# Official Transcript of Proceedings

# NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Metallurgy and Reactor Fuels Subcommittee

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Wednesday, April 8, 2015

Work Order No.: NRC-1504 Pages 1-187

**NEAL R. GROSS AND CO., INC.**
**Court Reporters and Transcribers**
**1323 Rhode Island Avenue, N.W.**
**Washington, D.C. 20005**
**(202) 234-4433**

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

METALLURGY & REACTOR FUELS SUBCOMMITTEE

+ + + + +

WEDNESDAY

APRIL 8, 2015

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Ronald G. Ballinger, Chairman, presiding.

COMMITTEE MEMBERS:

RONALD G. BALLINGER, Chairman

CHARLES H. BROWN, JR. Member

MICHAEL L. CORRADINI, Member

DANA A. POWERS, Member

JOY REMPE, Member

PETER C. RICCARDELLA, Member

MICHAEL T. RYAN, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER L. BROWN

ALSO PRESENT:

EDWIN M. HACKETT, Executive Director, ACRS

HUDA AKHAVANNIK, NMSS

KRISTINA BANOVAC, NMSS

GORDON BJORKMAN, NMSS

JOSEPH F. BOROWSKY, NMSS

ALADAR CSONTOS, NMSS

KRISTOPHER CUMMINGS, NEI

DARRELL DUNN, NMSS

BOBY EID, NMSS

ROBERT EINZIGER, NWTRB

STEVEN EVERARD, NMSS

DONNA GILMORE*

ACE HOFFMAN*

A.H. HSIA, NMSS

DANIEL HUANG, NMSS

MATT KEENE, Duke Energy

MARVIN LEWIS*

BRUCE LIN, RES

MARK LOMBARD, NMSS

RAY LUTZ, Citizens' Oversight*

DAMARIS MARCANO, NMSS

ROD MCCULLUM, NEI

CAROL NOVE, RES

GREG OBERSON, RES

JESSIE QUINTERO, NMSS

PATRICK RAYNAUD, RES

HAROLD SCOTT, RES

DON SHAW, AREVA

JEREMY SMITH, NMSS

DAVID TANG, NMSS

DAVID TARANTINO, NMSS

RICARDO TORRES, NMSS

BHASKER P. TRIPATHI, NMSS

*Present via telephone

T-A-B-L-E O-F C-O-N-T-E-N-T-S

P R O C E E D I N G S

(8:29 a.m.)

CHAIRMAN BALLINGER: Good morning. The meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards Subcommittee for Metallurgy and Reactor Fuels.

I'm Ron Ballinger, Chairman of the Subcommittee. Subcommittee Members in attendance are Pete Riccardella, Gordon Skillman, Dana Powers, John Stetkar, Mike Ryan, Joy Rempe and there used to be Mike, lose by five, Corradini.

The purpose of this meeting is to receive information, an information briefing from the staff and NMSS on NUREG-1927, Rev. 1, the standard review plan for license renewal of dry cask storage systems. The Subcommittee will gather information, analyze relevant issues and facts, formulate proposed positions and actions as appropriate for deliberation by the full committee.

Chris Brown is the designated federal official for this meeting. He is right here. The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on March 27, 2015.

A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice. It is requested that speakers first identify themselves and speak with sufficient clarity and volume so they can be readily heard. Also please silence anything that's electronic that beeps, except for maybe pacemakers.

We do not receive, we did not receive any requests from members of the public to make oral statements or written comments. The staff has requested a phone bridge line which is on. The bridge line will be opened at the end to receive public comments.

We'll now proceed with the meeting. And I call upon Mark Lombard, Division Director of the Spent Fuel Management to begin.

MR. LOMBARD: Thank you, sir. I appreciate it. I just want to say a few words. We certainly appreciate the Subcommittee's review of this important document NUREG-1927. And we wanted to have your early involvement in this process before we sent the document out for public comment so again look forward to your questions and comments on it.

This project is really the culmination of about 18 months of very hard work by the Renewal Team

and it covers both certificate of compliance, CoC and Spent Fuel Storage and Installation reviews for renewal. There's been significant collaboration in that 18 month time frame.

Over 20 public meetings were held including the general public and industry on this topic. The goal, and I believe we have achieved this goal, is to create a learning, predictable, sustainable framework for renewals going forward and this is really the first piece of several products that will define that framework and do make it sustainable for now and for the future.

So with that I just want to turn it over to you, Kris Banovac.

MS. BANOVAC: Thank you. My name is Kris Banovac. I'm a project manager in the Renewals and Materials Branch in the Division of Spent Fuel Management and I'll be providing an introduction to our meeting today and talking about our operations-focused approach to aging management for spent fuel storage renewal.

On Slide 2, just an outline of my talk. I'll be providing some background on our regulatory framework for spent fuel storage and also our requirements and guidance for spent fuel storage

renewals. I'll talk about some of the current challenges that we're facing with our storage renewal framework and then I'm going to talk about our path forward, what we've been doing and what we'll continue to do to have our operations-focused approach and to have a stable framework for spent fuel storage renewals.

And I'll talk about our plan for our revision to NUREG-1927. And then finally I'll just touch on the agenda for today and what you'll be hearing for the rest of the meeting.

As far as background for regulatory framework for spent fuel storage we have a two part regulatory framework in 10 CFR Part 72. There's an option for a specific license for storage of spent fuel in an independent spent fuel storage installation or ISFSI.

And there's also an option for a general license for storage of spent fuel at reactor sites with a Part 50 or Part 52 license as long as that storage is in an approved, an NRC approved dry cask storage system design. The general license provisions are in Part 72, Subpart K. And the NRC reviews and approves storage cask designs per the requirements in Part 72, Subpart L.

Approved designs are certified by the NRC through rulemaking, through a rulemaking process. They're provided a Certificate of Compliance or a CoC and they're added to the list of approved systems that are listed in 10 CFR 72.214. And at that point the systems are available for use by general licensees.

The general license term is tied to the term of the CoC that is being used at that site. So general licenses themselves are not renewed, CoCs are.

This next slide goes over the requirements for both renewal of specific licenses and CoCs. The regulations do allow for renewal of ISFSIs and the storage cask designs for a period not to exceed 40 years.

And specific license renewal applications must be submitted two years before license expiration. And CoC renewal applications must be submitted 30 days before CoC expiration.

MEMBER CORRADINI: How did the 40 years come about?

MS. BANOVAC: The 40 years. There was a rulemaking in 2011 for license and certificate terms. And in that rulemaking that extended the period both for the initial storage period and the renewal period for 40 years. And at the end of my slide I have

references with a link to the Statement of Considerations for that rulemaking.

So for renewals both specific license and CoC applications have to include a time limited aging analysis or TLAAs. And these consider the effects of aging on structure systems and components that are important to safety and it assesses their capability to continue to perform their intended functions for the period of extended operation.

The renewal applications must also include a description of the Aging Management Programs or AMPs. And those are for management of aging issues that could adversely impact structure systems and components important to safety.

In addition the renewal application must include design basis information as documented in the most updated final safety analysis report. And in order for NRC to approve storage renewals the licensees or CoC holders need to demonstrate that any aging effects on their dry cask storage systems will be safely managed and addressed so that they can continue to meet their safety functions in the period of extended operation.

On Slide 5 our guidance for the staff safety review of renewal applications is located in

NUREG-1927. And Revision 0 to this guidance was issued in March 2011 to accompany the license and certificate rulemaking. So that provided the implementing guidance for that rule. And --

MEMBER CORRADINI: And so and just --

MS. BANOVAC: Sure.

MEMBER CORRADINI: -- under the, that's okay. I just wanted to make sure. So under the two, you identified two paths, under both paths it's 40 years?

MS. BANOVAC: Forty years, yes.

MEMBER CORRADINI: And under both paths --

MS. BANOVAC: Up to 40 years.

MEMBER CORRADINI: -- up to 40 years, up to.

MS. BANOVAC: Yes.

MEMBER CORRADINI: And in both paths it's a consistent set of guidance and rules?

MS. BANOVAC: Yes.

MEMBER CORRADINI: So it doesn't matter whether I do it as an independent dry cask or within the plant license?

MS. BANOVAC: Yes. The regulation, so I'll go back, so the two regulations there's 72.42 as far as specific license renewals and 72.240 is for our

CoC renewals and they're almost identical. And so the key points that TLAAs and AMPs need to be submitted as part of the application, those are both for the specific license renewals and the CoC renewals.

One of the differences is when they need to submit the renewal application and timely renewal. Okay. And since we issued Rev. 0 of NUREG-1927 we have reviewed applications for both specific license renewals and CoC renewals. And so we did have a chance to use and test our guidance in NUREG-1927.

And what we found in our review experience was that there were several areas where we thought the guidance could be expanded and clarified. So we did identify a need to update NUREG-1927. And this slide lists a few other challenges.

Both storage and reactor operating experience has indicated potential degradation of structure systems and components during the period of extended operation. And in addition to known degradation mechanisms there's always the potential for unknown degradation mechanisms.

And also our dry storage systems are deployed at ISFSIs throughout the country so they are subjected to different climates and environments. And particularly for our CoC renewals, CoCs can be used at

various sites throughout the country and so there's a challenge for a CoC renewal application to define and assess all the operable degradation mechanisms for those different environments where the CoC could be used.

CHAIRMAN BALLINGER: I have a question that with regard to known versus potential. In the Reg Guide it says the applicants should include aging effects that may theoretically occur. What does theoretically occur mean?

MS. BANOVAC: Has the potential to occur.

CHAIRMAN BALLINGER: Okay. So it's the same as that. So it's a known mechanism that has the potential to occur.

MS. BANOVAC: Yes.

CHAIRMAN BALLINGER: Not an unknown, unknown mechanism that theoretically might maybe occur?

MS. BANOVAC: I think, yes.

MR. TORRES: And also aging degradation mechanisms might be, might have been seen in similar locations but not exactly in dry cask storage. So those types of degradation issues.

CHAIRMAN BALLINGER: I just was concerned about the word theoretically.

MEMBER CORRADINI: Since he asked is it physically existing and operating as a dry cask storage or does transport after the license removal or renewal or end of license for removal to another site part of the requirements?

MS. BANOVAC: So the requirements are just for the storage. There is a requirement in Part 72, I believe it's 72.236M where we do need to consider transport and sort of the next steps after storage when we do our reviews for issuance of the initial licenses and CoCs.

But our guidance in NUREG-1927 is just for the extended storage period.

MEMBER CORRADINI: Is there a judgment by the staff which is more limiting? I would expect transportation after the license is over is more limiting than having it sit there.

MR. TORRES: So I think that the way the rule is written it says that I think to the extent practical consideration should be given to transportation. I think that the staff evaluates the suitability for transportation but not to the specific requirements in Part 71.

MEMBER CORRADINI: Where I'm going, it's probably outside of the scope so I'll just say it and

then I'll let it go. Where I'm going is that you give the licensee a license to keep it there but then they can't move it afterwards because somehow its degraded in some sense that it's not allowable to move or it becomes incredibly economically, an economic penalty.

So I'm trying to figure out have you figured out not only is it there and it's going to stay there for x years but then it moves because eventually it will move, if it can be moved and where that criteria is.

DR. CSONTOS: That's a Part 72 to 72. There are two rules. So that's a really good point and we are discussing that internally. For this discussion it's more on the 72 part.

MEMBER CORRADINI: I understand. I gather it's out of the scope but on the other hand, you know, --

DR. CSONTOS: But it's very valid because what we are right now wrestling with internally is this what you call Part 72 to 71 back to 72 words, okay. Meaning that if you go to another consolidated storage facility or if you go to some other place that may store this but it's going to be transported in an intermediate step, those are considerations we need to start thinking about.

Okay. And so the transportation piece is something that we are looking into. But it's not a part of this right now in terms of the license renewal aspects because we're looking at 40 years of license renewal, okay, up to 40 years.

MEMBER CORRADINI: But you guys are aware and thinking?

DR. CSONTOS: Yes, we are thinking about it.

MEMBER CORRADINI: So as you've been thinking are there limits that might conflict or interact?

DR. CSONTOS: We are, you will probably get a presentation or a set of presentations from Meraj Rahimi in I think a month or two the high burnup fuel and the whole RIS and --

MR. BROWN: No, we're not going to --

DR. CSONTOS: No, okay. There is another set of presentations that we were supposed to give to you, all right, not as part of the renewal piece but as part of the high burnup fuel, the regulatory information summary and the whole process and the whole plan that we have there.

That takes into account the storage and transportation interfacing.

MEMBER CORRADINI: Okay, thank you.

DR. CSONTOS: And just to answer Professor Ballinger's question about the known and unknown that's a good question, that's a good point. We are looking at operational experience and operational experience from, you know, other industries as well as the nuclear industry so if things have happened in a reactor that's on the same site as an ISFSI is those are things that are the known but they're unknown for canisters.

So it may, it's what they call a known unknown if you want to call it that.

CHAIRMAN BALLINGER: That could work. But theoretically it's just abstracts.

DR. CSONTOS: Yes, I understand that. We'll, good comment.

MEMBER STETKAR: As long as we're sort of just, you know, getting some general questions out on the table here, I'm pretty familiar with NUREG-1801 the GALL Report for operating reactors. And I would appreciate it, I see the parallels between these obviously.

How are these two NUREGs coordinated? For example, I think the staff is working on a yet, you know, Rev. 3 of the GALL Report. We've entered into

discussions with the staff about extension of the GALL Report for life beyond 60 or subsequent license renewal.

How are, because there are a lot of very similar materials, you know, programmatic type aspects how are they coordinated to make sure that we're on track with both of these?

DR. CSONTOS: I will talk to it at the last slide.

MEMBER STETKAR: Thanks. I gave you a heads up on that.

DR. CSONTOS: We have staff who we borrow from NRR as part of our Renewal Strategy Team that Kris led, all right, and that we also have contracted with the folks who do the GALL revision, okay, as well. And our GALL-like document is called MAPS, Managing Aging Processes for Storage.

And we're trying to do that corollary, just like you said, and I'll go into that in a lot of detail. But we are well aware of it. That's exactly why, you want to hear some of the AMPs that we have here the concrete and the corrosion AMPs. Those are right from, you know, our knowledge base from --

MEMBER STETKAR: But what I'm worried about is getting out of sync.

DR. CSONTOS: Yes, and we have, what you'll hear from Ricardo is how we are in sync. He's been part of some of that work going on from the NRR side. We brought over some of the NRR folks over here to help us on our side.

So we're trying to be as much in sync as possible and not --

MEMBER STETKAR: Just having bodies doesn't necessarily mean --

DR. CSONTOS: They're the experts in, we have a materials generic, John Wise who is not here today because he's on, this is Montgomery County's holiday week. So, but he is from NRR, Division of License Renewal.

He was one of the technical experts in materials degradation and the GALL revision, the latest revision up. And the technical experts that our contractor who also are developing that revision.

MEMBER STETKAR: Okay. Whoever has got the thing beeping there please figure out who you are and turn it off. Thank you.

MS. BANOVAC: Okay. Any other questions or is it okay to pick back up? Okay. And so we're also expecting 15 renewal applications both for specific licenses and CoCs over the next ten years.

So given this wave of upcoming work we realized that now was the time to update NUREG-1927 and also take a hard look at our framework to determine what other guidance was needed.

So what we did, I think it's already been alluded to, we created a Storage Renewal Team with folks from the Division of Spent Fuel Management and the Office of Nuclear Material Safety and Safeguards and also to draw on the staff experience from the reactor renewal to have those parallels and also research in corrosion and degradation mechanisms and also in inspection.

We had staff from the Division of License Renewal and Office of Nuclear Reactor Regulation and also staff from the Office of Research that were on our team. We also had representation from our Office of the General Counsel.

And so what we did is we talked about the issues and the questions that came out of our storage renewal review experience, so the issues we had identified over the last few reviews. And we also reflected on the reactor renewal experience and the lessons learned from that.

And in addition to our team discussions and deliberations we have had extensive stakeholder

engagement. That's also been, Mark had mentioned we had a two day public meeting in July of last year that was focused solely on potential changes to NUREG-1927. We got some very valuable feedback from that.

And we're also reviewing guidance in a document NEI 14-03 which is an industry effort to develop parallel guidance for applicants. And so this would be a guidance that would complement NUREG-1927. And Kris Cummings will be speaking to that later after our break.

So we had a chance to review that and comment on that. And we have had very valuable stakeholder feedback over the last year.

And so what we realized after talking in our team and receiving the stakeholder feedback, you know, we need an operations-focused approach that is learning, proactive and responsive. I'm going to talk a little bit more about what that means.

And as Mark mentioned, we ultimately want a stable, predictable framework that has clear expectations. And so how do we do that? We feel a key piece is this revision to NUREG-1927 that is the focus of our meeting today. And I know we've already talked a little bit about the further guidance.

There's other guidance products that we've

identified that we need and also additional work which Al is going to speak to at the end of our meeting. And so what we mean by operations-focused approach it's based on achievable operational methodologies. Monitoring and in-service inspection should be based on parameters that are capable of identifying degradation before it challenges the structure system and component's ability to meet its intended function.

Those parameters should be based on technically defensible criteria. Operations-focused approach should include assessment of monitoring data and inspection findings to determine what actions should be taken. It should also include reporting, aggregating and trending of operational experience.

And one key here is we feel that these Aging Management Programs should be a learning program. So we feel that it should be a dynamic program that they should continue to consider and respond to operating experience for that particular ISFSI, for that dry storage system or other relevant operating experience within the nuclear industry and even outside of the nuclear industry.

CHAIRMAN BALLINGER: Okay. I have a question that will probably keep coming up. And that is the, some of the degradation modes, in particular

this stress corrosion cracking that we're all familiar with are of necessity probabilistic in nature. There's no way that you can inspect a canister and then guarantee that you won't propagate through the wall crack between the two inspections.

Now that compromises the intended function of that barrier, correct. And in the NUREG it says no leaks period. So what happens if in fact you do get a through-wall between inspection periods? Is that allowed? It doesn't sound like it's allowed here?

MS. BANOVAC: Yes, Professor Ballinger, is it okay if we push that question and that discussion? We do have a separate presentation that will be on the aging management, an example Aging Management Program for corrosion and stress corrosion. Is that okay? I think we could get into a good discussion.

CHAIRMAN BALLINGER: It heads up to where my head is going with this question.

MS. BANOVAC: Yes, so we'll get into a good discussion I think in that presentation. Thank you.

MEMBER SKILLMAN: Kris, let me ask this please. Your last bullet learning that word is kicked around a lot in this business and very often it's a word that doesn't carry a lot of discipline with it.

We talk about we're a learning organization and three months later you say, so what. What did you learn? Well I learned a lot. Well did you write it down? No. Was it recorded anywhere? No. Has it been codified? No.

What is the discipline behind ensuring that when new information is available that the AMP really is modified? Where's the discipline? Is it subject in part to Appendix B, Corrective Action Program? What makes it happen?

MS. BANOVAC: So, yes, the existing Quality Assurance programs and Corrective Action programs, those would have to respond to any aging issues that were identified. So those continue for storage not just for the reactor.

MEMBER SKILLMAN: And if they're not?

MS. BANOVAC: But as far as capturing the learning that's a very important piece. And I think probably Kris Kummings will get to it a little bit in his presentation. But, you know, we think that the learning aspect, it's continuous.

So on a daily basis as you are finding things, as the industry is responding to things it happens continuously. But there's also an idea to sort of capture or I think I forget the word you used

but to make sure it happens, an idea that on a periodic basis there will be essentially a pause and the licensees or CoC holders would need to take a look at the operating experience that's related to either that ISFSI, that dry storage system and essentially do an assessment and say, okay, you know, here's what's happened in this period of time.

Do I need to go back and change any of my parameters of my Aging Management Program? The word that industry has actually coined this term it's called a tollgate. And this is an idea that's presented in NEI 14-03 which, as I mentioned, I think Kris Kummings will be talking to that.

But there is this idea that there will be a pause that sort of forces the licensee and the CoC holder to stop and take a look at what has happened in that period of time and change as needed.

MEMBER SKILLMAN: Well let me continue. I understand the tollgate concept as it's described in 14-03. The real question is, what's the NRC going to do? I lived in a world of inspections of inspectors of findings --

DR. CSONTOS: That's, what you're talking about is how do we enforce it.

MEMBER SKILLMAN: That's the question.

DR. CSONTOS: And so we have a situation over here that's unlike the reactor side. Okay, we, the AMPs that we have in the GALL that's on the reactor side has thousands of years' worth of operational experience collectively internationally from all the reactors on how they're degrading or they're aging.

We don't have that much over here. We have some, okay. But we're getting some inspection data. We're getting some types of other information, operational experience data for concrete degradation and corrosion, things like that.

But it's much more limited compared to what we have on the reactor side. We have and this comes into where, how I'm wrapping it up at the end. We're looking at the sectional level. Right now we don't have a sectional level.

We don't have an inspection criteria. We don't have an inspection criteria that, you know, AMPs on the reactor side are on top of existing Section XI, ASME Section XI requirements, inspection and remediation and such. We don't have that yet here.

Okay. We are embarking on a process on going forward to develop that inspection criteria. That will then be enforceable by inspectors which

you'll also see in my slides the inspection guidance that we're going to be looking into. And that's not inspections like in technical this is how you do a non-instructive examination.

Rather it's how do we tell the inspectors how to go out and inspect for these types of issues and how do we enforce that and get this learning, like the tollgate that Kris talked about, how that learning piece comes in and it's somehow brought into the system to update AMPs.

Industry has a concept called the popup tollgates which is every, once every so many years everyone gets together and sits down and talks about operational experience and then comes back and says how do we change these Aging Management Programs?

That would also be incorporated into the GALL-like document we have, updates to that document. So I'll, it's kind of, I'm down on my slides here but that will give a preview to my slides if that helps out with the enforcement question I think that you had.

MEMBER REMPE: Well I have a question about, I'm sorry, are you done?

MEMBER SKILLMAN: I'm good. Thank you.

MEMBER REMPE: Okay. On the tollgates and

the issues that are not included in it and it kind of goes with this operations-focused approach. For example, I know a couple of issues were mentioned in the material we were provided.

But what about other things? We learned about seismic issues and other things that are not currently, what's the dividing line of what's in and what's out on issues that will be identified and addressed in the tollgates?

DR. CSONTOS: Well that's part of the next step with the MAPS report. That is where we're trying to, you're going to hear three Aging Management Programs that are example ones for what we've thought were the high priority ones to address right now, okay.

MEMBER REMPE: And how do you know high priority ones is something I'm --

DR. CSONTOS: Well and those were because of the operational experience that we've had out there. We've had concrete degradation. We've had corrosion issues that we've seen, okay. The high-burnup fuel AMP is one that, you know, we've had research data that shows that there's, you know, possibility of issues out there.

And so we wanted to make sure that, you

know, what we see is or what we're predicting in ISG-11 is okay.

MEMBER REMPE: Why isn't seismic included because you've had something at North Anna where they saw changes occur?

DR. CSONTOS: And that, and I think let's see, does anyone want to speak to the seismic piece? I think there is, we have been evaluating.

MEMBER REMPE: So anything is on the table. There's not just, because traditionally seismic has been addressed and doesn't change because of new experience that much. I mean maybe they would be. But it's not as easy to get it changed.

DR. CSONTOS: We have evaluated for certain cases, certain cases that are more specific. And the other piece to it is the coupling. And that's the piece that's the next stage as well, coupling between let's say degradation and seismic.

You know, what if we have a degraded condition, extended degraded condition? What does that impact and how does that, how does that play a role that we ensure that these systems are maintaining its performance.

MEMBER RICCARDELLA: And you know licensees are updating their seismic analysis and

response to new ground motions. Is that happening? Has that happened?

DR. CSONTOS: Whereabouts?

MEMBER RICCARDELLA: Mostly in the east coast this year.

DR. CSONTOS: It's the east coast, okay.

MEMBER RICCARDELLA: Central and eastern United States. Is that being done on the casks as well?

DR. CSONTOS: Do you want to talk a little?

MR. TRIPATHI: Yes, since you asked about the seismic I'm, let me understand the question first. Are you --

CHAIRMAN BALLINGER: Identify yourself before you speak.

MR. TRIPATHI: I'm sorry. I'm Bob Tripathi. I'm the DSFM, Mark Lombard's group in the CSTB. It's changing every day. But I think it's CSTB.

Anyway, my question to you, ma'am, was can you specify exactly what the question is about the seismic because we are fully aware of the, what's going on with the NGA East, NGA West and we are completely familiar with what's going on, on the

reactor side with the expected new demand in the seismicity in certain portions of the country.

So we will take care of all that information once it's, you know, trickled down. And once the licensees of the ISFSIs, not the reactor, licensees committed that okay we will follow these new guidelines. And there are some ISFSIs out there which may have to revisit for the upgraded seismic demand.

So we're going to incorporate all that information as it becomes available and as the commitment from the licensees are in place.

MEMBER REMPE: So that, sort of my question is it was more what's in and what's out with the tollgates and the prioritization and are some things that are traditionally addressed but not regularly updated to be included.

DR. CSONTOS: Part of it is the Section XI piece. There's two pieces of Section XI that we're looking into. One is inspections and the other one is assessment methodologies. And that is where you're loading characteristics go into how do we evaluate for degraded conditions for seismic and such like that.

MEMBER REMPE: Okay. Thank you.

MEMBER SKILLMAN: Let me go back to my question about AMPs and let me explain why I asked the

question. Al, as you point out on the reactor side in some cases AMPs have thousands of data points because there's so much information.

DR. CSONTOS: Yes.

MEMBER SKILLMAN: And there is generally not a large change from day to day or month to month because most of the information is very well known. On the other hand, on dry fuel storage any new information needs to be disseminated quickly because there isn't that much information available.

And there's some interesting things that can happen. You can have a cask down on the tidewater area and you can have osprey decide to nest on a cask. We probably haven't done a whole research on the chemistry of guano and casks.

And if you try to take the osprey nest off the cask you are probably up against the wildlife people in the state who say you can't touch that because that's a protected bird.

MEMBER CORRADINI: That's actually right on the money.

MEMBER SKILLMAN: My only point is that there's a lot we don't know in the cask area and any little bit of information needs to get to all the license holders so everybody's on a, kind of alert for

what they need to know. So updating the AMPs, the discipline of updating the AMPs is a good thing. End of story.

DR. CSONTOS: Well it's also about dissemination. We have a process in place for the reactors which is INPO-based as well as international based.

And on this side of the house and we're working with our, you know, our friends in the industry to try to figure out how are they going to create a system like INPO, a system on the reactor side for dissemination.

Right now there are users groups that are specific to each individual cask vendor that tries to promulgate that information within its membership. But like you said before, the materials are similar. I think it was Dr. Stetkar said the materials are similar between, you know, what we have on reactors to here.

Stainless steel is here and it's stainless steel in the reactor. So getting that information out, you know, and disseminating it also across vendors is something that we're also interested in.

MEMBER SKILLMAN: And as you point out, you know, in a control room if you have an incident

overnight your first action is to report it the next morning to INPO. Your OE is your, almost as important as notifying your region or doing your operability review.

So it's part of the process and it's not instantaneous. But it's very timely within hours.

DR. CSONTOS: And that's exactly why we are moving to this operations-based approach. We wanted to, I think, in a similar fashion learn, we've learned from the reactor side and we feel that this is a path forward for us.

And we're at the early stages of developing that infrastructure and that piece. We've been at this for about 14 months. But it's important that we get this OpE, I think OpE is the key crux to this whole effort.

MEMBER SKILLMAN: Thank you.

MS. BANOVAC: Okay. So I'm now on Slide 10. So this just outlines our plan for our revision to NUREG-1927. So we do appreciate your time and your comments, thoughts that you'll be sharing today.

So after today's meeting we're going to go back. We're going to consider what we heard here today and we're going to further revise our guidance in the draft Revision 1. We then expect to publish

that for public comment in the May/June time frame of this year.

We'll address the public comments as we finalize our guidance. And then we do plan to engage with ACRS after we have a chance to consider the public comments and address them as we finalize the guidance. And so we expect to do that in spring of next year.

And at that time we're planning for a second subcommittee meeting and then also the full committee meeting with a letter for the final guidance. We expect to publish the final guidance in summer of next year and throughout the process we're going to continue our stakeholder engagement.

As I mentioned we have received very valuable feedback so far and so we want to continue to get that feedback. And we're planning a public meeting during the public comment period for NUREG-1927. And then we're going to continue to engage with industry on the development of NEI 14-03 which will be complementary guidance to NUREG-1927.

MEMBER CORRADINI: So can I ask my last big picture question. So this all sounds very good. So is there an overall roadmap so that this doesn't ten years from now come in conflict with wanting to

move the things from dry cask to something else? What is the big picture plan on the regulatory side?

I know industry is developing one. Does staff, is staff developing something so that if I agree to let it be stored here I don't find that I've just created a problem because there is a limiting agent that has to be refurbished to get it from here to there? What is the picture plan or who is doing that in staff?

MS. BANOVAC: Going from storage to transportation.

MEMBER CORRADINI: Well transport to somewhere else. I assume interim storage which is the current favorable option.

MS. BANOVAC: And I think Al kind of alluded to it. So there's a separate effort to look at the, going from storage to transportation and maybe back to storage. And what would need, do we need to make any changes to the current framework?

You have your requirements of Part 72. You have your requirements in Part 71 for transportation. But as you go from one phase to the next then maybe back to storage again as far as making that a smooth transition we were looking at that.

That's a separate effort. And we'll look

at whether any changes are needed either to regulations or --

DR. CSONTOS: But we have considered it. We have considered it. In some of our deliberations on certain topics we have discussed them, you know, going to the ASME Code approach for degraded conditions.

Those can be ported over to, instead of taking the storage loads and seismic loads you take the transportation loads and you throw them in. Okay. So there are things that you can do that we are starting, okay, because of this potential interim consolidated storage application.

But those are things that for this group we have only touched on in some of our deliberations and discussions. So we don't impact that, what you're talking about.

But I think that the high burnup RIS, the high burnup fuel RIS worked by Meraj and Huda in our group, in our division would be I think valuable for you to see some of that discussion of how we are looking into that transportation piece as well because --

MEMBER CORRADINI: So I guess would end this way. The Chairman is the boss on this sort of

stuff. But it seems to me that whenever you come back and discuss these things always, I would always present the big picture because I'm always worried about an interaction that we solved this local technical issue or at least agree to it and then somehow now you put yourself in a box for something that's bigger.

And I'm sure industry is worried about this. I assume staff is and has a plan. It would be nice to see the plan every time you return so that we understand how the plan is changing.

DR. CSONTOS: And the public is also concerned about that because the public also, they would not like to see the canisters on their sites for perpetuity because of a regulatory --

MEMBER CORRADINI: Maybe they would. But it's got to be a plan.

DR. CSONTOS: Well what I've heard from the public has always been we don't want something to stop it being able to be moved away some place. That's, you know, so that's what we have to be careful about in terms of what our guidance is.

MS. BANOVAC: And then finally just to close I wanted to go over the agenda for the meeting. So we have made changes throughout NUREG-1927. So

following my presentation Ricardo Torres will be providing an overview of the changes that we've made throughout NUREG-1927.

Those changes do include the development of these example Aging Management Programs for reinforced concrete, for canisters and also for high burnup fuel. And we included those example AMPs as an appendix to NUREG-1927.

And since that is the start of some further developments that Al will talk to at the end of the meeting, we thought to spend some time today giving an overview of those three example AMPs. So we'll have a presentation on each of those.

And then after the break we'll have Kristopher Kummings from NEI will present on the industry efforts to develop NEI 14-03. And then finally I think, Al, by the time we get to your presentation it will probably be all presented.

But Al will give his presentation on the other guidance that we are planning to develop in other work. So Al will be presenting that to close out our meeting. And so with that I know we've been asking questions throughout.

But are there any other questions on sort of this broad overview? So, Professor Ballinger, it

is okay to move on to the next presentation?

MEMBER BROWN: I guess I will ask one question since I was late and I apologize for that. Maybe this was overtaken by other questions. But when I was trying to find, when I was looking through this a little bit like Mike was there's a bunch of stuff stored in dry cask now.

Is there, and I was reading part of your slides here, is there something that assesses stuff that's been in storage in known condition for 30 or 40 years or 30 years? We've had stuff out there for a long time and I just don't know how long they've been in casks, to then reassess those to see if they're suitable for additional periods of storage even at the same location.

Is that, the thought process is along but what is the big picture game plan for all the stuff? How do you handle stuff that's been sitting around for a long time?

Is it included in the reevaluations for just the basic storage not just necessarily transportation to some other site?

MS. BANOVAC: Yes, so the renewal review is focusing just on storage and continued storage.

MEMBER BROWN: Including the cask or just

the installation facility itself?

MS. BANOVAC: I would say, so if it's a specific license for an ISFSI it's the installation itself and the system.

MEMBER BROWN: It does include the cask in the system, correct?

MS. BANOVAC: Yes. And then the Certificates of Compliance would be just for that system and that design.

MEMBER BROWN: So there's a possibility you might have to take it, if you decide that those old casks are no good they would have to be taken out and put in new casks. Is that, that is a possibility?

MS. BANOVAC: That could be a corrective action if there was any --

MEMBER BROWN: All right. I just wanted to make sure that was in the game plan, that was all.

MS. BANOVAC: Yes, if there was aging or degradation where you could no longer use a canister or an overpack that could be one of the corrective actions, replacement.

DR. CSONTOS: We're in the early, early, early stages of that debate and that discussion internally.

MEMBER BROWN: I was trying to figure out

how you figure out whether they're okay or not since they're --

DR. CSONTOS: Well and that's part of what the future holds in terms of evaluating for degraded conditions and degraded state. We, it's too premature to talk about here at this point.

But it is something that we are taking into consideration and trying to figure out what that path is to get that 72 to 71 and 71 back to 72 space.

MEMBER REMPE: But there have been examples like out in Idaho where they detected some degradation and had to take corrective actions.

DR. CSONTOS: Correct. And you'll see that in the next or two slides from now.

MS. BANOVAC: So if that is okay for now, okay. So our next presenter is Ricardo Torres and he'll be providing an overview of the changes in our draft Revision 1 to NUREG-1927. Ricardo.

MR. TORRES: Perfect. Thank you, Kris. Well good morning, Committee Members. Now that Kris has provided a good overview of our challenges and our updated renewal framework and how we're addressing that which Al Csontos will also speak to additional guidance we'll be putting out.

I'll go straight into the specific changes

that were incorporated in Revision 1 of NUREG-1927. Next slide please. So Slide 2 provides a general overview of the structure and format of Revision 1 of 1927 which has stayed consistent with Revision 0.

Just, I'll point out that we've made changes to the 100 plus page guidance. But my plan today is to highlight some of the specific changes where the staff is seeking your feedback on.

Slide 3 please. The up front and general information chapters were revised to provide new definitions and clarify existing ones. We also revised them to ensure compliance with Part 72 and also the standard review plans for initial safety review update of the ISFSIs and storage cask systems, NUREG-1536 and NUREG-1567.

The staff also expanded guidance on application content, particularly for CoC renewals which was found lacking in Revision 0. A new section was also added to discuss timely renewal. And in this chapter we also provide guidance for the review of amendment applications submitted during the review of the renewal application as well as once the renewal has been issued.

And we also provide a section on the use of conditions to ensure AMPs remain effective during

the period of extended operation. Next slide please.

Chapter 2 discusses the scoping evaluation. The scoping evaluation is the process by which the applicant assesses and determines which SSCs are within the scope of renewal and need to be reviewed for degradation modes.

In this chapter we clarified sources of information that may be used for the scoping evaluation and the specific content that supports that evaluation. We also expanded guidance for the review of SCC subcomponents. We have an expanded discussion on fuel internals and additional clarification for identifying SSCs within the scope of renewal.

In this chapter we also provide guidance for ensuring that the reviewer is aware that exclusions from the scope of renewals should be properly justified in the application. Slide 5 please.

Chapter 3, this is pretty much the meat of the document. This is, was considerably revised. This is where the aging management review, the section on Time Limited Aging Analysis and Aging Management Programs is included.

The aging management review is a process by which the applicant determines what are the

applicable degradation modes to the specific SSCs within the scope of renewal and also identifies the aging management activities that will be used to handle those degradation modes. In this chapter we clarify the sources of information that may be used for identifying environmental data such that the operating in-service conditions of the SSCs can be properly determined.

Particularly for CoC renewals we emphasized that the reviewer should pay attention to all of the potential service environments where the dry storage system may be located when identifying these service conditions. And this could be done by the use of maintenance records, operating experience and so on.

The sections on the, the section on aging mechanisms and affects was also expanded to clarify valid sources of information that may be used to identify operable degradation modes including the use of site-specific and industry-wide operating experience, consensus code and standards as well as other applicable NRC guidance.

Slide 6. We also expanded discussion on aging management of fuel internals. We, this section was existing and we expanded it to address high burnup

fuel. The section on Time Limited Aging Analysis was also considerably revised. This was done to ensure consistency with the rule, Part 72.3 and also provide guidance to the reviewer for review of calculations and analysis not part of the approved design basis therefore not by definition TLAAs.

But these calculations could be submitted in support of the aging management review. As Kris alluded to or discussed we're seeking these Aging Management Programs, that they be learning so that they evaluate operating experience not just for the particular ISFSI but generic operating experience for the specific dry storage system as well as other dry storage systems using similar materials in similar environments.

We also expect AMPs to incorporate results from longer terms complementary research. So following this premise we expanded considerably the discussion on all ten AMP elements. These AMP elements mirror those of NUREG-1801, the generic aging lessons learned report for reactor license renewal.

In the section we clarify that monitoring and in-service inspections should include parameters capable of identifying degradation and that prior to a loss of intended function. And the use of these

parameters should provide the technical basis, technically defensible criteria for why they were chosen and how they tied to the specific degradation mode.

CHAIRMAN BALLINGER: Okay. Now I have a question. What do you mean by loss of intended function?

MR. TORRES: So there are a series of intended functions for the system including subcriticality control, criticality control, shielding radiation, shielding structural support that must be maintained. Each of those SSCs when the application comes in the applicant identifies which are the intended functions that each SSC should maintain and what are the potential degradation modes that may affect.

CHAIRMAN BALLINGER: Is a barrier like stainless steel canister barrier, what do you mean by loss of intended function?

MR. TORRES: That would be confinement.

CHAIRMAN BALLINGER: Confinement, no leaks.

MR. TORRES: Yes.

DR. CSONTOS: There is a certain leak rate.

MEMBER CORRADINI: There's got to be a leak rate. It's not zero.

DR. CSONTOS: It's not zero, yes. It's a, Joe, can you talk to what that leak rate is?

MEMBER CORRADINI: If I could just broaden Ron's question. What I guess I was expecting is there somewhere we could go look and see a list of design limits, leak rate, temperature, et cetera and I think that's where you were going.

CHAIRMAN BALLINGER: Well I think when they say leak rate they mean at closure time you seal it up and then you measure some kind of leak rate that's allowed.

MEMBER CORRADINI: But I assume there's also, I was looking in some of the pre-reading I was looking at some things. There were temperature observations, et cetera that they've got to maintain and check as time marches on, right?

CHAIRMAN BALLINGER: But I mean as aging occurs a through-wall crack, that is a violation of intended function.

DR. CSONTOS: As long as it's above the leak rate.

MR. BOROWSKY: This is Joe Borowsky, Division of Spent Fuel Management. It's important to

recognize that the design basis has a certain leak rate associated with it. Oftentimes that will be some specific value or the generic leak type criteria.

But even that has a certain value of what 1 times $10^{-7}$ ccs per second. So the system does have a leak rate associated with it.

CHAIRMAN BALLINGER: I guess what I'm trying to get at is that this, the Reg Guide is very, very good when it talks about operations-focused storage and tollgates and those kinds of things.

But is there, is it possible for a licensee to come in and take a risk-based approach to the license renewal that says okay, we're going to ensure that the probability of a perforation or a loss of intended function, that one of these things is less than x.

And we're going to demonstrate that it's less than x by a series of inspections and those kinds of things in the future. Is it possible for a licensee to take a risk-informed or risk-based approach?

MR. TORRES: We'd evaluate it. Yes, I mean there's nothing that I think --

CHAIRMAN BALLINGER: But it's not explicitly stated in the Reg Guide.

MR. TORRES: So that's I think where the discussion on TLAA comes in. The TLAA must have six criteria that must be met. On the last one we clarify that additional calculations and analysis could be provided in support of the, its criteria.

CHAIRMAN BALLINGER: It sneaks up on it. But it doesn't explicitly say that this is an approach that could be taken.

MEMBER BROWN: I thought the NEI had some specific guidance relative to the alternate approaches could be submitted other than what's specified in the NUREG.

CHAIRMAN BALLINGER: Yes, but in the NUREG it says you can do whatever you want, but buyer beware.

MEMBER STETKAR: It's standard NRC guidance.

(Simultaneous speaking.)

DR. CSONTOS: Right. As long as you justify it and such this is one approach that you can take, what we're talking about here.

MR. LOMBARD: If I might say, Mark Lombard from DSFM, if you find something during an inspection it goes in a Corrective Action Program. Following the Corrective Action Program they would do the assessment

evaluation against our requirements and determine if it passes or it doesn't pass.

And then if it doesn't pass they have to take mitigating measures at that point.

CHAIRMAN BALLINGER: But that's still deterministic.

MR. LOMBARD: Absolutely, yes. There is a, we haven't plugged into our regulatory framework yet a total risk-informed framework into it. But we're looking at that and now actually have a separate initiative to put that together over the next year or so.

CHAIRMAN BALLINGER: So that's in the plan.

MR. LOMBARD: Yes. Not specifically part of renewals but overall from a Part 72 standpoint to build a risk-informed framework.

MR. TORRES: So in the section we also expand on, as I said on the other elements and we state that the acceptance criteria should be justified by operating experience, consistent codes and standards. And the application should justify this acceptance criteria is achievable and actionable based on the information provided in the other elements.

We also clarified that the AMP should

assess monitoring and inspection findings to clearly determine actions to be taken including prevention, repair, replacement and litigation. And the corrective actions should also be consistent with the quality assurance requirements in Part 50 Appendix B or Part 72, Subpart G.

We also make it clear on the learning AMP section on the operating experience element that we expect applicants to commit to future reviews of site-specific as well as industry-wide operating experience.

We wanted this proactive approach to ensure that as data from future inspections comes in as well as data from longer term complementary research data comes in that licensees and CoC holders will evaluate whether or not their existing Aging Management Programs or procedures for implementing those AMPs need to be revised based on the review of that operating experience.

MEMBER SKILLMAN: Ricardo, going back to our prior discussion with Kris, is there anything in the update of the Reg Guide that points to either a suggestion or some form of verbal urging for timeliness for reporting for findings. Is there anything in there that says or that guides industry

when you determine that there is a change or there is a finding of substance, it's recommended that you make a timely report 30 days like you do on the reactor side?

MR. TORRES: So there are requirements in Part 72 that have a pretty high threshold for reportability. But as far as requirements for updating the NRC on whether or not they have reviewed this operating experience we're, we discussed this and we feel that the inspection procedure that Al will be talking about will provide further guidance to the actual inspectors when they go in to determine whether or not the licensees have properly done their reviews.

But the guidance here does not go into those specific details. It's, as you say --

DR. CSONTOS: It's a good comment about the timeliness of reporting. I think we'll have to take that into consideration.

I think the other answer to your question is that some of our AMPs don't, you know, what we've done so far is we've conditioned the licenses that we have approved for AMPs and not being able to change the AMPs which is different from what the reactors do because the reactors can go ahead and the reactor will, they can change AMPs quite often by themselves,

okay.

But because of the limited data that we have from our personal experience we felt it important that we condition the license that if you want to change an AMP you need to come before us, okay. So that was a little bit of a tweak that we had between ourselves and the reactor side to get to your, some of your concerns.

So we know that if somebody wants to augment their inspections they can do that. Okay, if they get OpE that says they need to shorten up their inspections that's one thing. But if they want to reduce it that is not going to be allowed unless they come before us.

MEMBER SKILLMAN: What I'm thinking is that Reg Guide compliance is voluntary, correct. So this is not a regulation.

DR. CSONTOS: Correct.

MEMBER SKILLMAN: It's basically a strong suggestion. And to industry's credit, industry wants to do the right thing because they have investment issues and they've got safety and they've got 10 CFR 20 issues that they need to contend with.

At the same time, 72.48 lets the licensees change anything they want any time they want and not

tell you.

DR. CSONTOS: And that's exactly why we did what we did for the conditions because that was a debate internally for a long time.

MEMBER SKILLMAN: If you want to have new information that helps everybody there needs to be some guidance that says, hey, team come on. Let us know or at least let your peers know so we are collectively getting smarter.

And unless that's embedded somehow in your Regulatory Guide you've probably missed an opportunity.

DR. CSONTOS: And that's where, it's a tough one for us because, like you said, this is guidance. We can't require the licensees and there's another nuance to this which is you have the CoC holders which are some of the vendors, okay.

And how does a Part 50 general licensee provide that information back to the holders and then disseminate it out everywhere? How do we get to those Corrective Action Reports? We see that as an inspection function, okay, an inspector is from a region.

That's part of what we're looking to augment in guidance space, in internal guidance space

for our staff coming forward too. But that, your enforceability question and this how do you promulgate in getting some sort of hard and fast, that's one we've been discussing reporting requirements and such internally for a long time as well.

I think what we've gone to is going saying that the regional inspectors are going to need to go check that and we'll have to go and figure that out in terms of the next inspection guidance which I'm sure we'll come and talk to you about as well.

MEMBER SKILLMAN: Thank you.

MEMBER STETKAR: I think we have to be a bit careful because there's no requirement on the reactor side that operating experience needs to be either shared among reactors or reported to the NRC. We rely on the resident inspectors to, you know, discover things that have happened.

We rely on INPO and, you know, various owners groups to share that information. But there is no, to my knowledge, there is no NRC --

DR. CSONTOS: There is a requirement to report to us so much as I think to a certain safety threshold.

MEMBER STETKAR: That's right, but that's based, yes --

DR. CSONTOS: Because it goes to what Dr. Ballinger's comment was which is, you know, a through-wall leak, is it something that is safety-significant enough if there's no real release out to the public to warrant a report to us? The problem is it's a compliance issue so therefore it is.

But for the reactor side leaks happen, you know, small leaks happen and they're not --

MEMBER STETKAR: I mean it's part of, you know, the reactor oversight process. That's an inspection process.

DR. CSONTOS: Correct. It's an INPO function and it's not, when it reaches a certain safety threshold then we get reports.

MEMBER SKILLMAN: 50.72 and 73 drive the reporting and the documentation. What I'm envisioning is the public's growing awareness of how much fuel is stored in ISFSIs and makes no difference what application you look at.

The public is learning, golly, here are all these things sitting out there and is this safe. And I think industry and the NRC need to be thinking we need to head this off at the pass. We need to be able to say we know how much fuel is there now, how much fuel is going to be there in the future, how it

can be moved around and transported like Dr. Corradini said, how lessons are being shared throughout industry for how safe these casks are and if there are findings how those findings are communicated.

Now industry is working to take corrective action to protect this growing force of casks. The public has become aware of it. It's an issue at the Environmental agencies and a lot of places.

MEMBER RYAN: If I may add I think that leads to the question and what does the future hold in terms of its reliability as we go forward.

MEMBER SKILLMAN: And that's --

MEMBER RYAN: For ten years, 50 years.

MEMBER SKILLMAN: And that's where the lessons on the AMPs are so important.

DR. CSONTOS: We have well-informed members of the public who are well aware of this and well aware of the concerns of degradation and reliability and maintenance and inspection issues, all these things that they are well aware of and we are too. So we're trying to get there.

MEMBER STETKAR: On the other hand, you know, the risk is, well this is zero. The public also needs to be aware that the NRC will focus its efforts on areas of higher risk and that --

MEMBER SKILLMAN: And that's appropriate.

MEMBER STETKAR: Indeed I, you know, I live under an air traffic control pattern and there's some likelihood that a plane is going to whack me some day. But I don't particularly worry about that. I'm aware of it.

MEMBER CORRADINI: I think all that Dick is saying I mean I appreciate and agree with what you are saying. But I don't think the perception is equal. So I think to the extent that it's a holistic approach on how you're doing that I think it's to the staff's benefit now because I'm sure industry is aware of this and are thinking about it.

But staff has got to, I guess I think Dick's point at least to think about it and have it connected.

DR. CSONTOS: Risk is a, is something we're thinking about.

MEMBER CORRADINI: The public doesn't view this risk like other risks. Whether or not we agree with that they just don't.

MEMBER POWERS: The trouble is we do look at risk.

MEMBER CORRADINI: I understand that. But it's the perception of risk as well as the risk

itself.

MEMBER POWERS: The trouble with the perception of risk. We look at risk. And we are creating a structure that's very parallel to what we do in aging management of reactors. And it looks like it's completely out of proportion to what the risk is.

MEMBER CORRADINI: How do we square that?

CHAIRMAN BALLINGER: That's why I keep a little bit focusing on this risk-informed and risk-based approach to this problem might yield some information that we don't have right now.

MEMBER STETKAR: Well on the other hand you can also take the position that this does not preclude the industry coming in with a risk-informed approach and saying consider this. You know, if the industry feels that this approach is too onerous.

DR. CSONTOS: Well and you'll hear from --

MEMBER STETKAR: Let folks take the lead and --

DR. CSONTOS: Right. And you'll hear from both the folks here. You know, we are well aware of the risks and associated risks. So you'll see that some of the requirements that we have made or some of the suggestions that we have made for inspections and such is not on the par of a Class 1 pipe, okay, or a

Class 1 system in a reactor.

You'll see that it's commensurate with a lower threshold.

MEMBER POWERS: But we still invoke Appendix B. Have we ever shown that Appendix B does us any good, that Appendix B does any good?

DR. CSONTOS: It's well before my time here and it's a criteria that's for quality assurance that is maintained throughout the nuclear industry and it's served us well I think. So for me to make a judgment on that now I can't do that.

MEMBER POWERS: I mean it seems to me this is a good place to try to make that judgment.

CHAIRMAN BALLINGER: But we're getting into a region here again I think what we're thinking about is where the degradation and the progression of the degradation is inherently probabilistic and not verifiable. With Section XI you go and look at the pipe, you get at it and you actually characterize the defects and then you take action based on those defects.

In this case it's entirely possible that you can't characterize the defects to the degree that you can with a Section 11 inspection and you can't characterize the going forward propagation of that

defect to a degree that you can say, okay, this is it. So that's I think where we're going.

MR. LOMBARD: If I may, Mark Lombard here. I think you can't say today that we have the technology to actually identify let's say for a stainless steel canistered system which I know you're very familiar with.

But we're pushing industry to develop those technologies and the inspection methods and techniques to, going forward to be able to identify those technologies.

CHAIRMAN BALLINGER: My problem is that if you had 100 percent reliability on inspection that is to say you could characterize whatever defect it is to whatever precision that you want, the inherent nature of the propagation of those defects is such that you can't predict what's going to happen because there's a distribution.

MR. LOMBARD: Yes, I understand.

CHAIRMAN BALLINGER: Okay, that's --

MEMBER CORRADINI: But you're also saying that in some cases you can inspect.

CHAIRMAN BALLINGER: Well you, it depends on how much money you want to spend. You're right. They're doing an admirable job, a really good job of

developing techniques of industry and everything to try to get at this.

But the very nature of the propagation process doesn't adhere itself to the kind of predictability that you might need. It could be a Friday weld, a Monday weld, who knows.

DR. CSONTOS: There are a lot of parameters that come into play.

CHAIRMAN BALLINGER: Yes, a lot of parameters.

DR. CSONTOS: And the same thing comes with a through-wall, if there is a through-wall crack there are things that we would have to try to ascertain to understand the risk. And that's where, you know, that's, you open up a large box if we go down that path of trying to evaluate what happens from a through-wall crack.

On our side we would prefer that we don't have to do that. I think that industry prefer we don't go through all that and its guidance and our requirements that we're trying to create here are such that we don't get a through-wall crack.

CHAIRMAN BALLINGER: I guess again, for the last, in this case the wish is not always the deed.

DR. CSONTOS: Correct. And that's, that was the details. So we'll get into that I think at a later point.

MR. TORRES: So just to continue, next slide please. So again in Chapter 3 we also include a discussion of some specific concepts of NEI 14-03 that the staff found complementary to this learning AMP approach.

Specifically the use of tollgates which are additional assessments to DOE's HBU report of the Quality Assurance program that we'll evaluate for new information coming in. NEI 14-03 also describes a general framework for the aggregation and dissemination of operating experience that we see immense value to that as well.

We, what we have done in NUREG-1927 is obviously better in the perspective of the reviewer and get some guidance for the potential review of that information if it comes in, in an application. We haven't yet endorsed NEI 14-03.

Finally, in Chapter 3 we found redundancy between the retrievability section and the expanded section on fuel internals and the Scoping and Relation, Chapter 2 and the Aging Management Review, Chapter 3. So we consolidated those details.

MEMBER SKILLMAN: So retrievability is in or out? It's just changed in location or it's out all together?

MR. TORRES: It's, retrievability still is defined in the definition section as an intended function. But it's, as far as the details of what regulations ensure retrievability, those are already discussed in Chapter 2 and Chapter 3.

So that information just seemed to be somewhat off. Also the way that we write our SCR it follows the format of 1927 so that the way that works is when you get to the spent fuel assemblies that's discussed in the Aging Management Review that's discussed in the scoping and relation and compliance with those regulations is addressed there.

So it just seemed it was a superfluous section to have also in the SCR because it's already addressed in both the scoping and relation and the aging management review.

MEMBER SKILLMAN: It's still in. Thank you.

CHAIRMAN BALLINGER: I'm reminded by Kris that there's some ongoing discussion about changing the retrievability criteria based on the fact that we don't have Yucca Mountain. There's a lot of things

that are going on.

DR. CSONTOS: The debate internally right now is to discuss whether or not they should be on a canister basis or a fuel assembly basis.

MEMBER CORRADINI: But I mean, this goes back kind of going toward what Dick said and Dana said and Ron, which is it strikes me that with all due compliments to the staff, you're looking at this and you're doing this really well.

But I am trying to look at this and work from that down so that you don't over engineer this and then something over here that's, is going to get you later. And I still don't sense that.

DR. CSONTOS: Well we're not, we're a in a very high flux period right now. And things are moving and such that we are evaluating various pieces of this. You're only seeing one piece of it. There's the high burnup piece, the whole Regulatory Commission summary about storage and transportation.

There's discussion about changing some of the other SRPs as well. And also the retrievability debate and discussion of the paper that's going up that we're thinking about, we have a team right now looking at this retrievability issue.

MEMBER CORRADINI: So maybe looking at

this paper will help us understand the big picture.

DR. CSONTOS: I think maybe we need to come before you, maybe think about a bigger picture type of discussion about where we see this whole area moving forward.

MEMBER CORRADINI: Because what Ron is getting at, which actually would link up with Dick and Dana, is that if I look at the big picture and I find the big picture has a certain level of risk that is not as big as one would expect but you've to do it holistically, then you might offer some risk-informed analysis or you would allow for the industry to be somewhat creative or innovative in how they do it because the long-term solution eventually is what's going to dictate this.

It's not going to be the ten year or the 20 year solution.

CHAIRMAN BALLINGER: By the way we're running the risk of getting way behind.

MR. TORRES: So as you all are aware there were five appendices in Revision 0 of 1927. Out of these appendices in Revision 1 we only retained Appendix A on Non-Quantifiable Terms as is.

We moved those appendices that the staff determined that added minimal value to the review

process based on the experience that we had with the previous applications. However, we replaced those appendices with new information. Appendix B includes the three example Aging Management Programs which will be discussed later this morning.

These example AMPs essentially represent a start to additional guidance that is on the works which will take form in a separate report in the style of NUREG-1801, Generic Aging Lessons Learned report for dry cask storage. Appendix C provides an expanded discussion on lead system inspections.

ISG-24, which was issued last year, provides guidance for the use of a high burnup fuel surveillance program for monitoring fuel performance during the period of extended operation. That has been incorporated in Appendix D.

Appendix C provides additional considerations for CoC renewals and it, this appendix clarifies the responsibilities of general licensees to the applicants, generally the CoC holders. And Appendix F provides a flow chart for calculating storage terms of dry storage systems.

Appendix C, as I said, is only a discussion that expands on Appendix E in Revision 0. That is, has been renamed to address what we now call

a lead system inspection. We clarify what's the purpose of that inspection. How do you, generic guidance for selection of systems realizing that multiple systems may need to be inspected to capture variations in designs, loadings applicable degradation modes.

We also provide generic guidelines for conducting the lead system inspection itself. We provide reviewer guidance on the use of surrogate inspections and we have an additional section on considerations for CoC renewals and more specifically the implementation of baseline inspections by all general licensees.

We hope that this, the information in this appendix will be useful to applicants for conducting these inspections and understanding what the NRC staff looks for when evaluating data and results from such inspections. Next slide please.

CHAIRMAN BALLINGER: In the text of the document it gives, when it talks about the lead system inspection it implies, it gives some criteria hottest, highest burnup, highest temperature, et cetera. And I think the words highest temperature are actually in there.

But in fact the selection of the lead

canister should be the one that has the highest probability of compromising its intended function and highest temperature isn't necessarily that one.

DR. CSONTOS: That's one of the major reasons why we changed this area because that --

CHAIRMAN BALLINGER: Some wording in there, you would think that some wording needs to be put in there that would imply that it's the highest temperature one or in other words --

MS. BANOVAC: I think that was in Rev. 0. Yes, so in Rev. 1 we kind of completely revamped this discussion, lead system inspection.

DR. CSONTOS: Right. So Rev. 0 had the highest temperature, hottest canister and that was fundamentally, you know, not correct. It was flawed.

CHAIRMAN BALLINGER: Okay. I thought I was reading Rev. 1 last night.

DR. CSONTOS: We took that issue to heart and revised it to be more, looking at it from a larger perspective.

MR. TORRES: Next slide please. So Appendix C, as I said, provides clarification, provides additional information for considerations on CoC renewals. Who is responsible for developing the TLAAs and AMPs? The AMPs are implemented and in

citing the applicable regulations and also discussing the use of 72.212 reports or documenting compliance with aging management activities.

Next slide please. Appendix F, as I said, provides a flow chart for calculating storage terms of dry storage systems loaded during either the initial storage period or during the renewal period. And we hope that this appendix will help clarify the timing for implementing aging management activities for general licensees.

And this concludes my overview of changes to 1927 Revision 1. I'll address any additional questions you may have.

CHAIRMAN BALLINGER: You're still on.

MS. BANOVAC: Okay. So no further questions we'll move on. And let me just pull up, Ricardo is also going to present the next talk. Just give me one moment here. And this will be the example AMP for reinforced concrete structures. All right, Ricardo.

MR. TORRES: Thanks, Kris. So as I said in Appendix B we've incorporated three example Aging Management Programs to provide additional guidance for licensees on what we look for when evaluating AMPs.

One of these AMPs is for reinforced

concrete structures which will be the focus of this talk. Slide 2 please. The AMP for reinforced concrete structures was developed based on guidance in consensus codes and standards as well as NUREG reports including ACI 349.3R, Evaluation of Existing Nuclear Safety-Related Concrete Structures, ASME Code Section XI, Subsection IWL, Requirements for Class CC Concrete Components of Light-Water-Cooled Plants, in NUREG-1801 the GALL Report for reactor license renewal.

We clarify that an applicant is, in the initial guidance an applicant can propose AMPs based on alternate criteria. These are not requirements by itself. We are looking for that exclusions of aging effects and mechanisms be properly justified with a technical basis based on site-specific or industry-wide operating experience as well as engineering analysis.

Also the justification should demonstrate the degradation mode will clearly not affect the ability of the SCC within scope of renewal from performing its intended function. Slide 3 please. So Slide 3 provides a list of aging mechanisms and effects covered by this AMP.

These are consistent with ACI 349.3R, ACI 201.1R, which is ACI Guides for Conducting a Visual

Inspection of Concrete In-service and the American Society of Civil Engineers Code 11 which is the Guidelines for Structural Condition Assessment of Existing Buildings.

These include degradation due to freeze-thaw, aggressive chemicals, aggregate reactions, corrosion of steel reinforcement, bleaching of calcium hydroxide, long-term settlement, irradiation and thermal desiccation. Slide 4 please.

And Item 1 of the AMP identifies the scope of the program. The AMP includes visual inspection of services, which is a condition monitoring activity. It includes a groundwater chemistry program for mitigating effects due to an aggressive water environment which include corrosion of reinforcement steel and chloride or sulfate induced degradation.

It includes periodic radiation surveys, a performance monitoring activity and continuance of daily inspection of the vents or inlet and outlet vents that provide passive cooling to the system to ensure that the design basis temperature limits are not exceeded due to reduced convection.

Item 2 of the AMP identifies the preventive actions. The AMP does not require additional preventive actions for structures designed

and fabricated in accordance to ACI 318, Code Requirements for Structural Buildings and ACI 349, Code Requirements for Nuclear Safety-Related Concrete Structures.

Next slide please. Item 3 identifies the parameters monitored or inspected. For additional inspections this should be able to quantify the aging effects of cracking, material loss, loss of bond and increased porosity and permeability.

The groundwater chemistry program monitors for pH and concentration of chlorides and sulfates as part of the mitigative actions. The irradiation service monitor for gamma dose and neutron fluence. And finally, inspections of the air inlet and outlet vents monitor for blockage that may lead to the design temperature limits being exceeded.

Next slide please. Item 4 the AMP Detection of Aging Effects. On this AMP the detection of aging effects provides the details of the when, where and how of the AMP. The specific aspects of the aging management activities for collecting data for evaluation.

In this element we clarify in NUREG-1927 that we're looking for information about the method or technique to be used, the frequency of inspection,

sample size, data collection and the timing of these inspections for monitoring activities. Visual inspections in this AMP rely on visual methods consistent with ACI guidance or a site-qualified system for remote inspections which is able to meet the acceptance criteria in the AMP.

Visual inspections include a base line inspection prior to entering the period of extended operation which provides the basis for monitoring and trending. And the inspection schedule is commensurate with ACI 349.3R, Chapter 6.

The areas of examination include all areas or as justified according to accessibility and previous operating experience. The AMP should clearly define accessible versus inaccessible areas and the respective sample sizes and data collection for visual inspections should be commensurate with applicable codes, standards and reports, ACI codes.

Next slide please. The groundwater chemistry program uses an analysis method able to meet the acceptance criteria and radiation surveys and performed using a calibrated detector with valid energy range. Both of these aging management activities include base line measurements prior to entering the period of extended operation and similar

to visual inspections the sample size should clearly be identified by the applicant with specific locations or a process for identifying specific locations where measurements will be taken.

The method of inspection of air inlet and outlet vents is through visual observation and the sample size is defined in the technical specification documenting the specific requirement. Next slide please.

In NUREG-1927 Revision 1 we emphasize that monitoring and trending should provide for an evaluation of the extent of the effects of aging and the need for timely corrective actions. This AMP describes, the AMP should describe how the data will be collected and evaluated.

This includes an evaluation of the results against the acceptance criteria and an evaluation regarding the rate of the degradation to ensure that the timing of the next inspection will occur before there's a loss of intended function. In this specific AMP the methods for monitoring and trending should be commensurate with ACI codes and standards which have been listed in Appendix B.

Slide 9 please. In NUREG-1927 we also clarify that the acceptance criteria again should

ensure that the SCCs intended functions are maintained for the renewal period. The proposed acceptance criteria should be justified by operating experience, engineering analysis or the use of consensus codes and standards.

And that's the approach that this AMP follows. The acceptance criteria is commensurate with ACI 349.3R-02 criteria. Acceptance, that three-tier criteria acceptance without further evaluation, acceptance after review and acceptance requiring further evaluation.

We look for the applicant to define when a finding is to be entered in the Corrective Action Program in the acceptance criteria element. For example if tier two criteria is exceeded, it's not met, that's when the Corrective Action Program would be triggered. Those details we're looking for on the application.

Next slide please. With the groundwater chemistry program the acceptance criteria is commensurate with ASME Code Section IX, Subsection IWL which defines an aggressive below-grade environment which is defined as pH lower than 5.5, chlorides exceeding 500 parts per million or sulfates exceeding 1,500 parts per million.

Radiation surveys should be performed to ensure compliance with 72.104 and the adequacy of the acceptance criteria at or near overpack locations should clearly consider the design basis calculation documented in the FSAR. And the acceptance criteria again for air inlet and outlet vents the absence of any blockage that may lead to design temperature limits being exceeded.

Next slide please. Timely corrective actions including root cause determination and prevention of recurrence for significant conditions adverse to quality are critical for maintaining the intended functions of the SSCs. The corrective actions taken in the program again are consistent with Part 72, Subpart G, Part 50 Appendix B, security program requirements.

And the existing Corrective Action Program provides for the assessments listed in this slide. In the interest of time I'll skip through them. But the AMP, at this specific AMP references applicable concrete rehabilitation standards.

ACI has put guidance which is, has been referenced in Appendix B. And we look for referencing of some of those codes in this specific element. Next slide please.

The confirmation process which is Element 8 of an AMP is intended to verify that preventive actions are adequate and that appropriate corrective actions have been completed and are effective. Administrative controls, Element 9, provide a formal review and approval process for activities performed under an AMP.

Both the confirmation and administrative controls should be commensurate with the QA program. Again, Part 72 as well as Part or Part 50 depending on the licensee, the QA Program again ensures that the precluding of repetitions of significant conditions adverse to quality.

And the QA Program also ensures that administrative controls include provisions that defined inspector requirements, instrument calibration and maintenance, record requirements, record retention requirements and documented control. Next slide please.

Operating experience you see is in providing justification for the effectiveness of each AMP program element. And it also provides critical feedback for enhancement of the aging management activities.

The operating experience cited in the AMP

should support the determination that the effects of aging will be adequately managed for, to maintain the SSC intended functions. And this AMP should review applicable operating experience including internal and industry-wide condition reports, Corrective Action Reports, vendor issued safety bulletins, NRC information notices as well as other applicable industry initiatives.

For example the, any additional EPRI-sponsored inspections. Degradation in the referenced AMP should clearly identify the degradation as either age-related or event-driven and should provide some justification for that assessment so that it's put into perspective for the upper coordinates of the AMP.

So this finalizes just my overview of the concrete AMP in Appendix B. I would be glad to answer questions.

MEMBER SKILLMAN: A question back on your Slide 12, Subpart G in Appendix B, 50 are clones. They're basically the same guidance. Not mentioned in your bulleted presentation here is configuration control.

And would it be fair for us to assume that since you're citing Part 50, Appendix B, that this is a partial listing on this slide and that configuration

control is also part of this?

MR. TORRES: Yes.

MEMBER SKILLMAN: Okay, thank you.

MR. TORRES: And if it's not listed in 1927 we can expand on that.

MEMBER SKILLMAN: Thank you.

CHAIRMAN BALLINGER: Any questions on this? Darrell, I think.

MS. BANOVAC: Yes, let me just pull up the next presentation. So our next presenter will be Darrell Dunn. He'll be presenting the example AMP for localized corrosion and stress corrosion cracking over canisters. So, Darrell.

MR. DUNN: Okay, thank you. So 1927 Revision 1, Appendix B contains an example AMP for localized corrosion and stress corrosion cracking of welded stainless steel dry storage canisters which we have identified in this revision of 1927 as a potential aging effect that may affect canisters in some environments largely based on operating experience with operating reactors.

I'll also mention that we've had the opportunity to come before the ACRS and including this subcommittee I believe and we've had some discussions with respect to this potential aging mechanism and got

many, those discussions have been beneficial. And finally I'll just point out before I start we're continuing to, our evaluation of this as a potential aging mechanism for the stainless steel canisters and we look forward to your feedback.

Okay. So the basis for development, this example AMP is based on a consensus code and standard and we used in the development of this example AMP the ASME boiler and pressure vessel code, Section XI which is Rules for In-service Inspection of Operating and Nuclear Power Plant Components because at this time there is no equivalent Section XI requirement for dry cask storage systems.

But, well I'll address that in a later slide. That, the use of Section XI is identified in NUREG-1801, the GALL Report as being effective in monitoring or effective in managing aging effects for operating nuclear power plant components.

That said, we recognize that chloride-induced stress corrosion cracking is a complex process with multiple dependencies including residual stress, controls how fast and far a crack might propagate. The operating environment which controls what type of atmospheric deposits get put on the canister.

And there could be local variations and

seasonal variations in environmental conditions that are important to consider and also canister temperature which is a function of the design, the loading of the canister and of course time. And that also has a big effect with the operating environment and the residual stress in terms of what we could potentially expect for localized corrosion and stress corrosion cracking initiation and propagation.

So next slide please. So the next ten slides I'm just going to walk through a high level summary of the example Aging Management Program. So the first element of the AMP is the scope of the program. And the scope of the program here is essentially in-service inspection for localized corrosion and stress corrosion cracking on welded stainless steel dry storage canisters.

We focused the scope of this program to areas of the canisters where we believe that localized corrosion would be, and stress corrosion cracking would be more likely to occur. So this includes fabrication and closure welds, the heat affected zones of those closure welds and fabrication welds, potentially locations where temporary supports or fixtures are attached by welding and then subsequently removed, if those processes have resulted in a

significant change in the residual stress or a micro-structure in those locations.

We know that crevices can be locations where chlorides can concentrate and localized corrosion can initiate. Horizontal surfaces tend to be surfaces where atmospheric deposits can accumulate and then of course surfaces that have lower than average temperature may be areas where localized corrosion or stress corrosion cracking initiates sooner than the average locations on the canisters.

Okay, so maybe back up, I do want to point out that we don't expect that localized corrosion by itself will be a degradation mechanism that could threaten the confinement boundary of the canister. But we also recognize that it's a potential location for which SCC can initiate and so that's why we're interested in looking at that particular degradation mechanism along with stress corrosion cracking.

MEMBER RICCARDELLA: Pitting and localized corrosion.

MR. DUNN: Pitting and crevice corrosion. Okay. So AMP Element 2 is Preventative Actions. This example AMP is a condition monitoring AMP and so at present we recognize that preventative actions are not

presently incorporated into existing dry canister storage system designs.

But we also understand that future designs or amendments could include different preventative actions such as surface modifications to impart compressive residual stresses on welds and weld heat affected zones or the use of materials with improved localized corrosion and stress corrosion cracking resistance.

Next slide. So the AMP Element 3 is Parameters Monitored or Inspected. This is, we have identified here as the canister surfaces, the welds, the weld heat affected zones or discontinuities and imperfections which is language that is consistent with ASME Section XI.

Specifically we would be looking for areas that, where localized atmospheric deposits can accumulate on the canister surfaces and indications of potential corrosion products on the canister surfaces. That type of examination could be conducted using a visual inspection which I'll get into in the next slide.

However, the size and location of localized corrosion such as the size of pitting corrosion or crevice corrosion or stress corrosion

cracking would likely require some other more complicated examination method such as a surface or volumetric method.

AMP Element 4 is Detection of Aging Effects. And what we've identified here in the example AMP is a qualified and demonstrated technique to detect evidence of localized corrosion and stress corrosion cracking. We've taken sort of a hybrid approach to doing this.

We know that remote visual inspection has been used in previous canister inspections and we know that remote visual inspection has been able to identify areas on canisters where there has been iron contamination and subsequently corrosion of that, there was iron contamination on the surfaces. And so corrosion products were identified on the canister surfaces even though corrosion of the canister itself was not occurring.

In addition, some of the testing that we've conducted indicates that when we get conditions where cracking can occur we also get pitting to occur, we get the formation of corrosion products which are very readily visible using visual methods. If those were to be identified in a remote visual inspection then the suspected areas, areas with corrosion

products, those areas would need to be, undergo some additional evaluation and that would likely again have to be done with some type of volumetric to determine or to characterize in size the nature of those areas.

CHAIRMAN BALLINGER: Okay. This is a very weighty sentence which the devil is definitely in the details and the wish is not the deed. Is there a qualified and demonstrated technique to detect evidence of localized corrosion in the canister, in the configuration itself?

MR. DUNN: By visual methods there have been the, so for example the Calvert Cliffs inspection was done using a system that's capable of an EVT-1 inspection which can detect localized corrosion, the initiation of localized corrosion. Okay, so it's very capable for doing that.

CHAIRMAN BALLINGER: Evidence of localized corrosion.

MR. DUNN: Yes.

CHAIRMAN BALLINGER: Okay. Let's give the fact, okay, so we have evidence. If we have evidence then what do we do? Is there another technique that's coming down the pike that's, has to be much higher resolution than these that can actually characterize it?

And if we characterize it and say okay, yes, there's a crack. It's half an inch deep. Now what happens?

MR. DUNN: Okay. I'll get into the acceptance criteria to address the crack. But the answer to your first part of the question is there a technique coming down the line, yes, we hope so it's coming down the line. Has it been demonstrated today, no.

MEMBER RICCARDELLA: I mean Eddy current could certainly find it.

MR. DUNN: Eddy current could certainly, well I qualified it by saying in the configuration that we have in the, for the canisters with the shield and everything.

DR. CSONTOS: But there are, so EPRI through the industry has, they are working on it. They are developing and I know Eddy current is one of the ones that they are focusing, I know vendors are focusing on it.

Eddy current is one that they're really focusing on from the industry point of view to address this particular subject. So it was sizing, things like that because two stages and Darrell will get into it, two stages, detection, sizing. Two different

pieces.

CHAIRMAN BALLINGER: And disposition.

DR. CSONTOS: And disposition. That's the assessment piece. That's Section XI that we're talking about.

MR. DUNN: So but to be clear that is the volumetric, any volumetric or even surface examination of the canister using Eddy current for example, is something that has to be developed. Okay. We can do the remote visual inspection of a large fraction of the canister surface can be done using existing technology.

And we have pretty high confidence that if there is areas of localized corrosion from which stress corrosion cracking can initiate those can be detected. You've got to keep in mind that this is a very different process from something that's completely immersed in solution.

Those corrosion products don't get to get transported away. There's no solution there. So they stay there on the surface and they're --

DR. CSONTOS: That's the --

MEMBER RICCARDELLA: I mean if it was really bad couldn't you pull the canister and do the inspection? I mean if your visually detected

something that was really bad.

CHAIRMAN BALLINGER: You're talking $10^{8}$R.

MR. DUNN: Okay. There has been a system proposed for doing that. I don't think that it's been built or demonstrated. But, yes, conceivably you could do that.

DR. CSONTOS: And EPRI is also looking into this issue with their technologies as well and those are, you know, things that they can talk about. I don't want to go into them. We just are aware that they're working on these areas of you may not have to pull out the canister to do the repairs.

CHAIRMAN BALLINGER: But again there's ongoing work that may or may not prove fruitful in the future. But for a licensee that's going through this process of renewing a cask, what of those techniques are not available?

MR. DUNN: Well, okay for the visual, yes. If you're talking about for surface and volumetric we really believe it's a matter of getting a deployment technology. We believe the inspection technology exists. It's a matter of deploying it into these systems as they sit today.

DR. CSONTOS: And when you're saying, you know, if we need to have sizing, if there is a sizing

piece of the inspection that may not work inside a canister, then maybe the requirement is to pull it out, you know, and do the inspection. But there are other ways that we can skin this cat than just saying it can't be done.

MR. MCCULLUM: Al, is it appropriate for industry to speak?

CHAIRMAN BALLINGER: Go ahead.

MR. MCCULLUM: Rod McCullum with NEI here. There is a lot going on in industry. EPRI has inspected three canisters at EVT-1 level as I'm sure you're aware of.

All three vendors are developing and it is delivery. There are inspection technologies. You're not hearing much about it because they're highly competitive and it's proprietary at this point. But I think, I know there have been proprietary discussions in the TN renewal that's going on.

Industry is also, through the EPRI effort, working on susceptibility criteria. We've done crack growth rates. So we know these are very slow processes. That gives us time from the first indications of corrosion and the three casks we inspected were in what we consider some of our more vulnerable locations environmentally and of course

lead canister inspections on the series that are coming up now are going to look at that as well using susceptibility criteria being developed by EPRI.

So the bottom line is we are doing everything we can do at this point. The tollgates are designed to progressively, as we go to later tollgates, use more advanced technologies. Those works are underway.

And industry is finally committed to a White Paper that the gentleman to my right here, Kris Kummings is leading the effort on which will address this. Okay, what happens when we find the first evidence of corrosion?

Again we know from what we've got now that we have time. I mean obviously you can put it in a transportation overpack to give you an additional layer of confinement. We know how to do that and that would be the first response if anything emergent happened.

MEMBER RICCARDELLA: I'm sorry. Put it in a what?

MR. MCCULLUM: A transportation overpack. We know how to, a transportation overpack gives you an additional confinement boundary. So if you get to tollgate at site x, and you find evidence of corrosion

you could, we have the technology and it's deployed every day, you know, to take a canister out of a storage overpack and put it in a transportation overpack.

That then gives us time to develop mitigation. We understand that is not a fully satisfying answer to members of the public and so that's why we're working on this White Paper to further develop, you know, the what if scenarios and how we would respond to those.

And we know in parallel in the proprietary world the vendors are all working on things. And as license applications move forward or renewal applications move forward some of those would at least begin to see the light of day.

Finally, I think there is one that is somewhat public that with the situation in Monticello where you have a cask where the initial weld, not an aging issue but was questioned that some advanced NDE is being deployed there. And so that's part of these efforts and evidence that the efforts are bearing fruit.

So I think what we're keeping up with the pace of which things corrode fairly nicely.

DR. CSONTOS: And I think the Monticello

example is a good one to show also about the transportation overpack. That was a transport or transfer overpack. But that's another, that's the confinement boundary then.

Once you stick the canister into one of those the confinement boundary is now changed to that.

MR. DUNN: Okay. So I think I'm on the third bullet here the sample size. We identified in this example AMP a minimum of one canister at each site. And that would have to be canisters with the greatest susceptibility for this type of aging mechanism.

So longest time in service, coldest temperature where we can presence of the deposit itself and localized corrosion and stress corrosion cracking could potentially initiate. That would be the criteria for evaluating susceptibility.

Data collection is documentation and examination of the canister inspection and the location and appearance of deposits in areas that have undergone aging, localized corrosion or stress corrosion cracking. We picked a frequency of five years.

This is consistent with other inspection criteria in ASME code. But we also did some very

conservative calculations of what we expected a maximum possible crack growth rate to be. And we wanted to have inspection frequency more, such that we could have multiple inspections before we would expect the confinement boundary of the canister to be compromised.

Now if we take that data and when we marry it with actual environmental data we find that we're quite conservative. So a five year inspection interval would give us many opportunities to examine the canisters.

CHAIRMAN BALLINGER: So the five year criteria is based on, is going to be documented based on engineering judgment or based on facts? How is the five years arrived at in a way that can be followed by somebody that's looking at it?

In other words it's just we think it's five years and we think it's okay or the reason it's five years is because of da, da, da, da and it couldn't be any longer than this or that.

MR. DUNN: Right. We can provide and I'll, I don't believe in this example AMP that we have clearly defined how we got to that criteria. But that can be added if that's desirable.

MEMBER RICCARDELLA: There were some crack

growth calculations that led to that?

MR. DUNN: Yes, yes. So we can add that information. But again, it's really a very conservative criteria that led us to that point. And also it's important to remember that it is an example AMP.

A licensee can come with or a CoC holder can come with their AMP, propose an inspection frequency and justify that. Okay. The next slide is AMP Element 5, which is Monitoring and Trending. Here we looked for documentation of the canister condition, particularly with those areas of interest where we think that localized corrosion and stress corrosion cracking might initiate.

And this needs to be done in such a way that subsequent examinations can utilize that information to determine if there's a change in condition that warrants some additional assessments. Change in the size and number of any corrosion product accumulations.

We recognize that not all corrosion product accumulations on these canisters are going to be indications of localized corrosion. It could be iron contamination as we've seen before.

But if they are indications of localized

corrosion we would expect over time the size and number of those areas would likely change or increase as the canister temperature decreases and the probability for localized corrosion occurring may increase with time. And then finally the location and sizing of localized corrosion and stress corrosion cracking.

So AMP Element 6 is the Acceptance Criteria. And the acceptance criteria, the highest level of acceptance criteria that doesn't involve any additional actions would be no indications of pitting corrosion or crevice corrosion, no indications of stress corrosion cracking or no indications of the corrosion products on or adjacent to fabrication and closure welds or welds for any temporary supports or attachments that may have been used.

If there are locations where corrosion products are found that does require an additional examination for the presence of localized corrosion and stress corrosion cracking and canisters with localized corrosion and stress corrosion cracking must be evaluated for continued service.

In this example AMP we identified some potential ASME boiler and pressure vessel code Section XI acceptance criteria. The first one is defined in

IWB-3514 which is allowable pre-service and in-service planar and linear flaws for pressure vessel, for pressure retaining pipes or pressure retaining welds in piping.

And this includes austenitic materials. That has defined an acceptance criteria for the depth of a flaw as a function of thickness of the piping system.

MEMBER RICCARDELLA: Basically ten percent.

MR. DUNN: Maybe up to 15 percent if, with certain aspect ratios. But, yes, basically ten percent. IWB-3640 if IWB-3514 was exceeded and there was, a licensee wanted to justify the continued use of that system beyond that IWB-3640 is an analytical evaluation and acceptance criteria for planar flaws in stainless steel piping.

That is a, that analysis requires an analysis of flaw growth and also service load conditions including all potential service loads that the system would see in the period of time for which the evaluation was applied.

CHAIRMAN BALLINGER: Is there any consideration for listing as a reference Fitness for Service-1, which has chapters in it on exactly the

disposition of stress corrosion cracks themselves not just club surface defects and things like that?

MR. DUNN: Are you talking about --

CHAIRMAN BALLINGER: It's an ASME.

MR. DUNN: It's a newer one.

CHAIRMAN BALLINGER: The new ASME derived from API-579 and 580 or something like that which is basically ported over to an ASME document which is 1,000 pages long.

MR. DUNN: Right.

CHAIRMAN BALLINGER: But it's Chapter 7 and 8 and 9 in those deal with environmental degradation and specifically the disposition of stress corrosion cracks.

MR. DUNN: Yes, we've actually seen that being used in previous renewal applications. So we didn't base this example AMP on that. But that's certainly something we could consider.

CHAIRMAN BALLINGER: As far as I know that's the first example in the ASME Code where there's been a specific attempt at dealing with environmentally assisted cracking.

MEMBER RICCARDELLA: I know there are some others as well.

CHAIRMAN BALLINGER: But that's inspection

and repair, okay.

MEMBER RICCARDELLA: I know but it's crack growth analysis of stress corrosion cracking in stainless steel and in --

DR. CSONTOS: Or fatigue, or environmental fatigue.

MR. DUNN: So the 2013 version of the ASME Code and this particular section has specific sections that deal with, so they specifically identify stress corrosion cracking as a potential aging mechanism.

MEMBER RICCARDELLA: They do. But, you know, it's not the planar, it's not this external chloride cracking. That's a totally different mechanism.

CHAIRMAN BALLINGER: Yes, this deals, this comes out of oil and gas industry where they have specifically this problem.

DR. CSONTOS: Yes, and this is why what Dr. Riccardella just said is why we're asking them to look into for specifically for our purposes, for Section XI. And so hopefully at some point we can replace these with one that's geared towards dry cask storage and chloride stress corrosion cracking.

MEMBER RICCARDELLA: I mean it gives principles. You just have to go out and get the

applicable data that applies to the chloride process as opposed to IGSCC in boiler and water reactors.

DR. CSONTOS: This is a surrogate for this temporarily.

MR. DUNN: So we recognize that we're borrowing from operating reactor, from Section XI from Operating Reactor. But we have asked the ASME Section XI Standards Committee to take the actions necessary to establish rules for in-service inspection of ISFSIs and that would include development of requirements for canister and overpack examination and inspection requirements and also acceptance standards.

So and we will participate in that activity with ASME. So your suggestion about using the document derived from API-579 might very well be a starting point for that activity.

MEMBER RICCARDELLA: Step back, bigger picture, what are the consequences of a violation, you know, of a leak, a violation of containment boundary? I mean is it an issue?

I mean in Section XI we're dealing with something where you're putting, you know, wrap the containment and it's a much, it's a significant issue.

DR. CSONTOS: It's a difficult question to answer right now. The, I mean we do have, it's

considered low risk. I don't know if you want to say something about your PRAs.

MR. CUMMINGS: Let me speak to that. So Kris Cummings, NEI. So in my previous life I had done confinement evaluations for dry cask storage. And the latest canisters and tested to leak 1 times $10^{-7}$.

But prior to that they were tested to 5 times $10^{-6}$ and as part of that you had to do a confinement analysis dose analysis that even if you leaked at that design basis rate you could still meet the 25 millirem per year requirement in 10 CFR 72.

So that gives us at least an idea of if we had a crack and it were to leak at some rate we don't know what it is, that's a tough problem to crack, you know, how you do you go from a crack to a leak rate. That gives us some idea of the order of magnitude that we think the consequences would be, really low.

CHAIRMAN BALLINGER: See we keep circling around this risk-informed --

MEMBER RICCARDELLA: You know in Section XI we introduced risk-informed in-service inspection with the idea of evaluating both the potential for a problem and the consequences.

DR. CSONTOS: Right. That's why we haven't required every canister to be inspected. You

know and that's why we've seen that EVT-1 versus going directly to a UT or something along those lines there is a commensurate reduction in the threshold I think for the inspectability and inspection requirements per the risk.

But the other part to it is I know we're dancing around it, but, you know, there are some unknowns here when you're talking about if we do have a through-wall crack. Defining what they need to look at, what crud build up there is that, you know, what, how much of the fuel has been breached?

You have a lot of things that you need to start thinking about if you really want to quantify it in a really risk-informed manner. And I know that Dr. Powers, Dr. Ballinger, Dr. Riccardella, you've worked on XLPR. And I think this, and I worked on it for a while and that's how many years have we worked on that and I thought that was a fairly simple problem.

This is easily an order of magnitude harder problem in terms of risk, okay, analysis then I think XLPR is, okay.

CHAIRMAN BALLINGER: How much harder is it to do it deterministically?

DR. CSONTOS: I think it's a little because we already have it for Section XI and porting

it over, the deterministic side of it and understanding it from an engineering judgment point of view about the relative risk I think we've done a reasonable job in terms of trying to come up with a reasonable solution to this.

But it's, you know, it's from a risk, well I'll just end it there.

CHAIRMAN BALLINGER: But just to give you an example choosing the appropriate canister you say we don't, we won't inspect them all. Well just the welding process itself and how it's done and how it's allowed and start and stops and weld repairs and stuff like that sort of tells you that one canister can be, you don't know how to determine what the most susceptible canister is to some degree.

DR. CSONTOS: And that's where susceptibility criteria that, you know, Rod mentioned we are doing our own modeling in house to look at environmental, what Darrell had mentioned earlier was we're looking at environmental pieces.

We're also looking at some thermal results to see where the temperatures fluctuate on the surface of a canister so we can pinpoint the percentage as well as the location of where we need to really be looking for from a susceptibility criteria point of

view.

So we don't, it's not necessarily we have to have 100 percent coverage. We have to go look at those highest susceptibility locations to see evidence of localized corrosion, crevice corrosion, pitting, you know and such.

MEMBER RICCARDELLA: It would be interesting to put this through the Section XI risk-informed RSI process to see where it falls at high, medium or low.

DR. CSONTOS: Yes, I actually was thinking about that a while back too. But it's something that, you know, we're going to go see. We will talk to ASME about, you know, how we're going to approach that.

MR. DUNN: Okay. So the next slide is AMP Element 7, Corrective Actions. If there were an inspection that revealed an indication of localized corrosion and stress corrosion cracking this example AMP identifies the need for supplemental inspections to determine the extent of the conditions at a given site.

So once one canister is found to have an issue there would have to be additional inspections of additional canisters to determine the extent of condition and also the extent of the corrective

actions that are needed. And this is consistent with what ASME calls now additional examinations if areas of localized corrosion or cracking is identified.

It also in the AMP, example AMP also identifies the need for subsequent inspections of canisters with indications to monitor and trend the location where those indications have been identified and determine whether or not those are areas of active degradation.

And then finally, canisters that don't meet the prescribed evaluation criteria would need to be removed from the service or repaired. And obviously that is something that we haven't seen yet, hasn't been done yet and it's, something would have to be developed by the licensee.

Okay. Next slide. So for both the confirmation process and the administrative controls these AMP elements need to be consistent with the licensees Corrective Action Program and consistent with 10 CFR 72 Subpart G or 10 CFR 50 Appendix B, depending on whether or not they are site specific or are general licensee.

And it's for the confirmation process we're looking here to ensure that the inspections, evaluations and the corrective actions that are

necessary are completed in accordance with the site specific or general licensee Corrective Actions Program. And so some things that we specifically identified is the evaluation of the extent of condition.

If there's a, if there's localized corrosion or stress corrosion cracking identified that has been conducted properly. Evaluation for continued service if that's the path that's chosen or the adequacy of any repair, replacement or mitigation actions that were performed.

AMP Element 9 is Administrative Controls. Again this has to be consistent with the licensee's QA Program. But some of the things that we identified, specifically we were looking for here was training requirements for inspectors and the records retention requirements.

And the last AMP Element 10 is Operational Experience. So we've performed, a limited number of inspections have been conducted to date. There have been cases where atmospheric deposits were found on the surface of these canisters.

But in the limited number of inspections conducted to date there is no reported cases of localized corrosion or stress corrosion cracking

identified on the welded stainless steel canisters. We have, of course, published Information Notice 2012-20 which indicates that chloride induced stress corrosion cracking that occurred from atmospheric deposits accumulating on surfaces of structure systems and components and operating reactors and the subsequent deliquescence of those deposits, you know, that process can induce stress corrosion cracking.

So going forward we would expect that the licensees need to continue to evaluate the operating experience, look at things like the INPO database, NRC information notices and work that's performed by EPRI on this subject to inform their Aging Management Program going forward.

We did identify a couple of things that I think were brought up earlier in the discussion perhaps. Field data necessary to assess conditions for chloride induced stress corrosion cracking, whether or not that actually exists on the welded stainless steel canisters.

There has been a limited number of these evaluations conducted to date. They are somewhat challenging to do and I don't think we have a really great handle on how these need to be done or how they can be done.

MEMBER RICCARDELLA: I'm trying to understand your third bullet versus your first. First says no recorded cases and then --

MR. DUNN: Sorry, that's from, okay, so NRC Information Notice 2012-20 identifies cases for operating reactors.

MEMBER RICCARDELLA: Not canisters. I've got it.

MR. DUNN: Not canisters. And I apologize. I should have clarified that in the bullet. But it's operating reactor components not dry cask storage systems.

And then finally the laboratory data on chloride induced stress corrosion cracking rates are really necessary if we're going to have a better process to inform our in-service inspection intervals. What we have right now is a limited amount of data.

There's caveats with all the data that we have. We're comparing that to what we have for operating experience. But we recognize that right now we probably could use a much better set of quality controls to inform these in-service inspection intervals.

MEMBER RICCARDELLA: Is there a program on this in research?

MEMBER REMPE: Al, you mentioned earlier that you have models and to help you inform your inspection which can, when they inspect and what confidence do you have in those models?

MR. DUNN: Well the, right, the models that we have right now we're looking at crack propagation rate is a function of temperature and then marrying that to environmental data which is obviously site, location dependent. And what we find is that if you're at elevated temperature just because of the activation energy you can get higher crack propagation rates.

But the environmental conditions occur very infrequently at those elevated temperatures if the canister is at elevated temperature to get cracking to occur. So you, while you can have faster propagation rates those faster rates occur very infrequently, typically in humid days in summer where you can get higher values of absolute humidity in the local environment.

My comment about better laboratory data is right now we don't, we have a limited set of data and we have things that we don't like about all of that data, frankly. And it would be nice to have data that we had a greater degree of confidence in.

That said, what we've done is to take the data that we do have, build a model and then compare it to what we actually observed in operating experience to give us at least some degree of confidence that we're in the right ball park in terms of what we can expect for propagation rates.

MEMBER REMPE: So basically your models are predicting more than what you would probably see in the real world. Is that a true statement? And so you don't have a lot of confidence, it's just a close estimate.

MR. DUNN: Right now the models are, there's other layers of conservatism in the model. So the answer to your question is, yes. So for example, we're assuming that initiation or restarting of a crack if it was growing is instantaneous.

And we know for certain that's just not really the case. So, yes, we are probably over predicting the rate of degradation based on what we have now. But again, we have some uncertainty with the data that we have to build that model.

MEMBER REMPE: Thank you.

DR. CSONTOS: And that five year interval so far, okay, is not just for stress corrosion cracking. It is those unknown knowns or known

unknowns from the reactor side in terms of degradation mechanisms. So we felt that five years was appropriate just as a, because of the limited data set that we have right now for the OpE it was a reasonable approach right now to go with five years.

Reactors are ten years, okay. But at some point in the future if there is sufficient information coming in that says look we've done all these exams and we're not seeing much then we're open to relaxing those ISI intervals as well as looking at the research and confirmatory research and such to inform us of that as well.

MEMBER RICCARDELLA: Is there anything that's plant location specific? I mean I think this would be different for something --

DR. CSONTOS: This is why I said unlike XLPR this is such a more complex problem because it is environment dependent, it is site dependent, it is what kind of deposits you have, what, then you also have to look at problems with if there was welding issues, the supports.

There are just so many other factors that you have to take into account that's environment dependent that is very different than some of the other work that we've done on the reactor side.

MR. DUNN: Okay. I think that concludes my presentation.

CHAIRMAN BALLINGER: Thank you. I think we're one presentation behind because if we know that then we're on time. I'd like to take a break. I get tied up sometimes. Let's take a break until five minutes until 11.

(Whereupon, the above-entitled matter went off the record at 10:40 a.m. and resumed at 10:55 a.m.)

CHAIRMAN BALLINGER: Okay. We're back in session. Thank you very much. You're on next, Al.

DR. CSONTOS: My name is Al Csontos. I'm the Chief for the Renewals and Materials Branch in the Division of Spent of Fuel Management. This presentation is really along the margin of Bob Einziger who is now with NWTRB, really developed this monitoring program as well as the ISG-24 that is corollary to this.

And so I'm giving this out but I'm not an expert on fuels by any means. So I'm going to try to go over and give you what we've come up with and what we're going to be putting into the 1927 Rev. 1.

Okay. And it's the example of the High Burnup Fuel Monitoring Program. This is a program

where we're doing a surrogate surveillance program. It's akin to something similar to our RPV, the Reactor Pressure Vessel Surveillance Program in terms of, you know, for that it's the embrittlement issue.

Here we're worried about the cladding and cladding failures and cladding integrity, okay. And so as a result of that this is for high burnup fuel. We have observations that are done for low burnup fuel and that was the basis for ISG-11.

And then this is specifically for high burnup fuel with discharges greater than 45 gigawatts per metric ton of uranium. And so that was where, the point of this effort and I think you see it with how we've moved forward with the concrete, with the corrosion AMP and now this AMP.

We've gone to inspection and monitoring, okay. And the inspection and monitoring gives us a way to address or assess how the components and the subcomponents that are out there for these dry cask storage units are degrading and how they're being maintained over the long period of time for storage for renewals, for example.

And so in this case this is a surrogate surveillance program to check the condition of the high burnup fuel that's in dry storage to the ISG-11

expectations and the technical basis is in ISG-11. And then what we're doing here is we're trying to confirm that the intended function of the fuel and all these other pieces in there are maintained, internals are maintained as expected during the period of extended operation.

As a result of that what Bob has created was one that was using ISG-24 which is this use of a demonstration program as a confirmation of the integrity of the continued storage for high burnup fuel beyond 20 years. That's akin to what it was for the low burnup fuel demo project.

So he wrote this ISG out there to say this is how you would do a demo project for high burnup fuel. And that is where DOE as EPRI has, as DOE has contracted to develop this high burnup fuel dry cask storage RNB project which we refer to HDRP.

Next slide please. So a little bit of information on this DOE-EPRI HDRP. There are intact those can be loaded it's an AREVA TN-32 bolted lid at North Anna. We're going to be getting an amended request in for that.

And it's going to store intact high burnup fuel. It has nominal burnups between 53 and 58 GWd/MTU of uranium and it will contain about four

cladding types. And these are the four cladding types.

And so what this canister or this fuel so when other licensees come in they have this type of fuel they can then reference this test as part of their Aging Management Program. And so it's a surrogate surveillance of these four, two, four, five different cladding types and of the burnups that are there as well.

And this cask would be licensed to the ISG-11 temperature limit of 400 degrees and loaded in such a way that the cladding will, is as close to the limit as practicable. That's an area of debate right now. I know that Bob before he left and others were looking at, there are thermal folks who are looking at and DOE was looking at how to keep the fuel as hot as possible as far as temperature so that it gets as close to a conservative number as possible.

The problem is that we need an RN on our thermal analysis are very conservative. And so it's now that conservatism is actually hindering some of the higher temperatures that we were trying to push those fuel rods to.

Slide 5, so now we're going through the AMP element. I am going to not talk about AMP

Elements 7 through 10 because they are all basically the same. It goes from all the different other, the two other AMPs that you saw here for time. If you have any questions then I'll go and talk to it.

But I'll just talk about AMP Element 1 first, Scope of the Program. Licensee when they come in with the AMP they need to identify the maximum burnups for their cladding and their fuel, the cladding types, the maximum temperature that the cladding saw through their drying process and then the basket materials, the welds, identifying what type of neutron absorbing materials that were, what type of environment. Right now, it's dry helium, okay.

What will happen as a part of this demo project or a like kind demo project, okay, if it's not this if, for example, if your fuel is not captured in this demo project as a surrogate that you can't reference it then there will have to be another one, okay, somewhere else that you can point to as a surrogate or just as another surrogate test.

But the aging effects that we're looking to, from NRC's perspective, that we're looking to see out of this demo project, this DOE demo project is whether or not the fuel clouding is breached during storage, if there's any assembly distortion, residual

moisture after drying to see, that's an issue that we're worried about because whether or not the environment is really truly dry helium or if there is residual moisture after the drying process and changes in the hydride structure of the cladding during storage.

So AMP Element 2. It's a condition based monitoring program, Preventative Actions, making sure that the back filling is there especially for the demo project and that the maximum temperature, cladding temperature is still at the ISG level, 11 level or below but still getting as close to the ISG level 11 high temperature of 400 degrees level is important.

And it's dried to 1536 and 1567. Next slide. The Parameters Monitored and Inspection. I know that, Dr. Rempe, you have, we've talked about this before about the temperature of the clouding and how to get that a little bit better in terms of DOE demo project.

So we're looking at trying to get what the temperature of the clouding is and was in terms of during the drying what was the maximum temperature and also as it's sitting there in storage what's the temperature of the clouding. Inspection of the presence of fission gas in the cover gas. So when we

take these gas samples out of these, the system, okay, to see whether or not there's fission gases in the helium when we pull it out as well as is there water vapor.

And then how would, can we back calculate how much damage there was in the cladding or into how much water is retained? Whether there is hydrogen is part of the radiolysis of water that's in the canister, remaining water from the drying process.

After the samples will be taken out at some point later down the line I think, I don't know how long, is it 20 years, Rod? I'm looking at Rod.

MR. MCCULLUM: Yes, Rod McCullum. It's about 20 years, maybe 25 I think in some cases.

DR. CSONTOS: Okay. And looking at the profilometry getting some other information about the gases, the fission gases and then from the fuel and then also creep calculations to see, get some data from that.

And then obviously metallography and to see what the detail is with the hydrides and how they're changing as a function of storage for long, long terms through metallography.

MEMBER SKILLMAN: Let me ask this question. For these fuel assemblies what is their

original as loaded configuration? Are these pristine?

DR. CSONTOS: They are intact. They're burned, yes, they are burned.

MEMBER SKILLMAN: But I mean are these --

DR. CSONTOS: They're nominally 53 to 58 gigabyte.

MEMBER SKILLMAN: Are they leakers or are they known --

DR. CSONTOS: No leakers. So these are intact.

MEMBER SKILLMAN: Just burned, intact assemblies with differing clads.

DR. CSONTOS: Correct.

MEMBER SKILLMAN: Simply that.

DR. CSONTOS: Correct.

MEMBER SKILLMAN: Prior to their being loaded was there examination of the oxide layers and films because there burnups you can have all kinds of stuff on the exterior based on the chemistry from which they were pulled.

MR. CUMMINGS: Right. So there will be 25 rods pulled from either the fuel assemblies going into the cask or sister assemblies that will then be loaded in a transport overpack and taken to a facility that can do some of those sorts of pre-characterization.

Rod, you might have a little more details on the exact pre-characterization activities that they're doing.

MR. MCCULLUM: Yes, first I need to correct what I said earlier on the record. Al, I misunderstood. I thought you were talking about when the first tollgates were. You were talking about when we're going to do these tests on the fuel out of the actual demo cask.

DR. CSONTOS: Right.

MR. MCCULLUM: That will be any time after ten years. And the specific time frame will depend on two things.

It will depend on, you know, what we're seeing elsewhere in the scientific research in terms of the need to open it up and probably more programmatically it will depend on when DOE is able to move the cask to a facility. But it will be ten years or longer.

DR. CSONTOS: And also if the gas samples come back and we don't find any fission gases, if we don't have any evidence of any breaching then we just say leave it there and let's just see, continue the, basically the experiment.

MR. MCCULLUM: Yes, and to answer the, now that I've corrected my previous wrong answer, to

answer the specific question I think a good guide for the type of tests that, I'm not the scientific expert, but a good guide for the type of tests that will be conducted on these rods out of the demo cask and on the sister rods is to go to the ANL and EPRI reports of, remember there was a demo already on low burnout fuel.

In 2011 the cask that was opened at Argonne National Laboratory, yes, after 15 years in storage. It will be all of those tests and probably a little more because I'm sure the scientists out there have gotten smarter.

But if the Committee wants to know what sort of tests are being done I would, those reports are very thorough and very good.

DR. CSONTOS: We've had a couple of public meetings on those recently the amendment request. I wasn't at the last one because I was actually here in this room going over the concrete expert panel.

So I'm not as well informed about that last meeting and what was done there.

MR. CUMMINGS: My expectation is that they are going to capture that stuff. They certainly need to capture things like what is the hydride distribution and what the orientation is whether it's

circumferential or radial so that they can understand later when they do open it up and take some additional rods out what differences have occurred from when they first loaded it to later when they drained it, dried it, back filled it, left it to sit for 20 years or ten years or however long it ends up being, transport it to a facility, open it up, take some more rods out.

And so that's the scope. But again there's more detail in some of the public documents.

MEMBER SKILLMAN: Thank you.

MEMBER REMPE: I had a couple of questions and comments. First just to hit on a comment I like the report or review of available methods for functional and monitoring of the CSS.

And I find it interesting that when they talked about the ultrasound they said it needed to be less than a centimeter and actually more of an order of a millimeter or around that area. Yes, so that's a little larger than that.

DR. CSONTOS: We're not looking at YouTube by the way. But, yes, go ahead.

MEMBER SKILLMAN: Yes, I know. But they are definitely going to allow you to sample because that was a discussion first right and they have said, yes, we will allow you to sample?

MR. MCCULLUM: Rod McCullum, NEI. Yes, the utility there is committed to sampling. There is still some discussion as to what samples and how frequently. But the utility is and the project is moving very much through the design phase which is going into a license application that's being written now.

So I can tell you we are past the point of no return and we will sample all those specific details.

MEMBER REMPE: And do you have a place where you plan to open and do the evaluations at ten years or whenever you decide to do it yet?

MR. MCCULLUM: As I said earlier, that's really one of the driving factors on when we'll open it. DOE opened the first cask out in Idaho in 2001 at a facility called the Test Area North that they have since decommissioned.

The folks in Idaho would love to build another one out there. However, when I say the folks in Idaho it's the folks in a certain part of Idaho that --

MEMBER REMPE: The governor is not real happy.

MR. MCCULLUM: Right, right.

MEMBER REMPE: Ex-governor, excuse me.

MR. MCCULLUM: And, you know, the politics, I, in a technical meeting will not get into too much politics here. But it's uncertain where DOE will build this facility.

It's also that ten years from now we may have a DOE interim storage facility that could build such a facility and that would be a great combination to have a hot cell at an interim storage facility. Whether DOE will choose to do that or not, again I can't speak for them.

But we know we have time to build the facility. We know we have at least ten years until we're going to want to open this thing because we do want ten years of storage. I think that's in the current test plan.

And, yes, that is an issue. And that's something you should keep your eyes on is DOE's capability to open the cask because it's not coming back into the pool, number one the utility. That's not part of the deal they signed up for.

But even more importantly if you brought the fuel back into the pool and you did see some indications on the fuel you would never know whether that was due to quenching affects or aging affects and

that would really kind of makes it not a very exciting test. We want to open it dry.

DR. CSONTOS: And the functional monitoring report is an EST report. It's extended storage transfer. This doesn't really, it's not really coming into our area which is right now the first two renewals. We're getting the first renewal, you know.

And so it's something we're aware of but it's not really, you know, you can see the AMPs that we've developed and they're more now.

MEMBER REMPE: Thank you.

DR. CSONTOS: Okay. Going to the next slide, AMP Element 4. It's consistent with ISG-24, the thermocouple lances. I think we've talked about that and the thermocouples for the temperature profiles throughout the cask of the canister as a function of time.

Fission gas analysis for the cover gas and getting into the specifics of what fission gases that we need to be able to detect and be sensitive to. The residual moisture detection, I think that's a big deal for us and then hydrogen because of the radiolysis considerations. Next slide.

CHAIRMAN BALLINGER: I think you may, in

our conversation you may have said you had, but there's a lot of experience that inspecting casks with fuel in them but not light-water-reactor fuel at a N-Reactor where that storage facility is.

And they have had casks out there that have been being monitored for the last 20 years almost, especially for moisture, for those kinds of things that are not related to the fuel itself just the inside. Have you looked at that --

DR. CSONTOS: I am not aware of that.

DR. CSONTOS: -- because Bob Einziger was well aware. What was the N-Reactor fuel stuff, the monitoring system, the monitoring, have you taken advantage of the monitoring that I know has had to have been done for internal pressure, moisture, all kinds of things?

They had a couple of canisters that they instrumented the daylights out of and I don't know whether they're still instrumented. They may have just closed them up because nothing happened.

DR. EINZIGER: This is Bob Einziger from the NWTRB. The answer, the quick answer to your question is, no. I know that in the facility where they stored those canisters they have at least I think three slots where they are supposed to periodically

monitor the gas buildup in the canisters.

I don't know whether they're just set up to measure the pressure or the diameter because the big question is are they going to get bulging on these canisters due to buildup of gas that's going to prevent them from ever being pulled out of that facility? And I don't know what they've done.

I haven't seen any external reports. I don't know if any have been written. That's something that could be looked into to see what monitoring that technique they were, but it would be something where they would have to build into the system the ability to monitor.

It's not something that after ten years, you know what, I want to monitor these things. Let's go stick a probe in it.

CHAIRMAN BALLINGER: I know for sure that several canisters were intentionally instrumented because there was concern about gas buildup just like --

DR. EINZIGER: And the results of it would be just the monitoring techniques because the fuel is completely different the results and the monitoring would not be applicable.

CHAIRMAN BALLINGER: Yes, well radiolysis

of excess water in there. Those kinds of things you might be able to --

DR. EINZIGER: The other thing that you have to remember is that the LWR fuel is "supposed to" be dried to be less than a mole of water in a canister. For the DOE N-Reactor fuel, because they have sludge in those canisters, dry means not more than a couple of gallons. And so the results could be quite different.

CHAIRMAN BALLINGER: The sludge that was in K-Basin is a lot of different than the fuel itself. They didn't put sludge in the fuel canisters.

DR. EINZIGER: There is a certain amount of sludge that went with the fuel.

DR. CSONTOS: Okay. And just to be clear I thank you. We'll look into it. Just to be clear though the bulging that Bob talked about is not for, that's for the N-Reactor stuff. That's not for dry cask just for the members of the public who are the phone.

CHAIRMAN BALLINGER: Well we better not have any bulging.

DR. CSONTOS: Yes.

CHAIRMAN BALLINGER: Okay.

DR. CSONTOS: So let's go to slide, the

next slide, Slide 8, Monitoring and Trending. Evaluate information from the demo project loading, initial period of storage along with other information the pre-service, I would call it pre-service examination of the fuel. The nondestructive examination with the gas sampling, temperature data, et cetera.

Later on when the project is over the destructive examination of the cladding and the fuel and such. And then if we find that there's more things that we need to look at separate affects, surrogate experiments, individual, you know, maybe certain types of cladding or whatnot.

But that's down the line. And licensee monitor and evaluate and trend the information via the Corrective Action Program. Next slide.

This is Acceptance Criteria. Bob was very good at identifying all the different pieces of what we're looking for here. And that's clad in creep which is the operable degradation mechanism that we're looking into for the renewal period because all the other ones are right now scoped out because of the drying process.

And so we have here the clad in creep that would, total creep strain extrapolated to the total

approved storage duration is based on the best fit of data to less than one percent. ISG-11 temperature limits are based on this less than one percent creep.

And so the hydrogen you can see there is less than five percent and then the moisture --

MEMBER POWERS: Hydrogen ion concentration is less than five percent?

DR. CSONTOS: Extrapolated from gas measurements.

MEMBER POWERS: Well I can practically guarantee you that any place this side of the sun the hydrogen ion concentration in the cover gas is less than five percent.

DR. CSONTOS: Well that's worth checking.

MEMBER POWERS: I mean that's in plasma.

CHAIRMAN BALLINGER: I think they're talking about hydrogen concentrations. But why five percent. Why do you care unless you're going to introduce oxygen into the thing the five percent is, what does it matter?

DR. CSONTOS: Well it could be uptaken into the cladding and such and other things we have to worry about. So you have possible hydrogen embrittlement and other materials as well for the fuel and the cladding.

Drying the moisture, did I go over that or not?

MEMBER REMPE: Not yet.

DR. CSONTOS: Okay. So the drying, yes, that's one that we're really interested in to make sure that we, that the drying is actually drying and that there is no residual water.

That's why the hydrogen concentration is important because then if we see a little bit higher hydrogen concentration that we think is supposed to be there then that may relate to how moisture in the drying may not be sufficient. So we have to look into that.

And then of course the fuel rod breaches. I would like to see if whether or not the fuel rods are, you know, breached over a period of time over storage, you know, in less than a one percent of the fuel rod.

MEMBER REMPE: On the drying I assume that's because you're going to heat it and you're going to do it from the gas sampling. But if it's condensed at the bottom you can't tell.

DR. CSONTOS: There are some techniques that DOE has discussed and those are UT. There are some things like –

MEMBER REMPE: Burnup I mean, right.

DR. CSONTOS: Right. And so they're thinking about some UT techniques to look at residual water at the bottom. And so I don't know how far along those are but that is something that they can do from the angle at the corner of the base.

MEMBER REMPE: But again you have acceptance criteria. So this is something that you can only, I mean, how do you monitor that in a longer term other than initially if you heat it? But how can you decide whether you accept it or not if you can't monitor it?

CHAIRMAN BALLINGER: There's drying criteria for the initial emplacement of the fuels which means you, whatever the temperature is you pump on it for x, get the pressure down to y, stop and watch the pressure go, change with time and if it's, doesn't change within a certain amount over a certain time then you're below a criteria which has been experimentally established which I think is one liter of water in the bottom of the cask.

DR. CSONTOS: One mole of water.

CHAIRMAN BALLINGER: Right one mole, okay.

MR. CUMMINGS: I think it was a P and an L. From an operational perspective the feedback that

we get from the guys who are drying it is if there's water in there you won't meet that criteria. You won't meet the 3 torr for 30 minutes. It just doesn't happen.

So you can sit there and you can suck on it. You can suck on it. It's just, and you can hold it under. You know, you typically hold it down to 1 torr and then watch it come up or 2 torr and then watch it come up.

And if you just can't hold that 3 torr for under 3 torr for 30 minutes it's not dry. So you go back and you continue your drying process.

CHAIRMAN BALLINGER: So this drying is, there's a go, no go test that already exists?

MR. CUMMINGS: Exactly.

MEMBER REMPE: At the very beginning. Well once it's in place or out there --

CHAIRMAN BALLINGER: Once it's loaded.

MEMBER REMPE: Yes, once it's loaded and you put it out on the pad and you're out there and the temperature swings and all that other stuff are you going to still do some sort of evaluation or that's just, this is only an initial acceptance criteria?

MR. MCCULLUM: This is Rod McCullum here. On the demo that's one of the things that our sampling

will measure is moisture over time. I would, and I was about to point out anyway this question of whether or not our drying procedure is adequate or not, we believe it is, is really not an aging management question. It's a design basis question.

I think if NRC was concerned that our design basis criteria were incorrect they would be raising that as a generic safety issue. Nevertheless, and they haven't, but nevertheless because we always go an extra mile or 200, we do have under the auspices of DOE's NEUP program that was birthed out of EPRI's escape program a process going on at the University of South Carolina right now where they're going to actually rig up a test rig and prove that one liter really is one liter or less.

And, you know, I know that Dr. Einziger who is standing up has been involved in that experiment as well. So there will be more information. But we believe it's adequate and has been proven over time.

DR. EINZIGER: Bob Einziger from the NWTRB. The first misnomer, there has been no experimental evidence confirming that the drying criteria actually gets the cask dry. It's never been experimentally confirmed unlike the forced helium

dehydration method where they had done some experimentally confirmatory evidence.

The criteria is based on theoretical considerations of vapor pressure, et cetera. That's one thing. The second thing is there is a lot of places water can be in that canister depending upon the design of the canister and design of the fuel that's in there once it's been drained you could start out with anywhere between seven and 25 gallons left in the dashpots that you've got to get out.

You can have water sitting under grids. You could have water if there's failed elements and you could have any fuel water drain down to the bottom of the cask. A number of years ago Trevus at one of the NEI meetings presented that on drying and sort of shocked people.

And he said the time it takes to dry is independent of the temperature. And the reason for that is most of the water is down at the bottom of the canister where it doesn't depend on the fuel temperature. It's, if you have water in the fuel column it will be down there.

So there isn't a reason to look at whether it's dry. The NRC recently published a report on various ways this drying method is done. And there

are some that decide that you can't rise above 3 torr of pressure so we'll drive the initial pressure well down below 3 torr and by the time 30 minutes it will get up there.

There's other ways of measuring things. There's a falling rate method that's probably a little bit better but it's not much more time consuming. And so there is question in case you don't know recently the French were doing a very similar method but having trouble with their transportation cask where when they got to the hub they open them up and found a lot of hydrogen in them.

And so it's a valid question. It's right, like Kris said it's not just an extended storage issue or an aging issue, but the fact is that ISG-11 was predicated on it being dry. If it's not dry then there is other mechanisms of degradation that one has to at least analyze and take into consideration.

DR. CSONTOS: And that would be it for me because AMP Elements 7, 8, 9 and 10 are all very similar to the previous two that you just saw. Just to save time if you have any questions I can answer those.

MR. CUMMINGS: Great. Thank you very much. I appreciate the ACRS staff's time and the

Board Member's time to, for NEI to present on our guidance document on operations-based aging management for dry cask storage.

I want to commend the NRC staff and management in their efforts to update NUREG-1927. I think they've done a tremendous amount of work to get the NUREG updated and to provide some additional detail to the industry so that we do have a clear and efficient licensing process for license renewal.

That being said, we will have comments on the NUREG-1927 when it's updated after this meeting. But I won't go into those details today. I'll focus on, the next slide, I'll focus on, first I want to talk a little bit about the extended storage safety basis.

I'll go through a very brief overview of the guidance document itself and focus on two specific aspects and then talk about a little bit of the NRC comments, the response and some of the industry response on that. And again I'm going to focus on the things where I think we have some disagreement which is, I don't want to say it's relatively little but we have I think a lot more agreement than we have disagreement.

Next slide. So I know you guys probably

all know this. But I think it's important to reiterate and that came up during some of the previous conversation in that dry cask storage systems are very robust with no moving parts.

They're passive. They sit there. They essentially do nothing. They just sit there. The Part 72.42 rulemaking increased the license renewal terms from 20 to 40 years and that was consistent with previous license renewals.

The continued storage rulemaking, again, had quotes and statements in that rulemaking that the continued safe storage of spent fuel and dry cask for the time frames considered in the GEIS is technically feasible. I want to remind you that in 2007 both the NRC and EPRI went and did a PRA analysis of dry cask storage systems.

And I don't think it's so much important of the actual numbers that were created in those two PRA analyses as it is to compare the number that was in those reports to the reactor based numbers. And you've got seven to eight orders of magnitude lower risk associated with dry cask storage than you do operating reactors. And so the --

MEMBER POWERS: A more perhaps useful analysis would be to go through and look at the risk

achievement and risk reduction worths of all these vast number of steps that are used to assure that they don't get leakage from that. Do we have PRAs of the quality or the comprehensiveness that would allow us to go through and look at risk achievement and risk reduction associated with pages and pages of requirements?

MR. CUMMINGS: Yes, my sense is that the PRAs that have been done to date are not to the level of, you know, of full blown seismic or fire protection PRA or even if you look at the other types of PRAs. They're kind of a first aspect.

And they got them and they said well look we got this really low number. We don't need to go to the next step for this more detailed analysis.

MEMBER POWERS: I mean I suspect they could have gotten a low number pretty easily --

MR. CUMMINGS: Right.

MEMBER POWERS: -- out of that. The question that comes up is we're imposing huge numbers of requirements here exacting standards, strict quality control requirements, elaborate inspections and the question comes up which of those are giving us bang for the buck and which ones are just creating, killing trees from writing reports?

And we really honestly need you guys at EPRI to come up with a PRA that allows us to look at that because otherwise we're, you gravitate to what you know and what you're familiar with and that's what this looks like. And the question is do we want to do that or not? It's a cost benefit thing I suppose.

MR. CUMMINGS: Right, absolutely because I mean, you know, you had I think a good point, Dr. Ballinger, about, well, you know, if we can do some sort of a risk analysis to determine which of the casks is the most susceptible well we've got 2,200 of these, you know, sitting out there and doing a full blown risk analysis to determine which one is the most susceptible is probably not worth the complete cost that would be needed to do that.

However, to try to answer your question in terms of, you know, which ones are the bang for the buck, certainly, you know, being sure that you have your confinement boundary intact or you're focusing on that is certainly the primary focus because that is your prevention of radiological release or one of the primary means to prevent radiological release.

MEMBER POWERS: That gives you metric for success or failure that's a little more discriminating than cancer risk.

MR. CUMMINGS: Correct.

MEMBER POWERS: Okay. And what you want to know is focusing entirely on, should I focus on stress corrosion cracking or wastage, corrosion or something else? Which ones are really the ones that deserve a lot of attention, close inspection and which ones kind of look at every alternate decade and it's going to be fine?

CHAIRMAN BALLINGER: What concerns me is the difference between risk, doing a risk analysis versus the path forward that's happening now is let's say we commit to the path forward now of all these inspection things and we make assumptions that we're going to actually have inspection capability that can actually meet the criteria.

So given all that so we've committed and let's say we fail. For one reason or another some inspection technique or something that we need we just simply can't, it's just not, without spending a zillion dollars we can't do it.

Now we're in a hole because we've made a commitment to do certain things and we've convinced the public and everybody else that this is the right way to go and then all of a sudden we find that we're in a hole when in fact if we had done a rigorous risk

analysis of the system we may have done what Dr. Powers is saying is that it would point out what may be the obvious important sets of variables.

But we may have concluded that the risk is $10^{-14}$ and in which case $10^{-14}$, you know, is darn low.

MEMBER POWERS: I kind of like your containment boundary integrity. I mean I think that's a good metric to use. And it's a little more discriminating than the $10^{-14}$ which is a number that, you know, it borders on the meaningless to me.

But if you had an integrity and you've got a pretty reasonable definition of what you mean by integrity it's something like $10^{-7}$ standard cubic centimeters per second that's kind of a standard number that a lot of people use for vacuum systems and gives you a nice metric to do the PRA on and then you can, if you can do the risk achievement, risk reduction works on the steps that are being taken you know which ones to spend time on. That's the advantage of it.

CHAIRMAN BALLINGER: It's more like not necessarily leak rate but it's dose to the public which is really --

MEMBER POWERS: See the trouble is you go off into numbers that are in Never-Never Land out

there. If you take this metric that Kris has suggested which is one that's relatively easy to measure, I mean $10^{-7}$ you can do it kind of routinely on a vacuum system.

And you say okay anything between $10^{-5}$ and $10^{-7}$ is kind of my acceptance bound. As you get closer to $10^{-5}$ I would start getting more and more nervous.

Then you don't have to go to these numbers that news media are very good at saying five cancers will show up in the public as a result of the failings at this site and things like that. I mean that's, I think that's a great idea, Kris.

MR. CUMMINGS: And I know there was a meeting a few months ago about risk informed framework and defense in depth and talking about actually introducing PRA. I know the NRC is working on some of that with the PRA analysis.

And that was one of the things that was discussed is what's the appropriate metric. Is it a latent cancer fatality? Should we have dose-based metric? I think we're still talking about those things.

MEMBER POWERS: I really encourage you to go to your leak, I mean I like your leak rate a lot

because it gets you out of the headlines and into the science and engineering here.

MEMBER RYAN: The other thing is if you want to look at a dose scenario of one kind or six different kinds, whatever it might be, you're at the source term step which is part of, you know, you're bouncing around that is your source term, that's your release rate or it's not.

But if you go to apply that release rate, you know, what happens if I drink it, eat it, give it to my kid a wide range activities --

DR. CSONTOS: That's what I was saying before that this could be an order of magnitude or more complicated if you do a certain type of PRA if you have to analyze all those pieces. If your criteria is through-wall breach than that's easily, I think that's much more easily manageable.

MEMBER RYAN: The leak rate.

DR. CSONTOS: Right or given leak rate, right.

CHAIRMAN BALLINGER: He did not say through-wall breach. He said leak rate.

DR. CSONTOS: Leakage and that's what I'm saying. So those numbers will they, do they have any leakage?

MR. CUMMINGS: No, I don't believe they will from the perspective of a cask is fabricated and manufactured in accordance with its certificate. What now is the risk of a latent cancer fatality to a member of the public?

So, no, it didn't consider necessarily degradation aspects.

MEMBER RYAN: There is so much uncertainty in the later, in the risk of an exposure to a member of the public. Let's think about that for a second. Is that an infant or is that a senior citizen that's, you know, already got three cancers or is that a robust weightlifter that's in his 20's?

You know, I don't know what to do with that. That has a magnitude of sensitivity.

DR. CSONTOS: As well as how many sites all around the country. I mean it's --

MEMBER RYAN: Right. I get a headache thinking about it.

CHAIRMAN BALLINGER: The leak rate criteria also establishes a definitive single corrective action point.

MEMBER RYAN: Well maybe, maybe not. Except that it's closer to consistency.

DR. CSONTOS: The stainless steel

canisters other than the ones that have a bolted lid that have this leak detection capability don't have leak detection or leak rate detection capabilities associated for monitoring them at this point.

CHAIRMAN BALLINGER: Where there's a will there's a way.

DR. CSONTOS: It's a little harder than the inspection piece.

CHAIRMAN BALLINGER: And you're finding that out.

MR. CUMMINGS: I didn't envision so much interest going in the first slide.

MR. LOMBARD: If I could interject some information here. As Kris pointed out the two PRAs that were done previously, especially the one by EPRI I'm probably a little more familiar with it was assumed that the system that was evaluated was as designed and it only looked at the first year of operation, not any material degradation affects.

Our approach and we'd love to come and talk to you about this at some point because we're moving on, it's a seven step process that we're going through now. We've already looked at defense in depth and come up with a three by three matrix of how to define defense in depth for dry cask storage systems

and we're just now starting our, what are the safety goals?

What should the safety goal look like? And Dr. Powers is right on target. Should it be latent cancer fatality? I think that's an easy one to go to but it doesn't make a lot of sense. It's, it makes the calculation a little more difficult and it doesn't really bring it to reality.

We are not looking to require PRAs for dry cask storage systems because that would mean there would have to be a PRA for each different system and there's a lot of different systems out there right now. Of the 2,000 there's many different designs.

So we're looking at more of a qualitative approach to come out with a risk informed framework for dry cask storage systems. And again we would like to come and talk to you about that if you want to hear more about it.

MEMBER POWERS: It should be interesting to talk about it. But remember, you know, sometimes you save on the mackerel and spend on the cod. When you go to qualitative techniques you can lose this ability to evaluate your end of the bargain which is where should I marshal my resources and spend my attentions?

So be careful about saying well it's qualitative techniques will be good because sometimes, I mean that's the problem we've run into with ISAs where everything becomes important to safety and all things important to safety are the same. And it's just not true. We know some things are important than others.

And you've got to commit, you would just like to know where to spend your time because you haven't got an infinite number of people. I mean Al works like 20 hours a day I know. But to ask him to go the extra four may be a bit much. He needs some sleep.

MR. CUMMINGS: All right. So the content of NEI 14-03 is really as a, is process focused. So we don't get into a lot of the AMP details and things like that. It's really, it's how do we implement the overall program.

And so the two key areas of focus are kind of a forward looking approach to gathering the operating data and then also kind of the renewal application format and content. And I'm not going to go too much into the second one.

The main concept that's introduced in the guidance document, next slide, thanks, Kristina, is

the tollgate concept which we discussed a little bit. It's really a commitment to do these periodic safety assessments where you go out, you look at the operational experience, the various research programs that have been done at the national labs, EPRI internationally, what have you.

And you look at the collected data and say am I still doing my Aging Management Program that's consistent with the data that's new from when the last time I did it or even my own data that I've collected at each individual site and then each of the sites that we'd be doing it.

So it's really go out, get the data. Am I still doing the right thing or am I doing something that, you know, I've now gotten information to say maybe I don't need to do that anymore. Maybe it's not five years, it's ten years.

But as we collect the data it's going to be important that we, you know, understand whether that's an approach that we can take or not. It has been piloted in the Calvert Cliffs and Prairie Island license renewals. Calvert Cliffs has been approved.

It is a little bit different in there if you take a look at those. Those tollgates are associated with specific issues whereas the tollgate

concept in NEI 14-03 is more of a holistic safety assessment type approach.

Next slide. This is just giving you graphically kind of an idea of, you know, how we go along and you have a tollgate and if you look at all the data and you say everything looks good you've confirmed that you're doing the right thing then you move through the tollgate and you go on over the top of that is things like the CISCC, aging management, the high burnup R&D program. Those are two key aspects.

MEMBER POWERS: Are we going to run into the same problem we ran into with Appendix J?

MR. CUMMINGS: I'm not familiar with that. If you could --

MEMBER POWERS: We have times for testing valves and nobody likes to do it because it's a pain in the neck to do it. And so this tollgate was a ten but why don't you go to 15.

I'm sure it would be okay. And what's portrayed as four tolls quickly becomes one.

MR. CUMMINGS: Well let me try to address that as I go forward. Next slide. One of the key concepts especially with regard with licensee implementation is that for it to be effective the

operations based Aging Management Program requires the ability to efficiently change the AMAs based on the feedback from that operating experience and those safety assessments.

And that's what I think that the key areas that we've been continuing to have some areas where we need to reach closure with the NRC that if you put all of that information into the license conditions or into the tech specs you now can't do that efficiently. You have to go back to the NRC to get that changed.

So let's take the example of CISCC and you make a commitment to do a visual examination and then everything goes as planned and we get the new inspection techniques that's based on eddy current and we can see cracks or whatever. We have the ASME Code that goes forward.

Rather than being able to implement that essentially I don't want to say immediately but in a timely manner we would now have to go back to the NRC and get that revised to allow that new method to be done. So we're really just looking to ensure that we have that flexibility in the same way that we had that flexibility on the reactor side.

All of the AMAs are in the license renewal application. They're put into the FSAR. They're put

into the implementing procedures. We're advocating for a similar approach here on the dry cask storage side understanding that there is that kind of nuanced licensee responsibility between the CoC holder which is the cask vendor and then the implementer of the CoC which is the utility.

So now if the utility wants to change something whether it's doing it more often or more importantly modifying the program something different than what's in the CoC, they've now got to go back to the cask vendor to get that done which then the cask vendor would have to go back to the NRC.

Next slide, Operating Experience. Again that's one of the key areas where we're trying to work through how is that operating experience being shared. Right now each of the cask vendors have users groups. They do a very good job of sharing their operating experience, you know, loading things like that with all of the members of their users group.

So the users of that specific system or more importantly the users of that specific cask vendor. The challenge right now is really how do we share that information amongst cask vendors. We don't have a process for that and so I'll talk a little bit later about our ideas on how we might try to make that

work.

Next slide. So the status is we've submitted it. We've received some initial comments from the NRC and we're working through a meeting that we had about a month ago. The feedback that we hear from the Board Members here on ways that we can improve the NEI guidance document.

So I want to talk a little bit about the sharing of operating experience, the change control and the lead canister inspection. So right now we're working to develop options for an improved operating experience program.

The two current areas that we're considering is expanding the cask vendors existing programs to have them expanding to aging management is not a big issue. I think the biggest issue is how can we get these entities that are very competitive and very proprietary oriented to share some of that information as a holistic industry approach.

The other idea is to take the existing plant operating experience infrastructure, i.e. INPO and find some way to implement dry cask storage operating experience and aging management experience into that sort of infrastructure. Again the challenge there is that the INPO membership is fairly hefty and

so having some other process within that that's reflective of facilities that only have dry cask storage, don't have an operating reactor and then also vendor interaction with that is some of the key things that we need to try to address or the challenges that we would need to try to address in INPO.

Next slide. So I think I touched on a lot of the issues here about placing the Aging Management Program under licensee control. Having it in license conditions is inconsistent with the NEI proposed rulemaking 72-7 and we feel that it's also inconsistent with a risk informed framework.

Really to remain a learning Aging Management Program we need to ensure that flexibility is there for the CoC holders and the utilities to implement the lessons that we learned from the tollgate assessments. And on top of all that there's also the underlying QA program that requires maintenance of the design basis.

In the certificate it says you have to maintain your confinement boundaries. So if we move along and we get, you know, however long out 60 years, 80 years, you know, the time doesn't matter and we find that there's some issue with the confinement boundary, it's a responsibility under the QA program

to restore that design basis.

And so that's going to have to achieved and that is achieved right now through or can be through the QA program and the Corrective Action Program.

MEMBER BROWN: Maybe I'm wrong and somebody over here can correct me. But I thought when we do our license renewals that the Aging Management Program is a key part of that assessment for extensions, license extensions and that the Aging Management Program kind of sets the metrics for the renewal itself.

To me I always thought of that as being part of the license conditions when the license was renewed. Yet here I'm storing high burnup fuel, all other kinds of stuff like this and yet an Aging Management Program in its adequate definition as part of the license is not part of the license condition?

And that's inconsistent. I guess I don't understand how that's inconsistent with at least the overall safety and health of the public in terms of allowing license extensions or even brand new ones to go forward with these installations and systems.

MR. MCCULLUM: This is Rod McCullum at NEI. I think it's a question of level of detail.

Absolutely there should be a license commitment to have an Aging Management Program. It's the question of where do the details of that Aging Management Program reside.

Do they reside in procedures? Do they reside in the safety analysis report or do they reside in the license themselves? If you look at the Aging Management Programs the renewed reactor operating licensees are committed to those details do exist in those lower tier documents.

It comes down to and there's a related issue that we had a lot of dialogue between industry and NRC here is it comes down to the utility of the 72.48 process because in reactor space you have 50.59 and those details are controlled under 50.59. If you change one of those details in the way that it creates an accident different than that described in the SAR you have an obligation to go out and seek NRC approval of it, 72.48 works the same way.

We have struggled with the staff in Part 72 space to gain an acceptance of the use of Part 72 the way Part 50.59 is used in reactor space. We have another NEI guidance document 12-04 which is under review by the staff to try to get us past those struggles.

And I think we're going to because 12 means it was created in 2012, we're going to kind of invigorate our efforts to get past that. But I agree with you absolutely. There should be a commitment to an Aging Management Program in the license.

It's where the details of that program exists and who controls them because if it truly is learning it needs to be able to be adjusted without having to go through a Notice and Comment rulemaking with the regulator before you can adjust it.

DR. CSONTOS: So in license renewal for reactors there are a couple of generic license conditions. To incorporate the Aging Management activities as a part of the --

MEMBER BROWN: It's the GALL, you're talking about the GALL.

DR. CSONTOS: Exactly. It's, they reference the GALL. They reference all their Aging Management Programs that are coming from the GALL. We don't have a GALL here.

And so what we've given you is three example AMPs and then the other ones that we're going to be developing in the MAPS report that's the GALL-like, I'll go into a little bit.

But the difference is that as a result of

not having an ASME Code Section XI type of process and procedures and criteria and all that that's already developed, like I said, AMPs in the reactor world are in addition to the operating piece which is Op Section 11. And those aging management that they do from looking at hey, well we saw a leaker here.

Well we've alleviated it based on Section XI requirements and such. And so all of these we don't have that yet. And until we have that I think that is kind of, that needs to come before we can fix some of these other things because we also would love to have a way for the licensees to, you know, incorporate operating experience at a faster pace because it's more, it's an incentivization to do the right thing.

But we were not comfortable during the, you mentioned the two license renewals that are ahead of us that we're doing right now, one that was approved. We didn't have, the staff did not have the confidence that we couldn't do that at that point and just give those generic outs basically.

And so we required those and they're more specific. That sort of specificity of the language was in there. You must inspect here, here, here, here because we don't have that Section XI yet to

reference. And that's why we're doing what we're doing. And you'll hear it --

MR. MCCULLUM: Rod McCullum if I may. I just want to point out Al and I are in violent agreement here. And really we accepted that he had to do or NRC had to do what had to be done for those first two cases.

But we think that the long-term solution to this is, we embrace the MAPS. We've reviewed the drafts. We've commented. Our comments have been incorporated. We're happy with the MAP reports. The GALL-like thing is almost there whenever NRC says it's there.

We've also expressed a willingness to NRC to participate in this, Al has used the term and I'll put it on the record ASMEizing of our world in dry storage where we do have an ASME Section XI equivalent. We'd like to have industry people participating on that.

To us the answer here is to get those things in place so we can put the level of detail where it belongs not to keep putting the level of detail on the license and potentially stifling learning aging management.

CHAIRMAN BALLINGER: Okay. We're running

late so --

MR. CUMMINGS: I have one more slide and then I can finish up.

CHAIRMAN BALLINGER: We're not running too, too late.

MR. CUMMINGS: Next slide. Next slide. And so then the last issue where we need to have some additional discussions is about this concept of lead system inspections. You know, it's going to be really important to kind of distinguish what the scope and purpose of a lead canister inspection is which would possibly be done before the renewal application versus the Aging Management Program inspections.

One of the, again one of the nuances associated with CoC holders with Part 72 general licensees is that the CoC holder has no legal authority to require the general licensees to perform inspections prior to the period of extended operation. They have a current licensing basis in their original license which says no inspections.

So we think that there's something that we can discuss there. Does it really make a difference to do an inspection at year 19 or year 21? We've got the confidence through 20 years. The NRC has stated that. So I think there's some additional discussion

that we need to have about what the scope of those renewal, what those inspections are and how they get done.

And then with regard to CISCC we talked about it a little bit. EPRI has a forthcoming susceptibility report that will allow the industry to rank not only canisters at an individual site but canisters between sites to determine which would be more susceptible.

It's not a PRA analysis. It's more of a what are the factors that would go into susceptibility for chloride-induced stress corrosion cracking. So that was the gist of my concept. I would be happy to answer any other questions.

MEMBER SKILLMAN: I would like to make three comments, maybe they're questions but let me introduce them as comments and perhaps you would respond. On your Page 19 of NEI 14-03 you introduce the topic of the tollgates.

You write the timing of the initial tollgate should be chosen to be sufficiently early to allow any degradation to be addressed before canister integrity is affected but sufficiently far out in time to take advantage of anticipated advances in inspection techniques so on and so forth.

Building on Dr. Powers earlier comment, it seems to me that there really ought to be a hard stop for your first tollgate. And it should be something that industry is comfortable with, but it should generally be uniform so there's an understanding of when the tollgate will be arrived at.

MR. CUMMINGS: Sure.

MEMBER SKILLMAN: And building onto that comment there is nothing in your tollgate assessment which at Page 20, 265 that talks about the quality or the thoroughness or your tollgate assessment. What is the standard?

I can imagine with the types of individuals that are in the consulting industry one tollgate assessment might be 5,000 pages and another might be 11 and the 11 would probably be just fine. But there needs to be some form of a standard so is there a good understanding of what the utilities are going to be investing in. They need to know that. That should not be --

MR. CUMMINGS: Sure, good comment.

MEMBER SKILLMAN: -- if you will like the design basis reconstitution that many people went through 20, 25 years ago, if you remember that activity. And the third comment has to do with what

we just spoke about, the interface with the Aging Management Programs.

On your Page 26 you write it is expected that these AMPs will be integrated into an existing site Aging Management Program. Those are your words. Well if you mean that then you need to clarify this discussion that we've just had here.

If that's something to be done in the future then that needs to be reflected in NEI 14-03. If you really do anticipate, like Charlie does, that on license renewal your AMP for your casks is included in your license renewal amendment activities, which is what this infers, then that ought to be clear.

MR. CUMMINGS: Okay, okay.

MEMBER SKILLMAN: Thank you.

MR. CUMMINGS: Those are good comments.

MEMBER SKILLMAN: Thank you.

CHAIRMAN BALLINGER: Last but not least.

DR. CSONTOS: The future. In the year 2000.

MR. CUMMINGS: You need a synthesizer to turn the music on top of that.

DR. CSONTOS: So okay, lastly I'll just be talking about what else we're doing.

CHAIRMAN BALLINGER: By the way the car

was stainless steel.

DR. CSONTOS: The what?

CHAIRMAN BALLINGER: Back to the Future.

DR. CSONTOS: That's right, the DeLorean. I'm glad it wasn't near an ocean then. So, yes, so we're talking about the future. You've already heard this.

I wanted to just tell you that what we found out was that the staff we all got together about 14 months ago said look, there's experience. We need to change some things. We went through this operations-focused aging management approach similar to the reactors developing all this that we talked about.

Rev. 1 of 1927 is the culmination of that effort. We've heard the comments about the stove piping or being, you know, myopic and just thinking about our own little area, okay. We hear you.

You know, we haven't come to talk to you about the larger picture but maybe we should come and talk to you about the larger picture so we can show how renewals is a piece of that because, you know, one of the big picture items of this is that if we ever go, if the country ever goes to an interim consolidated storage site for this fuel these AMPs

that are here can be also ported to there, okay.

The type of work that we're doing, aging management is something we do for planes, trains, automobiles, reactors and here. And so it's whether it's here at all the different sites or at some other interim site it's still going to be aging management, okay.

So why did we focus on this area alone, okay, for right now that we came to talk to you about is because of what we had. We had three renewal applications in house that we were having some trouble with, okay, at the time in terms of how do we go forward with aging managing the degradation or possible degradation?

We also have these 15 renewals coming up in ten years. And when we go to that slide, that's the next slide, you can see here this is a slide of the number of renewal applications that are coming in house by the fiscal year, okay.

And we've had three that I talked about in 2012 and 2013. Two of them were the site specific, Calvert Cliffs and Prairie Island. The third one was VSC-24 which is a general or a CoC application, okay.

The VSC-24 was at a couple sites and then the other two were individual sites. We are now

reviewing the 1,004 CoC which is at 17 sites. That's what I'm showing in 2015. And so that's where we were, we were hit with this difficulty or the challenge for us was how do we develop a renewal strategy that can be done and used ubiquitously across the country because a CoC, they could apply for any place really that they want to place it.

And so having the multiple sites became a challenge for us. And you can see now 2018, 2019, 2020, 2020 you have a peak applications of six at 35 different sites. The key to handling this future workload is this guidance development and the standards development.

And that's where I think in the future from basically 2018 onward we can use this updated guidance. Okay, next slide.

So what are we looking at? This is Slide 4. We are, like I said, we had a meeting here with the expert panel, a lot of professors and such looking at degradation of concrete structures, okay. There is a report that's going to be coming out of that from our Office of Research colleagues that we'll present in the near future.

That will discuss all the different ideas of all the different other degradation mechanisms that

we may not have captured in Ricardo's AMP, okay, the concrete AMP. Next one is Aging Management Tables. This is the predecessor to a GALL-like document, okay and an AMP.

We need Aging Management Tables specifically for individual systems and all the different components and subcomponents that are associated with those systems. How do we scope them in and we scope them out? Those are all, what we do is we create a big, large table with all ten AMP elements and we then identify all the different pieces for it.

And then that's our contract through our Office of Research. They provide that to us. We develop here and then assess internally the Aging Management Programs. From the Aging Management Programs we will then incorporate them into this Aging Management Program that is part of the MAPS report, okay.

And that's on the next slide. Yes, it's on the next slide. So that's where the MAPS report, I'll talk about that in a second. The Extended Storage and Transportation that's our EST program, there's a lot of things that we worked on that were for, we thought, were in the long, long-term that came

into the nearer term, okay, aging issues.

NDE inspection technology reviews. We don't develop it here at NRC. We just review what the licensees, so vendors or industry have come up with as a possibility.

And I can tell you that we've been at workshops where they show us robots that are the size of my hand that they think can go in and out and go anywhere and vacuum technologies that can just go anywhere they want and little, miniaturized robot-like features.

MALE PARTICIPANT: Snakes.

DR. CSONTOS: Snakes as well, that's right. And so, yes, so they're very, very innovative on the, from industry point of view and that's why I feel, Darrell and I feel confident that these are, you know, they're achievable.

CHAIRMAN BALLINGER: These are industries that are not, they have to adapt us to our environment.

DR. CSONTOS: Adapting the technology to the real --

CHAIRMAN BALLINGER: That's a fairly large step in all of this.

DR. CSONTOS: Yes, and --

CHAIRMAN BALLINGER: It costs a lot of money.

DR. CSONTOS: They're working on it. They called it SCC modeling. I mentioned to you earlier, Darrell mentioned it to you earlier. Some of that also includes some work that we're looking into using GoldSim to do somewhat of a probabilistic but not a full probabilistic review of that.

But to take into account what you said, Dr. Ballinger, which is the probabilistic nature or I could call it stochastic nature of stress corrosion cracking, okay. The thermal analysis that's really important for the chloride SSC modeling.

The thermal analysis does tell us because one of the things that Darrell has been looking at is the corrosion and the temperature and relative humidity affects. And we also need to know what the surface temperatures are because not only is it that each of the system by system that we need to segregate or to identify and prioritize which canister it is.

It's also the locations of where on the canister like for horizontal system it's the hottest at the top and the center. Well that's not as an important area, although it has a lot of deposition because of the flat it's a more, a flatter surface,

but it may just be too hot for cracking to occur.

So why look there if we feel confident it's not going to be, why as Dr. Powers said, you know, we need to be a little bit more maybe focused in where we use, you know, these, where we focus our efforts.

Cladding integrity research. We are doing work at Oak Ridge National Laboratory. That's why Meraj Rahimi is actually there at a, what do you call them --

MALE PARTICIPANT: Program review.

DR. CSONTOS: Program review, there you go, program review of our research. And we do fatigue testing there for high burnup fuel and also some cladding stress modeling that our Office of Research does, okay.

Stakeholder engagement, we are, you know, we had public meetings about the DOE, the High Burnup Dry Cask Research Development Program. That's that demo program the for the high burnup fuel working with also the amendment, public meetings with North Anna and we're interested in this Chloride RIRP program. We have a public meeting I think next week.

CHAIRMAN BALLINGER: The 21st.

DR. CSONTOS: The 21st, two weeks from

now. And we'll provide some information on some of our latest work. And it's a way for us to provide information back and forth.

You had mentioned in your previous, the previous talk about chloride SCC and we will be focused on that. But there is other aspects that before we went to chloride SCC we all looked at a larger subset of corrosion mechanisms.

And EPRI developed a report called the Failure Modes and Affects Analysis Report that documents all sorts of different mechanisms that we have seen on the reactor side and then we focused on chloride SCC because it seemed to be the fastest and the more difficult mechanism.

14-03 we've already provided comments and we, it would be very good to hear what you all have to say. Next one is the guidance infrastructure. So those are all technical pieces. But guidance infrastructure that we're developing again 1927, we're hopefully going to get that out for public comment in the next month or two.

Licensees have been really itching for this information. The draft RIS, this is the RIS I was talking about will look at the 72 to 71 and back to 72 based this draft regulatory information summary

for high burnup fuel for storage and transportation. It's out. It's available.

I don't have the ADAMS number on here but I can get it to you. And then there is the MAPS report. This is the GALL-like NUREG analog that Dr. Stetkar mentioned at the beginning of the whole day here. We agree with him.

This is a, we're calling it the MAPS report. We're not going to take credit for that naming. That was Rod, I believe.

MR. CUMMINGS: It was Rod. I won't take credit for this.

DR. CSONTOS: So the magic worked out there and what we're going to do there is part of the Aging Management Tables that our contract are creating, actually research is creating and then our AMPs that we're developing are going to be system specific, okay.

And as a result of that we're going to be incorporating them in a logical manner that ties into, can you go to the slide before? One more, for this chart. Those that are coming in for renewal first, okay, after the 2018 time frame, those will be the first ones that we develop the AMPs for so that we can promulgate that information as soon as possible, okay.

And we do that in a logical step wise manner. We go to the various systems that are coming in for renewal first so that they get our guidance out there ahead of time. This is where, the next one is the inspection for licensee's aging management activities. On the reactor side there are AMP inspection audits or AMP audits, okay, AMP effectiveness audits.

We over here are looking into how are we going to implement and we need to get clear acceptance criteria, clear guidance to our inspectors out in the regions, okay, as well as possible other inspectors to go and observe and see how the licensees are doing their aging management activities. And so that's something that we're just in the infancy of developing.

That would be out there as soon as we can. While we're also doing this there is just so many different little pieces that we're trying to pull together and this one is a huge one. ASME boiler and pressure vessel, Section XI for in-service inspection of dry cask storage canisters.

The last part, the last ASME Code meeting they agreed, Section XI agreed to change their charter and take this on, okay. So it was a really important

step that and we're going to have our first task group meeting on the 27th I believe, right.

MALE PARTICIPANT: Yes, that's correct.

DR. CSONTOS: Of April. And so that's a, the ASME Code meeting is out in Colorado Springs. So that will, that's a big area for us. We have one of our staff that's attending the ACI Code to make sure that our interests are being met because ultimately we would love to see us use the codes and standards as a way for getting a consensus on our inspection programs.

And then again, the review of the Rev. 1 we hope for 14-03. And then lastly, this is the schematic of where we're trying to get all this done so that we can get the guidance out to the licensees as soon as possible. And I know that the code and standards goes up into 2020. It's not my process.

But as long as there is maybe a code case so people can reference as head of that, that would be ideal. And after 2020 we gave the licensee, for Calvert we gave them five years to develop an inspection technique.

They have told us they are going to try to get it done in three. When I have been at the ASME Code meeting they don't feel this is a bridge too far

in terms of inspection techniques.

They really believe they can get something out there fairly soon because they can just leverage off of what's being done on the reactor side. And that's it.

CHAIRMAN BALLINGER: Questions from the Committee? I believe, what about comments from the audience? Hearing none the bridge line is opened. Is anybody out there? You'll have to identify yourself by saying something.

MR. LEWIS: Marvin Lewis, member of the public.

CHAIRMAN BALLINGER: Hi, Marvin.

MR. LEWIS: Yes. Thank you for having this presentation. It's very, it helps put it all together especially for somebody who can't put full-time into it.

Really I don't know if it's a comment or a question. But, you know, when you're talking about wall cracks, cracking through-walls and all that and I was wondering, okay, so we're worried about the gases leaking out which of course includes the krypton and xenon and whatever along with the hydrogen.

Now gases mix pretty good. They don't have to be shaken or stirred. They mix pretty good.

And I just was wondering when the helium comes out, you know, the helium has been pressurized of course is non-radioactive, when the helium does leak out it probably leaks out with some radioactive therein.

And I just was wondering and I'm hoping to comment that you're going to look at the possibility of looking for these leaks using a) a hearing leak detector and b) some kind of a field meter, maybe on a pole or a stick to keep the observer away from any high radioactivity if there is any.

And I was wondering, you know, you were talking about how long it takes to leak out and that the helium would leak out first. And I can't understand that because it would be easy mixing as first of all these great species would be -- which would leave a mixing.

So I'm just making, you can consider that a question or a comment or a request for further work. I don't know. Okay, thank you for allowing me to speak.

CHAIRMAN BALLINGER: And thank you very much. Is there any, I thought I heard somebody else out there as well, is anybody else out there?

MR. HOFFMAN: Ace Hoffman.

CHAIRMAN BALLINGER: Yes, Mr. Sussman.

MR. HOFFMAN: Hoffman.

CHAIRMAN BALLINGER: Hoffman, excuse me, yes, Mr. Hoffman.

MR. HOFFMAN: Thank you. I have a question about the moisture inside of the dry casks that might be there.

It sounded to me like I heard that it's possible that moisture could get into the fuel rods themselves through microscopic cracks I would assume. And if it does get in there it's virtually impossible to spin it up to 3 torr for a half hour it is not going to be, there's no way you can remove that quickly.

Did I hear correctly that there could be fuel inside or water inside the fuel rods themselves or is it only on the outsides of all the rods and in the assemblies and so forth?

CHAIRMAN BALLINGER: We're not, we can't answer questions.

MR. HOFFMAN: All right. I'm sorry. That's my question.

CHAIRMAN BALLINGER: Excuse me. But you can send in a note to Chris Brown at here and he can respond to your question.

MR. HOFFMAN: Okay, thank you.

CHAIRMAN BALLINGER: Okay. Is there anybody else out there?

MALE PARTICIPANT: I thought I heard Ruth.

MS. GILMORE: Donna Gilmore.

CHAIRMAN BALLINGER: Yes.

MS. GILMORE: Okay. Can you hear me okay?

CHAIRMAN BALLINGER: Yes.

MS. GILMORE: Okay, great. You know, somebody brought up the issue of the transportation and it would seem to me that your NUREG-1927 even though you don't deal with the transportation you should be informed by it.

So for example if you're going to allow, could whoever is not muted please mute because they're making it difficult to hear the conversations.

CHAIRMAN BALLINGER: We can hear you quite well.

MS. GILMORE: Okay. I'm hearing a lot of background noise. So anyway, at least be informed by it. For example, if you're going to allow a certain amount of cracking in a canister and then you have a transportation requirement that the canisters need to be perfectly intact before you can transport them, you know, you're kind of setting things up to fail.

So I don't see how you can ignore, you

know, all the transport requirements in trying to set your standards. It doesn't make any sense. Am I missing something?

CHAIRMAN BALLINGER: Again, if you, you can pose that question and send a note to Chris Brown here and we'll respond to that.

MS. GILMORE: Okay. So you're asking for comments and not questions. Is that what you're saying?

CHAIRMAN BALLINGER: Yes.

MS. GILMORE: I see, okay. So, okay, another comment would be I know you're planning to have the industry come up with some method to inspect maybe three to five years. There should be requirements as to what you're going to require that the inspection must be able to do.

You know, I'm, so that would be one of my comments. I'm not sure if anybody has addressed exactly, you know, how thorough that inspection needs to be able to be to meet your aging management requirements. So that's one comment.

And then you have, currently you have temperature limits set and other requirements and it needs to be really clear and I would like to see included in the NUREG exactly more specifically what

the acceptable options are for them to do, you know, if they don't meet these requirements. So anyway. I guess that's all for now.

CHAIRMAN BALLINGER: Thank you very much. Are there any other members of the public out there? Hearing none, thank you. We'll close the bridge line.

MR. LUTZ: Excuse me, excuse me. Can I, I'm sorry. This is a member of the public. Can you hear me?

CHAIRMAN BALLINGER: Yes, we can. Can you give us your name please?

MR. LUTZ: Yes, I'm sorry. We were trying to get it off mute. My name is Ray Lutz. I'm with Citizens' Oversight. And the thing that I see really missing from all of these discussions is there is kind of a gap between our local Public Utilities Commission which deals with costs and the NRC which deals with some of the safety issues.

Apparently the way you guys have defined these safety issues is that you do on an inspiration by inspiration or even a design by design basis. Your license is by perhaps a manufacturer of the ISFSI or the cask system and not, I'm not, the problem is that we're not exploring the issue of where are these installations are being sited because there's a

decision first of all about which cask system or which dry ISFSI type system that's being used, the various ones that are being approved by the NRC the Public Utilities Commission says it's out of their hands in terms of which ones are being collected.

And also it appears that no one is even considering where these things are being placed. It's just a de facto conclusion that they're going to be placed at every single decommissioned plant right now. And everyone says that's what the DOE says. That's the DOE's problem.

And then the NRC says that's not our problem and the Public Utilities says it's not our problem either so no one is talking about it. And we need to get more discussion is, well I know you guys cannot answer any questions which is a sad thing.

But it seems like there needs to be some directions for the states to pursue maybe a consolidated ISFSI configuration where it would be in a location that would be preferable for these extremely long periods of time that we're talking about here and not just defaulting to installing these at the plants.

So that's a problem that I see is that there's a big chunk of things here that are not being

discussed. The stuff that you're talking about seems like you're doing a pretty good job and I appreciate a lot of the good questions that were asked during the conversation today.

But there's a little bit larger questions about not exactly whether we think they're going to corrode but where are we putting them exactly? Are there other options? These kind of questions and those are not being addressed.

Okay, so that's the end of my comment I guess. Thank you.

CHAIRMAN BALLINGER: Thank you.

MS. GILMORE: This is Donna Gilmore. I actually have a couple more comments. I'll be quick, all right. Number one I met with Doctor Singh, the president of Holtec. He said, he told us that even a microscopic crack could release millions of curies of radiation into the environment.

He also said he would not recommend repairing these canisters because even a repair will create a location for more corrosion to occur. So I just want to get that out there. And I have a video of him making these statements. I posted it on my website at sanonofresafety.org.

CHAIRMAN BALLINGER: Thank you.

MS. GILMORE: And one more comment is you could please make the slides available ahead of time to the people that have e-mailed you and said they want to participate in the conference because that would be very helpful to have the slides to review, you know, as you're having the meeting.

CHAIRMAN BALLINGER: Okay. Thank you very much.

MS. GILMORE: Thank you. And I really appreciate all the great questions that I heard today. I really liked the honest discussion.

CHAIRMAN BALLINGER: Thanks again. Anybody --

MR. LUTZ: One more thing. Can I ask a question? This is Ray Lutz again. Is this session being recorded and can the recording be made available to the public?

MR. BROWN: We have a transcript that will be probably available in two weeks on the internet.

CHAIRMAN BALLINGER: Yes, there will be a transcript available on the internet within two weeks.

MR. LUTZ: Wonderful, okay. Thank you very much. We'll look forward to that. Thank you. Bye bye.

CHAIRMAN BALLINGER: Anybody else out

there? Hearing none we close the, okay, can we go around the table for final comments.

MEMBER RICCARDELLA: I have no further comments.

CHAIRMAN BALLINGER: Dick?

MEMBER SKILLMAN: Reporting timeliness I think is a comment that I'm comfortable reinforcing. Thank you for the presentation, really solid, really good. Thank you.

CHAIRMAN BALLINGER: Dr. Powers?

MEMBER POWERS: I'm resonating a lot with an implied comment in Kris' slides that said we're relatively new in this process and that we need to have the capability to be flexible maybe or active or in some way adjust as we learn things along the way here and not get too encumbered by the rigidity of a system so that we can respond to things that we learn as we go along.

I appreciated that comment a lot and I think we need to think carefully about just exactly that. The problem that we're going to run into is the time scales here are incommensurate with the time scales which people pay attention to this issue. So the people that are going to be responding to the learning are not necessarily the people that set up

the system.

CHAIRMAN BALLINGER: Charles.

MEMBER BROWN: No, I appreciated the discussion and the meeting. It was very informative for an electrical guy to listen to this stuff, have to pay attention to blacksmith technology goes to the dynamic realm in which I exist.

But I have learned a lot in the past and I really wanted to reemphasize the point that I really think you have to have some type of Aging Management Programs, a framework, not every detail but some framework for those programs to be developed and defined as part of the license condition and the renewal condition.

I just, I've sat in on dozens of the license renewals and the GALL, AMP, the aging management stuff and the time limited, the TLAAs and all the other stuff that goes into that are very, very good and I just think this is an area that's ripe. If you're going to get into you might as well do it and do it right.

So that's the only other, just reemphasize my comment for good or for bad.

CHAIRMAN BALLINGER: Anything else? Well this was a great presentation, at least from my

standpoint, and I think everybody else appreciated it and we look forward to further interaction with picking up on some of the comments that we've made and things.

I think the issue is sort of, now speaking as one person, that the issue of risk I think you've heard that around the table. So I hope that you would at least consider that going forward. And with that if there's not anything else we are adjourned. Thank you.

(Whereupon, the above-entitled matter went off the record at 12:26 p.m.)

# *Industry Guidance for Operations-Based Aging Management for Dry Cask Storage (NEI 14-03)*

**Kristopher Cummings**
Nuclear Energy Institute
ACRS Subcommittee on Metallurgy and Reactor Fuel
April 8th, 2015 • Rockville, MD

# Topics to Address

- Extended Storage Safety Basis
- Overview of NEI 14-03
- NRC Comments and Industry Response on NEI 14-03

# Extended Storage Safety Basis

- Dry Casks are robust systems with no moving parts
- Part 72.42 rulemaking increased license/renewal terms from 20 to 40 years
  - "This increase is consistent with the NRC staff's findings regarding the safety of spent fuel storage as documented in the renewal exemptions issued to the Surry and H.B. Robinson ISFSIs" 76 Fed. Reg. 8874 2/16/2011
- Continued Storage rulemaking
  - "continued safe storage of spent fuel in dry casks for the timeframes considered in the GEIS is technically feasible" NUREG-2157, September 2014
- EPRI and NRC Dry Storage PRAs conducted in 2007
  - Annual cancer risk between 1.8E-12 and 3.2E-14 *
- Opportunities to further verify performance being pursued

* Compares to 2E-6 LCF/yr. public & 1E-5 LCF/yr . worker thresholds of negligible risk from NRC's framework for "Risk-Informed Decision-making for Nuclear Material and Waste Applications", Revision 1, February 2008

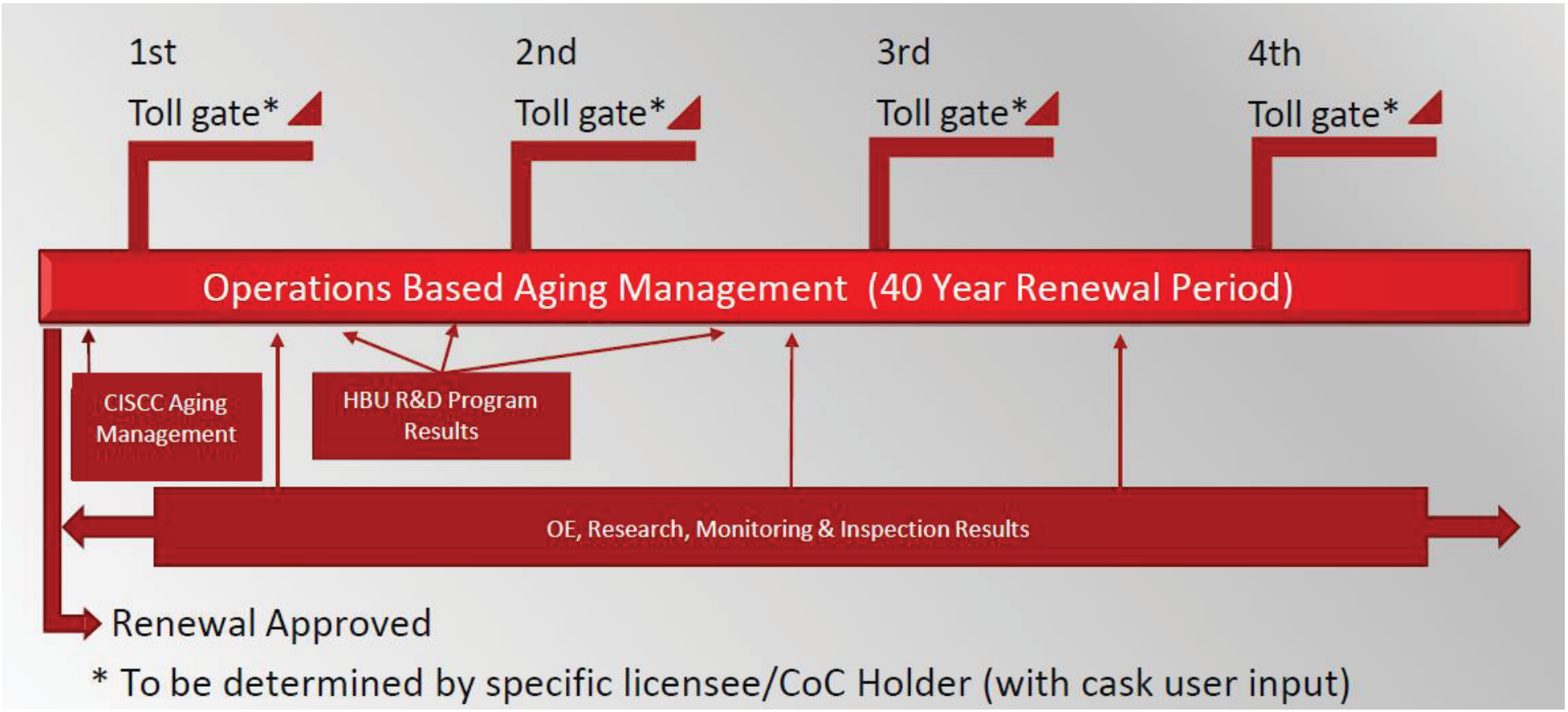
# NEI 14-03 Content

- Key administrative resource to ensure consistency in cask license renewal applications
- Process Focused:
  - Technical details of applications up to licensees and cask designers (CoC holders)
- Augments NUREG-1927 and specific aging management plan guidance being developed (e.g., MAPS Report)
- Two areas of focus
  - Forward looking approach to gathering dry cask storage operating data
  - Renewal application format and content

# Toll Gates

- Commitment to periodic, documented safety assessments
- Assessment timing specified after renewed operating period begins determined by the specific licensee or CoC holder
- Integrates OE, research, monitoring, and inspection results and assesses aggregate impact (e.g. applies CISCC susceptibility criteria & HBU R&D results)
  - If confirmatory, proceed to next toll gate (no action)
  - If not, pre-plan for possible outcomes – e.g., implement corrective actions, if needed, under licensee's corrective action program
- Piloted in Calvert Cliffs and Prairie Island renewals tailored for specific issues – Canister corrosion, high burnup fuel

# Toll Gates for ISFSI License Renewal



# Licensee Implementation

- Key concept:

  ***Effective licensee implementation of an operations-based DCS aging management program will require the ability to efficiently change AMAs based on feedback from operating experience, research, monitoring, and inspections***

# Operating Experience

- Identification, screening, and sharing of OE within and across DCS technologies is a key
- OE should be screened consistently and shared among affected entities in a timely manner
- Technology users groups play a key role

# NEI 14-03 Status

- NEI 14-03 completed in September 2014 and submitted to NRC for review and endorsement
- NRC Response received in January 2015 (ML15013A201)
  - Application Format and Content
  - Sharing of Operating Experience
  - Tollgates
  - Change Control of Aging Management Information
  - Lead System Inspections
  - AMPs and TLAAs
- Industry is working to address NRC Response and provide an updated revision for NRC final endorsement in NUREG-1927

# Sharing of Operating Experience

- Industry is working to develop options for an improved operating experience sharing program:
  - Enhancement of cask vendors existing program to capture and disseminate OE.
  - Utilize existing plant operating experience sharing infrastructure for dry cask storage

# Change Control/Tech Spec Content

- Placing aging management program in license conditions is inconsistent with PRM 72-7 and NRC risk informed framework initiative.
- Emphasis has been on ensuring licensee/CoC holder control of dry cask storage AMPs is consistent with plant license renewal.
- To remain a “learning aging management” program need to ensure that flexibility exists to modify or update the AMPs in a timely manner.
- Underlying QA program requires maintenance of the design basis (and restoration of the design basis, if needed).

# Change Control/Tech Spec Content

- CoC amendments require rulemaking and are not an efficient change mechanism
  - Later amendments are not applicable to casks loaded under the renewed original CoC or earlier amendments
- Level of detail in recent renewed site-specific ISFSI licenses may hinder ability to be responsive (CoC holders do not have the ability to quickly modify the program if in the CoC).

# Lead System Inspections

- Need to clearly distinguish scope and purpose of a lead canister inspection (before renewal application) versus the aging management program inspections.
- CoC holder has no legal authority to require general licensees to perform inspections prior to period of extended operation.
- Initial inspections (and TLAAs) will provide operating experience basis to inform need for additional inspections at each site.
- Forthcoming EPRI Susceptibility Report will provide criteria and ranking for use of surrogate inspections for SCC.

# Thank you

Questions?

# Abbreviations

- AMA – Aging Management Activity
- AMP – Aging Management Program
- CAP – Corrective Action Program
- CISCC – Chloride-Induced Stress Corrosion Cracking
- CoC – Certificate of Compliance
- DCS – Dry Cask Storage
- HBU R&D – DOE/EPRI Demonstration Project
- OE – Operating Experience
- MAPS – Managing Aging Programs for Storage
- PRA – Probabilistic Risk Analysis
- TLAA – Time-Limited Aging Analysis

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

# Elements of an AMP NUREG-1927, Rev. 1

## Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel

Ricardo Torres

NMSS/DSFM/RMB

Meeting with Advisory Committee on Reactor Safeguards
Subcommittee on Metallurgy & Reactor Fuels
NUREG 1927, Rev. 1
April 8, 2015

# Revision 1:
# Aging Management Review

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

I. Scope of the Program
   - SSCs, subcomponents
   - Materials of construction, service environments
   - Aging mechanisms for material/environment combination
   - Aging effects caused by specific aging mechanisms

II. Preventive Actions
   - Actions to control allowable physical conditions
     - Prevent adverse service environments
     - Mitigate/ avoid adverse chemical reactions

# Revision 1:
# Aging Management Review

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

III. Parameters Monitored or Inspected

- Clear link to aging effects identified in the scope of the program
- Selection allows for:
  - monitoring the effectiveness of activities that prevent or mitigate aging,
  - monitoring the performance of SSCs as an indirect indicator of degradation, and
  - detecting, through direct inspection, the presence and severity of conditions or discontinuities that may have an effect on the function of SSCs.

# Revision 1:
# Aging Management Review

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

IV. Detection of Aging Effects

- Defines specific aspects of the activities to collect data as part of the inspection or monitoring activities
  - Method/technique (e.g. visual, surface, and/or volumetric inspections or surveys)
  - Selection and calibration of equipment
  - Frequency of inspection (e.g. inspection intervals)
  - Sample size (dependent on operational experience trending)
  - Data collection (clearinghouse for operational experience)

# Revision 1:
# Aging Management Review

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

V. Monitoring and Trending

- Trending of aging effects (e.g., corrosion rate, crack growth rate, etc.)
- Assess effects per prior inspections and industry-wide operational experience
- Baseline established prior to or at renewal

VI. Acceptance Criteria

- Quantitative basis (justifiable by operating experience, engineering analysis, consensus codes/standards)
- Actionable and achievable

# Revision 1:
# Aging Management Review

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

VII. Corrective Actions

– CAP consistent with the QA requirements in either 10 CFR Part 72, Subpart G or 10 CFR Part 50, Appendix B.

- Actions to prevent recurrence
- Justification for deferral of actions
- Evaluation of impact to other SSC subcomponents
- Possible increased inspection frequency and sample size

# Revision 1:
# Aging Management Review

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

VIII. Confirmation Process

- QA Program consistent with 10 CFR Part 72 Subpart G, or 10 CFR 50 Appendix B
- Ensures preventive actions are adequate
- Determine follow-up actions to verify effective implementation of corrective actions, and
- Monitor for adverse trends due to recurring or repetitive findings.

# Revision 1:
# Aging Management Review

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

IX. Administrative Controls

- QA Program consistent with 10 CFR Part 72 Subpart G, or 10 CFR 50 Appendix B
- Instrument calibration and maintenance
- Inspector requirements
- Record retention requirements
- Document control

# Revision 1:
# Aging Management Review

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

X. Operating Experience

– Provides justification for the effectiveness of each AMP program element and critical feedback for enhancement

- Internal and industry-wide condition reports,
- Licensee event reports
- Vendor-issued safety bulletins
- NRC Generic Communications
- Applicable industry-initiatives (e.g., Department of Energy or Electric Power Research Institute sponsored inspections)

# Acronyms

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- ACRS: Advisory Committee on Reactor Safeguards
- ADAMS: Agencywide Documents Access and Management System
- AMP: Aging Management Program
- AMR: Aging Management Review
- CA: Corrective Action
- CFR: Code of Federal Regulations
- CoC: Certificate of Compliance
- DLR: Division of License Renewal
- DSS: Dry Storage System
- HBU: High Burnup
- ISFSI: Independent Spent Fuel Storage Installation
- ISG: Interim Staff Guidance
- NEI: Nuclear Energy Institute
- NMSS: Office of Nuclear Material Safety and Safeguards
- NRR: Office of Nuclear Reactor Regulation
- OGC: Office of the General Counsel
- QA: Quality Control
- RES: Office of Nuclear Regulatory Research
- SSC: Structure, System or Component
- TLAA: Time-Limited Aging Analysis
- VSC: Ventilated Storage Cask

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

# Changes in NUREG-1927, Rev. 1

## Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel

Ricardo Torres

NMSS/DSFM/RMB

Meeting with Advisory Committee on Reactor Safeguards

Subcommittee on Metallurgy & Reactor Fuels

NUREG 1927, Rev. 1

April 8, 2015

# Structure and Format

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Upfront material (Abbreviations, Definitions, Introduction)

I. General Information Review

II. Scoping Evaluation

III. Aging Management Review

  - Time-Limited Aging Analyses
  - Aging Management Programs

- Appendices

# Upfront and General Information

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Updated terminology and definitions:
  - Added/clarified existing definitions; made consistent with 10 CFR §72.3, NUREG-1536 and NUREG-1567
- Expanded guidance on application content, particularly for CoC renewals
- Added section on timely renewal
- Added reviewer guidance for:
  - Amendment applications submitted during renewal reviews and after the renewal is issued
  - Use of conditions for ensuring AMPs remain effective during the renewal period

# Scoping Evaluation

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Scoping evaluation identifies SSCs reviewed for aging mechanisms and effects
- Clarified sources of information that may be used to support the evaluation
- Expanded guidance for:
  - Review of SSC subcomponents
  - Scoping of fuel internals
  - Identifying SSCs within the scope of renewal
- Clarified reviewer guidance for ensuring exclusions from the scope of renewal are justified

# Aging Management Review

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- AMR assesses proposed aging management activities for SSCs within the scope of renewal.
- Expanded guidance on environmental data and identification of aging effects and mechanisms:
  - Lead system inspection results
  - Use of maintenance records, operating experience specific to material/service environment (site-specific, industry-wide)
  - Use of consensus codes/standards
  - Other applicable NRC guidance or reports

# Aging Management Review

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Expanded discussion on aging management of fuel internals
- Revised TLAA section:
  - ensure consistency with 10 CFR §72.3
  - provide guidance for review of calculations/analyses not part of approved design bases
- Expanded discussion on each of ten AMP elements
- Provided new guidance on learning AMPs and use of operating experience

# Aging Management Review

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Included discussion of specifics NEI 14-03 concepts:
  - Use of “tollgates” or periodic assessments of operating experience/confirmatory research
  - Aggregation and dissemination of operating experience
- Deleted Retrievability section

# Appendices

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Appendix A on Non-Quantifiable Terms – No changes
- Removed appendices that added minimal value to the review process
- Added new appendices:
  - Example AMPs
  - Lead system inspections
  - Use of a demonstration program as a surveillance tool for HBU fuel performance (per ISG-24)
  - Special considerations for CoC renewals
  - Storage terms (period that a DSS has been loaded)

# Appendix C:
## Lead System Inspection(s)

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Expanded guidance for Lead System Inspection(s)
  - Purpose of the Lead System Inspection
  - Selecting System(s) for Inspection:
    - Inspection of multiple systems may be necessary to capture variations in designs, environments, materials, loadings, and applicable aging effects
  - Guidelines for the Lead System Inspection
  - Use of Surrogate Inspections
  - Considerations for Lead System Inspections for CoC Renewals

# Appendix E:
## Special Considerations for CoC Renewals

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Development of TLAAs and AMPs
  - CoC holders
- Implementation of AMPs
  - General licensees to comply with the terms, conditions, and specifications of the CoC, including but not limited to, the requirements of any AMP (10 CFR §72.212(b)(11))
  - General licensees should update the evaluation required under 10 CFR 72.212(b)(5) to show how they will meet the new CoC terms, conditions, or specifications for aging management
- Corrective Actions
  - General licensees use their Corrective Action Program (CAP) (consistent with the criteria in 10 CFR Part 50, Appendix B) to capture and address aging effects.

# Appendix F:
## Storage Terms (CoC Renewals)

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Flow chart for calculating length of storage term of a dry storage system (DSS) loaded during either the initial storage period or renewal period(s) of a CoC

# References

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- 10 CFR Part 72
  http://www.nrc.gov/reading-rm/doc-collections/cfr/part072/
- NUREG-1927, Rev. 1 Draft
  http://pbadupws.nrc.gov/docs/ML1506/ML15068A331.pdf
- NUREG-1927, Rev. 0
  http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1927/
- NUREG-1536
  http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1536/
- NUREG-1567
  http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1567/
- DSFM ISG-24
  http://pbadupws.nrc.gov/docs/ML1405/ML14058B166.pdf

# Acronyms

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- ACRS: Advisory Committee on Reactor Safeguards
- ADAMS: Agencywide Documents Access and Management System
- AMP: Aging Management Program
- AMR: Aging Management Review
- CA: Corrective Action
- CFR: Code of Federal Regulations
- CoC: Certificate of Compliance
- DLR: Division of License Renewal
- DSS: Dry Storage System
- HBU: High Burnup
- ISFSI: Independent Spent Fuel Storage Installation
- ISG: Interim Staff Guidance
- NEI: Nuclear Energy Institute
- NMSS: Office of Nuclear Material Safety and Safeguards
- NRR: Office of Nuclear Reactor Regulation
- OGC: Office of the General Counsel
- QA: Quality Control
- RES: Office of Nuclear Regulatory Research
- SSC: Structure, System or Component
- TLAA: Time-Limited Aging Analysis
- VSC: Ventilated Storage Cask

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

# Development of Infrastructure for Operations-Focused Approach to Aging Management

Aladar A. Csontos, Ph.D
NMSS/DSFM/RMB

Presentation to:
Advisory Committee on Reactor Safeguards
Meeting of the Subcommittee on Metallurgy & Reactor Fuels

NUREG-1927 Revision 1
April 8, 2015

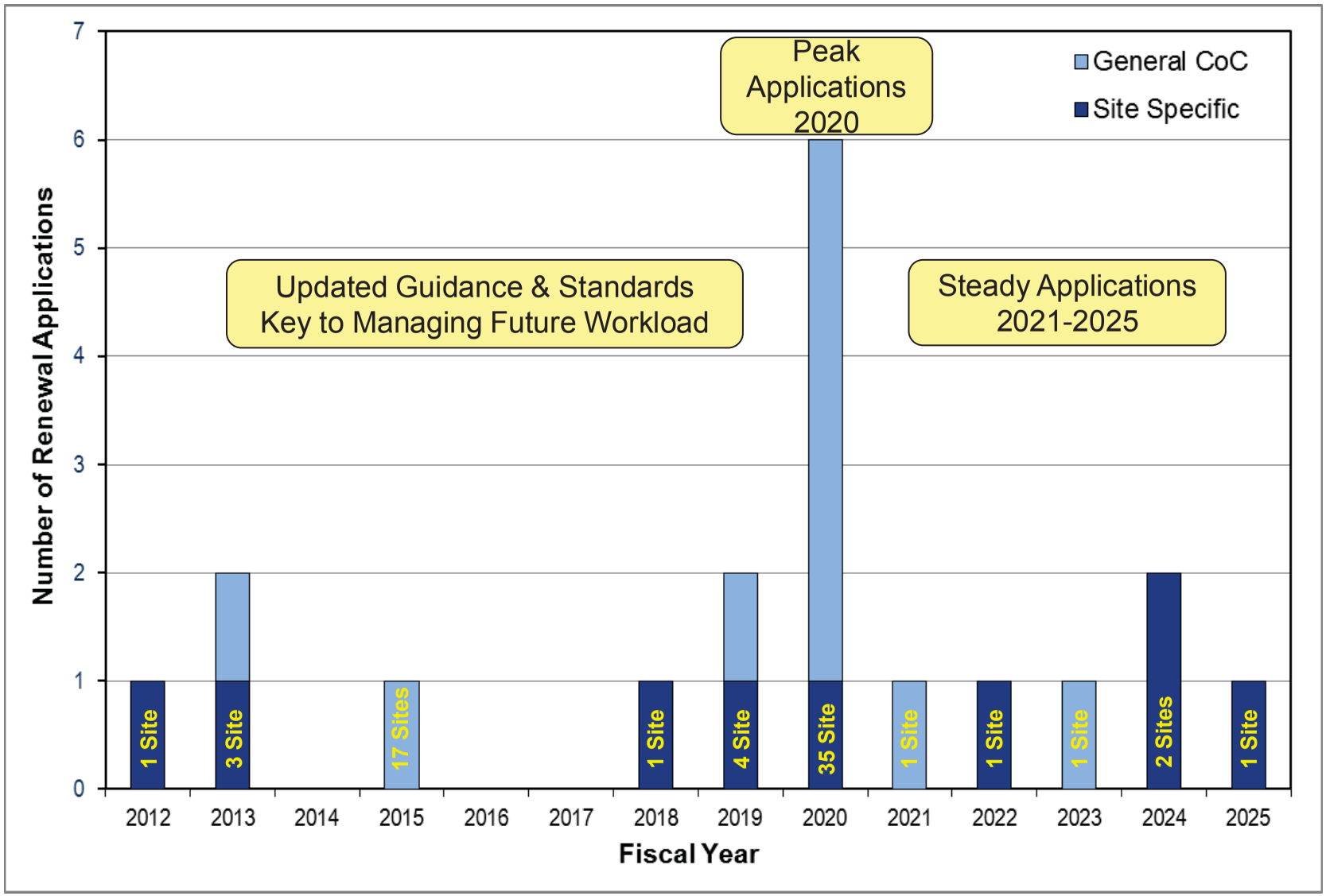
# Spent Fuel Storage Renewal Experiences & Expectations

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Staff experience with storage renewal reviews
- Updated Storage Renewal Framework:
  - Operations-focused aging management
  - Learning, proactive, & responsive aging management
  - AMPs that consider & respond to OpE & confirmatory research
  - NUREG-1927, Rev. 1 with three example AMPs
- Upcoming wave of renewal applications in next 10 years:
  - 7 Specific license renewal applications
  - 8 CoC renewal applications
- Additional staff guidance and consensus codes/standards development will be key to managing the future workload

# Current & Future Spent Fuel Storage Renewal Projections

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*



# Developing Supporting Information for Guidance Infrastructure

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- NRC Technical Support Activities:
  - Report on the recent Expert Panel Workshop on Degradation of Concrete in Spent Nuclear Fuel in Dry Cask Storage Systems
  - Aging Management Tables (AMT) supporting additional AMPs
  - Aging Management for Extended Storage and Transportation
  - Non-destructive examination (NDE) inspection technology reviews
  - Chloride induced stress corrosion cracking (CISCC) modeling
  - Thermal analyses for horizontal ventilated & vertical multipurpose casks
  - Cladding integrity research fatigue testing and cladding stress modeling
- Stakeholder engagement:
  - DOE High Burnup Dry Storage Cask Research & Development Project
  - NEI CISCC Regulatory Issue Resolution Protocol
  - NEI 14-03 Guidance on Operations-Based Aging Management

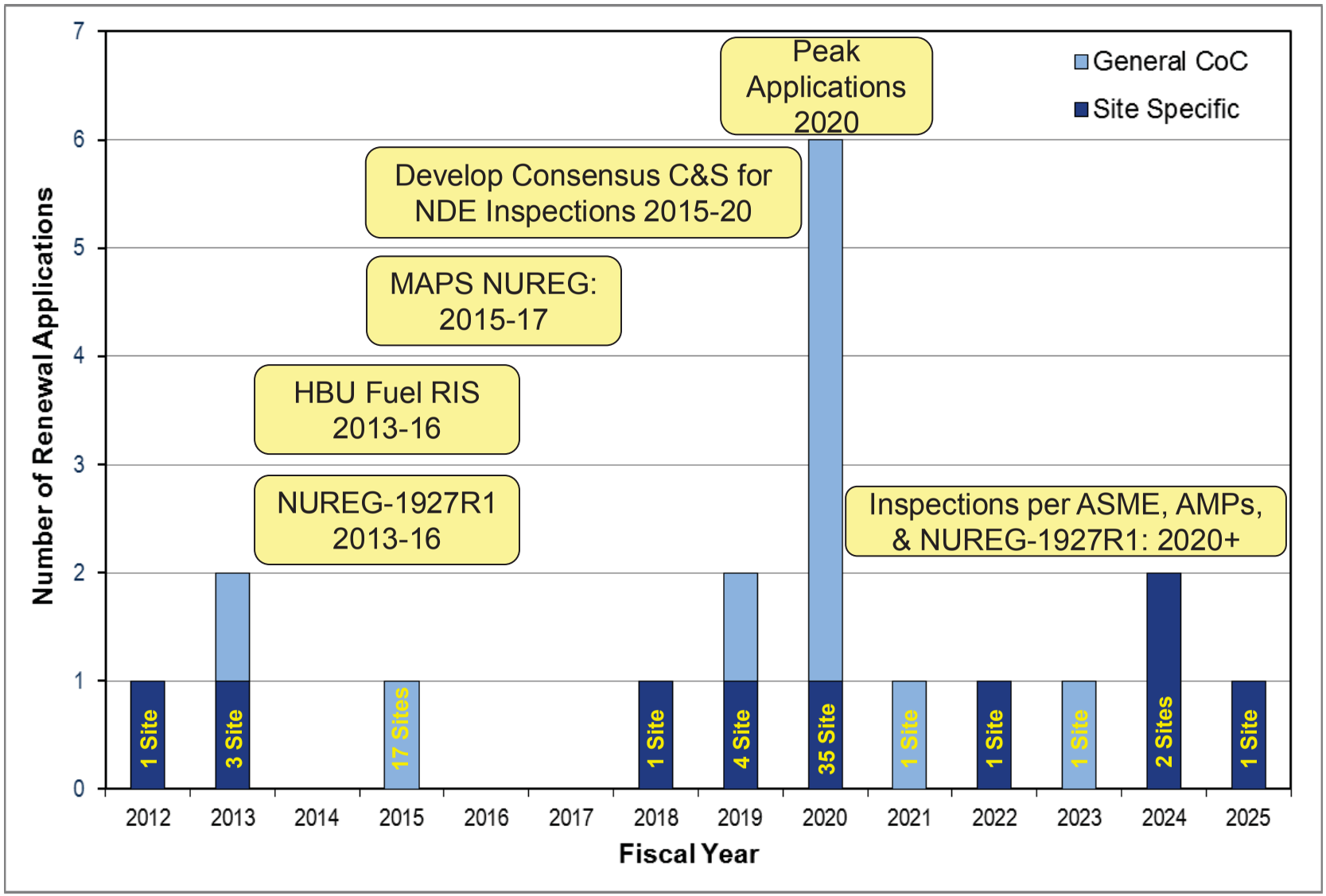
# Guidance Infrastructure for Spent Fuel Storage Renewal Reviews

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- NRC guidance infrastructure development underway:
  - Publish NUREG-1927R1 for public comment (2015)
  - Issued Draft Regulatory Issue Summary on High Burnup Fuel for Storage and/or Transportation for 45-day Public Comment (3/5/2015)
  - Managing Aging Processes for Storage (MAPS):
    - GALL-like NUREG analog
    - Additional AMPs for specific storage systems
  - Guidance for NRC inspections of licensees' aging management activities
- External stakeholder infrastructure development:
  - Consensus ASME Boiler and Pressure Vessel Code Section XI for inservice inspections (ISI) of dry cask storage canisters
  - Consensus ACI Code for ISI of dry cask storage concrete overpacks
  - Review of NEI 14-03 R1 "Dry Cask Storage License Renewal Industry Guidance for Operations-Based Aging Management"

# Current & Future Spent Fuel Storage Renewal Projections

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*



U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

# Aging Management Program for Reinforced Concrete Structures

Ricardo Torres

NMSS/DSFM/RMB

Meeting with Advisory Committee on Reactor Safeguards

Subcommittee on Metallurgy & Reactor Fuels

NUREG 1927, Rev. 1

April 8, 2015

# Basis for Development

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Based on guidance in consensus codes/standards and NUREG reports:
  - ACI 349.3R, “Evaluation of Existing Nuclear Safety-Related Concrete Structures”
  - ASME Code Section XI, Subsection IWL, “Requirements for Class CC Concrete Components of Light-Water-Cooled Plants”
  - NUREG-1801, “Generic Aging Lessons Learned (GALL) Report”
- Applicant may propose AMPs based on alternate criteria:
  - Exclusion of aging effects/mechanisms should be justified with a technical basis (e.g., site-specific/industry-wide operational experience data, engineering analysis).
  - Justification should demonstrate that the excluded aging mechanisms will not adversely affect the ability of the in-scope SSC to perform its intended function during the renewal period.

# Scope of the Program

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

Aging mechanisms and effects (ACI 349.3R, ACI 201.1R, SEI/ASCE 11)

| **Mechanism** | **Effect** |
|---|---|
| Freeze-thaw | Cracking, loss of material (spalling, scaling) |
| Chemical attack [Cl, $SO_4$] | Cracking, loss of material (spalling, scaling) |
| Aggregate reactions | Cracking and loss of strength |
| Corrosion of embedded steel | Cracking, loss of material (spalling, scaling) and loss of bond |
| Leaching of $Ca(OH)_2 \rightarrow CaCO_3$ | Increase in porosity/permeability, loss of strength |
| Long-term settlement | Cracking, distortion |
| Gamma/neutron irradiation | Cracking, reduction in strength (change in mechanical properties) |
| Thermal dessication | Cracking, reduction in strength (change in mechanical properties) |

# Scope of the Program & Preventive Actions

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Visual inspection (condition monitoring)
- Groundwater chemistry program (mitigation)
  - Mitigate below-grade (underground) effects
    - Corrosion of embedded steel
    - Chemical attack (chloride, sulfate induced degradation)
- Periodic radiation surveys (performance monitoring)
- Continuance of daily inspections of air inlet/outlet vents
- Preventive actions not required for structures designed and fabricated in accordance to ACI 318 or ACI 349.

# Parameters Monitored or Inspected

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Visual inspections
  - Quantify the aging effects of cracking, material loss (spalling, scaling), loss of bond, and increased porosity/permeability
- Groundwater chemistry program
  - pH; concentration of chlorides and sulfates
- Radiation surveys
  - gamma dose and/or neutron fluence
- Inspections of the air inlet/outlet vents
  - any identification of blockage that may lead to the design temperature limits being exceeded

# Detection of Aging Effects

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Visual inspections
  - Visual method (feeler gauges, crack comparators, site-qualified system)
  - Baseline inspection prior to entering renewal period
  - Inspection schedule commensurate with ACI 349.3R-02
  - All surface areas, or a justified sample size
  - Clearly identifies and justifies specific locations
  - Defines accessible and inaccessible areas and respective sample size
  - Data collection for visual inspections is commensurate with applicable consensus codes/standards/reports

# Detection of Aging Effects (Cont.)

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Groundwater chemistry program, Radiation surveys
  - adequate chemical analysis method; calibrated detector with a valid energy range
  - Baseline measurements prior to entering renewal period
  - AMP defines their respective sample size
  - Sample size clearly identifies and justifies specific locations
- Inspections of the air inlet/outlet vents
  - Visual observation
  - Sample size as defined in technical specification (all air inlets and outlet vents)

# Monitoring and Trending

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Methods commensurate with defect evaluation standards (ACI codes referenced in AMP)
- Monitoring and trending methods reference plans/procedures used to:
  - Establish a baseline prior to or at the beginning of the period of extended operation
  - Track trending of parameters or effects not corrected in a previous inspection

# Acceptance Criteria

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- For visual inspections, the acceptance criteria are commensurate with the 3-tier quantitative criteria in ACI 349.3R-02:
  - Acceptance without further evaluation,
  - Acceptance after review, and
  - Acceptance requiring further evaluation.
- The acceptance criteria clearly identify when a finding is to be entered in the Corrective Action Program (e.g., when Tier 2 acceptance per ACI 349.3R-02 is exceeded).

# Acceptance Criteria (Cont.)

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Groundwater chemistry program
  - Commensurate with ASME Code Section XI, Subsection IWL (aggressive below-grade environment)
  - pH < 5.5, chlorides > 500 ppm, or sulfates > 1500 ppm
- Radiation surveys
  - Ensures compliance with 10 CFR 72.104
  - The adequacy of the acceptance criteria at or near overpack surfaces considers design bases calculations documented in the FSAR
- Inspections of the air inlet/outlet vents
  - Absence of any blockage that may lead to the design temperature limits being exceeded

# Corrective Actions

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Corrective Actions in accordance with 10 CFR 72 Subpart G, or 10 CFR 50 Appendix B
  - Perform functionality assessments, apparent cause evaluations, and root cause evaluations
  - Trend conditions, address extent of condition
  - Determine actions to prevent recurrence; ensure justifications for non-repairs
  - Identify operating experience actions, including modification to the existing AMP (e.g., increased frequency)
  - Determine if the condition is reportable to the NRC (e.g., results in the loss of intended function)
- AMP references applicable concrete rehabilitation standards (ACI codes provided in AMP)

# Confirmation Process & Administrative Controls

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Consistent with 10 CFR Part 72, Subpart G, or 10 CFR Part 50, Appendix B
  - Preclude repetition of significant conditions adverse to quality
  - Determine follow-up actions to verify effective implementation of corrective actions, and
  - Monitor for adverse trends due to recurring or repetitive findings
  - Instrument calibration and maintenance
  - Inspector requirements – consistent with ACI 349.3R
  - Record retention requirements
  - Document control

# Operating Experience

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Review applicable OE
  - Internal and industry-wide CRs and CARs
  - Vendor-issued safety bulletins
  - NRC Information Notices
  - Applicable industry initiatives (e.g. DOE cask demo, EPRI-sponsored inspections)
- Identifies any degradation in the referenced OE as either age-related or event-driven, with proper justification for that assessment.
- Past OE supports the adequacy of the proposed AMP

# Acronyms

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- ACI: American Concrete Institute
- AMP: Aging Management Program
- ASCE: American Society of Civil Engineers
- ASME: American Society of Mechanical Engineers
- ASTM: American Society for Testing and Materials
- CAR: Corrective Action Report
- CFR: Code of Federal Regulations
- CoC: Certificate of Compliance
- CR: Condition Report
- DOE: Department of Energy
- EPRI: Electric Power Research Institute
- FSAR: Final Safety Analysis Report
- ISFSI: Independent Spent Fuel Storage Installation
- INPO: Institute of Nuclear Power Operations
- ITS: Important to Safety
- OE: Operating Experience
- RAP: Repair Application Procedure
- SSC: Structure, System, or Component
- TLAA: Time-Limited Aging Analysis

# References (Cont.)

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*


- 10 CFR Part 72.104, http://www.nrc.gov/reading-rm/doc-collections/cfr/part072/part072-0104.html
- ACI 201.1R-08 (2008), “Guide for Conducting a Visual Inspection of Concrete in Service”
- ACI 207.3R-94 (2008), “Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions”
- ACI 224.1R-07 (2007), “Causes, Evaluation, and Repair of Cracks in Concrete Structures”
- ACI 318-11 (2011), “Building Code Requirements for Structural Concrete”
- ACI 349.3R-02 (2010), “Evaluation of Existing Nuclear Safety-Related Concrete Structures.”
- ACI 349-06 (2007), “Code Requirements for Nuclear Safety-Related Concrete Structures”
- ACI 364.1R-07 (2007), “Guide for Evaluation of Concrete Structures before Rehabilitation”
- ACI 506R-05 (2005), “Guide to Shortcrete”
- ACI 562-13 (2013), “Code Requirements for Evaluation, Repair, and Rehabilitation of Concrete Buildings”
- ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWL (2013), “Requirements for Class CC Concrete Components of Light-Water-Cooled Plants”
- ASTM C260/C260M-10a, “Standard Specification for Air-Entraining Admixtures for Concrete”
- ASTM C295/C295-M-12, “Standard Guide for Petrographic Examination of Aggregates for Concrete”
- NRC. 2000. NUREG-1567, “Standard Review Plan for Spent Fuel Dry Storage Facilities”, ML003686776
- NRC. 2010. NUREG-1801, “Generic Aging Lessons Learned (GALL) Report”, ML103490041.

# References (Cont.)

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*


- NRC. 2010. NUREG-1536, Rev. 1, "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility - Final Report," ML101040620.
- NRC. 2015. Draft NUREG-1927, Rev. 1, "Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel," ML15068A331.
- SEI/ASCE 11-99 (2000), "Guideline for Structural Condition Assessment of Existing Buildings"

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

# Example AMP for Localized Corrosion and Stress Corrosion Cracking of Welded Stainless Steel Dry Storage Canisters

Darrell Dunn
NMSS/DSFM/RMB

Presentation to:
Advisory Committee on Reactor Safeguards
Meeting of the Subcommittee on Metallurgy & Reactor Fuels

NUREG-1927 Revision 1
April 8, 2015

# Basis for Development

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Example AMP based on consensus codes/standards and NUREG guidance
  - American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME B&PV) Code Section XI - Rules For Inservice Inspection Of Nuclear Power Plant Components
  - NUREG-1801, Generic Aging Lessons Learned (GALL) Report
- Chloride-induced stress corrosion cracking (SCC) complex process with multiple dependencies
  - Residual Stress
  - Operating Environment
  - Canister Temperature

# AMP Element 1
# Scope of the Program

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Welded stainless steel dry storage canisters
  - Fabrication and closure welds
  - Weld heat affected zones
  - Locations where temporary supports or fixtures were attached by welding
  - Crevice locations
  - Surfaces where atmospheric deposits tend to accumulate
  - Surface areas with a lower than average temperature
- Inservice inspection for localized corrosion and SCC

# AMP Element 2
# Preventative Actions

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Example AMP is for condition monitoring.
  - Preventative actions are not presently incorporated into existing dry storage canister designs
- Future designs or amendments could include
  - Surface modification to impart compressive residual stresses on welds and weld heat affected zones
  - Materials with improved localized corrosion and SCC resistance

# AMP Element 3
# Parameters Monitored/Inspected

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Canister surfaces, welds, and weld heat affected zones for discontinuities and imperfections
- Appearance and location of atmospheric deposits on the canister surfaces
- Size and location of localized corrosion (e.g., pitting and crevice corrosion) and stress corrosion cracks

# AMP Element 4
# Detection of Aging Effects

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Qualified and demonstrated technique to detect evidence of localized corrosion and SCC:
  - Remote visual inspection, e.g. EVT-1, VT-1, VT-3, or Eddy Current Testing (ET) may be appropriate
- Suspected areas of localized corrosion and/or SCC require additional evaluation
- Sample size
  - Minimum of one canister at each site
  - Canisters with the greatest susceptibility
- Data Collection
  - Documentation of the examination of the canister
  - Location and appearance of deposits
- Frequency
  - Every 5 years

# AMP Element 5
# Monitoring and Trending

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Document canister condition particularly at welds and crevice locations using images and video that will allow comparison in subsequent examinations
- Changes to the size and number of any corrosion product accumulations
- Location and sizing of localized corrosion and stress corrosion cracking

# AMP Element 6
# Acceptance Criteria

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- No indications of:
  - Pitting or crevice corrosion
  - Stress corrosion cracking
  - Corrosion products on or adjacent to fabrication welds, closure welds, and welds for temporary supports or attachments
- Locations with corrosion products require additional examination for localized corrosion and/or SCC
- Canisters with localized corrosion and/or SCC must be evaluated for continued service. Potential ASME B&PV Code Section XI Criteria
  - IWB-3514
  - IWB-3640

# AMP Element 7
# Corrective Actions

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Supplemental inspections to determine the extent of condition at the site
- Subsequent inspections of canisters with indications
- Canisters that do not meet the prescribed evaluation criteria must be repaired or removed from service
- Applicants may reference the use of a Corrective Action Program (CAP), which is consistent with the quality assurance (QA) requirements in either 10 CFR Part 50, Appendix B, or 10 CFR Part 72, Subpart G

# AMP Element 8
# Confirmation Process

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Licensee Quality Assurance Program consistent with 10 CFR 72 Subpart G, or 10 CFR 50 Appendix B
- Ensure that inspections, evaluations, and corrective actions are completed in accordance with the Site Specific or General Licensees Corrective Action Program (CAP)
  - Extent of condition
  - Evaluation for continued service
  - Repair, replace, mitigation actions

# AMP Element 9
# Administrative Controls

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Licensee Quality Assurance Program consistent with 10 CFR 72 Subpart G, or 10 CFR 50 Appendix B
- Training requirements for inspectors
- Records retention requirements

# AMP Element 10
# Operational Experience

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- No reported cases of localized corrosion or SCC in welded stainless steel canisters
- Atmospheric deposits on canister surfaces have been observed
- Several reported cases of chloride-induced SCC from atmospheric deposits observed in operating reactors (NRC Information Notice 2012-20)
- Field data necessary to assess whether conditions for chloride induced SCC may exist on welded stainless steel canisters
- Laboratory data on chloride-induced SCC growth rates are necessary to inform inservice intervals

# Acronyms

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

AMP: Aging Management Program

ASME B&PV Code: American Society of Mechanical Engineers Boiler and Pressure Vessel code

CAP: Corrective Action Program

CFR: Code of Federal Regulations

EVT-1: Enhanced Visual Testing-1 (Boiling water reactor vessels and internals project, BWRVIP-03)

TLAA: Time-Limited Aging Analysis

SCC: Stress Corrosion Cracking

VT-1: Visual Testing-1 (ASME B&PV code Section XI, Article IWA-2200)

VT-3: Visual Testing-3 (ASME B&PV code Section XI, Article IWA-2200)

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

# Example of a High Burnup (HBU) Fuel Monitoring Program

Aladar A. Csontos, Ph.D
NMSS/DSFM/RMB

Presentation to:
Advisory Committee on Reactor Safeguards
Meeting of the Subcommittee on Metallurgy & Reactor Fuels

NUREG-1927 Revision 1
April 8, 2015

# Purpose of HBU Fuel Monitoring Program

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Surrogate surveillance program to check condition of HBU fuel in dry storage to ISG-11 expectations:
  - Discharge burnup greater than 45 GWd/MTU
  - ISG-11 “Cladding Considerations for the Transportation and Storage of Spent Fuel” (NRC 2003)
- Confirmation that intended function(s) of fuel maintained, as expected, during the period of extended operation
- AMP expectation for HBU fuel demonstration program:
  - DOE & EPRI “HBU Dry Storage Cask R&D Project” (HDRP)
  - Or an alternative program meeting ISG-24 “Use of a Demonstration Program as Confirmation of Integrity for Continued Storage of HBU Fuel Beyond 20 Years (Appendix D, NUREG-1927, Rev. 1)

# DOE-EPRI HDRP

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Intact HBU fuel stored in AREVA TN-32 bolted lid cask at North Anna ISFSI (Dominion VA Power)
- Nominal burnups between 53-58 GWd/MTU
- Fuel assemblies include four cladding types:
  - Zircaloy-4, low-tin Zircaloy-4, ZirloTM, and M5TM
- Surveillance cask to be licensed to the ISG-11 temperature limits and loaded such that the fuel cladding temperature is as close to the limit as practicable

# AMP Element 1: Scope of Program

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Assembly subcomponents/materials of construction:
  - Maximum burnup
  - Cladding types, maximum cladding temperature
  - Basket material/welds
  - Neutron absorbing materials
- Environment:
  - Dry helium
- Aging effects determined for material/environment combinations per ISG-24 Rev. 0 or the HDRP:
  - Fuel cladding breach
  - Assembly distortion
  - Residual moisture after drying
  - Changes in the hydride structure of the cladding

# AMP Element 2: Preventative Actions

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Condition monitoring program
- Casks/canisters dried per the accepted guidance in NUREG-1536/NUREG-1567
- Backfilled with helium cover gas
- Maximum cladding temperature is maintained below the recommended ISG-11 Rev 3 limits

# AMP Element 3: Parameters Monitored or Inspected

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Consistent with guidance in ISG-24:
  - Maximum cladding temperature
  - Inspection for the presence of fission gas in the cover gas
  - Inspection for presence of water vapor in the cover gas
  - Inspection for hydrogen to determine that any radiolysis of residual or bound water does not produce a flammable condition
  - Profilometry at the completion of the storage period to determine creep deformation
  - Gas puncturing at completion of storage to determine cladding stress for creep calculations
  - Cladding metallography at the completion of storage to determine condition of cladding hydrides

# AMP Element 4: Detection of Aging Effects

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Consistent with guidance in ISG-24:
  - Calibrated thermocouple lances to measure the radial and axial temperature profile
  - Fission gas analysis technique for the cover gas with sensitivity to detect release of 1% of the fission gas produced in 1% of the cask rods with the lowest burnup in the demonstration
  - Residual moisture detection technique with sensitivity to detect the vapor pressure at the bottom of the demonstration system
  - Hydrogen detection technique with sensitivity to detect 2% hydrogen in the cover gas of the demonstration

# AMP Element 5: Monitoring and Trending

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Evaluate information obtained from the HDRP loading and initial period of storage along with other available sources of information
  - Nondestructive examination (NDE) (i.e., cask gas sampling, temperature data)
  - Destructive examination
  - Confirmatory research – Separate Effects Surrogate Experiments
- Licensee to monitor, evaluate, and trend the information via the Corrective Action Program

# AMP Element 6: Acceptance Criteria

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Cladding Creep:
  - Total creep strain extrapolated to the total approved storage duration based on the best fit to the data <1%
  - ISG-11 temperature limits based on limiting creep to <1%
- Hydrogen:
  - Max $H^+$ content of cover gas over the approved storage period extrapolated from the gas measurements to be less than 5%
- Drying:
  - Moisture content in cask indicate no greater than one liter of residual water after the drying process is complete
- Fuel rod breach:
  - Fission gas analysis indicate <1% of fuel rod cladding breaches

# AMP Element 7: Corrective Actions

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Evaluations address lessons learned from aggregate feedback and corrective actions taken when warranted
- Corrective Actions in accordance with 10 CFR 72 Subpart G, or 10 CFR 50 Appendix B
  - Perform repairs or replacements
  - Modify the confirmatory program in a timely manner
  - Adjust age-related degradation monitoring and inspection programs (e.g., scope, frequency)
  - Actions to prevent reoccurrence
  - An evaluation of the dry storage system to ensure safety and retrievability functions are maintained
  - Evaluation of the effect of any corrective actions taken on other safety components

# AMP Element 8: Confirmation Process

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Consistent with 10 CFR Part 72, Subpart G, or 10 CFR Part 50, Appendix B
- QA Program ensures that the confirmation process includes provisions to preclude repetition of significant conditions adverse to quality
- The confirmation process describes or references procedures to:
  - Determine follow-up actions to verify effective implementation of corrective actions, and
  - Monitor for adverse trends due to recurring or repetitive findings.

# AMP Element 9: Administrative Controls

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Consistent with 10 CFR Part 72, Subpart G, or 10 CFR Part 50, Appendix B
- QA Program ensures that the administrative controls include provisions that define:
  - Instrument calibration and maintenance
  - Inspector requirements – consistent with ACI 349.3R
  - Record retention requirements
  - Document control
- The administrative controls describes or references:
  - Frequency/methods for reporting inspection results to the NRC
  - Frequency for updating the AMP based on industry-wide operational experience

# AMP Element 10: Operating Experience

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Evaluate applicable operating experience
  - DOE-EPRI Cask Demonstration Program or other surrogate surveillance demonstration programs
    - storage conditions and fuel types similar to those in the dry storage system
    - Satisfy the ISG-24, Rev. 0 acceptance criteria
  - Other domestic/international research confirmatory research for separate effects surrogate experiments
  - Internal and industry-wide Condition and Corrective Actions Reports
  - Vendor-issued safety bulletins
  - NRC Information Notices

# Acronyms

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- ADAMS: Agencywide Documents Access and Management System
- AMP: Aging Management Program
- DOE: Department of Energy
- EPRI: Electric Power Research Institute
- R&D:  Research and Development
- ISFSI: Independent Spent Fuel Storage Installation
- ITS: Important to Safety
- RAP: Repair Application Procedure
- SSC: Structure, System, or Component
- TLAA: Time-Limited Aging Analysis

# References


- Bare, W.C, L.D. Torgerson. 2001. "Dry Cask Storage Characterization Project-Phase 1: CASTOR V/21 Cask Opening and Examination," NUREG/CR-6745, Idaho National Engineering and Environmental Lab, Idaho Falls, ID. ADAMS Accession No. ML013020363.
- M.C. Billone, T.A. Burtseva, and R.E. Einziger. 2013. "Ductile-to-Brittle Transition Temperature for High-Burnup Cladding Alloys Exposed to Simulated Drying-Storage Conditions," *Journal of Nuclear Materials*, Volume 433, Issues 1–3, pages 431–448, February 2013.
- R.S. Daum, S. Majumbdar, Y. Liu, and M.C. Billone. 2006. "Radial-hydride Embrittlement of High-burnup Zircaloy-4 Cladding", *Journal of Nuclear Science and Technology*, Vol. 43, No. 9, p.1054, 2006.
- Einziger, R.E., H. Tsai, M.C. Billone, B.A. Hilton. 2003. "Examination of Spent PWR Fuel Rods after 15 Years in Dry Storage," NUREG/CR-6831, Argonne National Laboratory, Argonne, IL. ADAMS Accession No. ML032731021.
- EPRI. 2014. "HBU Dry Storage Cask Research and Development Project Final Test Plan," February 27, 2014, DOE Contract No.: DE-NE-0000593.
- K. Kamimura. 2010. "Integrity Criteria of Spent Fuel for Dry Storage in Japan" *Proc. International Seminar on Interim Storage of Spent Fuel*, ISSF 2010, Tokyo Nov 2010, page VI3-1.
- NRC. 2000. "Standard Review Plan for Spent Fuel Dry Storage Facilities," NUREG-1567, Washington, DC. ADAMS Accession No. ML003686776.
- NRC. 2003. NRC Interim Staff Guidance 11, "Cladding Considerations for the Transportation and Storage of Spent Fuel," Revision 3, November 17, 2003. ADAMS Accession No. ML033230335.
- NRC. 2010. "Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility," NUREG-1536, Revision 1, Washington, DC. ADAMS Accession No. ML091060180.
- NRC. 2014. NRC Interim Staff Guidance 24, "The Use of a Demonstration Program as a Surveillance Tool for Confirmation of Integrity for Continued Storage of HBU Fuel Beyond 20 Years," Revision 0, July 11, 2014. ADAMS Accession No. ML14058B166.

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

# Introduction and Operations-Focused Approach to Aging Management for Spent Fuel Storage Renewal

Kristina Banovac

NMSS/DSFM/RMB

Meeting with Advisory Committee on Reactor Safeguards
Subcommittee on Metallurgy & Reactor Fuels

NUREG 1927, Rev. 1
April 8, 2015

# Outline

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Background
  - Regulatory framework for spent fuel storage
  - Requirements and guidance for spent fuel storage renewals
- Current challenges
- Path Forward
  - Guidance / Infrastructure needs
  - Operations-focused approach
  - Plan for NUREG-1927, Rev. 1
- Meeting agenda

# Background

## Regulatory Framework for Spent Fuel Storage

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Two part regulatory framework for spent fuel storage in 10 CFR Part 72
- Specific license for storage of spent fuel in an independent spent fuel storage installation (ISFSI)
- General license for storage of spent fuel in NRC-approved storage systems
  - General license authority provided to Part 50 and 52 license holders through 10 CFR Part 72, Subpart K
  - Storage system design requirements in 10 CFR Part 72, Subpart L
  - Approved designs are provided a Certificate of Compliance (CoC), listed in 10 CFR 72.214, and are available for use by general licensees
  - General license term is tied to the term of the CoC that is in use at the ISFSI; general licenses are not renewed

# Background

## Storage Renewal Requirements – Specific Licenses & CoCs

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Renewal of specific licenses and CoCs for storage of spent fuel, for a period not to exceed 40 years (10 CFR §72.42 and §72.240)
- Time-limited aging analyses
- Description of the Aging Management Program (AMP)
- Design bases information as documented in the most recently updated final safety analysis report
- Maintain intended functions in the period of extended operation

# Background

## Current Spent Fuel Storage Renewal Guidance

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Guidance located in NUREG-1927, Rev. 0, "Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificate of Compliances"
  - Provides NRC guidance for renewal of ISFSI licenses and CoCs for storage cask designs
  - Issued in March 2011 to accompany the 10 CFR Part 72 final rulemaking for "License and Certificate of Compliance Terms"

# Current Challenges

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Recent staff renewal review experience indicated need for expanded guidance
- Storage & reactor operating experience indicates potential degradation of structures, systems, and components
- Known vs. potential unknown aging/degradation mechanisms
- Difficult to define and assess all operable degradation modes for all potential chemistries for all locations and environments
- 7 specific license and 8 CoC renewal applications expected within next 10 years

# Path Forward

## Storage Renewal Team

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Intra-Agency team created in December 2013
- Staff members from NMSS, NRR/DLR, RES, and OGC
- Reflect on storage operating experience, staff's storage renewal review experience, and reactor renewal experience
- Extensive Stakeholder Engagement
  - Held over 20 NRC Public Meetings on renewal topics
  - Participated in numerous conferences, workshops, and meetings
  - Reviewed NEI 14-03, Rev. 0, Guidance for Operations-Based Aging Management for Dry Cask Storage
  - Incorporated feedback from stakeholders into revised guidance

# Path Forward

## Identified Needs

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Operations-focused approach to storage renewals
  - Learning, proactive and responsive
- Stable, predictable and efficient renewal regulatory framework with clear, transparent, & reliable expectations
  - Revision to NUREG-1927 (focus of meeting today)
  - Development of other guidance and infrastructure (last presentation in meeting)

# Path Forward

## Operations-Focused Approach

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Based on achievable operational methodologies:
  - Condition based monitoring and/or in-service inspections (ISIs)
- Assessment of monitoring and/or ISI findings and data
- Criteria for actions/decisions:
  - Prevention, repair, replacement, or mitigation measures
- Report, aggregate, & trend operational experience
- “Learning” AMPs that assess and respond to operating experience

# Path Forward

## Plan for NUREG-1927, Rev. 1

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Revise draft guidance per today's meeting
- Publish draft guidance for public comment (May/June 2015)
- Address public comments and finalize guidance
- Engage with ACRS on proposed final guidance (Spring 2016)
- Publish final guidance (Summer 2016)
- Continue stakeholder engagement
  - Public meetings
  - Continued engagement on NEI 14-03

# Agenda for this Meeting

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- Overview of changes in NUREG-1927, Rev. 1
- AMP for reinforced concrete structures
- AMP for localized corrosion and stress corrosion cracking of welded stainless steel canisters
- High-burnup fuel monitoring program
- Industry presentation on operations-focused approach to aging management
- Development of infrastructure for operations-focused approach to aging management

# References

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- 10 CFR Part 72
  http://www.nrc.gov/reading-rm/doc-collections/cfr/part072/
- "License and Certificate of Compliance Terms" Final Rule
  http://www.gpo.gov/fdsys/pkg/FR-2011-02-16/pdf/2011-3493.pdf
- NUREG-1927, Rev. 0
  http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1927/
- DRAFT NUREG-1927, Rev. 1 (for coordination with ACRS subcommittee at this meeting), ADAMS Accession No. ML15068A303

# Acronyms

U.S.NRC
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

- ACRS – Advisory Committee on Reactor Safeguards
- ADAMS – Agencywide Documents Access and Management System
- AMP – Aging Management Program
- CFR – Code of Federal Regulations
- CoC – Certificate of Compliance
- ISFSI – Independent Spent Fuel Storage Installation
- ISI – In-Service Inspection
- NEI – Nuclear Energy Institute
- NMSS – Office of Nuclear Material Safety and Safeguards (NRC)
- NRR/DLR – Office of Nuclear Reactor Regulation, Division of License Renewal (NRC)
- OGC – Office of the General Counsel (NRC)
- RES – Office of Nuclear Regulatory Research (NRC)