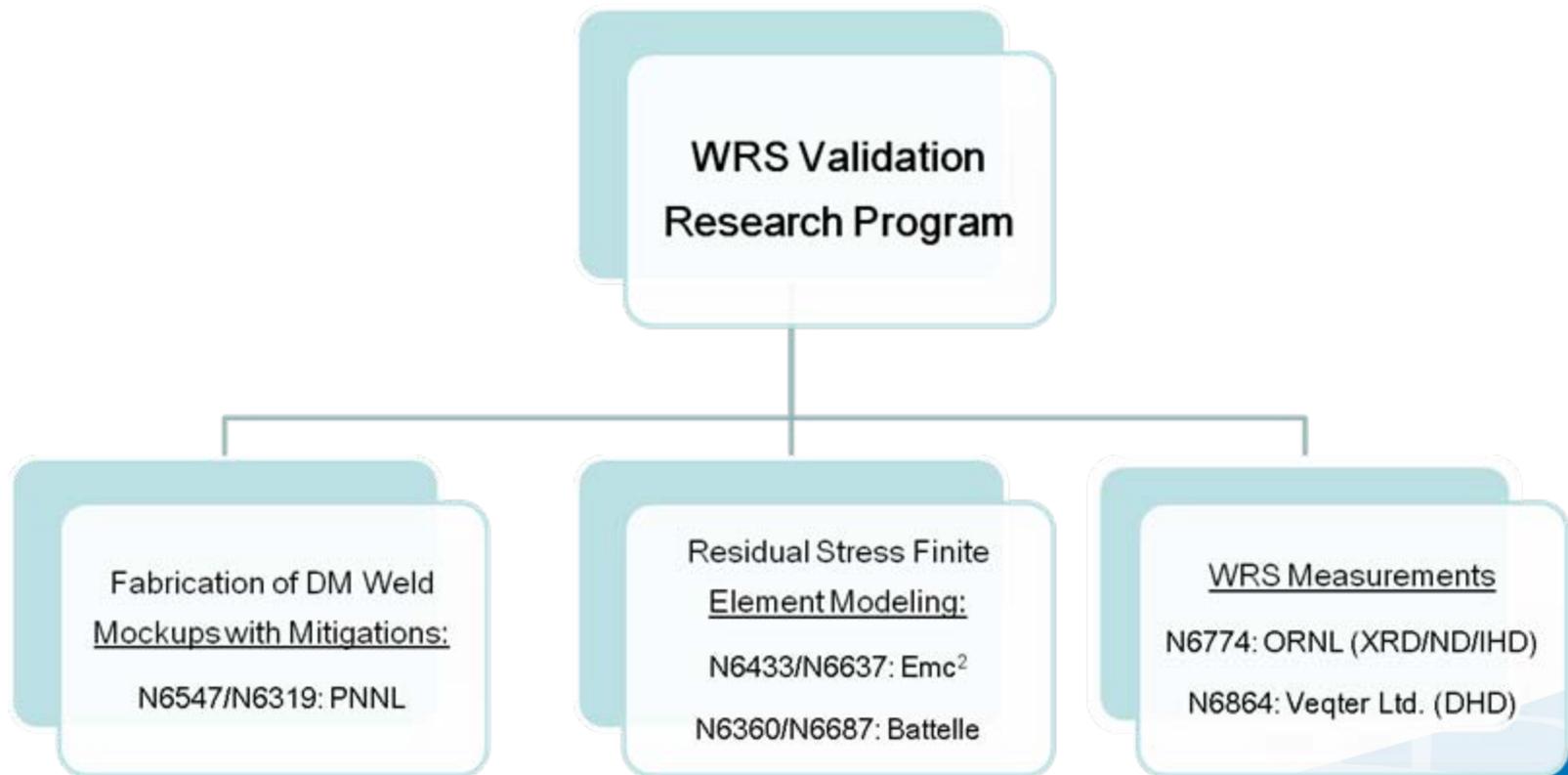
PWSCC Piping Research



PWSCC Piping Research



Piping WRS Validation Research Program



Phase I-IV Piping WRS Validation Research Program

- **Background:**
 - Component integrity analyses for PWSCC in DM welds showed that the results were highly dependent upon WRS profiles
 - ACRS letter dated 10/19/07 supported further WRS research
- **Purpose:**
 - Refine WRS FEA model development for 82/182 DM welds through sequential development from Phase I to IV
 - Develop reasonable assurance that WRS FEA models are defensible through a blind validation using well controlled mockups to various WRS measurement testing techniques
- **Expected Outcome:**
 - Blind validation of WRS FEA models using well controlled mockups focusing on through-wall axial & hoop stresses
 - Develop uncertainty distributions in WRS modeling

Phase I-IV Piping WRS Validation Research Program

- Phase I: EPRI Simple Plates & Cylinders
 - EPRI Lead: Mockup fabrication, WRS measurements, & project aims
 - Purpose: Refine WRS FEA model development by varying welding parameters and validate models to ND and DHD techniques
- Phase II: NRC PZR Mockups (Intn'l. WRS & FSWOL)
 - NRC Lead: Mockup fabrication, WRS measurements, & project aims
 - Purpose: Blind validation of mockups to XRD, ICHD, DHD, and ND
- Phase III: EPRI WNP III Safety & Relief PZR Components
 - EPRI Lead: Mockup fabrication, WRS measurements, & project aims
 - Purpose: Blind validation of real components to XRD, ICHD, and DHD
- Phase IV: EPRI WNP III Cold Leg OWOL Validation
 - EPRI Lead: Mockup/OWOL design and fabrication, WRS measurements, FEA modeling, and project direction and planning
 - Purpose: Blind validation of OWOL process to XRD, ICHD, and DHD

Specific Research Programs



N6360: Evaluation of Leak-Before-Break Criteria

- Vision:
 - Evaluate industry proposed PWSCC mitigation strategies of full structural weld overlay and mechanical stress improvement (MSIP) for current LBB systems to ensure that the probability of fluid system piping rupture remains extremely low
 - Benchmark and validate finite element models of residual stress profiles of representative DM welds with MSIP and weld overlay configurations
 - Quantify the changes in operational risk that PWSCC susceptibility creates for acceptability of LBB criteria as found in Appendix A of GDC-4
- Basis:
 - PWSCC has been determined to be the cause of in-service failures of nickel-based alloy DM welds and the source of limiting indications found in reactor coolant pressure boundary components
 - Supports UNRs NRR-2002-018, NRR-2002-020, NRR-2005-011, NRR-2006-006
- Execution: Estimated completion - FY2009
- Deliverables:
 - Technical letter reports on the effectiveness of full structural weld overlays and MSIP to mitigate PWSCC growth in DM welds
- Coordination: Battelle Lead with PNNL, Emc², EPRI, MRP

N6433: Component Integrity Analytical Support



- Vision:
 - Develop more realistic flaw evaluation tools and fracture mechanics models to assess the risk of failure and leakage caused by PWSCC of nickel-base alloys
 - Conduct initial studies into integrity issues for polyethylene piping materials
- Basis:
 - PWSCC has been determined to be the cause of in-service failures of nickel-based alloy DM welds and the source of limiting indications found in reactor coolant pressure boundary components
 - Supports UNRs NRR-2002-018, NRR-2002-020, NRR-2005-011, NRR-2006-006
 - Relief requests have been submitted by licensees that proposed the use of polyethylene piping for safety-related applications
 - Supports NRR-2006-007 for polyethylene piping
- Execution: Estimated completion - FY2009
- Deliverables:
 - Improved tools for performing fracture mechanics evaluations of DM welds, assessments of the risk of failure and leakage of DM welds due to PWSCC and preliminary assessments of the integrity of polyethylene piping
- Coordination: Emc² Lead with Battelle, PNNL, EPRI, MRP

N6687: Reactor Coolant Pressure Boundary Analyses

- Vision:
 - Provide flexible technical analyses to NRR to develop and/or confirm the technical bases for future regulatory decisions related to reactor coolant pressure boundary and LBB system integrity with PWSCC mitigation assessments
 - Benchmark and validate finite element models of residual stress profiles of Phases I-IV of the NRC/EPRI WRS research program
- Basis:
 - PWSCC has been determined to be the cause of in-service failures of nickel-based alloy DM welds and the source of limiting indications found in reactor coolant pressure boundary components
 - Supports UNRs NRR-2002-018, NRR-2002-020, NRR-2005-011, NRR-2006-006
- Execution: Estimated completion - FY2011
- Deliverables:
 - Technical letter reports on the effectiveness of optimized weld overlays and other mitigation methods to mitigate PWSCC growth in DM welds
 - Improved tools for performing fracture mechanics evaluations of DM welds, assessments of the risk of failure and leakage of DM welds due to PWSCC
- Coordination: Battelle Lead with PNNL, Emc², EPRI, MRP

N6637: Pressure Boundary Integrity Analyses & Support



- Vision:
 - Support ASME code case review and confirmation for nickel-base alloy fabrication and inspection, polyethylene piping structural integrity, flaw tolerance, joining and inspection and other ASME Code-related activities determined to be necessary to support NRC regulatory considerations
 - Perform fracture mechanics based flaw tolerance evaluations of RCPB components including nickel base alloy welds and polyethylene piping base materials and joints
 - Confirmation of 50 year service life of high density polyethylene piping material, including fusion joints, considering the effects of flaws on slow crack growth rate at elevated service temperatures

N6637: Pressure Boundary Integrity Analyses & Support

- Basis:
 - Supports UNRs NRR-2002-018, NRR-2005-011, NRR-2006-006
 - New issues arose from prior research to support NRR-2002-018 that were out of scope of the existing contract, hence, N6637 developed
 - Relief requests have been submitted by licensees that proposed the use of polyethylene piping for safety-related applications
 - Supports NRR-2006-007 for polyethylene piping
- Execution:
 - Current research efforts conducted under job code N6637
 - Prior research conducted under job codes N6363 and N6433
- Deliverable:
 - Expedited and ongoing ASME code case reviews
 - Technical letter reports on component integrity analyses and model assessments used to predict the service life of polyethylene piping
- Coordination:
 - Industry/Licensees/EPRI/MRP/ASME

N6547: Weld Residual Stress Validation

- Vision:
 - Develop reasonable assurance that WRS FEA models are defensible through a blind validation using well controlled mockups to various WRS measurements
- Basis:
 - Component integrity analyses for PWSCC in DMWs showed that the results were highly dependent upon WRS profiles
 - PWSCC has been determined to be the cause of in-service failures of nickel-based alloy DM welds and the source of limiting indications found in reactor coolant pressure boundary components
 - Supports UNRs NRR-2002-018, NRR-2002-020, NRR-2005-011, NRR-2006-006
- Execution: Estimated completion - FY2009
- Deliverables:
 - Technical letter report on available WRS measurement techniques
 - Design and fabrication of two mockups for international round robin tests
- Coordination: EPRI and over 20 international WRS modeling and measurement groups for international round robin study

N6774: WRS Measurements and Assessments

- Vision:
 - Develop reasonable assurance that WRS FEA models are defensible through a blind validation using well controlled mockups to various WRS measurements
- Basis:
 - Component integrity analyses for PWSCC in DMWs showed that the results were highly dependent upon WRS profiles
 - PWSCC has been determined to be the cause of in-service failures of nickel-based alloy DM welds and the source of limiting indications found in reactor coolant pressure boundary components
 - Supports UNRs NRR-2002-018, NRR-2002-020, NRR-2005-011, NRR-2006-006
- Execution: Estimated completion - FY2010
- Deliverables:
 - WRS Measurements using the following techniques: X-ray diffraction, neutron diffraction, and incremental hole drilling for Phases II-IV of the WRS program
 - Provide website for international round robin uploads and downloads
 - Technical letter report on results of the international round robin study
- Coordination: EPRI and over 20 international WRS modeling and measurement groups for international round robin study

N6864: Deep Hole Drilling WRS Measurements

- Vision:
 - Develop reasonable assurance that WRS FEA models are defensible through a blind validation using well controlled mockups to various WRS measurements
- Basis:
 - Component integrity analyses for PWSCC in DMWs showed that the results were highly dependent upon WRS profiles
 - PWSCC has been determined to be the cause of in-service failures of nickel-based alloy DM welds and the source of limiting indications found in reactor coolant pressure boundary components
 - Supports UNRs NRR-2002-018, NRR-2002-020, NRR-2005-011, NRR-2006-006
- Execution: Estimated completion - FY2010
- Deliverables:
 - Through-wall WRS measurements using the proprietary Deep Hole Drilling technique for Phases II-IV of the NRC WRS program
 - Technical letter report on results of the measurements
- Coordination: EPRI and over 20 international WRS modeling and measurement groups for international round robin study

N6438: Probabilistic Pressure Boundary Safety Assessment

- Vision:
 - Develop more realistic flaw evaluation tools and fracture mechanics models to assess the risk of failure for reactor pressure vessels through validating and benchmarking physically-based material models and generic analysis methodologies to provide more robust prediction and assessment tools than current-day design-specific empirical and experimental approaches
- Basis:
 - Develop the technical bases for currently-identified RPV integrity needs:
 - Plant-specific PTS analysis guidance (Regulatory Guide 1.154)
 - Heat up and cool down limits (10CFR50 Appendix G)
 - Surveillance requirements (10CFR50 Appendix H)
 - Embrittlement trend prediction (Regulatory Guide 1.99)
 - MODULAR probabilistic code for structural integrity assessments
 - Supports UNR NRR-2007-001
- Execution: Estimated completion - FY2013

N6438: Probabilistic Pressure Boundary Safety Assessment

- Deliverables: Data, analyses, and reports for
 - Regulatory Guide 1.154 & 1.99
 - 10CFR50 Appendix G & H
 - Current embrittlement trends for 40+ & 60+ years
 - Modular code for component integrity assessment of structures
- Coordination:
 - EC Projects
 - PERFORM-60: Computational platform to project embrittlement & assess structural integrity to 60 years
 - STYLE: Assessment protocols for non-RPV components (e.g., piping)
 - PC-1: High fluence and flux effects on embrittlement
 - IAEA Projects
 - CRP-8: Master curve
 - CRP-9: PTS

N6578: Pressure Boundary Materials

- Vision:
 - Develop and validate predictive material property models aimed at the continued development, refinement, and generalization of structural integrity assessments
 - These models aim to ensure that NRC staff have tools to independently assess licensee submittals and to maintain the safety of the operating fleet by ensuring that all active embrittlement mechanisms and potential failure modes are appropriately accounted for
- Basis:
 - Accurate prediction of RPV structural integrity relies on data and models that describe the mechanical behavior of RPV materials across a spectrum of loading rate and temperature conditions, and how this behavior is influenced by the effects of neutron irradiation.
 - In recent years, trends across a wide variety of ferritic steels are now sufficiently well accepted that they are used in the probabilistic fracture mechanics computer codes as part of its risk-informed development of regulatory products. Nevertheless, certain datasets need to be developed to confirm the predictions made and the models that have been developed based on amalgam of smaller datasets, and to quantify and refine the scatter/uncertainty characterization adopted by current models. Because failure is usually predicted by probabilistic fracture mechanics models in the tails of toughness distributions, these models aid in reducing the uncertainty in failure predictions made by PFM computer codes
 - Supports UNR NRR-2007-001

N6578: Pressure Boundary Materials

- Execution: Estimated completion - FY2014
- Deliverable: Technical letter reports detailing the following items:
 - Heat treatment, metallurgical conditions, cleavage crack initiation and arrest toughness, ductile fracture toughness, and Charpy V-notch energy characterization of low and high transition temperature material
 - Design, analysis, and test results from an improved crack arrest specimen
 - Effect of prior hardening on the plastic flow and T_0 properties of ferritic material
 - Cleavage crack initiation (K_{Jc}) characterization of the low and high transition temperature material using shallow crack specimens
 - Effect of elevated loading rate on fracture toughness characterization of the low and high transition temperature material
- Coordination: Carderock is the Lead with ORNL, Naval Air Systems Command, and various university and research organizations involved in fracture mechanics

N6319: PWSCC in Leak-Before-Break (LBB) Systems

- Vision:
 - Develop strategies for managing PWSCC in LBB systems to ensure that the probability of fluid system piping rupture remains extremely low (GDC-4)
 - Assess POD in DM welds through collaboration with EPRI PDI
 - Determine ability to detect existing cracks in post-MSIP and overlaid welds
- Basis:
 - PWSCC has been determined to be the cause of in-service failures of nickel-based alloy dissimilar metal (DM) welds and the source of limiting indications found in reactor coolant pressure boundary components
 - Supports UNRs NRR-2002-018, NRR-2002-020, NRR-2005-011, NRR-2006-006
- Execution: Estimated completion - FY2010
- Deliverables: Technical letter reports:
 - Overall PWSCC management strategy
 - NDE effectiveness of PWSCC mitigations
 - Reliability of NDE to detect PWSCC flaws in DM welds (POD curves)
 - Fabrication of Overlay and MSIP Mitigation NDE/WRS mockups
- Coordination: PNNL Lead with EPRI, MRP, Battelle, Emc²

N6593: Assess Emerging NDE For DM Welds

- **Vision:**
 - Provide data and correlations necessary for NRC staff to independently evaluate licensee ISI programs for assessing integrity of DM welds
 - Evaluate current and emerging NDE techniques that licensees may be planning to apply for ISI of passive components.
 - Review and analyze results from the initial international Program for Inspection of Nickel Alloy Components (PINC) Round Robin Testing
 - Establish extended international collaborative partnerships (PINC II)
 - Expand upon the “Atlas” information tool from PINC
 - Use Results to Assess Current ISI Inspection and Acceptance Criteria Specified in ASME BPV Code Section XI
- **Basis:**
 - International PINC program with 7 participants was successful in addressing the effectiveness of some NDE techniques at finding PWSCC cracks in Alloy 600 and 82/182 components, i.e. particularly bottom mounted instrumentation penetration tubes and DM welds
 - PINC ended in FY09 with some issues unresolved
 - Supports UNR NRR-2006-006

N6593: Assess Emerging NDE For DM Welds

- Basis (continued):
 - PINC II or **P**rogram to **A**ssess **R**eliability of **E**merging **N**ondestructive **T**echniques for DM welds (PARENT) will focus on tight cracks, including PWSCC and hot cracks in welds in piping and in other components
 - PINC II or PARENT program (~10 participants) is designed to address some of the issues remaining from PINC and to look forward to new challenges for emerging NDE technologies
 - Supports UNR NRR-2006-006
- Execution: Estimated completion - FY2013
- Deliverables: Technical letter reports on the following:
 - Large-diameter inside-surface DM NDE techniques
 - Evaluate new techniques for rapid-growth degradation mechanisms
 - Atlas database tool with PWSCC crack morphology and corresponding NDE results, developed under the PINC program, will be reviewed, applied and extended to support NRC inspectors for ISI
 - NDE test results from mockups containing representative simulated and fabrication flaws
- Coordination: PNNL Lead with ~10 international participants

N6398: Reliability of NDE for NPP Inservice Inspection

- Vision:
 - Evaluate accuracy and reliability of NDE methods used for ISI
 - Provide info to assess adequacy of proposed industry changes to ISI programs
 - Evaluate effectiveness of ISI techniques for detecting service degradation, e.g.:
 - PWSCC in Alloy 600, 82, 182 DM welds and J-groove penetrations
 - IGSCC in austenitic welds
 - Potential degradation in cast stainless steel and weldments
 - High density polyethylene piping (HDPE)
 - Weld overlays/cladding/in-lays
 - Reactor internal examinations
 - Vessel Penetrations (CRDM and BMI nozzles)
 - Provide technical assistance to NRC program offices on as-needed basis
- Basis:
 - PWSCC has been determined to be the cause of in-service failures of nickel alloy DM welds and the source of limiting indications found in reactor coolant pressure boundary components
 - Relief requests submitted by licensees for use of HDPE piping for safety-related applications

N6398: Reliability of NDE for NPP Inservice Inspection

- Basis (continued):
 - Supports NRR UNRs:
 - Metallic Piping: NRR-2002-018, NRR-2002-020, NRR-2005-011, NRR-2006-006, NRR-2006-012
 - Polyethylene Piping: NRR-2006-007
 - Vessels: NRR-2006-012
- Execution: Estimated completion - FY2012
- Deliverables: NUREG/CRs and technical letter reports on the effectiveness of ISI techniques for detecting service degradation, e.g.:
 - PWSCC in Alloy 600, 82, 182 DM welds and J-groove penetrations
 - IGSCC in austenitic welds
 - Potential degradation in cast stainless steel and weldments
 - HDPE piping
 - Weld overlays/cladding/in-lays
 - Reactor internal examinations
 - Vessel Penetrations (CRDM and BMI nozzles)
- Coordination: PNNL Lead with EPRI, MRP, IRSN through MOU

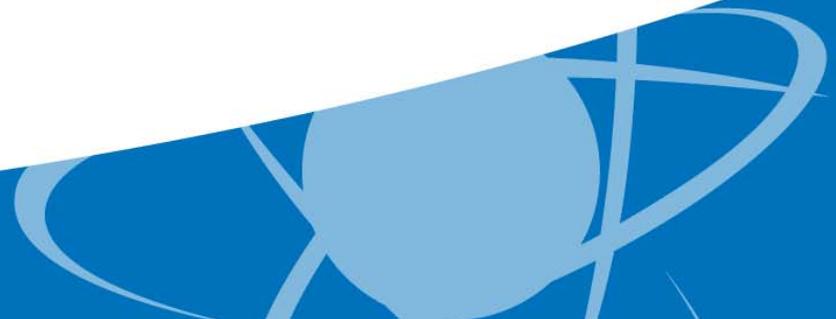
RES/DE/CMB Research Programs



RES/DE/CMB: Overview

- Materials research supporting NRR:
 - Evaluating short/long term regulatory issues:
 - UNRs and expedited needs
 - ‘Ready to serve’ efforts include research
- Topical areas:
 - Pro-active Management of Materials Degradation
 - Corrosion/Metallurgy:
 - Environmentally Assisted Corrosion
 - Primary Water Stress Corrosion Cracking
 - Stress Corrosion Cracking of Stainless Steel in Marine Environments
 - Steam Generator Tube Integrity

Proactive Management of Materials Degradation



Pro-active Management of Material Degradation (PMMD) – N6029



- The objective of this program is to provide technical support to NRC staff in developing information regarding materials degradation mechanisms, inspection or monitoring, and behavior of materials. The goal is to proactively address potential future degradation in operating plants to avoid failures and to maintain integrity and safety. This work will become part of the activities of an international cooperative research group whose function will be to conduct research that is needed and share the results for implementation of programs to proactively manage materials degradation. The information developed will provide NRC a foundation to implement appropriate regulatory actions to keep materials degradation from adversely impacting safety and to evaluate licensee's programs for the proactive management of materials degradation.
- The research is to:
 - Develop a master program for the proactive management of materials degradation
 - Establish international collaborative partnerships
 - Expand upon the information tool that started under JCN N6019
 - Identify research needed to address/establish a level of understanding of the degradation processes to ensure the ability to proactively manage degradation

Pro-active Management of Material Degradation (PMMD) - Basis

- Degradation of materials in certain nuclear reactor components progressed to the point where the reactor pressure boundary and defense-in-depth features were compromised.
- Many plants are also applying for increases in power rating.
 - could increase the likelihood of materials degradation and underline the interest in proactive management.
- The majority of the U.S. reactor fleet is applying for license renewal to extend the operating life from the current 40 years to 60 years, and there is now active interest in extending the operating life to beyond 60 years.
- Material degradation processes from known and emerging mechanisms and those previously experienced probably will continue to affect susceptible plant components and may increase in occurrence as the operating fleet of reactors continues to age.
 - With aging nuclear power plants, degradation that was not an issue during the initial years of operation may become an important process during later operation.

Pro-active Management of Material Degradation (PMMD) - Approach

- Establish a refined plan
- Establish international collaboration
- Target items of low knowledge and high/medium susceptibility to degradation
- Create an information tool



Environmentally Assisted Cracking



SCC of Alloys 690/52/152 N6782

- The objective of this program is to obtain crack growth rate data for Ni-base alloys, with emphasis on those with higher Cr content, specifically Alloy 690 and its matching weld fillers Alloy 152, Alloy 52, and Alloy EN 52H. These alloys are likely replacements for Alloys 600/82 /182. Alloy 690 and its weld metals have been reported by industry to be resistant to SCC.
- In order to accomplish this objective, autoclave systems in suitable load frames and the associated water supply, conditioning and pressurization subsystems will be operated reliably.
 - These autoclave systems will allow testing under simulated and/or accelerated (e.g., increased temperature, more aggressive environments, increased load range or load interaction effects) PWR and BWR conditions.
 - Direct current electric potential drop (dcpd) methods will be used to acquire crack extension data, and effective reference electrodes will be used to acquire corrosion potential data.
 - The systems will be capable of both dynamic and static loading with load control to better than 1%.

SCC of Alloys 690/52/152 Basis

- Primary water stress corrosion cracking (PWSCC) in nickel-base alloy primary pressure boundary components is a significant safety concern due to the potential for reactor pressure boundary leaks and the associated potential of boric acid corrosion of low alloy steels and the development of flaws in piping or welds. Either condition, depending on the size and location of the flaws, could result in a significant loss of coolant accident. The use of Alloy 690 and associated weld metals, Alloy 52 and 152 have been reported by industry to be resistant to PWSCC. Although the issue of PWSCC susceptibility is being addressed by industry, user need request NRR-2006-006 specifically identifies the need to obtain PWSCC growth rates of these resistant alloys to determine the validity and acceptability of licensee flaw analyses, and to support regulatory inspection requirements.



SCC of Alloys 690/52/152 - Approach

- Stress-corrosion, CGR systems designed specifically for testing in high-temperature, simulated LWR coolant will be used.
- SCC behavior of Ni base alloys in PWR primary water will be evaluated.
- Each CGR test system will be able to test two samples (0.5T to 1T compact tension) simultaneously at temperatures up to 360° C.
- The autoclaves and the water make-up system will effectively simulate high-purity BWR and PWR water as well as control levels of oxygen, hydrogen and selected impurities.
- The systems will have active dcpd for crack-length measurement and load/K-control plus in-situ measurement capability for temperature and electrochemical potential (ECP).
- The hydrogen over pressure will be varied to evaluate the effect of ECP on crack growth rates.
- At least one CGR system will be capable of testing metallic alloys with low activity levels.

Properties of CRDM Welds – N6783

- The objective of this program is to conduct nondestructive testing, metallurgical evaluations, leak path assessment, mechanical tests, and crack growth rate tests on CRDM nozzles and nozzle welds using material that has been in service.
- Materials examined will include Nozzle 63 from North Anna Unit-2. Material from Davis Besse Nozzle 1 may also be examined.
 - Test specimens will be obtained with orientations and geometries that allow the characterization of the Alloy 600 CRDM nozzle materials and the Alloy 82/182 J-groove weld and butter.
 - Information from mechanical tests will be used to obtain yield and tensile strengths necessary to establish conditions for crack growth rate tests.
 - The results for the crack growth rate measurements will be compared to data for Alloys 600 and Alloys 82/182 obtained from a variety of specimens including the previously tested material from Davis-Besse and V.C. Summer.

Properties of CRDM Welds – Basis

- More than 30 head replacements have occurred at operating PWRs, however, only a limited number of materials that have actually been in service are available for characterization and testing. In the 2001 refueling outage, some of the North Anna Unit-2 nozzles were repaired using Alloy 52/152 including nozzles 63 and 51. In the 2002 refueling outage, 63 of 65 J-groove welds had indications and 42 of these welds would require repair. At that time, the utility decided to replace the reactor head. Previously, EPRI sponsored the removal and analysis of several nozzles. Nozzle 63 is available to the NRC to conduct independent tests. Some prior characterization of Nozzle 63 has been performed including visual examinations, a volumetric leak path assessment and surface examination of the J-groove welds that identified axial indications.



Properties of CRDM Welds – Approach

- Non destructive examination of the nozzles will be conducted to the requirements of 10 CFR 50.55a(g)(6)(ii)(D) to determine the as-left condition of the nozzle and welds to position and size indications, as well as perform a volumetric leak path assessment.
- The results of the non destructive evaluation should be compared to the previous examination results as well as identify regions where specimens will be extracted for additional analyses.
- After the nozzle has been removed from the low alloy steel head material, a visual inspection should be conducted of the low alloy steel head surface in the leak path area defined by information obtained from the current and previous volumetric leak path assessments.
- Remaining material will be used to obtain samples for metallurgical analyses, mechanical test specimens and crack growth rate specimens using specimens machined from the Alloy 600 CRDM nozzle material, and the Alloy 82/182 J-groove weld and butter.
- Crack growth rates will be compared to published data for previous laboratory tests as well as data obtained from the testing of the Davis-Besse and V.C. Summer materials.

Environmentally Assisted Cracking (EAC) – N6519

- The objective of this project are to:
 - evaluate the susceptibility of austenitic SS to irradiation-assisted stress-corrosion cracking (IASCC) in BWRs as a function of the fluence level, material chemistry, welding process, fabrication history, and water chemistry.
 - evaluate the susceptibility of austenitic SS core internals to IASCC in pressurized water reactors (PWRs) as a function of the fluence, water chemistry, material chemistry, and cold-work. At this time, the database and mechanistic understanding of IASCC under the PWR conditions of higher temperature and higher fluence are very limited.
 - provide the NRC with technical data and analytical methods on the cracking of nickel-alloy components and welds necessary to independently estimate CGRs in reactor components for regulatory determinations of residual life, inspection intervals, repair criteria, and effective countermeasures for reactor internal components.

Environmentally Assisted Cracking (EAC) – Basis

- Neutron radiation embrittlement of reactor core internal components constructed of cast SSs is considered significant if the neutron fluence is greater than 1×10^{17} n/cm² ($E > 1$ MeV). This conservative value for the threshold fluence has been proposed for cast SS internals because the possible synergistic effects of neutron radiation and thermal embrittlement are not known.
- For cast SSs with duplex austenite/ferrite structure, a loss of fracture toughness can occur due to three processes: (a) thermal embrittlement of ferrite, (b) radiation embrittlement of ferrite, and (c) radiation embrittlement of austenite.
- The kinetics of thermal embrittlement is well known and the kinetics of radiation embrittlement may be estimated based on vessel embrittlement data. However, concurrent exposure to high temperature and neutron fluence could result in a synergistic effect that leads to more rapid embrittlement than would be expected for either of the two processes individually.
- Nickel alloys, including Alloy 600, Alloy 690, and Alloy X-750 and welds using other nickel-base alloys (weld metals 82/182 and 52/152) appear to be susceptible to primary water stress-corrosion cracking (PWSCC) to varying degrees. Evaluations are needed of the time to form axial and circumferential cracks and the CGRs in such components and their welds under applicable service conditions.

Environmentally Assisted Cracking (EAC) – Approach

- Crack growth and fracture toughness J-R curve tests will be performed on SS base metal and weld heat affected zone (HAZ) material to further establish the effects of fluence level, material chemistry, thermal treatment, and welding process on IASCC.
- Models and codes developed under CIR-II and from industry sources will be benchmarked and used in conjunction with this work.
- Slow-strain-rate-tensile, CGR, and fracture toughness J-R curve tests will be conducted on austenitic SSs that have accumulated fluences typical of PWR components.
- CGR tests will be performed on a few compositions of thermally treated Alloy 690 and Alloy 152 weld, including the Alloy 690 HAZ material from Alloy 690/152 weld.
- Also, tensile property data will be obtained on thermally treated Alloy 690 and Alloy 152 weld metal at temperatures from room temperature up to 870° C.
- Furthermore, the possible deterioration of mechanical properties of low-alloy steel HAZ region will also be investigated.

Environmentally Assisted Cracking – Reactor Internals – N6818



- While the objective of the Environmentally Assisted Cracking (EAC) program at a global level is to address the regulatory concerns arising from irradiation induced materials issues and assure structural and functional integrity of reactor core internals, the objective of this supporting project is:
 - to assist in development of a research plan following a thorough review of the available literature based on the research performed by the NRC and the industry, and
 - to review the MRP 227/175 and the PWR Internals AMP and provide a detailed analysis projecting the gaps that must be addressed in both the MRP and AMP documents prepared by the Industry.

Environmentally Assisted Cracking – Reactor Internals – Basis

- Austenitic stainless steels (SSs) are used extensively as structural members in the internal components of light water reactor (LWR) pressure vessels because of their relatively high strength, ductility, and fracture toughness. However, exposure to neutron irradiation for extended periods changes the microstructure (radiation hardening) and microchemistry (radiation-induced segregation or RIS) of these. Irradiation leads to significant increase in yield strength and loss of ductility, degradation of fracture toughness, radiation embrittlement, susceptibility to irradiation assisted stress corrosion cracking (IASCC), void swelling, and radiation creep relaxation.
- The major concern regarding the structural and functional integrity of core internal components is IASCC of austenitic SSs. In addition, although radiation embrittlement has not been considered in the design of LWR core internal components constructed of austenitic SSs, it has become an important consideration in ensuring that adequate structural integrity exists over the license renewal period. Another issue related to high neutron exposures that are relevant for PWRs is void swelling, and its effect on fracture toughness.



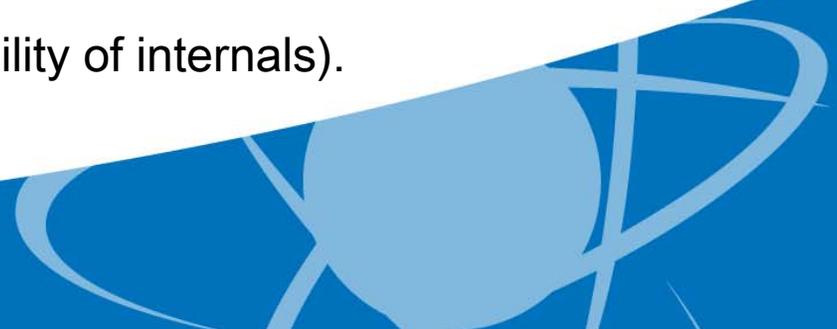
Environmentally Assisted Cracking – Reactor Internals – Approach



- Document the important conclusions from earlier studies that identify (i) the materials and environmental conditions that lead to significant effect of neutron irradiation, (ii) establishment of the crack growth rates (CGR) for core internal materials (iii) the potential of radiation embrittlement under BWR and PWR operating condition including the synergetic effects of thermal and neutron embrittlement of cast SS, (iv) the effects of void swelling including its effect on fracture toughness and (v) the effectiveness of the methods proposed by industry to mitigate radiation effects and the deficiencies/ the knowledge gaps in the existing research.
- Propose research plans that addresses the issues found as research program gaps.
- Propose additional test plans that will aid in fulfilling the NRC objective to develop regulations for the license renewal for life beyond 60 years.
- Review and assess the industry's reactor internal aging management program.

Halden: Environmentally Assisted Cracking – Y6270

- The Halden Reactor Project has been in operation for 50 years and is the largest NEA joint project. It brings together an important international technical network in the areas of nuclear fuel reliability, integrity of reactor internals, plant control/monitoring and human factors. The program is primarily based on experiments, product developments and analyses carried out at the Halden establishment in Norway, and is supported by 130 organizations in 17 countries.
- The material work encompasses the embrittlement and cracking Behavior of internal reactor materials.
- Key program areas are:
 - plant lifetime assessments (reliability of internals).



Zorita Internals Research Project-K6202



- *OECD Nuclear Energy Agency*
 - Committee on the Safety of the Nuclear Installations (CSNI)
- Cooperative research project on ex plant materials from José Cabrera NPP (Zorita NPP)
- José Cabrera NPP (Zorita NPP) was shutdown on April 2006, and the owner of Zorita NPP, has offered materials of potential interest in R&D
- The research could be focused on properties of long time operating and in-plant irradiated materials
- The current proposal of this cooperative research project is limited to Core Internals
- Some important features of these internals are: 26,5 EFPY, high fluence and thick sections The Deliverables will be the results of the tests performed
- Potential applications are up to each participant, some potential applications: Licensing purposes, Inspection programs, Lifetime management and Lifetime extension

Steam Generator – Tube Integrity Program



Steam Generator Tube Integrity Project - N6582

- The overall objective of this program is to provide the experimental data and correlations to permit the NRC staff to independently assess licensees' programs for evaluating the integrity of steam generator (SG) tubes as plants age. The research program results will also support the office of Nuclear Reactor Regulation (NRR) in a variety of regulatory decisions and licensing actions. Currently, the program objectives of NRR envelop the needs of the Office of New Reactors.

Steam Generator Tube Integrity Project - Basis

- Steam generator tubes provide an integral part of the reactor coolant pressure boundary. They serve as a barrier to isolate the radiological fission products in the primary coolant from the secondary coolant and environment. Knowledge of SG degradation phenomena has evolved along with SG designs and the various SG chemistries. Degradation of SG tubes has resulted from corrosion and wastage, pitting, denting, stress-corrosion cracking, and intergranular attack. Both the primary and secondary sides of the SG tubes have experienced cracking. Axial cracks, as well as circumferential cracks, have occurred. Tubes with cracks, if not detected and either removed from service or repaired, may rupture and possibly release radiological products.
- Degradation of SG tubes is an issue that continues to pose a potential safety risk to the public. This degradation has occurred as (a) intergranular stress-corrosion cracking (IGSCC) in the free span of tubes, (b) intergranular attack and IGSCC (IGA/IGSCC) at the tube support plate and egg-crate location and in regions of sludge accumulation, and (c) axial and circumferential cracking at the top of the tubesheet.



Steam Generator Tube Integrity Project - Approach



- This program builds upon the findings and conclusions of previous research programs as well as recent licensee operating experiences. At the beginning of the program, the work will focus on developing plans of action to address issues that were identified during the previous SG tube integrity program. Then, the research will incorporate additional topics which are important to evaluating SG tube integrity. These new topics arose largely from licensee operating experience.
- Research tasks under this program include:
 - Assessment of inspection techniques and reliability
 - Tube integrity and predictions
 - Degradation modes

Spent Fuel Storage Casks



Spent Fuel Cask Corrosion in a Marine Environment – N6195

- The purpose of this experimental work is to investigate the susceptibility of austenitic stainless steels to chloride induced SCC in a representative atmospheric marine environment. The experiment is being conducted with representative materials and marine atmospheric conditions specific to the austenitic stainless steel surface (including weldments) on spent fuel storage casks. The experimental objective will be obtained through an accelerated testing method, in order to obtain results in the specified time of this contract.
- The research is to:
 - Investigate the susceptibility of various grades of austenitic stainless steels to chloride-induced SCC
 - Establish the effect of temperature on the susceptibility of austenitic stainless steels to chloride-induced SCC
 - Establish the relative susceptibility of austenitic stainless steels base metal, heat affected zone, and weld metal to chloride-induced SCC

Spent Fuel Cask Corrosion in a Marine Environment – Basis

- Some domestic spent fuel storage casks are to be located in areas where salt-laden air can come into contact with the surface of austenitic stainless steel spent fuel casks due to the proximity of the casks to either brackish water or sea water. The staff of the Spent Fuel Project Office (SFPO) has requested that the Office of Nuclear Regulatory Research (RES) assist in determining the susceptibility of austenitic stainless steel to chloride-induced stress corrosion cracking (SCC) when exposed to an atmospheric marine environment. The SFPO needs to know if a spent fuel storage cask would be susceptible to SCC when the cask is located at a coastal facility for 20 years or more. A foreign study has shown that austenitic stainless steels commonly used to construct spent fuel storage casks do fail by chloride induced SCC when synthetic sea water is applied by dripping on a heated U-Bend specimen.



Spent Fuel Cask Corrosion in a Marine Environment - Approach

- The test shall expose the test specimens to a representative atmospheric marine environment.
- use environments that best represent the environmental conditions contacting spent fuel storage casks located at domestic independent spent fuel storage installations in proximity to sea water.
- The specimens shall be continuously heated and continuously monitored with thermocouples (constant temperature) throughout the testing.
- specimen shall be photographed, and samples taken of any salt films present.
 - The salt films shall be chemically analyzed qualitatively and quantitatively.
- The specimens shall then be cleaned and the surface examined using a low powered microscope.
 - Any evidence of pitting or stress corrosion cracking shall be verified metallographically.